

**Indigenous Pacific salmon stream caretaking:  
Ancestral lifeways to guide restoration,  
relationships, rights, and responsibilities**

**by  
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## Declaration of Committee

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## Abstract

Cumulative stressors continue to impact the health and survival of salmon, and the social-ecological systems they support and connect. Today, restoring the relationships, rights, and responsibilities of Indigenous Peoples to their salmon kin is central to a sustainable and just future with salmon. In this thesis, I coordinated a group of Indigenous and non-Indigenous researchers from across British Columbia to come together in a respectful and transparent way. Together, we aim to uphold ancestral Indigenous Pacific salmon stream caretaking knowledge, longstanding Indigenous rights and relationships to land and waters, and our joint responsibilities to care for these watersheds. To do this, we begin by describing traditional governance systems that house Indigenous salmon stream caretaking practices. Through a literature review and conversations with co-authors, we then describe eight Indigenous salmon stream caretaking practices. Finally, we share three contemporary focal stories of Indigenous salmon restoration projects that uphold ancestral knowledge; 'Syilx sockeye restoration', 'səlilwətaʔ (Tseil-Waututh) led salmon habitat restoration in xʔəłilwətaʔ (Indian River Watershed)', and 'Nuu-chah-nulth Peoples and salmon: responsive methods through steadfast lifeways'. We present stream caretaking knowledge and the focal stories as learning opportunities that may guide future human-salmon relationships and restoration.

**Keywords:** Pacific salmon; Indigenous restoration; stream caretaking; salmon restoration; Indigenous stream governance; co-producing knowledge

To all stream caretakers,  
and to Maggie, of course.

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## List of Acronyms

CRT	Columbia River Treaty
FWMT	Fish Water Management Tool
OCAP	Ownership, control, access, and possession
ONA	Okanagan Nation Alliance
ORRI	Okanagan River Restoration Initiative
TEK	Traditional Ecological Knowledge

## **Sharing my story**

The scientific process is not separate from power; it is deeply tied to the social-political-economic fabric of society, and thus demands critical personal reflection (Kovach, 2021; Liboiron, 2021; Muhl et al., 2023). As a student and researcher, who I am influences my understanding of knowledge production, the questions I ask, how I seek to answer those questions, and my priorities and actions throughout the entire research process (Reid, 2021; Silver et al., 2022). It is with this understanding, alongside guidance from mentor Kii'iljuus Barbara Wilson, that I focus this introduction on transparency, as I share who I am, my connection to this work, and how this project came to be. It feels vulnerable, yet necessary, for me to situate myself within this work, to make clear my roles and responsibilities, and to acknowledge how my biases, despite my best efforts, will impact the meaning-making of this work (Kovach, 2021). At the centre, this work is about sharing stories. How can I expect to be open to receiving the stories shared here, if I do not first share my own (Kovach, 2021)?

## **Who I am and my connection to this work**

I have always been drawn to interfaces, the place where two systems meet and interact. The forest and the beach. Freshwater and saltwater. Mossy bank and stream. Science and art. People and place. For me, it is in these interfaces that connection occurs, and an understanding of the whole is fostered.

I was born to a home of many interfaces. Nexwlélexwm (Bowen Island) taught me to be curious: How tall is this cliff that my sisters and I are standing on before the forest rolls out before it again? Who lives below the mud my feet are sinking into? When will the salmon traverse the saltwater/freshwater interface and return home again?

Salmon are perhaps the wisest navigators of interface. From fresh to salt and back again, salmon have taught me about timing, resilience, and returning home changed. I was raised by a salmon research scientist, and an elementary school teacher with a biology degree. It is because of them that I spent so much time on the land and water developing relationships to place and a curiosity for how all the parts became a whole. As my curiosity grew it was channelled into biology classes, and then later an undergraduate degree.

In my family, education was always deeply valued and prioritized. As a second generation Canadian of European (British/Swiss/German) descent, I have benefited from my privileges, and amongst them educational opportunities. These opportunities were tied to expectations that I must be high achieving in maths and sciences, and the understanding that medicine is the most honourable field. As I worked to keep up with my studies, my connection to, and curiosity of, the whole became fractured. I felt I had to forego my creative, relational side, and instead focus on memorizing the structures of amino acids and the steps of the scientific process.

The primary reason for this fracture was that what I was being taught ignored relationships: relationships to the land, relationships to the water, relationships to fish, and relationships to each other. Later, I was re-introduced to complex land-water-fish-human relationships through several teachers and scholars, but specifically through Dr Zoe Todd's work on fish pluralities, the multiple ways of knowing and defining fish (Todd, 2014). As I re-imagined and re-defined my relationship to fish, I took note of the weight of Indigenous People's relationships to fish as more-than-human beings, with their own personhood and agency. I saw that fish are active sites of political and legal exchange, and that "people and fish together, are important agents in both a) experiencing colonialism and b) dismantling colonialism" (Todd, 2014, p 231). My formal, western

education separated people and nature, and in doing so ignored my relationship to the lands and waters I call home, and importantly the historic and ongoing relationships of Indigenous Peoples to their fish, rivers, waters, and lands.

As a non-Indigenous researcher and student, I feel an ethical responsibility to co-create research that promotes social justice and self determination of Indigenous Peoples whose lands, waters, and salmon I work on and with. Alongside actions such as educating myself and adhering to Indigenous data protection and research protocols, it is my responsibility to foster relationships with Indigenous People that build on trust, transparency, and respect. It is my obligation to move through this learning journey, of which this thesis is only one step, with humility and commitment.

When my five year old kid gets home from kindergarten and tells me that when she grows up, she wants to go to the same ‘person school’ as me, so that she can ‘come home and give stories of salmon to her kids’, I feel a deep responsibility to do the best work I possibly can. As I work to support the realignment of salmon restoration with the original caretakers of these waters, I will continue to learn, make mistakes, admit them, and then learn some more. In one of our first committee meetings, Kii’iljuus Barbara Wilson, then new colleague, now a dear mentor, said to me, “We (Indigenous and non-Indigenous people) have to learn how to trust each other”. It is my hope that these last two and half years have, if nothing else, built some trust.

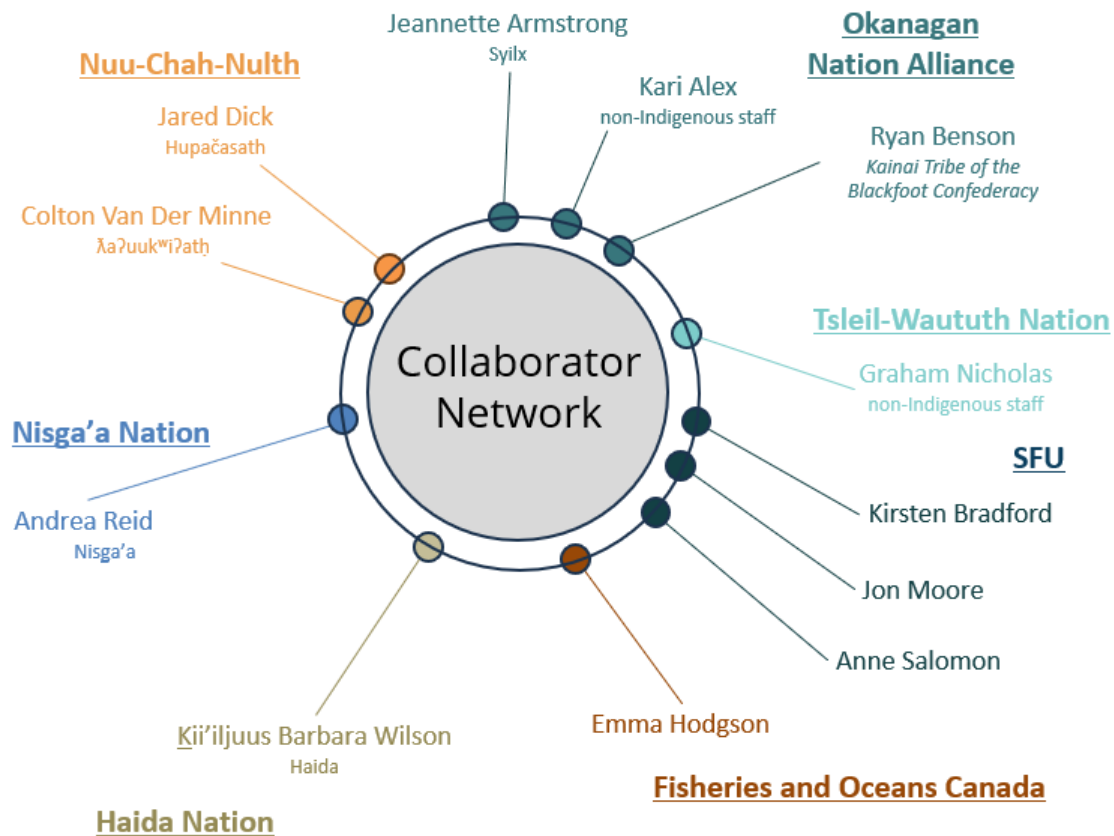
## **How this project came to be**

This project came to be through relationships. Some of these relationships began many years before this project, and some were fostered through the course of this project.

Acknowledging the harms that have come from colonial research paradigms (Tuhiwai Smith, 2021), this project was focused on building relationships that supported a diverse

group of Indigenous and non-Indigenous people to come together and work collectively on a paper where the goals were identified by, and relevant to, the Indigenous communities involved (Kirkness & Barnhardt, 1991; TallBear, 2014; Ignace et al., 2023).

We co-developed this research through a series of conversations. Instead of coming to this project with a specific research question, I began by listening to what key themes and goals were coming out of these conversations (TallBear, 2014; Salomon et al., 2018; Mahoney et al., 2021). Initial conversations started between myself and my committee, Emma Hodgson, Jonathan Moore, Anne Salomon, and Kii'iljuus Barbara Wilson. We then entered conversation with Andrea Reid and Colton Van Der Minne. As the project began to take shape, we expanded the conversations to Jeannette Armstrong, Ryan Benson, Kari Alex, Graham Nicolas, and Jared Dick (Figure 1). Beyond this core group, this process also involved engaging with other individuals and Nation groups, who were unable to collaborate due to capacity, but with whom resources were shared, and will continue to be shared with after publication (Appendix A, Appendix B).



### Collaborator network

Over the course of two and a half years, I brought the group together in various ways to facilitate collaboration, knowledge co-production, and relationship building. My role was to be a tool or conduit to achieve the goals identified by the group. I facilitated two Zoom workshops with the entire co-author team to share and discuss the focal stories and themes of the paper. I facilitated two in person co-writing workshops, with sub-groups of the co-author team to discuss the project's readership, tone, and message. I connected these meetings through many smaller meetings in person, on the phone, or on Zoom. I engaged with Syilx illustrator Lauren Marchand, who attended one of the group Zoom workshops, so that the knowledge, ideas, and stories shared could be brought to life through illustration (Appendix C). Finally, to complement these modes of knowledge production, I also completed a systematic literature review (Appendix D).

This thesis is a product of the relationships that were built or strengthened throughout the process. It is because of the willingness to enter new relationships, to trust each other despite the vulnerabilities and complexities of doing so, that this project came to be. From this point on, I have used the plural pronoun 'we' to reflect that this work was built with as a team.



# Introduction

Social-ecological crises are putting pressure on ecosystems, spurring recognition of the need to centre equity and diversity in restoration, management, and conservation (Brown and Brown, 2009; Corntassel, 2012; Elias et al., 2021; Parsons et al., 2021; Salomon et al., 2023). These crises are impacting Indigenous lands and waters that have been cared for over generations through ancestral knowledge and governance. Equitable and reciprocal land and water relations exist within Indigenous-led restoration, where people are central in caring for and fostering responsibility to the land and water (Kimmerer, 2011). Within the Pacific salmon (*Oncorhynchus spp.*) region, Indigenous Peoples have developed deep, reciprocal, relations with their salmon kin over thousands of years, and these relationships continue today (Figure 1, Reid et al., 2022), offering an incredible learning opportunity to guide salmon restoration that embraces ancestral Indigenous knowledge, for the potential benefit of all (See Table 1 for key definitions).



