2019 Southern Lakes Community-Based Salmon Planning

Year-End Report: March 31, 2020

Prepared for:
The Yukon River Panel
River Restoration and Enhancement Fund
Project Number: CRE-166-19N

Dennis Zimmermann and Shannon Bower, Project Facilitators

CARCROSS/TAGISH FIRST NATION

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Executive Summary

The Southern Lakes, situated in southern Yukon Territory, encompasses a landmass of approximately 25,000 km^2 including some of the largest rivers and lakes within the Yukon Territory. This landmass is made up of the Traditional Territories of the Kwanlin Dün First Nation (KDFN), Carcross/Tagish First Nation (C/TFN) and the Ta'an Kwäch'än Council (TKC). Salmon have been a part of this landscape, the people and the culture for millennia. These Traditional Territories are also located in the proximity to the large urban centre of Whitehorse. Much of this traditional territory remains effective habitat for a full range of northern boreal species and ecosystems, including Yukon River Chinook salmon.

Each of the three First Nation Governments represented in this community-based salmon plan have similarities and differences with respect to salmon, history, governance, and approach. The Yukon River, the water and the salmon have connected indigenous people for as far back as 13,000 years. The river and the salmon flow and swim through Canada and the United States and the Traditional Territories of the Inland Tlingit, Tagish, Southern Tutchone, Northern Tutchone, and Hän speaking people. For generations, indigenous peoples have lived, harvested, and traveled throughout the Yukon River drainage.

The Southern Lakes Community-based Salmon Plan is governed under the direction of a technical working group (TWG) made up of representatives from the three First Nation governments and project facilitators. Over the duration of the first project year, the TWG held regular meetings to plan, direct and implement the first phases of the project. The meetings and departmental collaborations conducted by TWG, along with the heritage and technical reviews, allowed us to identify preliminary themes and patterns in content and responses. These themes were vetted and discussed within the respective governments and, to some extent, Citizens over the course of the first year of this project.

Many of the salmon related values and perspectives brought forward by these respective First Nations Citizens acknowledge "the way it was" prior to borders or the numerous impacts that affected their salmon run. There is also a desire to have a salmon plan that acknowledges First Nations rights, agreements, self-determination, and a culturally and spiritually interconnected relationship with salmon. These indigenous perspectives need to stand side by side with western based scientific and management perspectives. To support these varying perspectives a socio-ecological system (SES) approach will be used as a framework for the plan. In an SES approach the biological components of the system are intrinsically linked to the social and cultural components of the system, such that changes to one part of the system will affect the other part of the system.

With a holistic mindset provided through the SES, the TWG was able to create an overarching narrative, list of values, perspectives and priorities provided by the community pertaining to salmon culture, salmon tradition, and salmon conservation. Community values are the foundation in any community-based planning effort and required if the Southern Lakes First Nation see themselves in the plan and contributed towards its success. A robust list of community generated themes and perspectives has been provided as an output of the first year of the project.

Planning, communications, research, engagement efforts and events formed the backbone of year one of this project and were essential strategies for encouraging Citizens to drive the development of the plan and communicate outcomes and ideas along the way. For the most part, these efforts took the form of collaborative meetings between the TWG and various departments and projects; community meetings,

fairs, newsletters and other forms of engagement; and, a large community engagement event, Weaving Salmon Connections, held February 3rd, 2020. It should be noted that the project was affected by COVID-19, limiting any additional community engagement planned for the remainder of the fiscal year. The TWG continue to meet online, however, person to person, community meetings are not permitted in any form.

Another important component of the work done to date was to define success metrics and build knowledge mobilization into plan development. To accomplish this, it was necessary to discuss what successful implementation of the plan could achieve. Thus, we co-created a list of success metrics. Once there was general agreement on the short-, medium-, and long-term metrics of success, we generated a potential list of tools that serve to drive the action-oriented aspects of the plan and support successful outcomes.

A list of implementation ideas was generated by the TWG that will be brought forward and refined during year two of this project. Overall, the main goal can be encompassed by the desire for Southern Lakes Chinook salmon to return to the landscape and resume its role in feeding the ecosystem, including birds, bears, trees, and insects and to contributing to the basic needs of First Nations, including self-determination as provided through Yukon's self-government agreements.

Pending successful funding for year two, KDFN, C/TFN and TKC will continue to focus on additional community engagement, implementation strategies and, production and printing of the final plan. This will be challenging given the uncertainty around covid-19 and the inability to conduct community engagement in the short term. Regardless, the TWG is committed to work towards completion of the report within the 2020-2021 fiscal year. This will require strength, adaptability, and resiliency, all of which can be drawn from the characteristics of Yukon River Chinook salmon themselves.

Acknowledgements

The authors of this report would like to extend our thanks to the participants on the Southern Lakes Salmon TWG, for your leadership, dedication, enthusiasm, and hard work on this project. Specifically, Brandy Mayes, Karlie Knight, Coralee Johns, Cheyenne Bradley, and Kristina Beckmann. We would also like to extend our thanks to the governments and Citizens of all three participating Southern Lakes First Nations: Carcross/Tagish First Nation, Kwanlin Dün First Nation, and Ta'an Kwäch'än Council for driving this year one work, guiding the project development, and making the engagements, events, and celebrations a resounding success. Your respect, stewardship and love for Yukon River Chinook salmon is clear and inspiring.

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1. Community-based salmon planning

The story of Yukon River Chinook salmon and their connection to the people and cultures of the Yukon is quite simply captivating and iconic. Yet, the very nature of salmon — their life histories, their range, and their significance to the environment, culture, lifestyle, and economy — making it challenging to sustainably manage their future. Many salmon populations face a multitude of pressures throughout their life history, from successful hatching and feeding in stressed tributaries as fry, to successful navigation of barriers as out-migrating juveniles, to surviving long enough in the ocean to make the legendary journey back to their natal streams for spawning. Combining these challenges with the current problems faced by all wildlife — climate change, over-consumption, pollution, predation and invasive species — it is no surprise that over the past several decades, salmon runs from many species and populations have been trending downwards in abundance and experiencing low levels of productivity.

This situation is heightened in the Yukon as a result of many factors, including complex governance systems, domestic and international agreements and treaties and transboundary relationships. Salmon runs in the Yukon are arguably more crucial to northern governments, Citizens and communities from a food and cultural security perspective, yet there is less capacity for research and management, many competing natural resource issues, and insufficient consideration given to First Nations' cultures, traditions, knowledge and laws to support salmon management. Many of the established management structures and venues do not reflect the current state of First Nation land claim implementation, self-government agreements, basic needs allocations and sovereignty.

How then do we go about incorporating the needs of First Nations Governments, Citizens and communities into salmon management in a way that recognizes the ongoing challenges faced by salmon themselves? Community-based salmon plans are a way to identify First Nations' values, perspectives and priorities and incorporate them into a comprehensive strategy for supporting and managing these salmon.

Southern Lakes Salmon

The Southern Lakes, situated in southern Yukon Territory, encompasses an area of approximately 25,000 sq. km, including some of the largest rivers and lakes in the Yukon. This landmass is made up of the Traditional Territories of Kwanlin Dün First Nation (KDFN), Carcross/Tagish First Nation (C/TFN) and Ta'an Kwäch'än Council (TKC). See Figure 1. Salmon have been a part of the landscape, the people and the culture for millennia. These Traditional Territories are also located in proximity to the large urban centre of Whitehorse. Much of this area remains effective habitat for a full range of northern boreal species and ecosystems, including salmon.

Top: KDFN staff and contractors working on a salmon restoration project. KDFN photo

Figure 1. Traditional Territories of Yukon First Nations
Source: env.gov.yk.ca; inset and circle show the Traditional Territories of participating Southern Lakes First Nations.

First Nations have been influenced by numerous impacts, including the Klondike Gold Rush, residential schools, the Alaska Highway, the Whitehorse Dam and increased urbanization. They are resilient and continue to hold onto their traditional values and pursuits. These First Nations have self-government agreements, which recognize these values and ties to the land.

While there is increasing competition for natural resources, habitat loss, and a need for pursuing the wage economy, there is an important cultural connection to salmon remembered and held by the Elders. There are few active fish camps, and few people fishing, however, the culture, ceremony and commitment to salmon is strong and woven into the people, cultures within these three First Nations.

Southern Lakes community-based salmon planning activities

The development of the three-government Southern Lakes Community-Based Salmon plan is an effort to reconnect people, culture and traditions around salmon. The project was designed to take place over two years, beginning in 2019 and finishing in 2021. This report focuses on Year 1 of the project: between April 1, 2019 and March 31, 2020.

These are the goals for the project:

1. collaborative, community-based, salmon planning within the Traditional Territories of the Southern Lakes First Nations, KDFN, C/TFN and TKC;
2. presenting Southern Lakes salmon-related priorities and values; and
3. supporting the salmon components related to the development of the *How We Walk with the Land and Water/Indigenous Land Relationship Plan*.

This report highlights progress made during the first year of the initiative:

1. an overview of the salmon planning activities to date;
2. a heritage review overview;
3. identification of community values and perspectives;
4. technical review overview; and
5. identification of upcoming activities, priorities and next steps.

Governance and planning activities

The Southern Lakes Community-based Salmon Plan is governed under the direction of a technical working group (TWG). The TWG made up of representatives from KDFN: Brandy Mayes and Cheyenne Bradley; C/TFN: Karlie Knight and Coralee Johns; and TKC: Kristina Beckmann (Figure 2). The project is supported by project facilitators Dennis Zimmermann and Shannon Bower. The following staff and contractors for each respective government participated occasionally: Bruce Wilson, Dave Sembsmoen, Diane Jimmy, John Meikle, Tami Grantham and Nick de Graff.

Figure 2. The Southern Lakes Community Based Salmon Working Group
Left to right: Dennis Zimmermann and Shannon Bower (Project Facilitators), Coralee Johns (C/TFN), Brandy Mayes and Cheyenne Bradley (KDFN), Karlie Knight (C/TFN) and Kristina Beckmann (TKC).

The project began in April 2019, with the First Nation governments of KDFN and C/TFN participating. TKC initially chose not to participate for reasons of personnel transition and capacity; however, decided in November 2019 to participate as a full partner in the project. Over the duration of the first funding year, the working group held regular meetings to plan and propose actions for the first phases of the project (Table 1).

Table 1. Meeting dates, host First Nation and associated outcomes, 2019 and 2020
Technical working group directing activities for the Southern Lakes Community-Based Salmon Plan project

Meeting date	Host First Nation	Outcomes
2019		
May 3	C/TFN	Broad-based system approach to salmon —not only about harvest, science or data; rather, cultural, spiritual connection and much more Review of C/TFN fishery-related initiatives C/TFN community-based priorities and considerations
May 10	KDFN	Focus on moving forward together as salmon people — builds on strength, partnerships and meaningful participation KDFN community-based priorities and considerations
July 3	KDFN, C/TFN	Project planning and project objectives Identify summer and fall engagement schedule and critical initiatives
July 19	KDFN, C/TFN	Discuss project budget, partners and methodology Identify broader salmon plan components and initial themes/priorities and direction to date
August 20	KDFN	Participated in the YRDFA call and discussed Alaskan management Shared data on fish ladder return and confirmed fall engagement schedule Confirmed respective action items
September 23	C/TFN	C/TFN Heritage, Lands and Natural Resources Department Provided a project update and gathered additional feedback Discussed other departmental projects (e.g., Community Knowledge Keeper) and their Fall engagement fair

Table 1, continued

Meeting date	Host First Nation	Outcomes
2019		
October 15	KDFN, C/TFN	Confirm overall values driving the salmon plan (KDFN Land Vision and C/TFN Virtues and Values) Thematically focus on the plan as a temporal/time narrative — Long Ago to Today and Oral to Written history — consider illustrations such as the caribou map with large lakes and Traditional Territories (map of the Southern Lakes with rivers and mountains) Must have a strategy component and focus only on Chinook (not Chum)
November 7	KDFN, C/TFN	Begin planning for the February Engagement Event in Whitehorse Identify how we will know if we have succeeded with this plan Brainstorm of potential actions, initiatives, and directions
December 4	KDFN	Planning for upcoming Yukon River Panel meeting Discussing Alaskan management as it relates to Southern Lakes salmon
December 19	KDFN, C/TFN, TKC	Planning for the February 3 event in Whitehorse — includes: invites, governance, purpose, facilitation, etc. Collaborative "toolbox" approach with each government having their own implementation plan supported by "tools"
2020		
January 8	KDFN, C/TFN	Met with Heritage and Lands staff to discuss project overlap (i.e., Heritage/Waterfront Planning and Land Relationship Planning) Discuss integration into the land-use planning and Chapter 11 work, possible Chapter 14 Schedule A — Headwaters Management Plan, and Chapter 13 Schedule C — Waterfront Heritage Plan Identify unique ways to lay out the plan
January 24	C/TFN	Meeting with C/TFN Land Management Board Discuss priorities for C/TFN and gather support Discuss engagement priorities and informed prior consent and approaches moving forward
March 17	KDFN, C/TFN, TKC	Discussed action items and next steps to year end and next fiscal year (pending funding) World Fish Migration Day engagement planning and postponement Youth engagement discussion Discuss COVID-19 implications and Zoom meeting scheduling

Socio-Ecological Systems approach

There is a significant level of complexity in supporting Yukon River Chinook salmon. These salmon can travel over 3,000 km as fry, reach the Bering Sea, and then return four to seven years later as spawning adults. They face many threats throughout their life cycle, during out-migration, during the years of feeding and surviving in the ocean, and then travelling back as adults while dodging nets and predators along the way. As will be demonstrated in the community values and perspective section of this report, salmon mean a great deal to the people and ecosystem around them. One way to represent this complexity — and the interrelationships, drivers and attributes around it — is through the use of a socio-ecological system (SES); see Figure 3.

The SES approach is a beneficial process for the Southern Lakes community-based salmon plan. It provides an opportunity to represent a way of viewing the world that allows people to make sense of complex subject matter without oversimplifying or losing crucial perspective. In an SES approach the biological components of the system are intrinsically linked to the social components of the system, such that changes to one part of the system will affect the other part of the system. This is an intuitive concept in fisheries, where we can easily see that decreased populations of fish can have an impact on fishers' lives and livelihoods. Another crucial part of the social-ecological systems concept is that of linkages and drivers: it is important to identify attributes of the system that link each part to another, and contribute to changing the system.

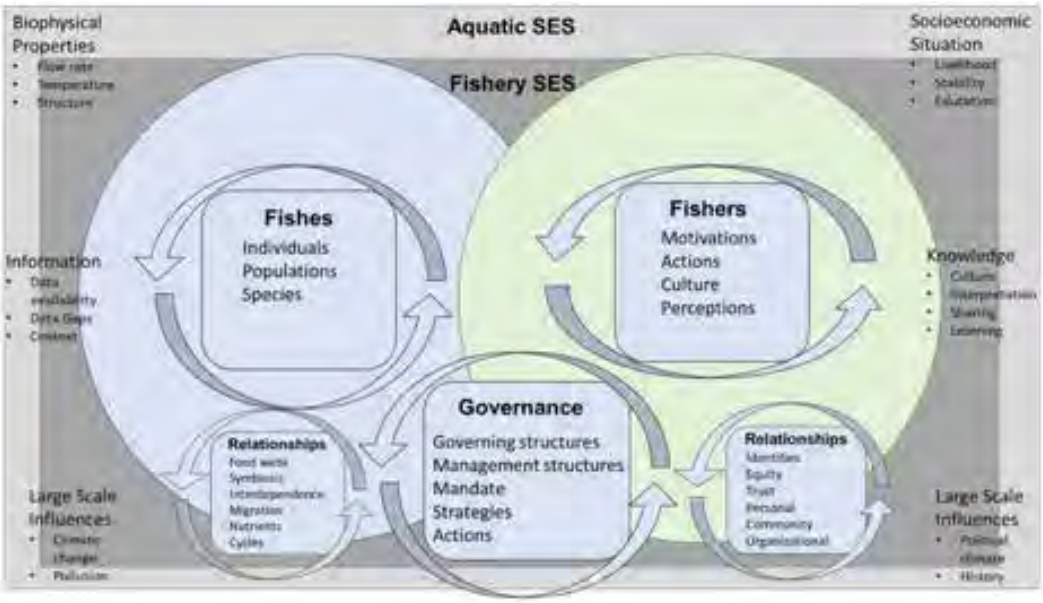


Figure 3. Example of components in a fishery socio-ecological system (fishery SES)

The fishery SES is embedded in the broader aquatic social-ecological system, which itself would be embedded in larger-scale systems. The biological and ecological components of the SES are represented by the blue circle, and the social and economic components of the SES are represented by the green circle. Each attribute (shown in boxes) is described by several components, and the circular arrows around each attribute indicates that these components are changeable and often subject to cycles according to external pressures. All of these components interact with each other, and all are influenced to varying degrees by internal and external drivers, some examples of which are shown around the edges of the figure.

Ultimately, the Southern Lakes First Nations community and government priorities will lead the plan in a manner consistent with established governance structures, existing management agreements/approaches, resolutions, traditional law, Elders' guidance, political direction, and traditional knowledge. In the case of this plan, many of these indigenous perspectives, including those that do not easily transfer into a western context, are provided space within and complement an SES approach. That is to say, indigenous or traditional knowledge (including songs, stories) can walk side by side with the western management processes used for salmon today. This plan will reflect both of these perspectives.

The SES approach was used to a limited extent in Year 1 of this project; however, it will be used to guide the prioritization and implementation of the plan in Year 2. The TWG will confirm community values and perspectives to be placed within the SES (Figure 4) as well as the way the components interact. This will ensure that the implementation of the plan supports community values and perspectives and leads to predetermined goals and outcomes. As mentioned, the SES acknowledges indigenous perspectives as well as supports the traditional western scientific research and management.

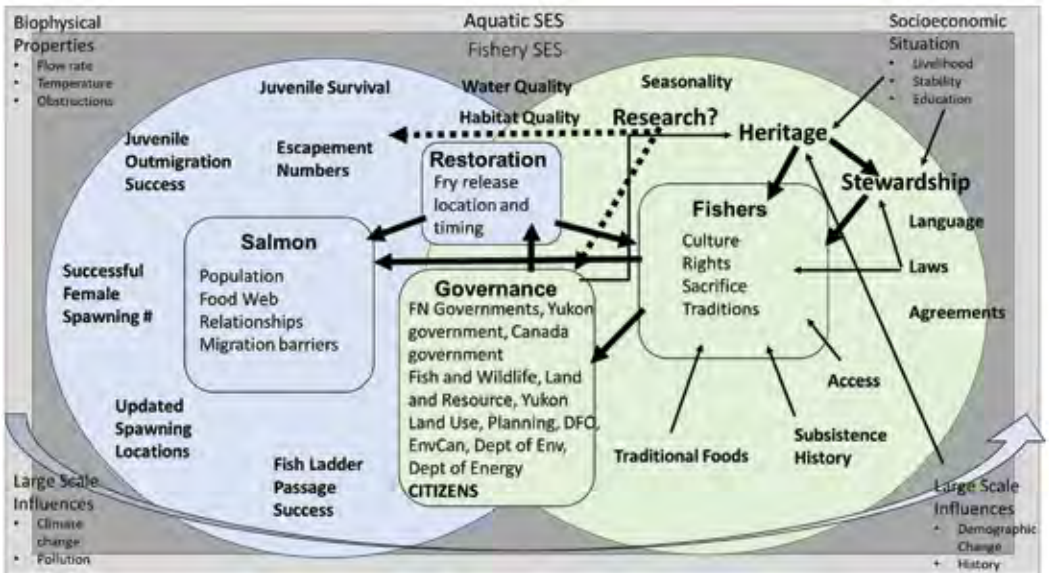


Figure 4. Sample SES analysis specific to Southern Lakes salmon systems

Figure 4 shows the same structure as in the generic system in Figure 3, but with the addition of specific components discovered during the research phase for this report. For example, the complexity of the governance bodies (if not the complexities of their interactions) are now clearly seen. Figure 4 also shows additional components influencing the stability of each side (social and ecological) in the salmon SES. The arrows shown on the right provide an example of how these components interact. For example, multiple components influence the concept of heritage, which becomes very important. Because of its significance, heritage then exerts a larger influence (shown in thicker arrows) on the working parts of the system. We also see the addition of new working parts, such as the restoration bubble, as restoration is such a crucial part of Chinook salmon management in the Southern Lakes region. The thick dotted lines with arrows emanating from research show that research has the potential to greatly affect governance decisions and thereby salmon populations; however, the degree to which this potential influence is exerted is currently unclear.

Southern Lakes salmon culture

Each of the three First Nation governments represented in this community-based salmon plan have similarities and differences with respect to salmon, history, governance and approach. The Yukon River, the water and the salmon have connected indigenous people for as far back as 13,000 years. The river and the salmon flow and swim through Canada and the United States and the Traditional Territories of the people who speak Inland Tlingit, Tagish, Southern Tutchone, Northern Tutchone and Hän. For generations, indigenous peoples have lived, harvested and traveled throughout the Yukon River drainage.

On behalf of three participating First Nations it is difficult to try to articulate *all* aspects of salmon culture for the purposes of this community-based salmon plan. Understanding "the way things were" at a time when salmon were plentiful and there were no borders is essential to moving forward. With this long history, there is a rich salmon culture and cultural narrative woven into First Nations interactions with salmon. First Nations perspectives are also presented here within a holistic indigenous world view that often is overlooked, ignored or misplaced within today's western and science-based structures, control and governance.

As mentioned earlier in this report, there are many challenges facing the Southern Lakes First Nations that have affected their connection to salmon. These impacts started during the initial years of contact with non-indigenous people and carried through to the Gold Rush, residential schools and major industrial projects (i.e., Alaska Highway, Whitehorse Dam, mining developments). In contrast, the era around today's modern land claim and self-government agreements is a time for self-determination and exercising rights to support salmon as well as economic development, education, health, justice and self-governance.

We know there was a rich salmon culture, as the salmon were in abundance in the Southern Lakes in the past. There were numerous fishing spots with active fish camps within the Traditional Territories of C/TFN, KDFN and TKC. Areas such as Lake Laberge, M'Clintock River, Michie Creek and what is now Whitehorse were all popular fishing spots as the salmon would return to spawn each year. Throughout the Southern Lakes, networks of trails would bring people together seasonally for fishing, hunting and berry picking. First Nations hunted for caribou and fished and salmon, which provided the majority of protein throughout the year.

Although there were different ethnic groups living throughout the Southern Lakes in the past, one of the initial themes brought forward by the Southern Lakes Salmon TWG was that of the Tagish Kwan (also referred to as Tagish Kwáan or Tagish Dene). The Tagish Kwan were a regional grouping of people who lived in the area between Marsh Lake and all the way to M'Clintock bridge. This was a major salmon fishing area and an area of overlap between the Kwanlin Dün and the Carcross/Tagish people. Prior to the TKC joining the project this was an area of focus. While this will still be a focus of the plan, the boundaries of the plan have geographically been extended beyond the Tagish Kwan area.

KDFN, C/TFN and TKC have all made incredible efforts over the last few decades in documenting their history, knowledge and stories. Each respective Heritage Department has an extensive inventory of recorded stories, photos, historic and ethnographic research around salmon that may be featured in this plan. It is essential that each First Nation Government and all Citizens are confident in the sharing, presenting and ownership of this knowledge for the purposes of the plan. Many stories, quotes, interviews and photos have been collected throughout phase one of this plan. However, it is premature to present this information in this publicly available year-end report without vetting it through each respective First Nation.

Summary of the Heritage Review

See Appendix D for the full Heritage Review. KDFN, C/TFN and TKC each have active heritage departments within their governments who work on broad mandates related to language programs, traditional skills, traditional knowledge, archives, oral history, heritage site management, policies/procedure development, archives, arts and historical research and more. These are all incredibly important aspects that should be captured in a holistic salmon plan and within an socio-ecological system approach. A prominent part of any salmon community engagement is paying attention to the stories, imagery, songs, ceremonies and the rich narrative from the past.

Heritage and culture are also treasured, protected and in the process of being reclaimed by each respective First Nation and their Citizens. This community-based salmon plan will tread carefully with this information, presenting only what each First Nation is willing to share. Some salmon heritage information has been made public and published in the past. There is also significant information on Southern Lakes salmon found within heritage publications such as KDFN's recent and ongoing waterfront revitalization project and C/TFN and TKC documents written by Herkes (2015) and Anderton (2005) respectively (see Appendix D).

Within the final production of the community-based salmon plan there will be many heritage and cultural related photos, stories and quotes that may come directly from Elders and other First Nations Citizens.

For the purposes of this report, a brief heritage report was written in order to uncover a relevant timeline around Southern Lakes salmon. The report, titled "Salmon Heritage of the Yukon River Headwaters: Tracing the Broken Salmon Trail," shares some of the information uncovered from a search of archival photographs, maps, reports, books and newspaper, before and after the "salmon trail" was broken. For the report and a list of additional reviewed heritage-related information please see Appendix D. This type of information will be brought forward and shared in Year 2 of the project in order to stimulate additional community participation and engagement.

Summary of the Technical Review

The current state of Chinook salmon in the Southern Lakes

See Appendix E for the full Technical Review. Currently, the health of the Yukon River Chinook run varies from year to year, but it has been trending downwards in the Yukon River system for decades. Identified threats to Chinook salmon populations include overfishing, development, habitat loss/change and climate change. There are numerous other factors at play in the health of Chinook salmon populations with respect to those salmon terminating their migration in the Southern Lakes region.

The Southern Lakes populations of Chinook are those salmon travelling through the Upper Lakes portion of the Southern mainstem. While Chinook have been shown to spawn in various locations in the Southern Lakes region, including Wolf Creek and Takhini River, the largest known spawning site for Chinook is in the M'Clintock River watershed, primarily in its largest tributary, Michie Creek. This population is believed to have experienced multiple significant declines. Harvest rates have decreased dramatically over decades for each First Nation. For KDFN and C/TFN the M'Clintock River watershed, and for TKC, Lake Laberge, were once major salmon fishing and gathering areas. Historically, salmon would migrate all the way to the headwaters of the Yukon River in Atlin, B.C., often spawning in Tutshi River, but these satellite populations

no longer exist. The exact timing of the loss of these satellite populations is unknown, but some individual salmon do reach this area on rare occasions.

Conversations on record describe family-oriented harvests of approximately 300 to 400 fish per 25 families and overall harvest of approximately 10,000 Chinook salmon along the M'Clintock River and surrounding area. Chinook harvest was practised widely throughout the community and was considered an important cultural event. By the mid-1950s, harvests are reported to have declined to a few hundred Chinook per year or even fewer. Currently, very few families practice Chinook harvest in the Southern Lakes, with reported harvest of only a few hundred Chinook or fewer. For individuals in C/TFN communities to access salmon they are now forced to leave their traditional territory and fish elsewhere. To harvest more than a ceremonial salmon, KDFN and TKC Citizens must also leave their Traditional Territories to fish or purchase Taku River salmon (from another drainage in B.C.). This disconnection between salmon and fishing activity has had a negative impact on salmon culture in these two communities and risks its loss entirely unless a new approach is sought.

Despite occasional high passage numbers at the mouth of the Yukon River system, numbers at Eagle sonar (in Eagle, Alaska, just downstream from the international boundary) fluctuate around minimum escapement levels, and Whitehorse Fish Ladder passage continues to trend downward. Research indicates that a high proportion (77–88%) of radio-tagged salmon passing the fish ladder migrated to the Michie Creek system, and Chinook reared at the Whitehorse Rapids Fish hatchery are released into Michie Creek.

The research outcomes of projects initiated and supported by KDFN, TKC and C/TFN have generated some alarming results concerning the future of Yukon River Chinook salmon in their Traditional Territories. Overall passage at the fish ladder is trending downward despite very low harvest in the Southern Lakes region. The downward trends in the number of successful passages in female Chinook and subsequent low redd counts are equally concerning and suggest that these trends are likely to continue. Coupled with the knowledge gaps surrounding Michie Creek-origin juvenile redistribution, rearing habitat and successful downstream passage of the power station, it appears that continued efforts for Chinook conservation and restoration are much needed.