**Figure 1. Transform to restore (Lauren Marchand, 2023)**

Syilx illustrator Lauren Marchand created 'Transform to restore' as an intention setting image, to articulate the goals and vision expressed by the collaborative at an author workshop on June 26<sup>th</sup>, 2023. *"Ancestral energy surrounds us, guiding Indigenous People through time. Salmon remains return to water for abundance, sustaining today's Indigenous communities. Present-day Indigenous People bear equal responsibility for the land. Coyote prints symbolize transformation, navigating two worlds with unchanging teachings. Orange and blue colours symbolize the balance between the past and present."* Artist statement by Lauren Marchand, 2023. (Appendix C)

It is with both urgency and care that we come together to gather Indigenous knowledge of human-salmon relationships and recognize its value. The intention of this paper is to uphold ancestral Indigenous knowledge of Pacific salmon stream caretaking, longstanding Indigenous relationships and rights to land and waters, and our shared responsibilities to care for these ecosystems. While this ancestral knowledge has been repressed and marginalized in the Pacific salmon region by colonial systems, today, efforts exist to reawaken, reclaim, and rebuild Indigenous stream caretaking practices to Tll'yahda (Haida for 'to make things right'), "because sometimes it's not teaching them (Indigenous Peoples) something new, but waking up, waking up ancestral knowledge" (Kii'iljuus Barbara Wilson, August 4th, 2023). Given the resurgence of Indigenous sovereignty (Brown and Brown, 2009; Coulthard, 2014; Simpson, 2017), the gravity of climate change (Gilchrist, 2022; IPCC, 2023), and the unprecedented fluctuations in wild Pacific salmon populations (Price et al., 2017; Wilson et al., 2021; Pacific Salmon Explorer, 2022; Reid et al., 2022), this gathering of knowledge comes at critical point in time and will add to the growing momentum of both Indigenous-led salmon restoration, and Indigenous-led restoration initiatives more broadly.

**Table 1: English language glossary of key terms (in order of appearance in main text)**

Term	Definition
<b>Stream caretaking</b>	Place-based, deliberate actions woven into governance and lifeways that maintain healthy salmon stream habitat, strong salmon populations, and equitable human-salmon relationships <sup>a,b</sup>
<b>Ancestral Indigenous knowledge</b>	Living, adaptable knowledge that informs lifeways, practices, and beliefs. Knowledge that is embedded within oral histories, that span

Term	Definition
	generations, and is collected through centuries of being on the land, observing changes and patterns <sup>c</sup>
<b>Reawaken</b>	To acknowledge, uphold, honour, and respect Indigenous knowledges ignored, outlawed, or suppressed by colonization <sup>d</sup>
<b>Indigenous-led salmon restoration</b>	Actions taken to create or care for salmon habitat, support salmon populations, and repair relationships between people and place <sup>e</sup>
<b>Transparency</b>	Working together without hidden facts, actions: Living your words <sup>f</sup>
<b>Lifeways</b>	The ways Indigenous Peoples conduct themselves in the world daily, guided by certain practices, principles, and laws. Lifeways encompass all aspects of life, both tangible and intangible. For example, lifeways include understanding and acting on the seasonal cues, asking permission before harvest, and not taking the biggest fish <sup>g</sup>
<b>Indigenous governance</b>	Systems of responsibilities tied to specific territories that flow through the hereditary leaders. These systems implement legal and guiding principles through social structures and place-based practices. The underpinnings are respect, responsibility, and transparency to maintain balance in social-ecological systems <sup>h</sup>

<sup>a</sup> (Langdon, 2006)

<sup>b</sup> (Thorton et al., 2015)

<sup>c</sup> (personal communication, Kii'iljuus Barbara Wilson, October 9th, 2023)

<sup>d</sup> (personal communication, Kii'iljuus Barbara Wilson, August 4th, 2023)

<sup>e</sup> (Hill et al., 2021)

<sup>f</sup> (personal communications, Niis Wes Gidandsa to Kii'iljuus prior to 2009).

<sup>g</sup> (personal communication, Kii'iljuus Barbara Wilson, August 4th, 2023)

<sup>h</sup> (personal communication, Kii'iljuus Barbara Wilson, October 9th, 2023)

We are a group of researchers, both Indigenous and non-Indigenous, located across British Columbia. We are connected by our concern for Pacific salmon, our work to support the resurgence of Indigenous salmon stewardship, and our commitment to conduct research and restoration in a more respectful, holistic, way. This collaboration is grounded in reciprocity where each team member is supported to be both a teacher and learner. K.B., a non-Indigenous researcher, aims to be a conduit for the work by providing research tools and building, gathering, and supporting the collaborative network. Respect, inclusion, transparency, and consensus have guided this process. These principles connect each member, and their unique position, context, and knowledge, allowing for sharing across Nations and communities. The author group includes members of, or people working on behalf of, the following Nations: Haida, Nisga'a, Syilx, səliiwətał (Tseil-Waututh), and two Nuu-chah-nulth Nations, łaʔuukwiʔath (Tla-o-qui-aht) and Hupačasath. We draw from these unique knowledge systems and their shared values and practices. We are students, mentors, researchers, and knowledge carriers, and with that comes the responsibility to ensure that future generations understand the complexity of our world.

We, the author team, hold collective understandings that guide our work. We acknowledge that as researchers we have a responsibility to uphold Indigenous rights (Ignace et al., 2023), thus we aim to co-create research that supports Indigenous self-determination of salmon systems (United Nations, 2007, Article 3,32; Harris, 2008; Sayers, 2021). Within research, we carry the obligation to support and adhere to Indigenous data protection and research protocols (such as [The First Nations Principle of OCAP](#) and Nation-specific research agreements) (Ignace et al., 2023). Our work acknowledges how Indigenous rights are woven together with responsibilities to lands and waters, as the “cultural and political are joined and inseparable, and they are both

generated through place-based practices - practices that require land” (Simpson, 2017, p 49-50). We remind ourselves that land and water are inseparable. As we place rivers at the centre of this work, we consider them as more than bodies of water but as “holistic, historical, and cultural agents with lives and rights of their own” (Hikuroa et al., 202, p 67). As veins and blood are important to the functioning of our bodies, so are the rivers and waters important to the functioning of our world. We know that within the context of many Indigenous legal orders, salmon, and other fishes, have agency and rights, with “whom humans share territories, stories, and reciprocal duties” (Todd, 2017, p 138). We are aware that Pacific salmon are inextricably linked to the lifeways of Indigenous Peoples (Coté, 2022; Reid et al., 2022). We understand that Indigenous knowledge is living and adaptable and has not been extinguished, but suppressed and driven underground, and therefore can be (and is being) reawakened (Corntassel, 2012; Simpson, 2017). Finally, we believe that for sustainable, thriving futures, we need to work together to create active, holistic care for systems and to be transparent about our intentions, understandings, and processes as we have been here.

The effects of climate change and biodiversity loss are initiating a shift to recentre place-based Indigenous stewardship and governance for more active and holistic management approaches (Groesbeck et al., 2014; Hoffman et al., 2021; Whitaker et al., 2023). For example, in forested ecosystems, the repercussions of centralized management are becoming increasingly apparent as wildfire frequency and intensity increases (Jones et al., 2022). Fires were/are stewarded by Indigenous Peoples through prescribed burning to manage resources, protect communities, and increase biodiversity (Hoffman et al., 2022). Rather than persisting with fire exclusion policies, there is a growing interest from fire management authorities within governments to find better management tools (Copes-Gerbitz et al, 2022; Hoffman et al., 2022).

Drawing on ancestral knowledge and engaging with prescribed burning is a valuable option (Dickson-Hoyle et al., 2022). Restoring Indigenous lifeways through revitalizing fire stewardship upholds keepers of fire knowledge and embraces rights to the land. It is also a path forward to more sustainable ecosystem and fire management (Dickson-Hoyle et al., 2022). Indigenous salmon stream caretaking practices also present opportunities to uphold Indigenous lifeways and create more active and holistic systems of care for salmon and their habitat. However, compared to the recent revitalization of Indigenous fire stewardship (Hoffman et al., 2022), in our view and from our experiences, there has been less visibility for Indigenous salmon stream caretaking practices.

Indigenous Peoples have cared for salmon streams over thousands of years through governance systems that include stream caretaking practices (Jones, 2002; Atlas et al., 2021). Today, many salmon populations have declined or disappeared, in part, due to the loss, degradation, and fragmentation of freshwater habitat (Gustafson et al., 2007; Finn et al., 2021). This degradation is a product of a system that disrupts and dismisses Indigenous salmon stream caretaking practices, knowledges, and lifeways (Atlas et al., 2021; Coté, 2022; Reid et al., 2022).

In this paper, the aim is to gather and bring attention to specific Indigenous stream caretaking practices to support restoration of Pacific salmon streams. We begin by describing certain governance systems that house stream caretaking practices. We then illustrate examples of Indigenous stream caretaking knowledge by describing eight distinct practices. Finally, we present three focal stories of current Indigenous-led Pacific salmon habitat restoration that uphold ancestral knowledge in a contemporary context.

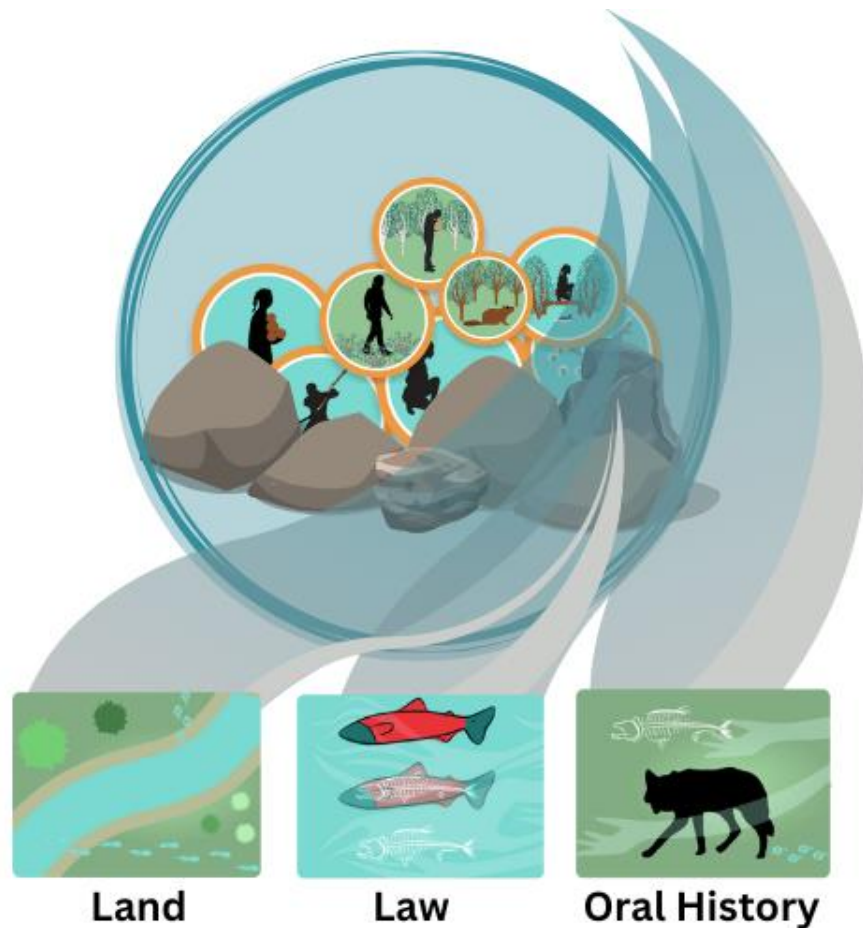
This collaboration focuses on First Nations across the land now known as British Columbia, Canada, with some examples from other Pacific salmon regions such as coastal Alaska, USA. With more than 200 Nations in BC, practices, laws, and oral histories vary due to distinct or isolated languages and locations. The following work represents only a fraction of the complex realities across these divergent yet interrelated systems. Multiple Indigenous knowledge systems are represented here, this does not (and cannot) represent all Indigenous salmon knowledge.