2. Overarching Southern Lakes Salmon Narrative

The following is an attempt to capture the overarching narrative around Southern Lakes salmon. It is followed by a robust collection of themes and values that have been identified by Citizens through the Year 1 community-based planning process.

KDFN, C/TFN and TKC are salmon people. They have been disconnected from salmon for reasons beyond their control. A new generation of Citizens have never been at fish camp. Families used to spend months at fish camp, harvesting, smoking and preparing Yukon River Chinook salmon. With this came the essential social, cultural and nutritional benefits of being together.

In the Southern Lakes, the Tagish Kwan revolved their harvesting into areas such as Michie Creek and M'Clintock River to include these salmon stocks into their seasonal round. Caribou and salmon were integral to the movement of the Southern Lakes First Nations on well-worn and established traditional trails. This was a time when salmon were abundant, with family fish camps "putting up" hundreds of fish each season to keep caches full for the winter. This was before borders, when language, mountain ranges and river drainages are what separated people. Although families and Nations had separate areas to harvest and set hunting and fishing camps, they were all connected by the water and animals with a deep culture of respect, spirituality and ceremony. It was entrenched in a world view where people were part of the ecosystem, not separate from it, or trying to "manage" it. It was also a time when stewardship meant asking what the salmon required from us, not just how we can benefit from them.

The "way it was" included a history rich in language, story and song. Elders passed on knowledge around salmon by living it seasonally at fish camp. What was normal, seasonal, ingrained behaviour was affected by the many impacts discussed throughout this report.

For the Southern Lakes First Nations, modern land claims and self-governance agreements provide the backdrop for re-establishing and re-connecting with salmon. This can occur in the terms and ways that are relevant for each First Nation Government and the wishes of their Citizens. Regardless of the approach by an individual First Nation, it can be done with self-reliance, self-determination and sovereignty in mind. Through finding a voice and building collective strength around salmon KDFN, C/TFN and TKC will be in control of their relationship with salmon. These are resilient First Nations, and they will chart a course for salmon in partnership with other agencies, the public and other stakeholders.

Recognizing that salmon stocks are in a long-term decline, with at times only a few hundred passing through the Fish Ladder, this will be a challenge moving forward. In these uncertain and changing times, the salmon plan needs to be adaptive, flexible and responsive to the status of salmon overall. In addition, there are the changing effects surrounding climate and the relationships with other harvestable fish (e.g., whitefish and lake trout) and animals (e.g., caribou and moose).

Top: Salmon habitat in the KDFN traditional territory. KDFN photo.

The narrative presented above was developed through the TWG, reinforced through research, and validated and built on by Citizens. This could also provide a way to organize and present information through the salmon plan (Figure 5).

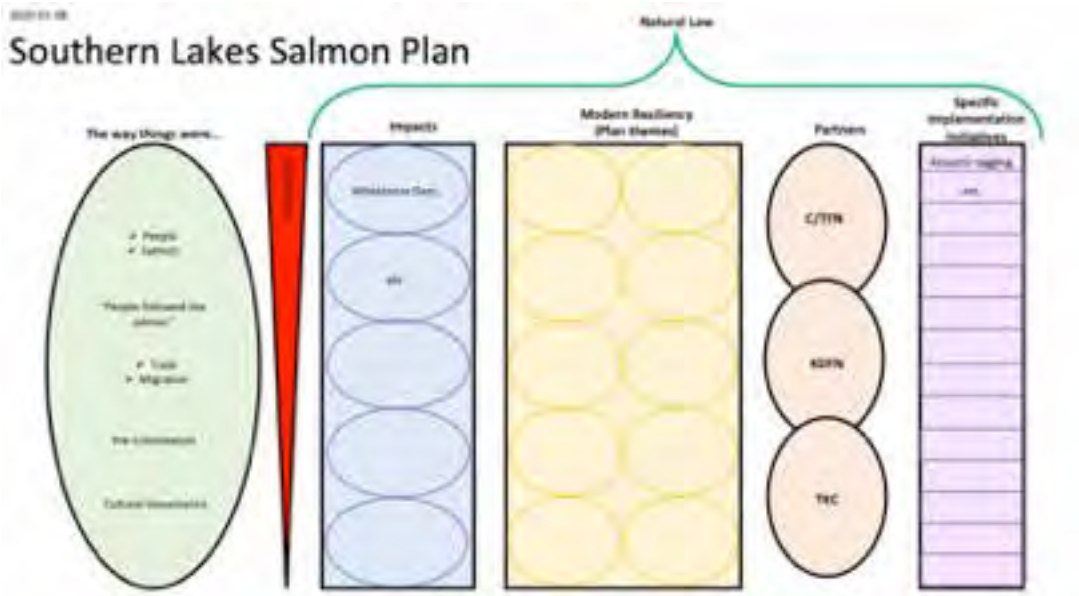


Figure 5. Potential ways that the plan could be organized
From left to right: The Way Things Were, Colonization, Impacts, Modern Resiliency, Partners and Specific Implementation Initiatives. Image developed by the TWG.

Community values and perspectives

The meetings and departmental collaborations conducted by the TWG, along with the heritage and technical reviews, allowed us to identify preliminary themes and patterns in content and responses (Figure 6). These initial themes were vetted and discussed within and among the communities over the course of the first year of this project via newsletters and several small-scale engagement meetings aligned with other related projects (e.g., Indigenous Land Relationship Plan — land-use planning).

Through this secondary process, we were able to create a list of values, perspectives and priorities provided by the community pertaining to salmon culture, salmon tradition and salmon conservation. Finally, these values, perspectives and priorities vetted and expanded upon during the year-end community engagement session, Weaving Salmon Connections (described in the Communications, Engagement and Events section; see also Figure 7).

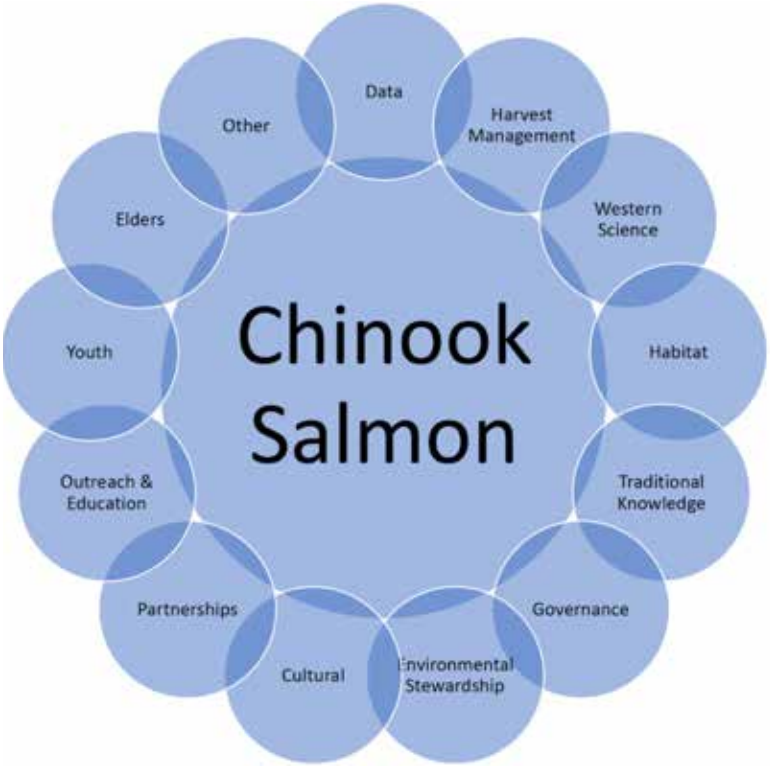


Figure 6. Some of the preliminary relationships and themes explored with the Southern Lakes salmon TWG
Between April 1, 2020 and October, 2020, only KDFN and C/TFN were participating. These relationships and themes were built on over the first year of the project and brought forward for further refinement on the February 3, 2020 community engagement session, Weaving Salmon Connections.

Themes and values

The following list of themes and values will be brought forward in Year 2 with the focus of identifying priorities and implementation strategies to achieve specific goals. See Figure 7 and Figure 8.

Traditional Law

- Focus on respect
- First Nations did not have borders
- Shared resources
- Think seven generations into the future
- Not superior or dominant over salmon, living with salmon in unison
- Stewardship to take care of salmon
- Sharing is always important
- Language needs to be central to the plan. It was the only borders we knew
- Natural law needs to be considered

Planning Initiatives

- Land Relationship Plan — *How We Walk With the Land and Water*
- Should align with the multi-government Southern Lakes Caribou Plan
- Connect to the Medicine Wheel or Seasonal Round
- Lands Vision — KDFN
- Marsh Lake Local Area Plan — KDFN
- Connections to special protections (i.e., habitat protection areas, special management areas, etc.)
- Should support Whitehorse Waterfront planning
- Traditional trails and routes

Training/Education

- Skookies Fish Camp — C/TFN (has not been used in a while)
- Culture Camp with KDFN at Michie Creek — C/TFN
- Bringing salmon into the schools
- Focus on youth and get them to bring it home to their parents
- Teach Citizens how to fish and to set the net —KDFN
- Loss of traditional skills — teach people how to fish, fillet, smoke and cook/can salmon

Figure 7. Initial themes and values

Presented during the year-end community engagement session, Weaving Salmon Connections, held February 3, 2020, to elicit discussion of values, perspectives and priorities.

Stories

- Nares Tlingit fish story about a “fish face” person — C/TFN
- Art, song and story
- Salmon boy story
- Salmon songs
- Sacred stories
- Oral history

Health and Wellness

- Family and social structure at fish camp is essential
- Elders and youth are getting nutrients from salmon
- Traditional medicines and medicines in the salmon
- Traditional foods
- Health comes from being on the land
- Connection to clans and families
- Part of the four quadrants: spiritual, mental, emotional, physical

Ceremony and Celebration

- Haa Kusteeyi — Inland Tlingit celebration around salmon
- People need to value the fish (not provide it to them in plastic)
- Prayer and ceremony as gratitude to the salmon
- Salmon ceremony for returning fish with other Governments

Historical Connections and Interrelationships

- Tagish Kwan are a shared connection with salmon and special places between the three First Nations
- The archeology of the area demonstrates people and salmon lived there for thousands of years
- Look at the river and what it means to be Kwanlin Dün — KDFN
- People living along the river, where they harvested and where they settled. These were salmon connections — KDFN
- Traveling and traditional trails corridors and the seasonal round

Spirituality

- Lost the ability to talk to animals and the relationship with them
- What is the relationships with salmon to other animals
- Seasonal round and harvesting in other areas — KDFN
- Medicine wheel

Western Science and Traditional Knowledge

- Two-eyed seeing walking side by side
- Climate change effects
- Data deficiencies around Southern Lakes Salmon
- Before western science, knowledge was held with the Elders in a living manner and communicated through story, art, blankets and song
- Restoration and stewardship projects to bring salmon back
- Existing research and monitoring programs in the Traditional Territory
- Hatcheries issues and opportunities

Habitat

- Need to respect and acknowledge our connection and water
- Clean water, clean spawning grounds and clear passage
- Effects on the other freshwater fish species – KDFN
- Ecosystem connections
- Water is life and central to all fish and wildlife
- Water temperature and quality monitoring is a key component

Whitehorse Dam

- Negative feelings, cut people off from salmon
- Healing, reconciliation and acknowledgment around the dam and negative effects
- Water licensing coming forward
- Salmon have lost their way
- Impacts from the dam have been infrequently studied and worthy of more research
- How many years has the dam cut off our salmon — C/TFN
- How are the water levels affecting salmon redds and salmon habitat

Partnerships

- Work with other governments on monitoring, especially Game Guardians
- Modern First Nation governments having an active role in development along the river
- Work with the public in partnership, in order to support us
- Plan will provide directions on how to engage with us on salmon and how we engage with partners and industry
- Ensure that treaties and indigenous rights are protected
- Understand and work with the Alaskans (i.e., Yukon Inter-tribal Fish Commission or Yukon River Inter-tribal Watershed Council)
- Connection to the Yukon River Panel

Harvest Management

- Focus on net sizes, releasing females, timing windows
- Have Game Guardians work with Citizens in order to monitor and educate
- Expensive to run a boat, set a net and run a fish camp; harvest support to keep people fishing — KDFN
- Food security and food sovereignty
- Self-determination and don't have to exclusively rely on other agencies for management direction
- Some generations have never experienced harvest and would like to

Figure 8. Proposed Themes and Values

These themes and values will be brought forward in Year 2. The focus will be to identify priorities and implementation strategies to achieve specific goals.

3. Communications, engagement and events

Communications, engagement efforts and events formed the backbone of Year 1 of this project and were essential strategies for encouraging Citizens to drive the development of the plan and communicate outcomes and ideas along the way. For the most part, these efforts took the form of collaborative meetings between the TWG and various departments and projects; community meetings, fairs, newsletters (Appendix A and B) and other forms of engagement; and a large community engagement event, Weaving Salmon Connections, held February 3, 2020 (see Appendix C).

As referred to earlier in this report (see Governance and Planning Activities, page 3), identifying areas of potential collaboration among various departments and projects was an important contribution of this project to plan development. For a salmon plan such as the one underway to be relevant and meaningful, it needs to intersect with other important projects on related topics and we need to ensure that the goals of these collaborative ventures are complementary and not conflicting.

Throughout Year 1 of this project, the TWG has met with and participated in various multi-level meetings and discussions to facilitate this collaborative process. Examples include participating in the YRDFA call and discussing Alaskan management as it pertains to Southern Lakes salmon; meeting with C/TFN Heritage, Lands and Natural Resources Department and the C/TFN Land Management Board; discussing other departmental projects (e.g., Community Knowledge Keeper) and participation in the Indigenous Land Relationship Plan - Fall Engagement Fair; planning for upcoming Yukon River Panel meeting participation and outputs; meeting with Heritage and Lands staff to discuss project overlap (e.g., Heritage/Waterfront Planning and Land Relationship Planning); and discussing integration into the land-use planning and Chapter 11 work, possible Chapter 14, Schedule A (Headwaters Management Plan), and Chapter 13, Schedule C (Waterfront Heritage Plan).