The knowledge presented here was gathered through both literature review (Appendix D) and documented conversations with Indigenous knowledge holders included in the authorship team. To put emphasis on alternate, Indigenous-led resources, we accessed sources outside of academic publishing, such as Nation websites and reports. We also included direct quotes as much as possible to amplify the voices of Indigenous knowledge holders and not transform their original context, tone, and intention. We augmented what was written in the literature with conversations and stories shared within the author group. These stories were a non-structured method of gathering knowledge that brought depth to the work beyond the published literature. As Margaret Kovach (2021, p 156) describes, “Story nurtures relationship. Story kindles reciprocity. Story compels responsibility. Story thrives where there is respect. Story is a gift. And in research, this changes everything.” Throughout the thesis, particular attention is given to language used, and the notions and histories related to certain terms. Particularly, for stream caretaking practices, we have opted to use terms that better reflect Indigenous ways of knowing than those more technical or jargon-heavy and prominent in the literature. We, the authorship team, uphold the knowledge presented here so that they may guide future human-salmon relationships and restoration.



## **Indigenous stream governance**

Indigenous salmon stream caretaking was, and continues to be, embedded in complex governance systems that mandate how, when, and where practices are implemented. Caretaking practices are guided by language, stories, and oral histories that are shared across generations through ceremony, laws, and lifeways (Reid and Ban, accepted). While each Nation is unique, there are common understandings including that people are part of ecosystems and hold relationships with the land, water, and all creatures, and that salmon have their own rights and personhood (Berkes et al., 2000; Langdon and Sanderson, 2009; Claxton and Price 2020; Johnson, 2020). As we discuss governance systems and stream caretaking practices below, we use the present tense. Many of these activities are still enacted today, while in other cases, colonial interference has disrupted them. By using present tense, we are acknowledging the continued role and presence of Indigenous Peoples on their territories and within their salmon systems.



**Figure 2: Governance systems house Indigenous salmon stream caretaking practices** (Artwork by Lauren Marchand, 2023, compiled and formatted by Kirsten Bradford)

Orange circles showcase eight Indigenous stream caretaking practices that are bound to and flow from the land, protected and maintained by law, and guided by oral histories. Governance systems house stream caretaking practices, and mandate how, when, and where they are implemented.

Caretaking practices are maintained and protected through law and guided by oral history. Families and individuals hold inherited responsibilities to specific territories such that decisions, like when and where to harvest, are overseen by a hereditary leader or the person assigned that responsibility (McHalsie, 2007). The responsibility for the territory is often passed on hereditarily and with intergenerational learning (Jones, 2002; Haida Marine Traditional Study Participants et al., 2011; Atlas et al., 2021). Oral histories

provide important teachings on how to care for rivers and fish, harvest, and live in relationship with salmon (George, 2003; Carothers et al., 2021; Morin et al., 2021). Responsibilities within governance practices provide the guidance and foundation for effective stream caretaking, create and protect important structures that maintain human-salmon relationships, and are vessels that carry stream caretaking practices through time and space. Importantly, restoration activities that attempt to apply caretaking practices outside of their governance context risk being unsuccessful or potentially harmful.

This section touches on some key elements of stream governance but does not, and cannot, capture the complexities and diversity of Indigenous stream governance across Nations. As language underpins law and influences its interpretation, we have included Table 2, outlining some key governance terms from three Nations represented in the authorship team. This table highlights some differences and similarities in governance approaches between Nations.

**Table 2: Nation specific governance language from three of the Nations represented by the authorship team.** The terms included here are those that have been compiled across all three languages. Additional terms for which we only had examples from one or two of the languages have been included in Appendix E.

<b>Haida</b>	<b>Nisga'a</b>	<b>Nuu-chah-nulth</b>
<b>Kil Yahdas</b> - law	<b>Ayuuk</b> - law <sup>e</sup>	<b>ḥawitmis</b> - laws
<b>k'aaygang.nga</b> - long, long ago ancient stories <sup>a</sup>	<b>Adaawak</b> - oral histories <sup>e</sup>	<b>hahuupa</b> – teachings <sup>f</sup>
<b>Tilgaay</b> or <b>Tilga</b> - land, ocean and people for which a hereditary chief has responsibility and authority to caretake <sup>b</sup>	<b>Ango'oskw</b> – territory for hunting/fishing taken care of through inherited responsibilities <sup>e</sup>	<b>ḥahuuti</b> - a chief's territory

<b>Tilgaay</b> - the land	<b>Ts'eets'iks</b> - the land <sup>e</sup>	<b>nismá</b> – the land <sup>g</sup>
<b>TilXanda</b> - stewardship, to take care of <sup>b</sup>  <b>Gina Ga Kyaht'as</b> - to look after everything	<b>Haboóidi</b> – keep/look after something (to) <sup>e</sup>	<b>?uu?aałuk</b> - taking care of
<b>Gina 'waadluxan gud ad kwaagid</b> - everything depends on everything or Interconnection	<b>Sayt-k'ilim-goot</b> – to be united with one heart, one path, one nation (literally one heart) <sup>e</sup>	<b>hišuk?iś ćawaak</b> - everything is one, everything is interconnected
<b>Yahguudang</b> - all acts must be done with respect. We respect each other and all living things <sup>c,d</sup>	<b>Kwhilxoosa'anskw</b> - have/show respect (to) <sup>e</sup>	<b>?iisaak</b> - respect
<b>litl'Igaay</b> - village chief  <b>Kilslaay</b> - chief not living in his own village or a highly respected person	<b>Sim'oogit</b> - chief <sup>e</sup>	<b>ḥawit (plural ḥawiih)</b> - hereditary chief  <b>ṭayii ḥawit</b> - highest ranking chief

<sup>a</sup> (Wilson and Harris, 2006)

<sup>b</sup> (Salomon et al., 2023)

<sup>c</sup> (HIGaagilda Xaayda Kil K'aalang Skidegate Haida Immersion Program Xaayda Kil Glossary, 2021)

<sup>d</sup> (Council of the Haida Nation and Government of Canada, 2018)

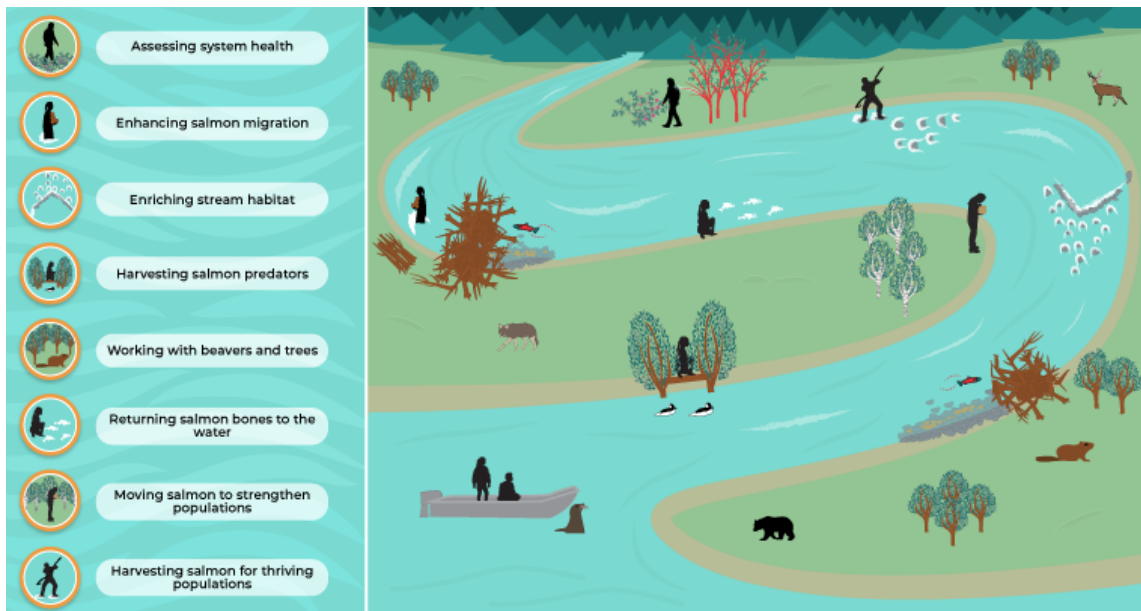
<sup>e</sup> (FirstVoices.com. Nisga'a Portal. First Peoples' Cultural Council)

<sup>f</sup> (Atleo, 2004)

<sup>g</sup> (FirstVoices.com. Nuu-chah-nulth (Barkley) Portal. First Peoples' Cultural Council)

# Indigenous stream caretaking practices

Within Indigenous governance, stream caretaking practices are conscious, deliberate actions woven into lifeways that maintain healthy salmon stream habitat, contribute to strong salmon populations, and equitable human-salmon relationships. Stream caretaking is also practiced through the limitation of these and other activities in areas of importance, for instance, salmon spawning grounds.



**Figure 3. Indigenous salmon stream caretaking practices (Lauren Marchand, 2023)**

Eight stream caretaking practices are shown here: assessing systems health, enhancing salmon migration, enriching stream habitat, harvesting salmon predators, working with beavers and trees, returning salmon bones to the water, moving salmon to strengthen populations, and harvesting salmon for thriving populations. These practices can transform salmon habitat, support healthy salmon populations, and maintain human-salmon relationships.

## Assessing system health

Ecosystem health is assessed through being on, and living in relationship to, the land (Turner and Reid, 2022). Assessing system



health is analogous to active stream monitoring. Nisga'a (like many First Nations people)

hold knowledge of what plants are blooming at specific times when salmon species are active or migrating, supporting a “highly developed capacity for building up a collective database” (Corsiglia and Snively, 1997, p 4). Kii’iljuus Barbara Wilson describes how for the Haida, “*our phrase ‘Sk’awGan Gaalang skaasda’ tells us specifically that when the salmon berries ripen and turn colour overnight, then it is time to go to the west coast to catch TaaGun (spring salmon). The action of the berries’ turning colour is like the phosphorescent trails made by the salmon as they swim at night.*” (Kii’iljuus Barbara Wilson, Haida, in Wilson et al., 2022). Thus, Haida kuuniisii (ancestors) “used berries as a calendar to tell us about the timing of what is happening under the waters of our oceans” (Niis Wes, n.d in Wilson et al., 2022). Over generations, assessing system health creates robust understandings of natural stream habitat patterns and deviations in those patterns. From this collective knowledge, stream caretaking practices can be undertaken to maintain optimal habitat conditions and reduce variability and uncertainty. Today, climate change is disrupting the predictability of many natural cycles, leading to possible constraints in maintaining traditional caretaking practices (Proverbs et al., 2021; Charlie et al., 2022; Turner and Reid, 2022).

## Enhancing salmon migration

There are many accounts of Indigenous Peoples enhancing salmon migration by removing barriers to upstream spawning grounds (Corsiglia and Snively, 1997; Jones, 2002; Langdon, 2006;



Carothers, 2021). Sometimes wrongly equated to colonial stream cleaning that focused on removing all stream material (Dolloff et al., 1986), enhancing salmon migration aims to maintain habitat connectivity by selectively removing material that blocks upstream spawning habitat (such as logs, branches, sediment, and rocks) while leaving other stream material in place that provides rearing habitat complexity. This enhancement of

salmon migration is governed by the people and families that hold hereditary rights to specific streams such as Tlingit salmon stream trustees who hold both an obligation and intergenerational knowledge to ensure that adult salmon can successfully pass from the estuary into the stream (Langdon, 2006).

In Haítzaqv practice, in the spring prior to spawning, those who hold harvest rights remove trees and branches that fall during winter and block access to upstream spawning habitat (Jones, 2002). Logs and branches in streams that do not block passage, and contribute to creating rearing or resting habitat, are not removed (Jones, 2002). Rocks are generally not removed as they provide habitat for fish to rest or hide from predators, but, if necessary, they may be repositioned in the stream bed to allow for upstream passage (Jones, 2002). In areas where material is unable to be cleared or where passage is impeded by sediment accumulation, small trenches in the gravel are created for salmon to pass through (Jones, 2002). Generations of Haítzaqv caretaking supported enhanced salmon migration as described by Cyril Carpenter “That’s how badly the rivers can be blocked by windfall and debris. The salmon could not go up there. Our ancestors knew this, they saw this and they were part of the manpower that kept all these rivers clear so they could guarantee that the salmon would come back. They had a farming system in place... I was always told by the old people that we have to look after the river” (Cyril Carpenter, Haítzaqv, in Jones, 2002, p 166).

Similarly, for people from the Ahousaht Nation (one of the Nuu-chah-nulth Peoples), enhancing salmon migration is a duty that requires understanding system balance and salmon behavior. Ahousaht people remove material to avoid washouts that may damage salmon redds, yet streams are not completely cleaned out. Log jams and big pieces of wood are often left as they provide protection for salmon and eggs, specifically in the fall when the waters rise so “fish could dig down beside the logs in the

gravel” (George, 2003, p 73). Through ancestral knowledge and hereditary responsibilities, enhancing salmon migration maintains stream complexity for juvenile salmon while reducing migration barriers for spawning salmon.

## Enriching stream habitat

Enriching stream habitat, sometimes referred to as ‘stream-scaping’, involves rearranging boulders and rocks to create preferred habitat for spawning adults, and rearing and migrating juveniles (Langdon, 2006). In Haida streams, a V structure is built up within the middle of and the deepest parts of the stream bed to create pools and passageways. This provides habitat for young fish in the creek until they are ready to go to sea and enables the returning salmon to continue upstream during times of drought (personal communication Kii’iljuus Barbara Wilson, April 6th, 2023). These V structures are built in the estuary and are replicated inland until streams become too steep for such modification (personal communication Kii’iljuus Barbara Wilson, April 6th, 2023). Langdon (2006) describes how Tlingit Peoples build stone structures in the Neva River to enrich salmon habitat. In some locations, stones are placed across approximately 40% of the riverbed in a semicircle to create slow moving water. Rocks are also placed across the entire river channel to create a large, slow-moving pool. Both modifications slow water to create salmon resting or spawning habitat, accumulate gravel for spawning habitat, and improve visibility to support selective sex and size harvest (Langdon, 2006).



Other stream modifications also improve existing fishing sites or create new ones (Langdon, 2006; Menzies, 2016). On Haida Gwaii, there is evidence of how the Kuuniisii corral returning salmon in the areas adjacent to streams for fishing and sorting which fish would be allowed to continue upstream. Kxooyax Stream, in Gitxaala territory, is an



example of a human-designed system highly modified to support salmon harvest. At the creek mouth and entrance channel, there are several rock alignment features including deep V structures that alter the stream flow and provide gaffing and dip netting access points, and stone holding pools to allow for selective harvest (Menzies, 2016). Charles Menzies states that the “lower reaches of Kxooyax Stream have been extensively modified and engineered to facilitate access to the salmon fishery. The complexity and extent of the features represent a significant intergenerational commitment in securing access and managing the use of salmon at this place.” (Menzies, 2016, p 136).

## Harvesting salmon predators

Harvesting salmon predators is a practice used to remove various predatory species from streams to reduce mortality of salmon. For example, Tlingit Peoples developed methods to harvest some types of ducks that otherwise dive down and dig up salmon redds to eat the eggs (Langdon, 2006). Using a small platform built on the stream large enough for one person to crouch hidden by branches, a few salmon eggs are released into the stream attracting a duck to the platform. When the duck is close enough, it is captured by hand. Because gulls only prey on floating eggs and do not disturb redds, Tlingit Peoples do not harvest them from salmon systems (Langdon, 2006). There is also knowledge of Tlingit Peoples actively trying to reduce Dolly Varden populations as Dolly Varden can be active predators of salmon eggs, fry, and smolts. Tlingit Dolly Varden traps are built by placing wooden boxes with holes after alder stakes in a V formation, or after fallen logs across streams to capture the Dolly Varden but allow for salmon smolts and fry to pass (Langdon, 2006). As Thomas Jack describes “you have to let the smaller salmon and dollies come out... and right where the ‘V’ comes, you have a trough... you put a box, fill the box with holes



in it, and the bigger trout will swim and fall into that... and you take that and make a dry fish out of it.” (Thomas Jack, Tlingit, Langdon, 2006, p 124).

Additional predators of salmon that are harvested include seals and sea lions (McKechnie and Wigen, 2011). These pinnipeds can congregate at river mouths, in estuaries, or even substantially up rivers to consume high numbers of in-migrating adult salmon (and at times out-migrating juvenile salmon) (Wright et al., 2007).

## Working with beavers and trees

Salmon stream habitats are shaped by the other plants and animals that call them home, and working with other species, particularly beavers (*Castor canadensis*) and trees, is a form of stream caretaking. Beavers have large impacts on salmon rivers by building dams and thus altering stream habitats, hydrology, temperatures, and connectivity (Malison et al., 2015). Depending on the context, beaver dams may be cleared from the river to enable adult salmon migration, or the dams may be left in place to provide selective fishing opportunities. For some Tlingit Peoples, certain beaver dams disrupt salmon spawning habitat access and are removed under the instruction of the stream caretaker (Langdon, 2006; Carothers et al., 2021). Thomas Mills describes how they started taking beaver dams apart on the Neva River after “we weren’t getting as much sockeyes as we used to and pretty soon we just looked up, walked up the whole river to find out why. And when we got up to the lake over there, we saw that the beavers blocked out the whole lake where the sockeye couldn’t get into the lake and the bears and wolves and stuff were just having a field day” (Thomas Mills, Tlingit, Langdon, 2006, p 124). With the introduction of beaver to Haida Gwaii in the 1930’s, riverine ecosystems became altered by beaver activity (Gaston et al., 2008). Beavers on Haida Gwaii target specific trees



such as Cedar (*Thuja plicata*) and Crab apple (*Malus fusca*), altering forest and riparian ecosystems (Gaston et al., 2008). Many streams are blocked by dams preventing passage of spawning salmon. In the case of multiple, consecutive dams, sediment and organic matter accumulation can occur and thus reduce oxygen availability to salmon (Gaston et al., 2008). Alternatively, Sts'ailes people use beaver dams as a natural weir, opening a small part of the dam to allow salmon to pass before blocking it off temporarily. With the dam closed, salmon congregate downstream allowing Sts'ailes Peoples to harvest selectively for males (Ritchie and Springer, 2010).

Within stream caretaking, trees are also an important factor to consider. Riparian forests provide shade, organic inputs, and bank stabilization. Shaded stream habitat, and cooler water temperatures, are an important consideration when deciding where to build stream modifications (see 'Enriching stream habitat' section). Alder trees provide antiseptic properties to streams (personal communication Kii'iljuus Barbara Wilson April 6th, 2023). Thus, stream habitats close to alders are selected when moving salmon populations (See 'Moving salmon to strengthen populations'). In certain ecosystems, cottonwood, particularly Black Cottonwood (*Populus trichocarpa*), create important riparian habitats, supporting a diversity of plant and animal species, and are harvested by Indigenous Peoples for medicine, food, and textiles (Egan et al., 1997).

## Returning salmon bones to the water

Returning salmon bones to the water is an important practice for many First Nations. In Nisga'a culture, salmon need the scent trail from the bones to return from the ocean to their home stream

otherwise "the fish will feel insulted and will not come back" (Corsiglia and Snively, 1997, p 3). Similarly, Kwakwaka'wakw people return salmon bones to the streams so the fish



can reconstitute themselves and reincarnate the following year (personal communication Chief Kwaxistalla Adam Dick to Duer, in Thorton et al., 2015). Nancy Turner and Fikret Berkes summarized a conversation between Nancy Turner and Dr. Mary Thomas, Secwepemc elder, who spoke of how she “watched and helped while her grandmother carefully moved the carcasses of the salmon after they had spawned, from the banks of the Salmon River back into the water. Her grandmother explained that the salmon would nourish the baby fish to come” (Turner and Berkes, 2006, p 502). The Salmon Chief in Syilx culture completes the Syilx first salmon ceremony by asking for an abundant run of salmon, while returning the first salmon bones and remains back into the stream (Good Water, 2018). Returning salmon bones to the water is a shared practice amongst many Nations to strengthen human-salmon relationships and care for salmon streams.

## **Moving salmon to strengthen populations**

Moving salmon eggs between streams is a way that First Nations respond to environmental events impacting salmon streams, address localized shortages of salmon, and increase



spatiotemporal diversity of salmon runs (Jones, 2002; George, 2003; Thorton et al., 2015). Moving salmon to strengthen populations, or transplanting, is performed in response to floods and landslides where streams are blocked by stream material, severely degraded by sediment deposition or erosion, or have changed water course. According to Tlingit oral tradition, moving salmon began in response to the aftermath of the great flood when salmon were no longer found in many streams (Langdon, 2006). In Tlingit practice, the eggs and milt are swirled together in a watertight basket. In areas with good flow, holes are created in the new streambed and the mixture is poured into the hole and covered back up (Langdon, 2006). Ahousaht Peoples “sometimes used to take the eggs in the gravel and move them to a good location, if the stream was jammed

up or if it changed course. The old people knew these practices.” (George, 2003, p 74). In Haida practice, after fertilization occurs, the eggs are transplanted in wet moss from the compromised stream to a new stream. Usually, the selected stream is surrounded by an understory of various berry bushes, small trees, rotting tree remains, and alder trees as alder trees provide shade and antiseptic properties, as noted earlier (personal communication Kii'iljuus Barbara Wilson April 6th, 2023).

Moving salmon is also used to establish new salmon runs in streams with no or small runs (Haggen, 2006). Haítzaqv People move sockeye in their territory, as John Bolton states “... like all the systems that we have in our area... they didn't always have sockeye. They took sockeye from Rivers Inlet and how they did that is they put baskets in the spawning beds in rivers and after the sockeye spawned, they'd pull the baskets out and they'd transport them up this way and they put them out in our rivers and let the eggs spawn out there.” (John Bolton, Haítzaqv, in Jones, 2002, p 183)

Finally, moving salmon can improve spatiotemporal diversity, such as Tlingit Peoples establishing late chum salmon runs to extend the fishing and processing season (Thorton et al., 2015). In Thorton et al. (2015), Herman Kitka Sr. recounts knowledge from his elders around transplanting chum salmon eggs and milt from a mainland river in Southeast Alaska to an island stream at Deep Bay. The Tlingit language for this process is Wudas[?] yík héendei xáat áwé, meaning 'We're the ones that raised it and put it in the river'. Because mainland chum salmon spawn later in the season compared to local spawning salmon species, they are moved from the mainland to the island and planted in front of the smokehouse to provide the clan with access to oilier, mainland salmon (preferred for drying compared to island salmon) later in the year when they have more time to process it (Thorton et al., 2015). Thorton et al. (2015) suggest that transplanting contributes to social-ecological resilience by improving the

abundance, predictability, and spatiotemporal distribution of salmon for human use, in turn bolstering the community's ability to adapt to change.

## Harvesting salmon for thriving salmon populations



Harvesting salmon for thriving salmon populations is a practice aimed at decreasing population-level impacts of harvest by selectively harvesting based on size, sex, or status of the run. Across many different First Nations, harvesting efforts are focused on catching males and releasing females to maximize the number of females returning to spawn (Jones, 2002). Because a single male can fertilize the eggs of several females, a higher number of males can be harvested and egg fertilization rates will stay high (Morin et al., 2021). Harvesting efforts may also select for size, such as allowing larger, healthier fish to pass that may have more success spawning.