Weaving Salmon Connections workshop

The Weaving Salmon Connections Workshop took place February 3, 2020 at the Kwanlin Dün Cultural Centre (Figures 9 and 10). The purpose of the event was threefold: to come together as three Nations — (Kwanlin Dün First Nation, Carcross/Tagish First Nation and Ta'an Kwäch'än Council — to celebrate salmon and share what has been done on the community-based salmon plan to date; to discuss the plan itself and identify the themes and priorities for the plan established by all three Nations; and to join in learning and celebration with Yukon's educators. Approximately 35 individuals, including Elders and youth participants from the three Nations attended the event alongside 20 educators. Please see the final report for the February 3 event in Appendix C.

Top: Fox Creek fry release. TKC photo

During eight months of developing and initializing the community-based salmon plan, the TWG gathered feedback and ideas from community members, Elders, youth and local experts in order to identify preliminary themes that need to be incorporated into the salmon plan. The themes were then brought forward to this event for discussion in an effort to validate current ideas and identify additional themes that needed to be incorporated into the plan (Table 2 and Figure 9). The themes brought forward at the meeting were well supported, with many Citizens speaking to their cultural, scientific and overall importance.

Table 2. Preliminary list of perspectives and priorities

List provided by the community, brought forward and then built on at the engagement session, Weaving Salmon Connections, held February 3, 2020.

Initial list of themes	
Re-connection	"Every stream is a salmon stream"
Stewardship	"Everything is related to one another. From our stories, the Elders, we know it was the responsibility of the people to take care of salmon. If we don't, and if we don't respect it, it will go away."
Respect	"We ate everything, and we never used to waste any food. We ate everything off the fish, even the fish head. This was how you learned the old ways, by listening and doing."
Relationships	The discussion included a wealth of relationships, from family and community, to people and nature.
Restoration	"Marsh Lake used to be red with salmon… It would be nice to get that back."
Salmon people/ identity	"Re-connection and reawakening our salmon spirit is a part of us coming together and strengthening our governance."
Teachings and knowledge	"I'd like to make a curriculum about how Raven made the world. We are salmon people. We didn't have these borders. We need to talk about spirituality, and that animals, fish and human beings are equal — we're not higher. That's the way Crow said it."
Health and Wellness	The discussion of health and wellness centred mainly on traditional medicine and traditional laws.
Research	Discussion of research centred mainly on the need to include both traditional and technical science ways of knowing, and to discuss work being done by each participant Nation. During lunch, members of each Nation presented on the restoration work and research being done on behalf of salmon, including projects in Fox Creek (TKC), Michie Creek, M'Clintock and Ibex rivers (KDFN), and the Yukon and Takhini rivers (C/TFN).
Family and community	"We want to be able to harvest in our own waters. Our generation has never experienced that, and we want to. We want to have the experience of spending time on the water with our families."

Sharing	"Our people have always looked after each other. That's why we're still here."
On the land	"We are hungry for salmon."
Food sovereignty/ security	"It crosses all political lines when you're hungry and need food. That's something we have to start drilling home for our grandchildren — to give them something they can use to survive."
Partnerships	Discussion of partnerships ranged from the need to work together to create solutions, to discussion of various existing partnerships at various scales, to discussion of potential/needed partnerships.
Ceremony and prayer	Discussion of ceremony and prayer included the need to experience and instill gratitude as a part of knowing salmon.
Language	Workshop participants were supportive of First Nation language (Tlingit/Tagish/ Southern Tutchone) in the plan and acknowledge its importance. There was also a recognition of the relationship between language and traditional laws.
Habitat	Discussion on habitat focused on spawning habitat health and the need to consider habitat for all juvenile salmon stages, not just adults.
Treaties/ agreements	"What are our Indigenous Rights under treaty?"
The following were new themes explored during the Weaving Salmon Connections event	
Sacred stories	"We have a lot of stories in these three Nations. We use these stories to help out children so that they know what to do in the future… The salmon can't do it. [We have to.]"
Healthy water (contaminants, microplastics)	"Think about our water. If that can happen to our salmon, down the road we have to think about what can happen to our children… We have to clean up the water. "
Gratitude and ways of knowing	"That's the way nature manufactured it, and the only way it would work. We should listen to these kinds of stories. They used mostly clan and discussion, anything else was no good. Clan and discussion was the way closest to the truth."
Traditional laws/ values	"We need to include traditional values of salmon: we use every part of the salmon; we make sure when we catch them in the net they are not suffering."
Medicine (as part of health and wellness)	"There's medicine in salmon… There's a certain way you can make rotten eggs from the salmon… I don't know how many people know how to do salmon medicine anymore — I don't know if anyone knows how to make the rotten salmon eggs.

Figure 9. Advertisement for community engagement event
February 3, 2020 community engagement event, Weaving Salmon Connections.

4. Actions, tools and metrics of success

An important component of the work done to date was to include consideration of potential actions, knowledge mobilization and implementation. Thus, we co-created a list of success metrics (Table 3). Once general agreement on the short-, medium- and long-term metrics of success was achieved, we highlighted a potential list of tools that can serve to drive the implementation of the plan and support successful outcomes (Figure 10). This list of tools and actions will be refined during Year 2 of the project.

Table 3. List of short-, medium- and long-term metrics of success

Metrics of success can be used to evaluate eventual outcomes of the Southern Lakes Community-Based Salmon Plan.

Metric of success
Short term
Fish camps and cultural harvest occur (though not with Chinook harvest); connections to the land are encouraged, healthy family structure supported
People are eating salmon
Knowledge around salmon has been transferred
There are salmon connections to the ancestors
There are salmon present and observed in the traditional territory
People are salmon stewards
Salmon bring people and organizations together

Top: Youth releasing salmon fry at Fox Creek. TKC photo

Medium term
Fish camps and cultural harvest occur (though possibly not with Chinook harvest), connections to the land have been made, healthy family structure supported
People are eating salmon – health benefits are being realized
People are sharing salmon – healthy family structure, traditional law
Social structures around salmon have been re-established
There are salmon connections to the ancestors
There are salmon present and observed in the traditional territory
People are salmon stewards
Salmon bring people and organizations together
Long term
Salmon are being harvested through fish camps and cultural harvest
People are eating locally sourced salmon – health benefits are being realized
People are sharing locally sourced salmon – healthy family structure, traditional law
Cultural connections to the salmon and land are strong
There are salmon connections to the ancestors
Salmon support food sovereignty
People are salmon stewards
Salmon bring people and organizations together

Figure 10. Interactive development of themes, values and priorities
Photo taken during the February 3, 2020 community engagement event, Weaving Salmon Connections.

Stewardship

- Stewardship projects (habitat restoration, clean-ups, etc.)
- Salmon stewards at the Fish Ladder
- Develop outreach programs between Elders and Youth
- Develop a training program for First Nations youth

Conservation

- Citizen science projects (water quality, monitoring, etc.)
- Work with Alaska (e.g., Yukon River Inter-tribal Fish Commission and the Tanana Chiefs Conference)
- Collaboration between FNs on data sharing
- Support salmon stewards/game guardians

Education

- Credit in school — on-the-land curriculum
- Develop a recipe book, cooking lessons, canning workshop
- General education about salmon (e.g., life cycle, migration)
- Provide cultural awareness training to public

Culture

- Reconciliation around the dam, colonization, major impacts
- Opportunity for a Citizen "subsistence days" for salmon
- Culture and harvest camp for salmon
- Language, stories and ceremony within salmon

Figure 11. Potential tools that can drive the actions and implementation of the plan

These tools and ideas can contribute to revitalizing salmon culture and better understanding the nature of the obstacles to generating higher returning numbers of salmon, but in and of themselves don't guarantee that higher numbers of salmon will return. That needs to be the longer-term goal and will include successfully addressing fish passage issues one way or another, ensuring that Chinook salmon born in the Southern Lakes return to the Southern Lakes.

In addition to the metrics for success and potential tools to drive implementation, the TWG also spent time brainstorming possible actions for implementation. Table 4 lists ideas, actions and strategies that were discussed over the course of the planning process (presented in no particular order).

Table 4. Ideas, actions and strategies discussed over the course of the planning process
Presented in no particular order

Credit in school – on-the-land curriculum	Foodsafe, safe salmon storage education
Opportunity for a Citizen "subsistence days" for salmon	Connect w/health departments around salmon (diabetes, cancer)
Salmon in the school curriculum	Seek compensation for lost salmon due to the dam (money, fish)
General education around salmon (life cycle, migration, etc.)	Develop a sharing accord with other transboundary First Nations
Culture and harvest camp around salmon	Have a program to purchase salmon at feasts and potlatches
Reconciliation around the dam, colonization, major impacts	Provide KDFN, C/TFN major points for the YRSA from the plan
Citizens/families salmon harvest support program	Implement treaties around salmon (Chapter 16/ YRSA)
Language, stories and ceremony within salmon	Identify the Basic Needs Allocation for salmon
Stewardship projects around salmon — clean-ups, etc.	Continue to support restoration and enhancement work
Build relations with other First Nations	Beaver, muskrat trapping programs
Share with each other and transfer knowledge	Beaver dam management (e.g., Michie Creek)
Salmon fishing/filleting/smoking lessons (step-by-step guide)	Conduct E-DNA

Take knowledge holders out on the land to talk about salmon	Continue carcass surveys
Capture salmon specific videos, stories, pictures, oral history	Continue water temperature monitoring
Create a dedicated place/location for salmon harvest	Develop climate change adaptation/scenario planning
Develop outreach programs between Elders and Youth	Continue fish passage work (FECPL)
Have land stewards conducting outreach around salmon	Support salmon stewards/game guardians
Support the education exchange with Alaska	Collaboration between FNs on data sharing
Identify salmon-specific place names	Ground-based monitoring program
Identify salmon ceremony or natural law (i.e., use the entire fish)	Develop traditional map based on salmon, and not political map
Have a program to support purchasing fishing gear	Citizen survey on salmon use and interest
Have a ceremonial salmon harvest (harvest a few)	Support artisan workshop to use salmon (i.e., fish scales)
Identify traditional fishing spots and family camps	Provide cultural awareness training around salmon to public
Program to fish for alternative species (i.e., pike, burbot)	Salmon stewards at the Fish Ladder (meaningful)
Develop a harvest reporting tool (freshwater and salmon)	Work with Alaska, YRITFC and TCC
Develop a recipe book, host cooking lessons, canning workshop	Develop ways to engage public in the salmon plan

Upcoming activities and next steps

The Southern Lakes community-based salmon plan is proposed as a two-year project. Year 1 accomplished its stated objectives, with Year 2 focusing on 1) additional community engagement; 2) focus on implementation strategies; and 3) production and printing of the final plan.

Note: At the time of writing this final report for Year 1, Canada is coming to terms with COVID-19 and the resulting inability to host community engagement initiatives in the short term. A large-scale event for the salmon plan was planned to coincide with the World Fish Migration Day (WFMD) Initiative (www.worldfishmigrationday.com) in May 2020. The Southern Lakes Community-based Salmon plan event was registered on the website: www.worldfishmigrationday.com/events/2005/southern-lakes-community-based-salmon-planning). Due to COVID-19 the WFMD was postponed until October of 2020.

The TWG is planning to meet online and continue to work on the plan (pending successful funding for 2020–21) until such time as community engagement can occur. Aside from the planning, strategy and drafting of the plan, to take place between May and August, the TWG was planning an additional Salmon Culture Camp/Harvest to take place with the arrive of Yukon River Chinook in August 2020. It is unknown at this time if community engagement is likely to occur within the next year. Regardless, the TWG will produce a plan in some form and may need to be creative and innovative in ensuring that Citizens are driving this process.

Figure 12 provides a schedule that was produced by the TWG, anticipating completion of the plan in December of 2020 in conjunction with the post-season Yukon River Panel meetings in Alaska. These timelines will have to be revisited given the uncertainty around COVID-19.

Figure 12. Schedule of activities and events associated with the Southern Lakes Salmon Plan
Note: Schedule was developed prior to COVID-19

Appendices

Appendix A. October 2019 Newsletter


OCTOBER 2019

SOUTHERN LAKES SALMON PLANNING

Developing a Community-Based Salmon Plan

WE ARE SALMON PEOPLE

This plan is based on our values and priorities.

Chinook salmon along the Yukon River have always been incredibly important to our people, culture, animals and the habitat that live along the river. Fish camps have always played an important role with the transfer of knowledge, family connections and overall health and wellness for all of the First Nations in Yukon.

Like other downriver communities along the Yukon River, our two nations, the Kwanlin Dün First Nation (KDFN) and the Carcross/Tagish First Nation (C/TFN) are salmon people. Places like Michie Creek, M'Clintock River, Takhini River, Canyon City, Tagish and Marsh Lake were important parts of the seasonal round with many salmon to harvest there.

"Further up the Yukon River was an important gathering place near the mouth of the M'Clintock River. People were attracted by the abundant salmon. Lucy Wren recalled that people from Tagish and Carcross boated to Marsh Lake then travelled far up the M'Clintock River to set fish traps.

Other people have referred to this resource-rich area as being the "bread basket" of the region. Many of the people who lived in the extensive region between Marsh Lake and Tagish and their descendants refer to themselves as the Tagish Kwan". Source: Listen to the Stories – A History of the Kwanlin Dün: Our Land and People'p.13.

THIS SALMON PLAN IS OUR FOUNDATION.

We need to revitalize and renew our cultural connection to salmon.