Various sources describe how harvesting salmon for thriving populations, or 'selective harvesting', supports salmon populations over time. For example, Clara Peratrovich describes the process of gaffing sockeye in Tlingit territory and comments that males have "a slight hump and they're bigger. The males are flat and big. You can always tell the round belly of the female. In fact, that's the only type that the Native people target for is the male. They don't bother with the female. ...that's the reason why the fish was so plentiful. Nobody bothered with the female." (Clara Peratrovitch, Tlingit/Haida, in Langdon, 2006, p 138). Using palaeogenetic analytical techniques to assign sex identification to salmonid bones, Morin et al. (2021) identify that two of the four sites within Tseil-Wauit (Burrard Inlet) show a significant bias towards harvesting male chum salmon compared to female, dating between 2300-1000 BP (ca.400 BCE-CE

1200). Morin et al. (2021) suggest that sexually selective harvest, specifically at weirs, is an intentional fishing technique of the Tseil-Waututh People to ensure sustainable salmon harvest over generations.

Harvesting for thriving salmon populations also allows for increased processing efficiency since male fish are generally larger than females (Jones, 2002). Dana Charlie states “The other reason [for targeting male salmon] is that males have more meat. You lose 4–5 pounds from a 10 pound (female) salmon to bones and the reproductive system. On a 10 pound male, you only lose about 1 pound of that. There’s not much cavity inside the male like there is in the female. I won’t clean a female for smoking, there’s just not enough flesh there. Kind of a waste of time, for me it is” (Dana Charlie, Sts’ailes, in Ritchie and Springer, 2010, p 48).

## Focal Stories

Grounded in governance systems, Indigenous salmon stream caretaking practices are adaptive systems to care for salmon and streams, improve salmon harvest, and maintain human-salmon relationships over thousands of years. While these practices have been disrupted by colonial systems, today there is work being done to revitalize, rebuild, and reawaken them. For example, Indigenous Peoples are restoring their caretaking practices and responsibilities through stream restoration. Here, we present three focal stories of contemporary Indigenous salmon restoration from across British Columbia in the A. s̓qawsitkʷ (Okanagan River), B. xʔəlilwətaʔt (Indian River Watershed) and C. Bedwell and Kennedy Watersheds (Figure 12).

Gathering and developing the focal stories was a collaborative process that supported the group to draw inspiration from each other, while providing an opportunity to share their own unique story. Following Zoom workshops to share stories and develop common themes between the three restoration projects, the content of each focal story was determined by the respective authors, to create a platform for co-authors to highlight their work in their own words. Within the editing process, only small feedback to promote clarity was given, in an effort to keep these stories in the words and tones of their authors. The first focal story is written by Jeannette Armstrong, Ryan Benson, and Kari Alex, representing the Okanagan Nation Alliance, about long-term Syilx sockeye restoration in s̓qawsitkʷ (Okanagan River). The second focal story is written by Graham Nicholas, on behalf of the Tsleil-Waututh Nation, about the Nation's on the ground restoration efforts to restore xʔəlilwətaʔt (Indian River Watershed). The final focal story is written by Colton Van Der Minne and Jared Dick, both members of Nuuchahnulth



Nations, highlighting their culturally sound restoration and research efforts in their territories with Ha'oom Fisheries Society and Uu-a-thluk Fisheries.

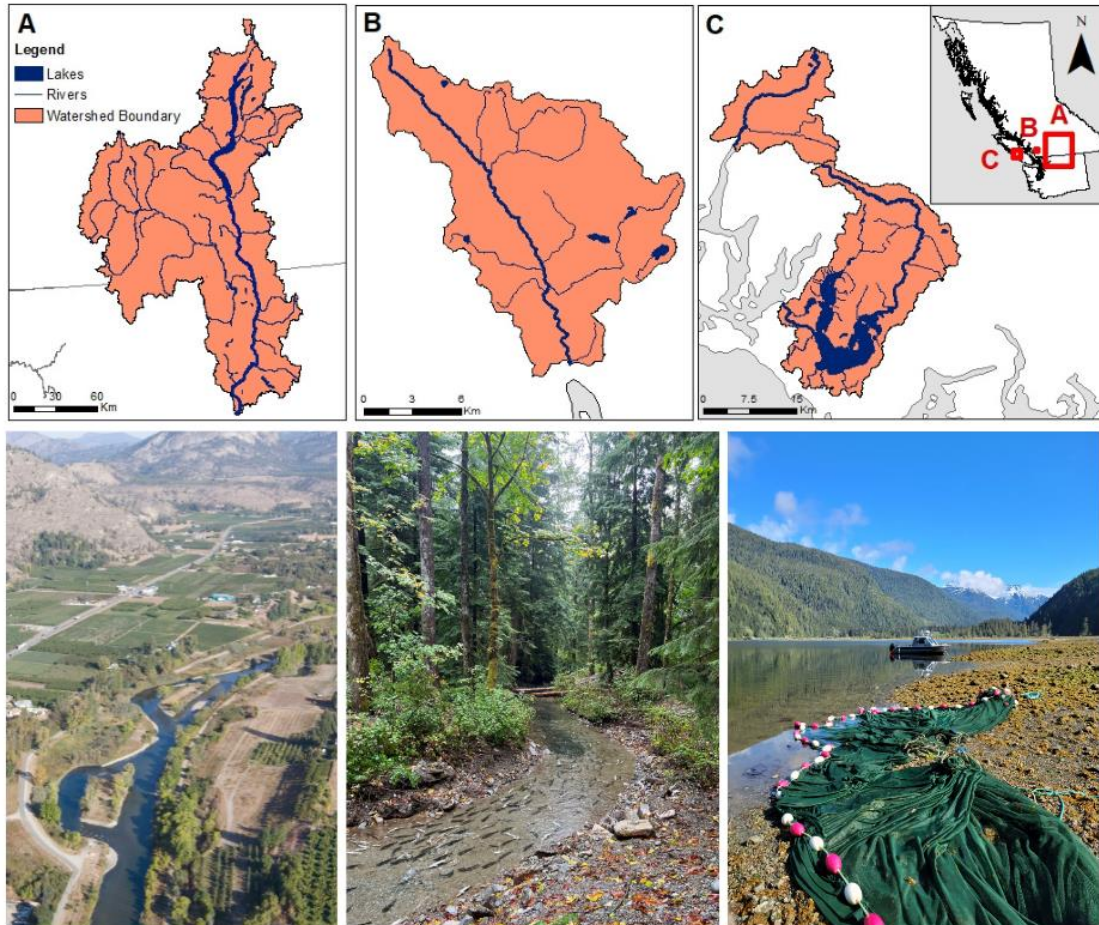


Figure 4. Three focal story salmon watershed systems located across British Columbia, Canada.

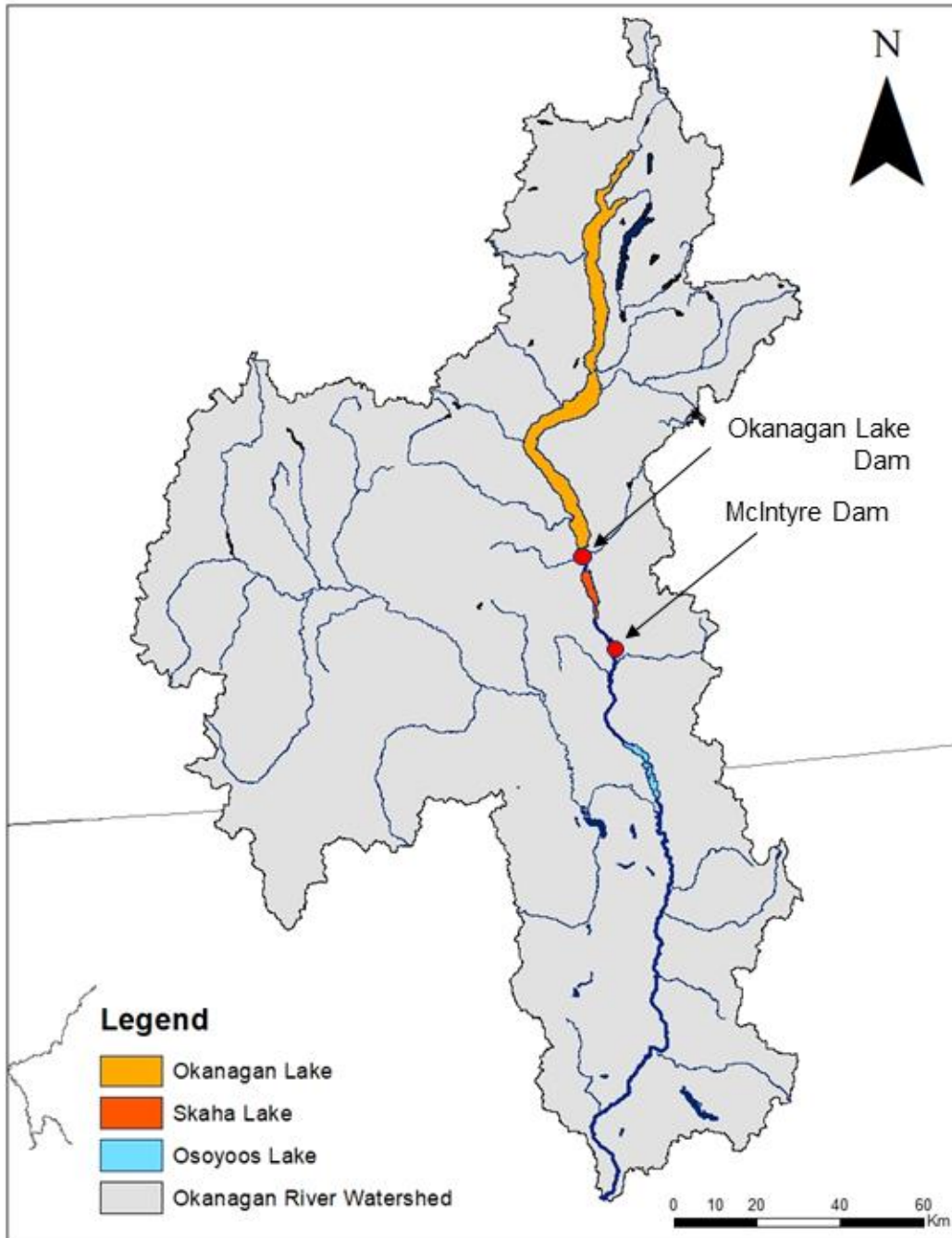
A. s̓qawsitk<sup>w</sup> (Okanagan River) Watershed (photo by Kevin Dunn), B. x̓əliiwətaʔt̓ (Indian River Watershed) (photo by Graham Nicolas), C. Bedwell Watershed and Kennedy Watershed (photo by Colton Van Der Minne).

## Sylix sockeye restoration

By Jeannette Armstrong, Ryan Benson, Kari Alex

The lower n̓x̓wəntk̓wɪtk̓w (Columbia River) in the United States once thrived with numerous sockeye salmon populations that migrated through this lower river, including the Canadian s̓qawsitk<sup>w</sup> (Okanagan River) sockeye population that spawned and reared

in South Central British Columbia. Okanagan sockeye historically passed through Osoyoos Lake to BC and made their way north into Skaha and Okanagan lakes (Kennedy and Bouchard, 1998; Ernst, 2000; Long, 2005) (Figure 13). Historical records show that salmon overall were once about ten times more abundant in the Columbia River than today (Wagner, 2023). The Syilx-Okanagan Nation in Canada are a salmon people, and sockeye salmon has a vital nutritional, cultural, and spiritual significance (Blanchet et al., 2021). It has been noted that Syilx would eat four or five times as much salmon as game during the year (Spier, 1938).



**Figure 5: s̓qawsitk<sup>w</sup> (Okanagan River) Watershed**

The wave of European settlement starting in the 1800s marked the beginning of the large-scale fragmentation and destruction of s̓qawsitk<sup>w</sup>. With colonization, water management changed from reciprocity with nature to a system of possession and control

over resources (Phare, 2009). European settlement brought dams, agriculture, water engineering, and overfishing to the Columbia River and Okanagan watersheds, and these changes were accompanied by European-centric fish management which altered fish assemblages both in Indigenous fish numbers and adding a long list of exotic fish species (Clemens et al., 1939; Ferguson 1949; Northcote et al., 1972; Okanagan Nation Alliance, 2001, 2002, 2003; Rae, 2005; Webster, 2007). In the Canadian portion of the Okanagan, approximately 84% (30.4 km) of the river has been channelized, straightened, narrowed, and diked (Bull, 1999; NPCC, 2004), and only 16% of the river remains in a natural or semi-natural state. The channelization of the s̓qawsitk<sup>w</sup> destroyed kilometers of sockeye spawning habitat, and the construction of McIntyre Dam at Okanagan Falls blocked salmon migration to Skaha and Okanagan Lakes (Wagner, 2023). As result, the river length has been reduced by 50% (Bull et al., 2000), and is considered one of the most endangered rivers in British Columbia (ORC, 2008).