IMPACTS TOOK US AWAY FROM SALMON

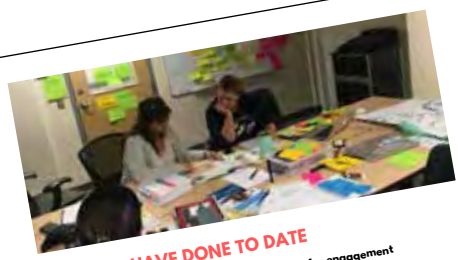
The strength of our agreements and partnerships will help us

As salmon people, we have been impacted by many decisions that have taken place on our traditional territories. The Gold Rush, mining projects, residential school, construction of the Alaska Highway, and the hydro-electric dams and structures (Whitehorse and Marsh Lake) have had devastating effects on our ability to maintain both the salmon runs and the cultural connection that comes with it. In addition, there are many additional external factors such as ocean-based harvest, climate change, Alaskan harvest, and issues related to habitat and generally low productivity of the salmon.

Chinook salmon along the Yukon River are almost half of what they were historically with an extremely low number reaching the tributaries within our two traditional territories. The Whitehorse Dam and the associated Whitehorse Rapids Fish Ladder and Hatchery saw a devastatingly low amount of returns in 2019 at 280 salmon, when the longer term average is 1,307. This is despite the 150,000 -400,000 chinook salmon fry released into the Upper Yukon River system each year since 1984.

Currently, there are very few active fish camps within our traditional territories. As settled governments with active land claim implementation taking place, being able to access salmon through harvest and ceremony becomes incredibly important.

RECONNECTING AND CELEBRATING SALMON CULTURE IS A PRIMARY FOCUS OF THIS PLAN



WHAT WE HAVE DONE TO DATE

Heritage, Lands and Resources are getting ready for engagement

The Lands and Resources Departments for the Governments of the KDFN and C/TFN have been involved in this project with an external contractors, Dennis Zimmermann and Shannon Bower from Big Fish Little Fish Consultants, since the summer of 2019. They have formed a steering committee with the focus of overseeing this two year project. Numerous meetings have taken place and the information around the Tagish Kwan, Whitehorse Rapids Dam, Michie Creek, M'Clintock River and the Land Relationship Plan as foundational elements within the plan.

The plan will be broad in nature, reflect community values and support a socio-ecological system approach. This means that it will be holistic in nature and support all aspects of salmon and community. This includes but is not limited to: harvest, western science, traditional knowledge, culture, food security, youth, traditional law, partnerships, governance, education, heritage and much more.

The first year of the project is dedicated towards reviewing existing literature around salmon and connections to our people. A series of engagement meetings will take place throughout 2019 and 2020 to identify the values and priorities for each nation around salmon. A community gathering will take place in February of 2020 to bring citizens and staff together to collaboratively discuss and plan for salmon.

A LARGE TWO-NATION SALMON CELEBRATION IS BEING PLANNED FOR 2020


EVENTS AND CONTACT INFORMATION

Come out and support us in building this salmon plan

Pending successful funding, the second year of the project will involve the final writing, design and production of the salmon plan as well as a large Fish Camp/Culture Camp/Salmon Celebration to bring citizens and the public together to celebrate KDFN and C/TFN salmon culture.

The final plan will feature the values and priorities of the community around Yukon River Chinook and identify ways to re-connect with salmon culture and collectively support their conservation and rebuilding.

Upcoming Events:

- KDFN and C/TFN Heritage, Lands and Resources Meetings - Oct. - Feb. 2019-20
- Salmon Celebration and Community Engagement - February 2020
- World Fish Migration Day Celebration - May 2020
- Culture Camp and Salmon Celebration - August 2020

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Dennis Zimmermann - Project Facilitator
867-336-3474 bflfyukon@gmail.com

"WE USED TO GO FISHING AT M'CLINTOCK, LOTS OF FISH AND MAKE BIG PARTY AT MARSH LAKE" LILY KANE

Appendix B. February 2020 Newsletter

FEBRUARY 2020

SOUTHERN LAKES SALMON PLANNING

Developing a Community-Based Salmon Plan

SL SALMON WORKSHOP

"The Salmon Trail's Been Broken: We Must Remeber It"

The Weaving Salmon Connections Workshop took place February 3, 2020 at the Kwanlin Dün Cultural Centre. The purpose of the event was three-fold: to come together as three Nations - Kwanlin Dün First Nation (KDFN), Carcross/Tagish First Nation (C/TFN) and Ta'an Kwäch'än Council (TKC) to celebrate salmon and share what has been done on the community-based salmon plan to date; to discuss the plan itself and identify the themes and priorities for the plan; and, to join in learning and celebration with Yukon's educators. Approximately 35 individuals, including Elders and youth participants, from the three Nations attended the event alongside 20 educators. A workshop report is available from any one of the technical working group members (see contact information - last page).

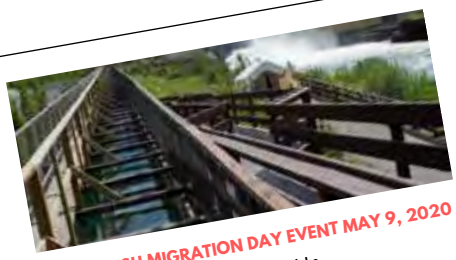
"When we talk about being caretakers of the salmon that extends to the waters. When I think about this plan and the three Southern Lakes First Nations coming together like this to talk about protection of the salmon, it's very powerful. It's time, and I'm so glad to see this happen." Workshop Participant

RESEARCH, SUPPORT AND RESTORING SALMON

Taking Responsibility for Salmon in Each Traditional Territory

Long term declines of Yukon River Chinook salmon abundance and low productivity have led to harvest restrictions and sacrifices on the part of each First Nation. As a result, each First Nation Government is actively working to better understand, support and restore salmon. Staff within each Heritage, Lands and Resources department have fisheries programs that are focussed on trying to address these concerns within each traditional territory. For example, KDFN staff and dedicated contractors (such as Nick de Graft) have been working for decades on ensuring free passage to the important spawning habitats of Michie Creek and the McClintock River. The C/TFN, in partnership with the KDFN and TKC and the Canadian Wildlife Federation have been involved in a unique tagging and tracking project that assesses the movements of salmon after they pass through the Whitehorse Fish Ladder. This research aims to shed light on how, and where, the salmon are moving and spawning which could aid in recovery efforts. The TKC have been working for over a decade on the Fox Creek Chinook Salmon restoration program to re-establish a self-sustaining population of Chinook salmon. This program involves releasing salmon fry and then eagerly awaiting their return as adults four to six years later. Demonstrating their commitment and collaboration, these three First Nations are working together to share information, data, resources, and their passion for Yukon Chinook salmon. Science, research and restoration are key strategies that will be highlighted within the plan alongside traditional knowledge and other cultural and ceremonial values around salmon.

"MARSH LAKE USED TO BE RED WITH SALMON...IT WOULD BE NICE TO GET THAT BACK"



WORLD FISH MIGRATION DAY EVENT MAY 9, 2020

Connecting fish, rivers and people around the globe

The World Fish Migration Day is a one day global celebration to create awareness on the important of free flowing rivers and migratory fish. Migratory fish, such as the Yukon River Chinook salmon travel thousands of kilometers (~3,000km) from their ocean feeding grounds to reach their spawning grounds in the freshwater of the Southern Lakes. Along the way, and against the current from the Bering Sea in Alaska to the traditional territories of the KDFN, C/TFN and TKC they face numerous obstacles along the way. Harvesters in Alaska and Canada set nets, predators try to catch them and increasing temperatures due to climate change make this a difficult journey. When they have almost reached their spawning grounds, many face one more obstacle; navigating the longest wooden fish ladder in the world at the Whitehorse Fishway. The Fishway provides an opportunity for the public to view these amazing salmon, actively participate in their stewardship and to collect brood stock for the associated fish hatchery. The Word Fish Migration Day is an opportunity to share this amazing salmon story with the rest of the world and stand together to support migrating fish! The three Nations will gather citizens to discuss the salmon plan and celebrate southern lakes salmon.

WORLD FISH MIGRATION DAY

EVENTS AND CONTACT INFORMATION

Come out and support us in building this salmon plan

Year one of this project has been supported by the Restoration and Enhancement Fund of the Yukon River Panel. The technical working group for the salmon plan is made up of (featured in the photo above, left to right): Dennis Zimmermann, Shannon Bower, Coralee Johns - C/TFN, Brandy Mayes - KDFN, Cheyenne Bradley - KDFN, Karlie Knight - C/TFN, and Kristina Beckmann - TKC.

Upcoming Events:

- World Fish Migration Day Celebration - May 9, 2020
- Culture Camp and Salmon Celebration - August - TBD 2020

Contact Information (Technical Working Group):

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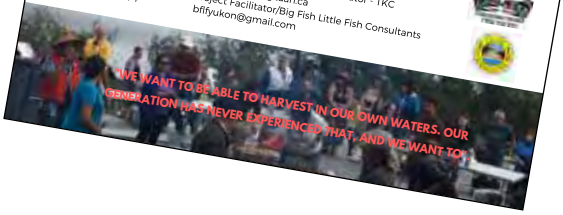

Appendix C. Final Report: Weaving Salmon Connections event, February 3, 2020

"When we talk about being caretakers of the salmon, that extends to the waters. When I think about this plan and the three Southern Lakes First Nations coming together to talk about protection of the salmon, it's very powerful. It's time, and I'm so glad to see this happen."

Workshop participant

The Weaving Salmon Connections Workshop took place February 3, 2020 at the Kwanlin Dün Cultural Centre. The purpose of the event was threefold: to come together as three Nations (Kwanlin Dün First Nation, Carcross/Tagish First Nation and Ta'an Kwäch'än Council) to celebrate salmon and share what has been done on the community-based salmon plan to date; to discuss the plan itself and identify the themes and priorities for the plan established by all three Nations; and to join in learning and celebration with the Yukon's educators. Approximately 35 individuals, including Elders and youth participants from the three Nations, attended the event alongside 20 educators. The event started with an opening prayer by TKC Elder, Julia Broeren, following an opening round of introductions prior to starting the discussion.

"We are the spokespersons, the guardians of the animals of this country."

Workshop participant

During the past eight months of developing and initializing the community-based salmon plan, the Southern Lakes Salmon Technical Working Group (TWG) elicited feedback and ideas from community members, Elders, youth and local experts in order to identify preliminary themes that need to be incorporated into the salmon plan. The themes were then brought forward to this event for discussion, in an effort to validate current ideas and identify additional themes that needed to be incorporated into the plan. The themes brought forward at the meeting were well supported, with many Citizens speaking to their cultural, scientific and overall importance. The themes brought forward are described here, with either a representative quote or a general description of the resulting discussion:

- **Re-connection**: "Every stream is a salmon stream"
- **Stewardship**: "Everything is related to one another. From our stories, the Elders, we know it was the responsibility of the people to take care of salmon. If we don't, and if we don't respect it, it will go away."
- **Respect:** "We ate everything, and we never used to waste any food. We ate everything off the fish, even the fish head. This was how you learned the old ways, by listening and doing."
- **Relationships:** Discussion included a wealth of relationships, from family and community, to people and nature
- **Restoration:** "Marsh Lake used to be red with salmon… It would be nice to get that back."
- **Salmon People/Identity:** "Re-connection and reawakening our salmon spirit is a part of us coming together and strengthening our governance."
- **Teachings and Knowledge:** "I'd like to make a curriculum about how Raven made the world. We are salmon people. We didn't have these borders. We need to talk about spirituality, and that animals, fish and human beings are equal — we're not higher. That's the way Crow said it."
- **Health and Wellness:** Discussion of health and wellness centred mainly on traditional medicine and traditional laws.

- **Research:** Discussion of research centred mainly on the need to include both traditional and technical science ways of knowing, and to discuss work being done by each participant Nation. During lunch, members of each Nation presented on the restoration work and research being done on behalf of salmon, including projects in Fox Creek (TKC), Michie Creek, M'Clintock and Ibex rivers (KDFN), and the Yukon and Takhini rivers (C/TFN).

"We also have to talk about how salmon is a transformer, like Salmon Boy. When we talk about anything, we have to talk about the word respect. We really have to know those words."

Workshop Participant

- **Family and community:** "We want to be able to harvest in our own waters. Our generation has never experienced that, and we want to. We want to have the experience of spending time on the water with our families."
- **Sharing:** "Our people have always looked after each other. That's why we're still here."
- **On the land:** "We are hungry for salmon."
- **Food sovereignty/security:** "It crosses all political lines when you're hungry and need food. That's something we have to start drilling home for our grandchildren — to give them something they can use to survive."
- **Partnerships:** Discussion of partnerships ranged from the need to work together to create solutions, to discussion of various existing partnerships at various scales, to discussion of potential/needed partnerships.
- **Ceremony and prayer:** Discussion of ceremony and prayer included the need to experience and instill gratitude as a part of knowing salmon.
- **Language:** Workshop participants were supportive of First Nation language (Tlingit/Tagish/Southern Tutchone) in the plan and acknowledge its importance. There was also a recognition of the relationship between language and traditional laws.
- **Habitat:** Discussion on habitat focused on spawning habitat health and the need to consider habitat for all juvenile salmon stages, not just adults.
- **Treaties/agreements:** "What are our Indigenous Rights under treaty?

From start (left) to finish (right) workshop participants provided invaluable thoughts and input on the themes for the salmon plan and identified crucial new themes.

In addition to the themes presented to the attendees, new themes came to light during the discussions:

- **Sacred stories:** "We have a lot of stories in these three Nations. We use these stories to help out children so that they know what to do in the future… The salmon can't do it. (We have to.)"
- **Healthy water** (contaminants, microplastics): "Think about our water. If that can happen to our salmon, down the road we have to think about what can happen to our children… We have to clean up the water."
- **Gratitude and ways of knowing: "**That's the way nature manufactured it, and the only way it would work. We should listen to these kinds of stories. They used mostly clan and discussion, anything else was no good. Clan and discussion was the way closest to the truth."
- **Traditional laws/values:** "We need to include traditional values of salmon: we use every part of the salmon; we make sure when we catch them in the net they are not suffering."
- **Medicine** (as part of Health and Wellness): "There's medicine in salmon… There's a certain way you can make rotten eggs from the salmon… I don't know how many people know how to do salmon medicine anymore — I don't know if anyone knows how to make rotten salmon eggs.