Only three sockeye populations remain in the Columbia River, originating from Redfish Lake in Idaho, Lake Wenatchee in Washington State, and from Osoyoos Lake in British Columbia. All three of these populations have exhibited recent year increases in returns relative to their multi-decadal averages. Okanagan sockeye (Osoyoos) have accounted for more than 80% of the aggregate return since the year 2006.

The Syilx Okanagan Nation Peoples are the Indigenous s̓əx<sup>w</sup>tx̓t̓əm (caretakers, stewards) of the s̓qawsitk<sup>w</sup> ecosystem since time immemorial and have managed the sockeye and other resource species of Skaha Lake and the Okanagan River system for countless generations (Armstrong, 2020). Disputes between Syilx Okanagan Nation Peoples and the Department of Indian Affairs, involving salmon rights and habitat, were common (Ernst, 1999). In 1914, Chief Baptiste Cheanut wrote to the Royal Commission of Indian Affairs, “we spoke to you about our trouble when your commission was here

Oct 9th...the Indians need fish every day, a short time after we take the land [interpreted as the reserve system] somebody take the river away from us.”

Traditional Ecological Knowledge (TEK) regarding s̓qawsitk<sup>w</sup>, and Syilx Okanagan s̓əx<sup>w</sup>tx̓t̓əm include the responsibility to respect and protect siw̓tk<sup>w</sup> (water) and tmix<sup>w</sup> (all life forms). This right has existed for the Syilx Okanagan Peoples since time immemorial. The Okanagan Nation Alliance (ONA) Fisheries Department was formed to provide technical support to the Syilx Okanagan Nation member communities to address the extreme habitat degradation and salmonid losses within the s̓qawsitk<sup>w</sup> ecosystem. The mandate of the ONA Fisheries Department is “the conservation, protection, restoration, and enhancement of Indigenous fisheries (anadromous and resident) and aquatic resources within Okanagan Nation Territory” (Okanagan Nation Alliance, 2017). The ONA has been working to enact the Nation’s vision to bring back the health of s̓qawsitk<sup>w</sup>, best summarized by late Chief Albert Saddleman’s direction to “put the river back and put back the fish.” (Okanagan Nation Alliance, 2021).

The Okanagan Nation Alliance and the Colville Confederated Tribes held a workshop with stakeholders in 1997 to formally explore the possibility of bringing sockeye back to the Okanagan Lake (Peters et al., 1998). “Putting the river back” was approached by two main efforts: multi-phase river restoration (construction) projects and improving the decision-making process for flow-timing through dam releases at lake outflows. The Okanagan River Restoration Initiative (ORRI) Steering Committee began in 1999 and established an initial vision of restoration. ONA found partners at Fisheries and Oceans Canada and the Provincial Ministry of the Environment. Together they developed funding and collaborative arrangements with the Chelan County, Grant County, and Douglas County public utilities, Washington State Fisheries, and other government agencies (Correia et al., 2022). ORRI restoration projects include bringing

back instream habitat diversity, for example effective deep pools near riffles, lateral diversity (meanders, islands, and gravel bars), boulders, and large woody debris. McIntyre Dam was reconfigured to allow for salmon passage in 2009.

The Fish Water Management Tool (FWMT) decision-support system was deployed in 2004 to facilitate “fish friendly” water storage and release decisions at the Okanagan Lake Dam that reduce density-independent losses of sockeye eggs and fry to flood-and-scour or drought-and-desiccation events (Hyatt et al., 2015; Alexander and Hyatt, 2020; Ng et al., 2023). Detailed records of annual fish-and-water management strategies (i.e., compliance monitoring) show reductions in the frequency of flood-and-scour or drought-and-desiccation events that could have induced density-independent losses of sockeye eggs, alevins, and lake-rearing fry (Hyatt et al 2015). An increase of 148% was observed in the mean annual index of sockeye smolt production from Osoyoos Lake in years following FWMT deployment (2004-2021 brood-year test-interval) by comparison with years prior to FWMT deployment (1996-2003 brood-year control interval; Stiff et al., 2023).

In order to “put back the fish,” the Syilx salmon reintroduction initiative began in 2004 to return salmon to Skaha and Okanagan Lakes. Sockeye broodstock was gathered from Osoyoos Lake, eggs hatched in a hatchery, and fry released into Skaha Lake. Total hatchery fry released into Skaha has ranged from 350,000 to 4.5 million (Stefanovic et al., 2016; 2018). Since 2018, 10,000 (ceremonial) to 4 million fry were also released into Okanagan Lake. In 2022, full passage into Okanagan Lake came to fruition. Approximately 5,000 adult sockeye migrated into Okanagan Lake that year. All were hatchery origin and the majority migrated and spawned in natal release streams (McGrath et al., 2023). These massive reintroduction efforts have re-established previously extirpated sockeye populations in both Skaha and Okanagan lakes.

The efforts in the Canadian Okanagan were also aided by enhancement work in the lower Columbia River. Harvest rates were reassessed by rejecting historic escapement objectives that capped total production far below the maximum carrying capacity of freshwater spawning (Hyatt and Rankin, 1999) and rearing environments. As well, U.S. agencies worked to improve juvenile fish-passage through Columbia River dams (Widener, et al., 2019).

This coordinated approach has resulted in record-breaking returns of sockeye to the Okanagan in 2010, 2012, 2014, 2016, 2020, and 2022 return years, which marks the culmination of a remarkable turnaround for populations of this species in the Columbia River Basin. The all-year average of 185,836 total returns of Okanagan sockeye from 2008 to 2021 exceeds the annual average total production of 47,863 during 1967 to 2004 by roughly a factor of four. The other two remaining Columbia sockeye populations have not shown equivalent increases in adult production. Although both Wenatchee and Okanagan adult sockeye abundance reflected similar ups and downs over the decades, the relative proportion of Okanagan to total Columbia sockeye returns has gone from 62% to 83% since 2004, suggesting that the larger portion of improvement has occurred in the Okanagan basin (Kahler and Bickford, 2013).

Throughout the process community consultations, ceremony, and celebration at each step provided guidance and continued governance. The insights and holistic perspectives of the Okanagan Nation *səxʷtx̣təm* caretakers (Armstrong, 2012; Terbasket, 2016) will continue to guide future research. The Columbia River Treaty (CRT) is scheduled for renewal in 2024. In preparation of this date, Tribal and religious leaders signed the “Declaration on ethics and modernizing the CRT” sent to governments of Canada and the United States (Sept 23, 2014) calling for five principles which include: “Healthy ecosystem function as an equal purpose to economic and other

purposes,” and “...healthy waters and flows that provide for abundant and sustainable native fish and wildlife populations.” The success of the Okanagan salmon restoration highlights the importance of governance by Indigenous communities to influence regulatory regimes that have previously excluded them from decision-making and limited access to their resources.

## **səlilwətaʔ (Tseil-Waututh) led salmon habitat restoration in xʔəlilwətaʔ (Indian River Watershed)**

**By Graham Nicholas**

The səlilwətaʔ (Tseil-Waututh) Nation has been stewarding and managing their territory and natural resources since time out of mind. Prior to European contact and colonization, the ancestral səlilwətaʔ had sophisticated management systems throughout their lands, including practices to ensure sce:ʔtən (salmon) populations persisted and remained abundant for future generations (Morin et al., 2021). Today, the ability to harvest sce:ʔtən for community and cultural needs has been greatly limited by a variety of factors. səlilwətaʔ lifeways are threatened as they have generally become disconnected from the four main pillars of their traditional subsistence foods— sce:ʔtən, stəwəʔ (herring), clams, and maʔəqʷ (duck/marine birds)—due to colonial government policies leading to impacts such as overharvest (at times causing extirpation) and contamination. sce:ʔtən in xʔəlilwətaʔ (Indian River Watershed) are one of the last remaining cultural keystone species within səlilwətaʔ core territory that can still be readily accessed by the community, and are a priority for the Nation to protect and restore for future səlilwətaʔ generations.

Today, as part of the xʔəlilwətaʔ/Indian River Watershed Integrated Stewardship Plan, səlilwətaʔ led stewardship and restoration is focused on understanding and



addressing the negative stressors impacting sce:ftən within xʔəliiwətaʔt (Tsleil-Waututh Nation, 2022). In conjunction with the impacts of colonial forestry practices, climate change is affecting the watershed through more frequent intense weather events such as heat domes, drought, and atmospheric rivers. The Nation has witnessed how extreme weather events, coupled with altered, fragile hillslopes, with unmaintained historical infrastructure (road, culverts, and pipelines), increase the frequency and severity of road washouts and hillslope failures such as landslide and debris torrents.

The erosion of improperly decommissioned logging roads is causing large volumes of rock and sediment to enter the river, blocking and filling in critical salmon spawning habitat and elevating the river's bedload. This overburden of boulders and gravel has been observed to reduce the water holding capacity of channels, while also physically disconnecting channels from the mainstem. This is preventing salmon from accessing channels to spawn in, and potentially increasing mortality of salmon fry if they become trapped in isolated pools when the water table drops in the summer.

səliiwətaʔt recognizes that to truly restore the watershed a 'top down' approach is needed – addressing upslope stressors which influence downstream habitat. This includes properly decommissioning historical logging roads to directly mitigate the accelerated input of aggregates into the river. This is a difficult and expensive undertaking: the government and industries that allowed these impacts to occur need to take responsibility for restoring the landscape they altered. In the meantime, səliiwətaʔt will not sit idle and watch salmon populations struggle to access adequate spawning and rearing habitat while waiting for those conversations and commitments. In the absence of the Province fulfilling its obligations, səliiwətaʔt is actively working to restore the river to conditions needed to protect salmon in xʔəliiwətaʔt. Since 2013, səliiwətaʔt has led eight

restoration projects in xʔəliiwətaʔt, totaling roughly 6km of spawning and rearing habitat that has been created or restored.

səliiwətaʔt current restoration strategy is directed to groundwater-fed side channels that primarily support kʷal 'əxʷ (chum) spawning and kʷəxʷəθ (coho) rearing. Side channels are the primary focus as the mainstem of the Indian River is so dynamic and powerful that restoration activities there will likely fail. Groundwater-fed side channels maintain stable water levels during high river flows in winter and freshet, and during low summer drought conditions. Additionally, groundwater remains colder (5-6°C vs. 13-15°C) compared to the mainstem during summer months, which helps buffer water temperatures within the whole system. These channels are critical to help alleviate drought conditions that are becoming more common.

'Brandt' and '5k' channels are two successful groundwater side channel restoration projects led by səliiwətaʔt in 2022 and 2023. Both channels were heavily affected by a massive landslide event in 2017, initiated by a major rain-on-snow event. The landslide sent a torrent of rock, boulders and logs down a major tributary of the Indian River, that blocked the outlet of Brandt channel and infilled 5k channel, disconnecting both channels from the mainstem.

These restored groundwater side channels were critical in September 2023, when the mainstem of the Indian River went subsurface and dried up for the second year in a row. Salmon were unable to access roughly 3.5km of spawning habitat, and were pooling up in large groups, in a limited amount of water resulting in large pre-spawn die-offs. By having 5k channel functional, steady streams of cool groundwater provided both spawning and refuge for the hu:ḥ (pink salmon), which do not typically spawn in groundwater channels. Situations like this highlight the need for future

restoration of groundwater channels in the xʔəlilwətaʔt. səliwətaʔt will continue to steward xʔəlilwətaʔt and the fish which rely on this system for generations to come, with the goal of reconnecting the community to salmon and the associated cultural practices and protocols.