Participants also had concrete suggestions for ways to potentially act on some of these themes, and for additional topics to be included within the themes themselves. Options for additional partnerships, water forums, funding opportunities, the need for more game guardians, fishing camp and tourist infrastructure, and engagement were widely discussed. The event closed with a prayer by Elder Diane Smith and a song by KDFN Councillor Sean Smith. Citizens and educators joined together in a circle for this powerful finale.

"We may be three nations, but we speak with one voice."

Workshop Participants

Next steps for this project include the production of this event report (February), a Southern Lakes Salmon Newsletter (February/March), completion of a funding report for 2019 and an update on the funding proposal for 2020 (April). If the funding proposal for 2020 is successful, the new themes that emerged from this event will be incorporated into the draft salmon plan, which will be finalized for circulation and comment in September 2020 before the final plan is produced in December. In addition, the TWG for the salmon plan project will have meetings in March, April and June to continue the work on the draft salmon plan and planning for upcoming salmon events.

Many thanks to all participants, Elders and youth for joining in this important event, and for sharing their thoughts and suggestions for ways to move forward.

Left: Members of the Southern Lakes Technical Working Group (KDFN, C/TFN and TKC, Contractors) for the community-based salmon plan; right: meeting participants.

Appendix D. Heritage Review

Salmon Heritage of the Yukon River Headwaters: Tracing the Broken Salmon Trail

"People from Marsh Lake, Tagish and Lake Laberge used to meet here [at King Salmon River or Salmon Creek] in summer at a fishcamp several miles up the M'Clintock River. For many years there was a fish trap at this spot."

Angela Sidney, *Place Names of the Tagish Region, Southern Yukon* 1980

For thousands of years, the people who lived in the headwater region of the Yukon River — the ancestors of the Carcross/Tagish, Kwanlin Dün and Ta'an Kwäch'än peoples — relied on the salmon to make the 3,200-km journey from the ocean back to their birthplace to spawn. The salmon were dependable and predictable, always arriving at around the same time and the same places every summer. Although the long trip against the current without eating took its toll, the large fish still provided a welcome addition to the food supply, dovetailing nicely with the caribou hunt and other fisheries that comprised the seasonal round. Sadly, in the past 120 years the connection between the people and the salmon has slowly and steadily severed, and the salmon cycle itself has been seriously compromised. Just 282 king salmon (which people started to call *Chinook* in the 1970s) reached the Whitehorse fish ladder in 2019, the lowest number in 40 years.

Casting a wide net at the Yukon Archives – searching for photographs, maps, reports, books and newspapers – has turned up an interesting catch, an assortment of bits and pieces before, during and after "the salmon trail" was broken. Early explorers, gold rush stampeders, non-Indigenous settlers, fur farmers, soldiers and highway builders, business and political leaders – all played a role in the demise of the salmon. Industrial developments, new settlements, fish camp dislocations, sewage and other contaminants, overfishing, mismanagement and changes to the climate are all factors in this ongoing saga.

Archaeological work conducted in the M'Clintock River region 10 years ago suggests that after the last ice age ended 11,000 years ago, the first people of the Southern Lakes were hunters — mostly of caribou, but also bison and elk — with fishing added around 5,000 years ago and then salmon a few thousand years later. "Archaeological sites dating to 1,200–200 years ago are found in locations similar to the preceding time period [5,000–1,200 years ago, when camps near waterbodies were used on a more regular basis], but occur more frequently in river settings, suggesting that salmon fishing was becoming increasingly important in the seasonal round," according to the 2015 Government of Yukon booklet, *Ges Tu'è', Gyò Chúa, T'ahéeni: The Archaeology of the M'Clintock Region*.

When the United States sent Army Lieutenant Frederick Schwatka to explore the length of the Yukon River by raft in 1883, fish of all kinds, but especially salmon, were both a commodity and a currency all along his journey. He left Bennett Lake in mid-June and reached the Bering Sea in late August. He descended the river along with the juvenile salmon just as the adults were swimming back up to return to their spawning grounds.

With the help of First Nation guides and interpreters, by June 26 he made it to the outlet of what he called Lake Tahko (Tagish Lake), where he found a First Nation house a few miles down the river. "The house was deserted, but evidently only for a while, as a great deal of its owner's material of the chase and the fishery was still to be seen hanging on the rafters," he writes in his book, *A Summer in Alaska*. "Among these were a great number of dried salmon, one of the staple articles of food that now begin to appear on this part of the great river, nearly two thousand miles from its mouth. This salmon, when dried before putrefaction

sets in, is tolerable, ranking somewhere between Limburger cheese and walrus hide. Collecting some of it occasionally from Indian fishermen as we floated by, we would use it as a lunch in homeopathic quantities until some of us got so far as to imagine that we really liked it. If smoked, this salmon is quite good, but by far the larger amount is dried in the open air."

He visited First Nations people fishing at the mouth of M'Clintock River and once he passed safely through Miles Canyon and rapids on July 1, his crew hunkered down for a few days of what he said was the best fishing of the entire trip – catching 400 to 500 grayling at the foot of the rapids. His party didn't see anyone else until past Lake Laberge, but he did mention that gold prospectors had started trickling into the Upper Yukon country. In 1885 American George Carmack was among that trickle, a trickle that in 1896 he and his Tagish family turned into a flood when they discovered gold in the salmon-bearing watershed of the Klondike River. Gold has trumped salmon ever since, even though, interestingly, salmon usually go hand-in-hand with most placer gold found in salmon streams.

The gold rush of 1896–98 changed everything. Fish camps at the head of Miles Canyon and the foot of the Whitehorse rapids were quickly overrun with travellers, says a report on Canyon City, *From Trail to Tramway.* The building of the railway from Skagway to Whitehorse in 1900 killed the canyon community, but kick-started the development of Whitehorse itself on land used by First Nations for centuries. The river became a source of food and also a dumping ground for sewage and other garbage. Dozens of riverboats plied the river between Whitehorse and Dawson and soon the companies were not only dredging the river and lakes for better passage but also devising ways of getting rid of the ice on Lake Laberge a few weeks earlier in the spring.

Government documents from the 1920s detail the process of White Pass & Yukon Route proposing to build a dam near the head of the river, just a few miles north of Marsh Lake. It wanted to hold back water from the lakes in the fall/winter, releasing it in the spring to help flush out the ice 80 km downstream at Lake Laberge. No mention was made of the impact on the salmon or the freshwater fish but the fact timber values would not be affected was noted. The dam was turned over to the federal government in 1948, shortly before riverboat traffic came to an end, and has been rebuilt several times since.

In her book, *Place Names of Tagish Region, Southern Yukon*, published in 1980, Angela Sidney didn't mention salmon specifically, but said the dam affected two traditional fishing places: Big Fishnet and Little Fishnet. "Before the Marsh Lake dam was built, there used to be two or three sloughs here [at Big Fishnet] at the head of the Yukon River. People would come to fish here in spring, particularly Tagish people, Marsh Lake people and people from further down the river near present-day Whitehorse," she said. As for Little Fishnet, the slough closest to the dam was also valued. "In spring, when Marsh Lake began to rise, people would put in sinew fishnets here after sunset, pull them out before sunrise, and then dry the fish they had caught. It was a good spot to catch ling cod and pike," said Sidney.

The building of the Alaska Highway in 1942 changed the course of history for the southern Yukon once again. The massive construction project and all the people who came with it put pressure on everything, include fish and wildlife. More importantly it paved the way for more settlement and industrial development in the 1950s, which ultimately resulted in the building of the Whitehorse Rapids dam in 1958.

The Whitehorse dam, just downstream from Whitehorse Rapids, was one of three sites studied by the Northern Canada Power Commission, a federal agency. The site was chosen over Kusawa Lake and Aishihik Lake for the $7-million project in part because it most complemented the Frobisher project, another huge power development scheme being bandied about to flood the entire Southern Lakes region and sell power to Alaska.

"However with a view to Frobisher in the future, the Whitehorse rapids location was chosen because a dam would be needed here to be integrated into the general scheme," said a November 1956 story in the *Whitehorse Star*, adding "Early hopes the dam would create a virtual lake from the rapids to Marsh Lake will not be realized."

No consideration seems to have been given to the affect the dam could have on the salmon run and no fish ladder was part of the original plan. It took intense lobbying by the Yukon Fish and Game Association to persuade the federal government to include a structure to help the salmon return to their spawning grounds. Finally, in July 1958, the federal government agreed. "Without the ladders, fish going upriver would have been stopped at the hydro site, with dire results for fishermen in the area above the rapids," said the story, but no mention was made of what happened to the salmon that summer. Dam construction was well underway at the time and it went into service in November.

In the summer of 1959, the newspaper reported that roughly 1,000 salmon, as well as other fish such as trout, grayling, cod and inconnu, used the newly-constructed ladder. The lone federal fisheries officer, Keith Elliot, had to guard the salmon ladder from people who were secretly gaffing "the tired fish" at the bottom. Worse still, when he went to make sure the salmon had reached their usual spawning grounds at Michie Creek, there were none to be found. "They could be anywhere in a network of several hundred miles of waterways, making them hard to find," Keith Elliot told the *Whitehorse Star* in late October when asked about the "lost" salmon.

In 1969 a third turbine was added to the dam and for the next decade the annual newspaper stories reported many dramatic declines in salmon – less than 200 one year. At the same time, more studies started to be done and management efforts stepped up. Before the fourth turbine was added in 1985, a hatchery was established to increase the salmon numbers of the Yukon River headwaters. It continues to operate and provide more salmon fry to the system.

In a 1978 interview, Johnny and Julia Joe, who spent their lives hunting and fishing in the Upper Yukon watershed from their base on the north end of Marsh Lake, told writer Robert McCandless about the many changes that had upset their traditional way of life.

"I used to get three hundred rats sometimes along the river here [between M'Clintock Bay and the Yukon River Bridge, about 10 miles]....Now they build a dam and keep the water high, cleanout a big bunch of willow along the bank and the muskrat are all gone," Johnny said.

"At the same time, they build a bigger dam at Whitehorse. There used to be big king salmon come up through here. Used to be a salmon camp near here and all Indians used to come there to dry salmon for winter. We had two big long traps. One time we got fifty salmon in one night. It was like Klukshu," he told McCandless, who interviewed him for his book, *Yukon Wildlife: A Social History.*

"I used to fish there below where the dam is. I've done lots of fishing there and here. That man stop my rats, stop my salmon, stop my money too. Now I make nothing. What I do get comes from the government, that's all. That's what I live by now."

Now, with modern-day treaties in place, First Nations have a greater say in how the Yukon and its resources, like salmon, are managed. The Umbrella Final Agreement was signed in 1993. Final agreements with the Ta'an Kwäch'än (2002), Kwanlin Dün (2005) and Carcross/Tagish (2005) have focused more attention on issues like the connections to salmon.

While the research to date has shed some light on the broken salmon trail, further work could be done to delve deeper into the details and provide a more comprehensive picture. Two upcoming water licence renewals will draw attention to the way the headwaters of the Yukon have been managed up to now and in the future. The City of Whitehorse needs to renew its licence to discharge treated sewage into the river in 2020 and in 2025 Yukon Energy's 25-year licence to operate the two dams expires. This provides a great opportunity to take a new look at people and their relationship to the headwaters.

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Appendix E. Technical Review

Summary

Currently, the health of the Chinook run varies from year to year but has been trending downwards in the Yukon River system for decades. Identified threats to Chinook salmon populations include overfishing, development, habitat loss and change and climate change, however there are numerous other factors at play in the health of Chinook salmon populations with respect to those salmon terminating their migration in the Southern Lakes region.

The Southern Lakes populations of Chinook refer to those salmon travelling through the Upper Lakes portion of the Southern mainstem. While Chinook have been shown to spawn in various locations in the Southern Lakes region, including Wolf Creek and the Takhini River, the largest known spawning site for Chinook is in the M'Clintock River watershed, primarily in its largest tributary, Michie Creek. This population is believed to have experienced multiple significant declines. Harvest rates have decreased dramatically over decades in Kwanlin Dün First Nation (KDFN) traditional territory, which entirely encompasses the M'Clintock River watershed and in Ta'an Kwäch'än Council traditional territory, including Lake Laberge, where Chinook salmon were virtually extirpated. Conversations on record describe family-oriented harvests of approximately 300 to 400 fish per 25 families and an overall harvest of approximately 10,000 Chinook salmon (Cox 1997). Chinook harvest was practised widely throughout the community and was considered an important cultural event. By the mid-1950s, harvests were reported to have declined to a few hundred Chinook per year or even fewer (Cox 1997). Currently, very few families practice Chinook harvest in the Southern Lakes, with a reported harvest of only a few hundred Chinook or fewer.

The Carcross/Tagish First Nation (C/TFN) is facing similar challenges to KDFN. Historically, salmon would migrate all the way to the headwaters of the Yukon River in Atlin, B.C., often spawning in Tutshi River, but these satellite populations no longer exist. The exact timing of the loss of these satellite populations is unknown. Some individual salmon do reach this area on rare occasions. For individuals in C/TFN communities to harvest salmon they are now forced to leave their traditional territory and fish elsewhere. To harvest more than a ceremonial salmon, KDFN and TKC Citizens must also leave their Traditional Territories to fish. This disconnection between salmon and fishing activity has negatively affected salmon culture in these two communities and risks it being lost entirely unless solutions are found.

Despite occasional high passage numbers at the mouth of the Yukon River system, numbers at Eagle sonar fluctuate around minimum escapement levels, and Whitehorse Fish Ladder passage continues to trend downward. Research has indicated that a high proportion (77–88%) of radio-tagged salmon passing the fish ladder migrated to the Michie Creek system, and Chinook reared at the Whitehorse Power Station hatchery are released into Michie Creek.