## **Nuu-chah-nulth Peoples and salmon: responsive methods through steadfast lifeways**

**By Colton Van der Minne and Jared Dick**

The Nuu-chah-nulth Peoples are traditionally governed by the Ḥawiih (hereditary chiefs), who administer many aspects of Nuu-chah-nulth relationships with nature. For example, Tʼaaq-wiihak (permission to fish) is given by the Ḥawiih and can be taken away if a fisher does not follow the rules and protocols. Other important positions in the community are čačaluk, who are streamkeepers that care for the watersheds and salmon runs (Uu-a-thluk, 2012). They pay close attention to the salmon and have the authority to open and close specific runs. Their care for the watersheds includes directing activities such as the managing of debris, materials, and at times salmon eggs within streams. Answering to the Ḥawiih, these positions help maintain respectful relationships between the Nuu-chah-nulth, our land and waters, and the living beings found within them that are central to our culture and identity.

The decisions of the above-mentioned people, and indeed the lifeways and relationships of all Nuu-chah-nulth Peoples, are guided by our core principles. One such principle is ʔiisaak (respect). We are taught at a young age to respect ourselves, respect each other, and respect all that is contained within the ḥaḥuulii (chiefly territories) of our Ḥawiih. Ensuring that harvest of a plant or animal is sustainable and protecting them, is showing them the due respect. By doing so, they will continue to provide for us and

future generations as our relationship is known to be reciprocal. In practice this means that we are taught to never take more than we need, never be greedy, and never waste.

Nuu-chah-nulth's approach to respectfully managing resources is rooted in *hišukʔiš čawaak* which means "everything is interconnected, everything is one" (Atleo, 2004). This holistic approach is based around taking care of the entire ecosystem, rather than its individual components. It is understood that you must care for the forests to care for the salmon. How we interact with the system will have an effect on how it reacts or behaves, as we are not external to – but deeply integrated into – the system. By respecting and managing all components we are nurturing the connections we know and those we don't: our own version of taking a precautionary approach.

In Nuuchah-nulth territory today, there are several organizations that represent the fisheries interests and responsibilities of the Nuuchah-nulth Peoples. One of these organizations is Uu-a-thluk, a fisheries organization launched by Nuuchah-nulth Ḥawiih in 2005 and administered by the Nuuchah-nulth Tribal Council. Another organization is Ha'oom Fisheries Society, formed in 2020 to facilitate the rights-based commercial fisheries for five Nuuchah-nulth Nations: Ahousaht, Ehattesaht, Mowachaht/Muchalaht, Hesquiaht, and Tla-o-qui-aht. Ha'oom was formed in response to a series of court cases between the five Nations and the government of Canada in relation to commercial fishing rights. A 2018 ruling limited the Nation's right to the commercial fishery by describing their fishery as small, artisanal, and lacking modern technology. In short, it attempted to tie the right to historical fishing practices. Unsatisfied with this decision, the five Nations won an appeal that removed these limitations in 2021 (Sayers, 2021).

These organizations answer to and are guided by the Ḥawiih, following traditional Nuuchah-nulth governance. However, colonial laws require that they establish boards of

directors which they must also answer to. The Ha'oom board is composed of representatives from the five Nations community members whereas the Nuu-chah-nulth Tribal Council's board is composed of one representative from each of the fourteen member Nuu-chah-nulth Nations. Nevertheless, each organization and their boards understand that they are first and foremost accountable to the Hāwiih.

Salmon caretaking efforts and practices by the Nations, and the organizations working for us, have retained their fundamental functions but have changed by necessity in order to combat the growing complexity and scale of today's challenges. For example, the reverberations from historic logging practices combined with the climate-induced increased frequency of extreme weather events regularly cause our mountain sides and riverbanks to slough into our streams (Jakob, 2000). Combating such frequent large-scale disturbances has pushed us to adopt new technologies; exchanging our axes for chainsaws and our baskets for excavators.

Effectively rebuilding our salmon populations has also required us to alter how we interact with the salmon and their eggs. Many of our Nations use hatcheries to incubate the eggs and thus facilitate the transplanting of many salmon fry to struggling rivers. This process is more intrusive and artificial than our historical practices, as it involves a high degree of our control over salmon reproduction and rearing, but it has become necessary to overcome modern-day pressures salmon endure.

Through the evolution of our relationships and practices, so too has our knowledge evolved. Contemporary salmon stream caretaking by the Nations and their organizations often takes the form of research. To continue to manage our lands and waters with the respect they deserve requires us to deepen our understanding of the complex interconnections of hišukʔiš čawaak and how they are changing. Much of the

recent research conducted by Nuu-chah-nulth Nations has been focused around juvenile salmon. Furthering our understanding of their life-history and ecology has empowered our Ḥawiih, and Nations to make informed decisions about our changing interactions, such as how to best operate our hatcheries or restore our streams. Our Ḥawiih, and leadership continually encourage us to conduct our own research, generate our own data, and use it to manage the ḥaḥuulii to the best of our abilities.

In many ways, Nuu-chah-nulth Peoples today relate to streams and fish much like we always have. Governance is structured to follow the Ḥawiih, and caretaking is strongly influenced by our traditional principles including ʔiisaak and hišukʔiš čawaak. However, while we are strongly tied to our past, we are not bound by it. Much like Western society is different than it was during initial colonization, so too have Nuu-chah-nulth Peoples changed. The key is that Nuu-chah-nulth Peoples are the only ones who can determine what constitutes our lifeways. This was the flaw of the 2018 court ruling- it held us to the past and attempted to externally determine what it means to be Nuu-chah-nulth. Although there are new institutions to support Nuu-chah-nulth relationships with the waters and some of our practices may appear different than they once were, at their core our lifeways are still, and will always be, Nuu-chah-nulth.

## Conclusion

Ancestral knowledge, governance, and lifeways guide Indigenous Peoples' reciprocal relationships to salmon, including their responsibilities to care for and restore salmon streams. The three focal stories shed light on how stream caretaking actions and restoration activities today continue to be informed and grounded by Indigenous ancestral governance principles, laws, and protocols. In the case of Syilx sockeye restoration, community consultations, ceremony, and celebration are present at each step, providing governance structures to guide Syilx Okanagan Nation səxʷtx̣təm as they enact their right and responsibility to care for and protect siẉtkʷ and tmixʷ. səliiwətaʔ salmon stream restoration sits within the larger effort to restore the four main pillars of their traditional subsistence foods and the xʔəliiwətaʔ/Indian River Watershed Integrated Stewardship Plan led by the Nation. Nuuchahnulth restoration and research is supported by Uu-a-thluk and Ha'oom under the guidance of the Ḥawiih and guiding principles like ʔiisaak and hišukʔiš čawaak. These grounding governance structures connect Indigenous Peoples directly to restoration today. In this way, restoration goes beyond restoring habitat features and reintroducing fish, to include restoring river values and ethics and strengthening the relationships and governance structures that connect these systems.

The context, climate, and approaches today are different than they once were. Both Nuuchahnulth and səliiwətaʔ restoration efforts must contend with the ongoing impacts of forestry, while Syilx and səliiwətaʔ are rapidly implementing adaptive responses to drought and low flow levels. Faced with these cumulative pressures, diverse partnerships and collaborations are being formed. In all three cases, the Nations and supporting organizations are leading research on the cumulative impacts to salmon

to identify priorities to care for, restore, and protect salmon populations in ways that align with their governance and lifeways. As the climate and context changes, so are the approaches used by the Nations. Modern technologies, such as the FWMT, are being utilized and implemented by Nations all while guided by governance and cultural protocol. What remains is that Indigenous relationships, rights, and responsibilities to Pacific salmon shape restoration activities, outcomes, and our collective future with salmon.

Rivers are “hybrids of nature and culture” (Fox et al., 2017, p 522), connecting people, places, ecosystems, and species. We all are impacted by, and have an impact on, rivers and thus hold a shared responsibility to care for them. With this shared responsibility in mind, we remind non-Indigenous readers, researchers, scientists, and restoration practitioners that the knowledge and practices shared in this work cannot be cut and pasted into contexts separate from the people, places, and governance systems they belong to. As described by the focal stories, diverse collaborations and partnerships between Nations and non-Indigenous groups can provide important capacity building and tools to Nations restoring their streams. Whatever collaborative processes may be in place, restoration and caretaking guided by ancestral knowledge and lifeways must be led by Indigenous Peoples whose land and rivers the work is taking place on (Mauer, 2021).

Coming together over this project as a group of Indigenous and non-Indigenous people, we were guided by core principles that supported meaningful and effective collaboration. As we built the collaborative, we asked first, knowing that the answer could be no, and didn’t assume there would be interest or capacity to collaborate; we worked with transparency, following through on our words with actions; we built trust over long periods of time and leaned on pre-existing trust-based relationships; and at the



foundation of this collaboration, we had respect for each other, salmon, and the land, as we worked to do research in a different way. We do this work alongside a larger movement within the scientific community that aims to co-produce research in transparent and respectful ways to support Indigenous resurgence and self-determination. This work contributes to increasing calls for meaningful, just, and transparent restoration collaborations that centre Indigenous values, worldviews, priorities, and food systems (Dickson-Hoyle et al., 2022; Grenz and Geralda Armstrong, 2023). Climate change and social-political power systems continue to produce inequitable outcomes within salmon social-ecological systems, revealing an ongoing need for socially conscious, values-based management (Bingham et al., 2021; Silver et al., 2021). Restoration is an opportunity to re-balance salmon social-ecological systems by upholding and restoring Indigenous land and water relationships, responsibilities, and rights. We gather, share, and celebrate stream caretaking knowledge alongside focal stories of Indigenous salmon restoration to recentre Indigenous salmon-people-place relationships so that they may inform transformative and lasting restoration outcomes.

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## **Appendix A. Knowledge mobilization tool: Infographic**

This appendix contains materials that co-authors, partner Nations, and others can use to share the information synthesized in this work. It includes two infographics, that can be used separately or together, describing Indigenous salmon stream governance and caretaking practices. These infographics were created to promote knowledge dissemination, but also to foster reciprocal relations, where the knowledge that was shared with and gathered by the author is returned to the communities it is from.

## INDIGENOUS PACIFIC SALMON STREAM CARETAKING PRACTICES

Conscious, deliberate actions woven into lifeways that maintain healthy salmon stream habitat, strong salmon populations, and equitable human-salmon relationships.



Indigenous salmon stream caretaking was, and continues to be, embedded in complex governance systems that centre the land and water, law, and oral histories, and mandate how, when, and where practices are implemented.

*Art by Lauren Marchand*

# INDIGENOUS PACIFIC SALMON STREAM CARETAKING PRACTICES



## ASSESSING SYSTEM HEALTH

Over thousands of years, living in relationship with the land creates robust understandings of stream ecosystems patterns and changes to inform stream caretaking

## ENHANCING SALMON MIGRATION

Selectively removing material, such as logs, branches, sediment and rocks, that block upstream spawning habitat while leaving other stream features in place to provide rearing habitat complexity



## ENRICHING STREAM HABITAT

Rearranging boulders and rocks to create preferred habitat for spawning adults, and rearing and migrating juveniles

## HARVESTING SALMON PREDATORS

Removing various predatory species from streams to reduce mortality of salmon, such as ducks, Dolly varden, and seals



## WORKING WITH BEAVERS AND TREES

Beaver dams may be removed to enable adult migration, or left in place to provide habitat for juvenile salmon. Trees provide habitat, shade, and antiseptic properties to be considered in stream caretaking.

## RETURNING SALMON BONES TO THE WATER

Salmon bones are returned to streams to create a scent trail, guiding salmon from the ocean to their home streams, supporting them to reconstitute, themselves while also nourishing future juvenile salmon



## MOVING SALMON TO STRENGTHEN POPULATIONS

Moving salmon eggs between streams is a way that First Nations respond to environmental events impacting salmon streams, address localized shortages of salmon, and increase spatiotemporal diversity of salmon runs.