The research outcomes of projects initiated and supported by KDFN, TKC and C/TFN have generated some alarming results concerning the future of Chinook salmon in their Traditional Territories. Overall passage at the fish ladder is trending downward despite very low harvest in the Southern Lakes region. The downward trends in the number of successful passages in female Chinook and subsequent low redd counts are equally concerning and suggest that these trends are likely to continue. Coupled with the knowledge gaps surrounding Michie Creek-origin juvenile redistribution, rearing habitat and successful downstream passage of the power station, it appears that continued efforts for Chinook conservation and restoration are much needed.

Introduction to the Technical Review

If research interest and dollars are an accurate measure of the importance of a research subject to society, then salmon are incredibly important to us all. Research into the life cycle, habitat needs and population sizes of Pacific salmon species is some of the most thorough and well-funded of any group of animals in the world. For this reason, there are many thousands of scientific papers available discussing each aspect of biological life as a salmon species, from egg to spawning adult, from ocean to stream. This technical review will examine the available knowledge informing the context of the Southern Lakes Salmon Management Plan, identify any knowledge gaps remaining, and offer suggestions for possible priorities for future technical research. Although historically, several species of salmon terminated their migration routes in the Southern Lakes area of the Yukon River, for several decades now Chinook salmon (*Onchorhynchus tshawytscha*) are the only salmon species that bypasses the Whitehorse Fish Ladder (WFL; pers. comm., N. de Graff). For this reason, this review focuses exclusively on Chinook salmon.

Chinook salmon: basic biology and background

Chinook salmon (*Onchorhynchus tshawytscha*), also known as King salmon for their large body size, are part of the broader Salmonidae family. They are largest Pacific salmon species, with a world record Chinook weighing 126 pounds. Their scientific name is derived from a combination of Latin and Russian: *Onchorhynchus* comes from the Latin (meaning "hook nose"), and *tshawytscha* is from the Russian name for the species. Like other Pacific salmon species, Chinook salmon are anadromous, meaning that they spend most of their lives in saltwater, but migrate to reproduce in freshwater (Figure E1 and Figure E2).

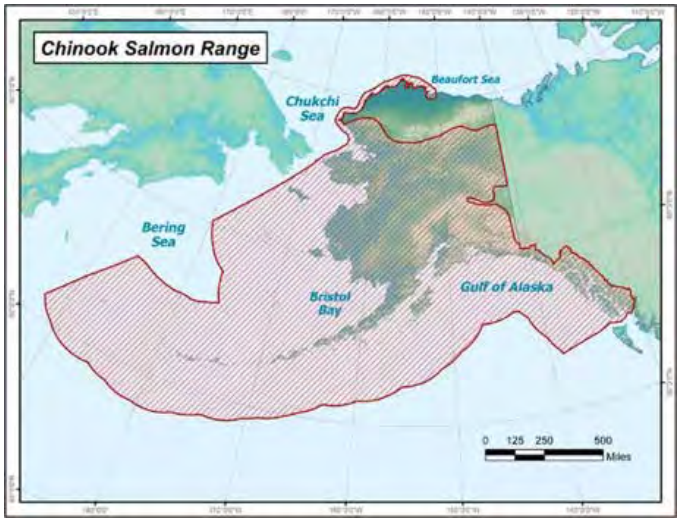

Figure E1. Range map for Chinook salmon over the course of their life cycle
Credit: adfg.alaska.gov

Chinook salmon have highly variable life stages, which can contribute to many different outcomes. They are stream-type salmon, meaning that they spend more time in freshwater than some of their southern counterparts. Northern Chinook salmon can spend up to three years in freshwater before migrating out to sea, compared to as little as three months for southern Chinook. In addition, they migrate within the freshwater system from their natal area to rearing areas (referred to as a redistribution) and may do so on two or more occasions in summer and fall after emerging from the egg (Bourret, Caudill and Keefer 2016). Additionally, rearing areas may be long distances away and across geographic boundaries from their natal

streams; e.g., Canadian-origin Chinook may use rearing habitats in the U.S. (Daum and Flannery 2001). This infers that northern Chinook salmon populations experience a variety of habitat types throughout their juvenile life stage (Bradford et al. 2009).

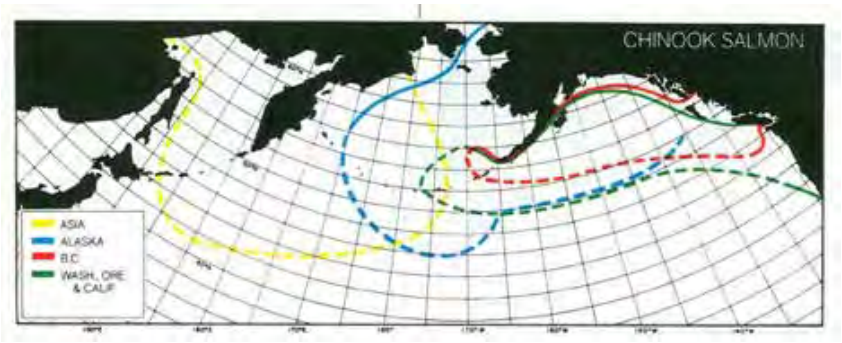

Figure E2. Map of different Chinook salmon oceanic migration routes throughout the Pacific Northwest
Credit: pac.dfo-mpo.gc.ca

The migration routes for northern populations of Chinook are the longest in the world, requiring them to travel up to 3,000 km to the mouth of the Yukon River system in the Bering Sea, Alaska and to the headwaters upstream of Whitehorse, Yukon Territory. This migration route means that the U.S. and Canada need to cooperate to ensure sustainable harvest of Chinook salmon. This cooperation is managed, with varying degrees of success, through the Pacific Salmon Treaty of 1985 signed by the two countries. Within this treaty is the Yukon River Salmon Agreement, which is specific to the Yukon River system. This agreement is maintained, and populations are managed through governance bodies such as the Yukon River Panel and the Yukon Salmon Sub-Committee in addition to formalized governance structures such as federal, territorial and First Nations governments.

Currently, the health of the Chinook run varies from year to year, but it has been trending downwards in the Yukon River system for decades (Figure E3). Identified threats to Chinook salmon populations include overfishing, development, habitat loss and change, and climate change. There are numerous other factors at play in the health of Chinook salmon populations with respect to those salmon that terminate their migration in the Southern Lakes region. Much debate centres around Alaskan harvest prior to Chinook passing the Eagle sonar station into Canada. Though subsistence harvest has been increasing on the Alaskan side over recent years, it is likely that this issue is compounded by other factors including higher water temperatures (water temperatures are sub-optimal above 20°C and become lethal over 25°C (Brett, Clarke and Shelbourn 1982). Runs also typically have low female sex ratios because females tend to stay longer in the ocean to build up reproductive resources and are subject to higher mortality rates in-ocean (Healey 1991), leading to population risk associated with high rates of female mortality during migration itself. For example, female salmon of other species *(Oncorhynchus nerka)* have been shown to migrate more slowly and use more anaerobic energy generation during migrations requiring burst swimming, leading to increased mortality rates for that sex (Burnett et al. 2014); this is certainly a possibility for Chinook salmon also.

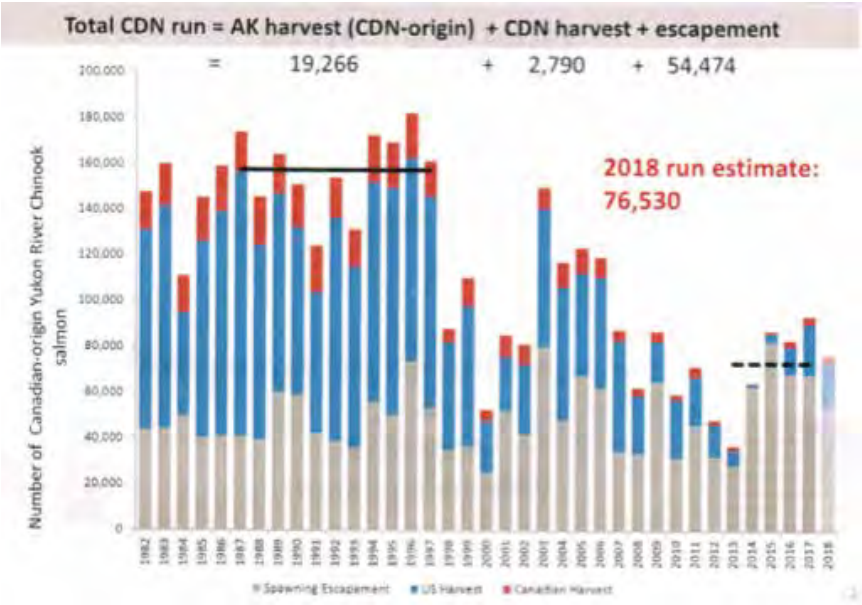

Figure E3. Run sizes for Chinook salmon 1982–2017, with estimate for 2018
Figure courtesy of N. de Graff (2017). The 1982 data is post hatchery supplementation.

Additional concerns about threats to Chinook salmon populations include habitat degradation in freshwater systems including pollution, sedimentation and turbidity, and competition in the ocean from ranched Pink salmon and other organisms. Ranching of Chinooks has been attempted, but with marginal success compared to Pink and Chum salmon (Mahnken et al. 1998). Pink salmon compete with Chinook salmon for zooplankton, but Chinook are additionally targeted almost exclusively by orca. A review by Connors et al. (2016) is recommended reading for a thorough description and treatment of various threats and limiting factors for Chinook salmon abundance at different life stages.

Chinook salmon can, however, be successfully raised in a hatchery setting. Numerous hatcheries rear juvenile Chinook throughout the Pacific Northwest and in the Yukon Territory. Acknowledged risk to establishing hatchery-origin populations include expression of unfit genes (compared to wild counterparts) and reduced resistance to microbes and parasites. A study conducted by Janowitz-Koch et al. (2019) examining the reproductive success of hatchery Chinook offered some positive news: reproductive success in natural broodstock hatchery-origin Chinook is lower than wild-origin Chinook, however if the two interbreed, reproductive success is equally high to that of wild-origin pairings. The study concluded that there were long-term benefits to hatchery supplementation for endangered populations, and that interbreeding could serve to mitigate the concerns regarding genetic fitness (Janowitz-Koch et al. 2019). In the Southern Lakes area, Whitehorse Power Station hatchery-origin salmon spawn in the Michie Creek and M'Clintock River spawning grounds, while others spawn in Wolf Creek, closer to their point of origin: the Wolf Creek hatchery (Twardek and Lapointe 2018a).

Southern Lakes Chinook Salmon

The Southern Lakes populations of Chinook are those salmon travelling through the Upper Lakes portion of the Southern mainstem (Figure E4). Currently, these salmon appear to spawn primarily in the M'Clintock River watershed, primarily in its largest tributary, Michie Creek. This population is believed to have experienced multiple significant declines. The original decline is thought to have occurred around construction of the Lewes Dam in 1899 and during subsequent reconstructions (Cox 1997); see Figure E5. This was compounded by a commercial fishery in the area (Gilbert and O'Malley 1921), possibly influenced by downstream overfishing during the Klondike gold rush (Gilbert and O'Malley 1921), and finally by construction of the Whitehorse Power Station (WPS) in 1958 (Figure E5). A wooden fish ladder was installed at the WPS in 1959 to allow for upstream fish passage, and a fishway was installed at Lewes Dam as well (YEC 2011). Additionally, the gates of Lewes Dam are open from May 15 to late fall every year. See Figure E5.

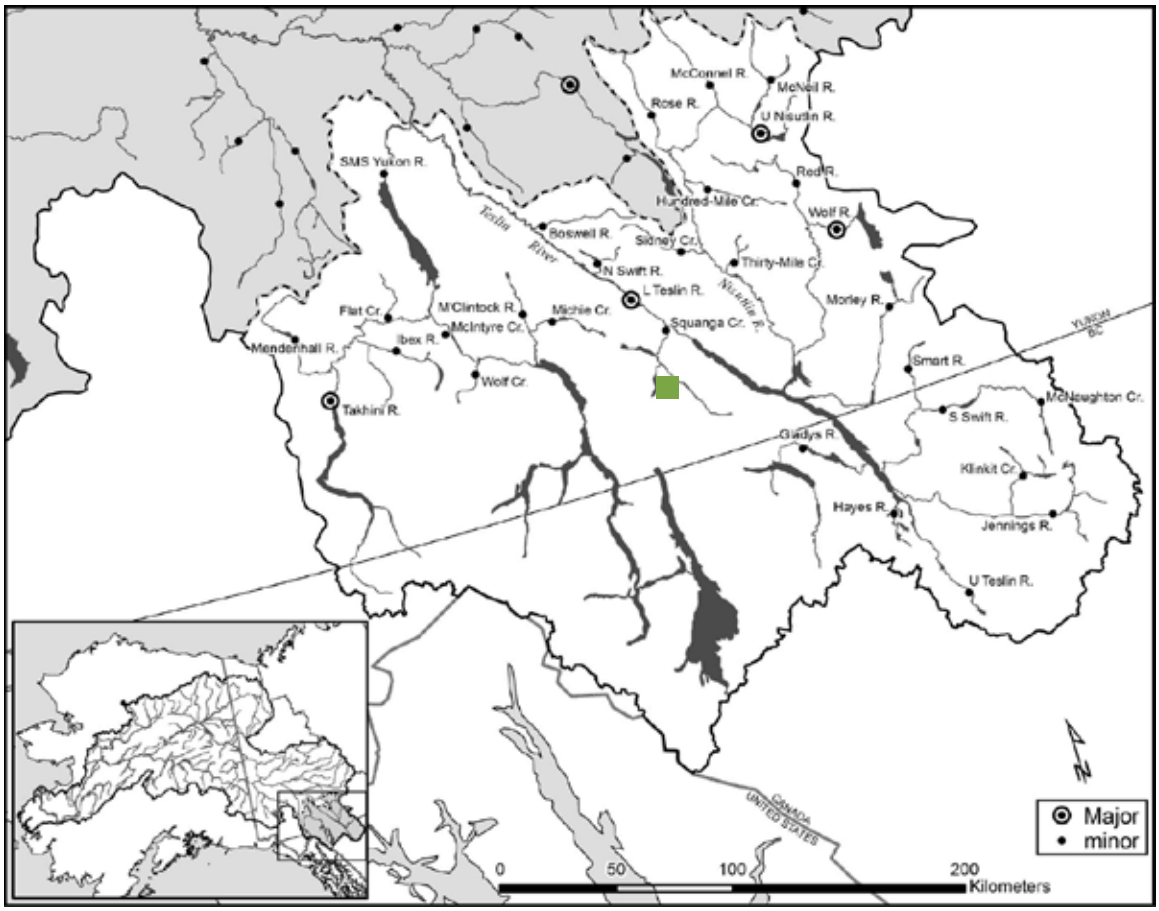

Figure E4. Michie Creek and major and minor spawning areas

Source: Brown et al. 2017. The spawning area is marked on the map with a green rectangle. Brown et al. (2017) noted that the symbols on the map identify the streams and mainstem reaches, but do not refer to spawning locations.