## HARVESTING SALMON FOR THRIVING POPULATIONS

Harvesting salmon for thriving salmon populations is a practice aimed at decreasing population-level impacts of harvest by selectively harvesting based on size, sex, or status.



Art by Lauren Marchand

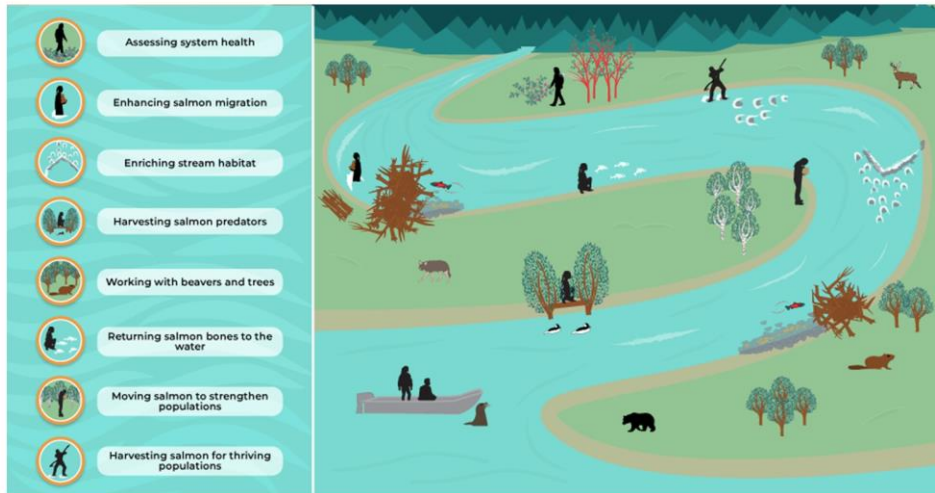
## Appendix B. Knowledge mobilization tool: Slides

This appendix contains materials that co-authors, partner Nations, and others can use to share the information synthesized in this work. It includes a slide deck describing Indigenous salmon stream governance and caretaking practices. This slide deck was created to promote knowledge dissemination, but also to foster reciprocal relations, where the knowledge that was shared with and gathered by the author is returned to the communities it is from.

The slides are also accessible here: [https://docs.google.com/presentation/d/1i6FTa43-vcTRQGcRLicTfy\\_GOoEQOcWH/edit#slide=id.p12](https://docs.google.com/presentation/d/1i6FTa43-vcTRQGcRLicTfy_GOoEQOcWH/edit#slide=id.p12)

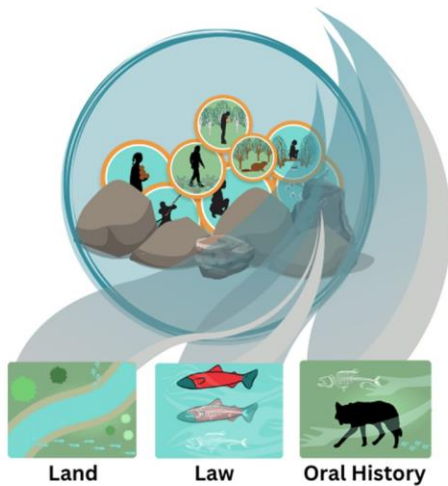






Indigenous salmon stream caretaking practices are conscious, deliberate actions woven into lifeways that maintain healthy salmon stream habitat, strong salmon populations, and equitable human-salmon relationships.

*Figure by Lauren Marchand*



## Indigenous salmon stream caretaking

Indigenous salmon stream caretaking was, and continues to be, embedded in complex governance systems that centre the land and water, law, and oral histories, and mandate how, when, and where practices are implemented.



## Assessing Systems Health

Over thousands of years, living in relationship with the land creates robust understandings of stream ecosystems patterns and changes (1). From this collective knowledge, stream caretaking practices can be implemented to maintain optimal habitat conditions and reduce variability and uncertainty.

"Our phrase 'Sk'awGan Gaalang skaasda' tells us specifically that when the salmon berries ripen and turn colour overnight, then it is time to go to the west coast to catch TaaGun (spring salmon). The action of the berries' turning colour is like the phosphorescent trails made by the salmon as they swim at night." Kiri'lijuus Barbara Wilson, Haida, (2).

## Enhancing Salmon Migration

Enhancing salmon migration aims to maintain habitat connectivity by selectively removing material, such as logs, branches, sediment and rocks, that block upstream spawning habitat while leaving other stream features in place to provide rearing habitat complexity (3,4,5,6)

"That's how badly the rivers can be blocked by windfall and debris. The salmon could not go up there. Our ancestors knew this, they saw this and they were part of the manpower that kept all these rivers clear so they could guarantee that the salmon would come back. They had a farming system in place... I was always told by the old people that we have to look after the river" Cyril Carpenter, Heiltsuk, (3)



## Enriching Stream Habitat



Enriching stream habitat involves rearranging boulders and rocks to create preferred habitat for spawning adults, and rearing and migrating juveniles (4,7,8)

Some built stream features include

- Stone semicircle structures across half the river or stone walls across the entire river to slow water and create spawning habitat (4,7)
- Stone V structures dug into the middle and deepest parts of the stream to create pools and passageways, and provide juvenile habitat and resistance to drought (8)

## Harvesting Salmon Predators

Harvesting salmon predators is a practice used to remove various predatory species from streams to reduce mortality of salmon, such as ducks, Dolly varden, and seals (4). Concealed platforms are used to capture ducks by hand, and size selective traps are used to capture Dolly varden.



" you have to let the smaller salmon and dollies come out... and right where the 'V' comes, you have a trough... you put a box, fill the box with holes in it, and the bigger trout will swim and fall into that... and you take that and make a dry fish out of it." Thomas Jack, Tlingit, (4).

## Working with beavers and trees



Salmon stream habitats are shaped by the other plants and animals that call them home, and working with other species, particularly beavers and trees, is a stream caretaking practice. For example, beaver dams may be cleared from the river to enable adult salmon migration or the dams may be left in place to provide important habitat for juvenile salmon. (4, 9)

Thomas Mills describes how they started taking beaver dams apart on the Neva River after “we weren’t getting as much sockeyes as we used to and pretty soon we just looked up, walked up the whole river to find out why. And when we got up to the lake over there, we saw that the beavers blocked out the whole lake where the sockeye couldn’t get into the lake and the bears and wolves and stuff were just having a field day” (Thomas Mills, Tlingit, Langdon, 2006, p 124).

## Returning salmon bones to the water

Returning salmon bones to the water is an important practice for many First Nations. Salmon bones are returned to streams to create a scent trail, guiding salmon from the ocean to their home streams, supporting them to reconstitute, themselves while also nourishing future juvenile salmon (5,10,11,12).

Dr. Mary Thomas, Secwepemc elder, spoke of how she “watched and helped while her grandmother carefully moved the carcasses of the salmon after they had spawned, from the banks of the Salmon River back into the water. Her grandmother explained that the salmon would nourish the baby fish to come” (Turner and Berkes, 2006, p 502).



## Moving salmon to strengthen populations



Moving salmon eggs between streams is a way that First Nations respond to environmental events impacting salmon streams, address localized shortages of salmon, and increase spatiotemporal diversity of salmon runs (3, 11, 13)

Ahousat people “sometimes used to take the eggs in the gravel and move them to a good location, if the stream was jammed up or if it changed course. The old people knew these practices.” Chief Earl Maquinna George, Ahousat, (13).

## Harvesting salmon for thriving populations

Harvesting salmon for thriving salmon populations is a practice aimed at decreasing population-level impacts of harvest by selectively harvesting based on size, sex, or status. (3, 9, 14)



Clara Peratrovich describes the process of gaffing sockeye in Tlingit territory and comments that males have “a slight hump and they’re bigger. The males are flat and big. You can always tell the round belly of the female. In fact, that’s the only type that the Native people target for is the male. They don’t bother with the female. ...that’s the reason why the fish was so plentiful. Nobody bothered with the female.” Clara Peratrovitch, Tlingit/Haida, (4).



## Conclusion

Grounded in governance systems, Indigenous salmon stream caretaking practices are adaptive systems to care for salmon and streams, improve salmon harvest, and maintain human-salmon relationships over thousands of years.

While these practices have been disrupted by colonial systems, today there is work being done to revitalize, rebuild, and reawaken them.

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## Appendix C. Artist statement

### 'Transform to Restore' *By Lauren Marchand*

Ancestors and Indigenous science, The ancestors energy are present and surrounding everywhere from people to the land, transcending time. We follow in their footsteps and no matter if we can experience their physical presence. We apply the science and knowledge we are responsible for as Indigenous Peoples, their mark is always present and we are guided by them in the present moment.

Salmon remains, The salmon remains has been a common caretaking protocol to return the remains of the salmon to the water in order to bring more abundance. The old feeding the new, the ancestors still feeding modern day sqilx'w (Indigenous people). Creating reciprocity of the cycle will bring the salmon home again and again.

Sqilx'w, The current day Indigenous people are just as impactful and carry just as much responsibility to the lands and waters as our ancestors have. We may move through with a world that looks different, but our importance and connection to the land spirits remains the same. Following in the footsteps of those that came before us, We must revitalize our relationship with the water and our connection to the water.

Coyote Footprints, The coyote prints come from Syilx captikwl, of 'How Coyote Brought the Salmon.' Alternatively, the representation of snk'lip on the top pattern of the t-dress is to show the transformation that occurs within us to walk through two worlds and while our ability to enact our teachings remain the same.

The contrasting colours of orange and blue show the balance we are seeking from what was to what is, and how we move through the changing times.



Figure C.1. Transform to Restore by Lauren Marchand, 2023

## Appendix D. Literature review methodology

We conducted a systematic literature review of Indigenous stream caretaking practices. We used one set of search terms and two databases. First, we completed a search in Web of Science by inputting the terms: (stream OR river) AND (restoration OR enhancement OR caretaking OR stewardship) AND (Indigenous OR “First Nation”) AND (salmon). This search identified 41 sources, of which all were reviewed and 1 was found relevant. From this publication a forward (articles that have cited the study since it was published) and backward (referenced sources) search was completed. The forward search resulted in no relevant sources. The backward source produced 1 relevant source. We then completed an advanced Google Scholar Search that searched for sources with all of the words ‘salmon AND Indigenous’ and with at least one of the words ‘stream, river, restoration, enhancement, caretaking, stewardship, “First Nation”’ (for example: ‘salmon AND Indigenous AND stream’, or another search being ‘salmon AND Indigenous AND river’). Because there were 111,000 sources produced by this search, we scanned abstracts to determine relevance. Once we had rejected 50 sources in a row, we stopped reviewing the results from the search (having done this for seven individual searches, as described above). We identified 5 sources as relevant, and again, we then did a forward and backward scan. We identified 2 relevant forward sources and 4 relevant backward sources. In total, 13 sources were identified as relevant.

Outside of published academic literature, grey literature, such as reports and websites, and conversations with co-authors were also used in this review, with 23 references used in total (Table D.1) These sources were identified by the author team, based on individuals knowledge, background, and experience.



**Table D.1.** References used in stream caretaking literature review section in alphabetical order

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## Appendix E. Governance language table continued

**Table E.1. Nation specific governance language from three of the Nations represented by the authorship team, with terms that were accessed for only one or two of the Nations.** The absence of a phrase in this table does not indicate that this phrase is absent in the Nation. Work is on-going with knowledge holders to identify relevant terms.

Haida	Nisga'a	Nuu-chah-nulth
<b>K'uuljaad</b> - matriarch	<b>Sigidimnak'</b> - matriarch <sup>a</sup>	--
<b>Nang jaada k'uulas</b> - boss woman		
<b>Naay</b> - physical house	--	--
--	<b>Wilp</b> - house (within a clan) <sup>a</sup>	--
--	<b>Lihkw</b> – stand guard (to) <sup>a</sup>	<b>čačaluk</b> - streamkeeper
--	--	<b>hitinkisnak</b> - beachkeeper

<sup>a</sup> (FirstVoices.com. Nisga'a Portal. First Peoples' Cultural Council)