The rate of successful passage through the Whitehorse Fish Ladder at the WPS may be lower for female salmon. A carcass survey conducted in 2018 downstream of the WPS found 86 carcasses (12% of the total 690 salmon that passed through the fishway), of which 93% were female (Twardek and Lapointe 2018b). Of these, only 30% of fish have spawned completely. Twardek and Lapointe (2018b) suggested that their findings from the study indicate either an issue with fish passage at the WPS, or a high number of fish spawning elsewhere than their primary spawning site. This echoes the point raised earlier by Cleugh and Russell (1980), who noted there have been concerns about fish passage surrounding the WPS since the project's planning, regarding not only adult spawning salmon, but also potential smolt mortality in turbines.

Figure E5. Whitehorse Rapids Dam (left) and Lewes Dam (right)

Chinook salmon in CTFN, KDFN and TKC Traditional Territories

Harvest rates have decreased dramatically over decades in Kwanlin Dün First Nation (KDFN) traditional territory, which entirely encompasses the M'Clintock River watershed. Similarly, Ta'an Kwäch'än Council and Citizens have history, culture and heritage that are equally strongly connected to salmon and yet their historically primary source of salmon fishing, Lake Laberge, experienced a virtual extirpation of salmon despite their historic numbers. The Carcross/Tagish First Nation (C/TFN) is facing similar challenges to KDFN and TKC. Historically, salmon would migrate all the way to the headwaters of the Yukon River in Atlin, B.C., often spawning in Tutshi River, but these satellite populations no longer exist (pers. comm., N. de Graff). The exact timing of the loss of these satellite populations is unknown, but some individual salmon do reach this area on rare occasions (pers. comm., N. de Graff). For individuals in C/TFN communities to access salmon they are now forced to leave their traditional territory and fish elsewhere. To harvest more than a ceremonial salmon, KDFN and TKC Citizens must also leave their Traditional Territories to fish. This disconnection between salmon and fishing activity has negatively impacted salmon culture in these two communities and risks its loss entirely unless solutions are found.

Conversations on record describe family-oriented harvests of ~300 to 400 fish per 25 families and overall harvest of approximately 10,000 Chinook salmon (Cox 1997). Chinook harvest was practiced widely throughout the community and was considered an important cultural event. By the mid-1950s, harvests are reported to have declined to a few hundred Chinook per year or even fewer (Cox 1997). Currently, very few families practice Chinook harvest in the Southern Lakes, with reported harvest of only a few hundred Chinook. Decreases in the prevalence of salmon harvest in the Southern Lakes is strongly associated with decreased Chinook salmon population sizes and passage of Chinook at the WPS. There are no data available for changes in returning salmon numbers after installation of the Lewes Dam; however, since 1959 construction of the Whitehorse Fish Ladder, returning salmon averaged 1200/year (including the

introduction of hatchery fish in the 1980s; Twardek and Lapointe 2018a; Table E1). However, despite occasional high passage numbers at the mouth of the Yukon River system, numbers at Eagle sonar fluctuate around minimum escapement levels, and WFL passage continues to trend downward (1,227 in 2017; 691 in 2018). WFL passage in 2019 had the lowest number of Chinook pass the WFL since 1977, at 282. Research has indicated that a high (77–88%) proportion of radio-tagged salmon passing the fish ladder migrated to Michie Creek system (Matthews 1999), and Chinook reared at the WPS hatchery are released into Michie Creek.

Table E1. Fishway counts and relative percentage of hatchery fish, Whitehorse Fish Ladder 1961–2005
Based on: KDFN 2006 (appendix)

Year	Count	% hatchery	Year	Count	% hatchery
1961	1,068	0	1984	1,042	0
1962	1,500	0	1985	508	0
1963	483	0	1986	557	0
1964	595	0	1987	327	0
1965	903	0	1988	405	16
1966	563	0	1989	549	19
1967	533	0	1990	1,407	24
1968	414	0	1991	1,266	51
1969	334	0	1992	758	84
1970	625	0	1993	668	73
1971	856	0	1994	1,577	54
1972	391	0	1995	2,103	57
1973	224	0	1996	2,958	35
1974	273	0	1997	2,084	24
1975	313	0	1998	777	95
1976	121	0	1999	1,118	74
1977	277	0	2000	677	69
1978	725	0	2001	988	36
1979	1,184	0	2002	605	39
1980	1,383	0	2003	1,443	70
1981	1,555	0	2004	1,989	76
1982	473	0	2005	2,632	57
1983	905	0			

Current research on Southern Lakes Chinook Salmon

KDFN, TKC and C/TFN have been highly involved in, supportive of, and integral to research and restoration efforts in the Southern Lakes region. All three nations have been involved in numerous research and restoration projects in the area, including long-term monitoring of Michie Creek and M'Clintock River spawning areas, incubation and fry releases at McIntyre and Fox Creeks, and telemetry monitoring of fish passage and efficiency. There is a lack of correlation between escapement numbers at Eagle sonar station and passage at the WFL (pers. comm., N. de Graff), thus these priorities align well with primary concerns.

KDFN's Michie Creek restoration project has been ongoing in various forms since 2003 and has examined conditions in spawning areas, gathered data on a variety of biophysical properties and biological communities, identified concerns, and suggested future priorities. These priorities were identified in earlier phases of the project (2004–05):

- identify potential land uses in KDFN rural blocks in watershed;
- conduct additional assessment of potential risks to salmon from human and natural disturbances;
- consider numbers of fish returning, escapement, and KDFN's Basic Needs Allocation under the UFA to examine ways in which the numbers of fish returning to the M'Clintock can be increased;
- identify actions for addressing potential risk factors, such as:
  - KDFN policies for land uses
  - fire management plan
  - KDFN resolutions to General Assembly regarding salmon;
- conduct a growth trial in hatchery to mimic sizes found in nature;
- continue stewardship activities monitoring and removing beaver dam and log jams;
- assess Byng Creek to describe habitat and map redds;
- identify local genetics and explore the availability of using historic scale structures for DNA to compare with other stocks including Robert Service Way population; and
- identify juvenile Chinook salmon diet and conduct benthic studies in Michie Creek after hatchery plantings (from Connors et al. 2016).

Later iterations of the project noted skewed male sex ratios in Chinook that successfully passed the WFL, leading to low numbers of redds (18 in total; de Graff 2018). The 2018 report also noted a decline in counts of female Chinook and associated redds over the entirety of the project (results from 2004 to 2018 seasons). Indeed, a preliminary assessment of the 2019 spawning season indicated no visible redds (pers. comm., N. de Graff; Figure E6).

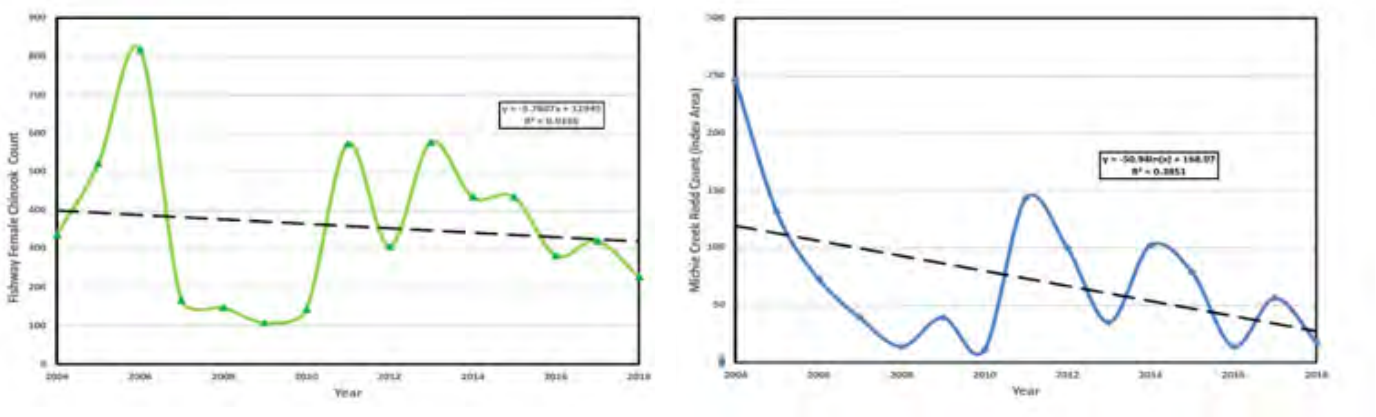

Figure E6a and b. Number of female Chinook passing the WFL and number of redds counted in Michie Creek, 2018
From de Graff (2018); a) green = number of female Chinook passing the WFL; b) blue = number of redds counted in Michie Creek

Research and restoration efforts on behalf of TKC involve the Fox Creek restoration project (including the McIntyre Creek Incubation Facility), an artificial redd program, juvenile and adult salmon monitoring, trail maintenance, education and training for capacity building, and the Family Fish Camp. Fox Creek was identified by Elders as a historical spawning stream and a great candidate for restoration.

In early years, broodstock for the Fox Creek restoration project were collected by Yukon Energy Corporation at the Whitehorse Fish Ladder and raised to eyed stage at the Whitehorse Rapids Fish Hatchery then sent to McIntyre Creek for incubation. The McIntyre Creek Incubation facility was destroyed March 31, 2018 in a fire. Since the fire, Yukon Energy has been donating fry for the annual fry release at Fox Creek, though numbers of fry in recent years have been (necessarily) lower due to low numbers of returning salmon at the fish ladder. Similarly, fry from the Stream to Sea initiative, where students raise salmon in the classroom, are tagged and released into Fox Creek (Figure E7).

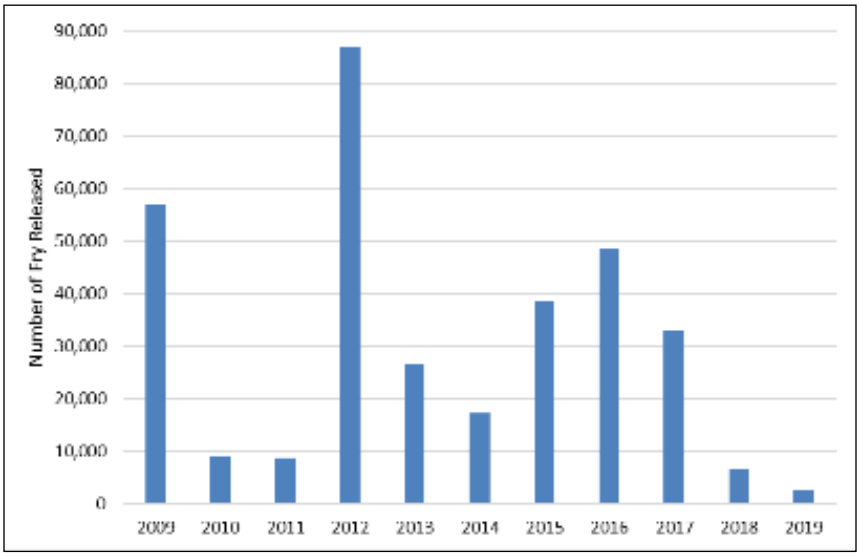

Figure E7. Total numbers of Chinook salmon fry released into Fox Creek, 2009–19
Source: TKC 2019

Currently, plans are underway to reorganize, improve and rebuild the McIntyre facility, with the specific goals of: "1. An exploration of potential partnership opportunities based on current, and proposed, salmon restoration work underway in the Yukon; and, 2. A review of TKC's current salmon restoration needs and salmon restoration activities occurring in Yukon that may be of interest to TKC to inform a recommendation or set of recommendations for future infrastructure needs, including potential locations and costs" (Yukon Salmon Restoration Feasibility Study, Request for Proposals, TKC 2019).

Juvenile and adult monitoring are conducted on an annual basis. In 2019, 53 juvenile Chinook were observed, captured and measured throughout the 2019 season, 70% of which were considered wild, a higher number than in previous years. Adults found in the system are monitored annually for age, sex and origin (hatchery vs wild) when possible, and carcass surveys are conducted when there is sufficient capacity.

Additional projects spearheaded by TKC include installation of a hydrometric station in June 2017 to determine discharge ratings and conduct in situ testing to monitor water quality (dissolved oxygen, water temperature, pH and dissolved minerals). The Artificial Redds project saw temperature loggers installed near actual redds to record the temperature of the substrate in order to estimate the time of emergence. Artificial redds were installed in 2015, 2016 and 2017 and it was found that eyed eggs would develop in mid-September, alevins in early November and 0+ fry emergence in early June. These predictions corresponded accurately with observations such that no artificial redds were used in recent years; i.e., the timing persists (TKC 2019). TKC also manages beaver populations via trapping to ensure salmon access to tributaries and streams. Training and capacity building are integral parts of all of these projects. Staff members are trained through the Yukon Fisheries and Field Assistant Program and summer students are trained to work in these projects (TKC 2017); see Figure E8.

Figure E8. TKC staff contracted to tag fry at McIntyre Creek Incubation Facility
Source: TKC 2017

Finally, TKC has engaged in hosting an annual culture camp at the site of Helen's Fish Camp on the west shore of Lake Laberge, a traditional meeting place (TKC 2013). At the annual camp, children and adults are encouraged to connect with salmon culture, learn about how to fish for salmon, and how to prepare salmon. Other activities such as canoeing, making art, and making medicines are also part of the event (TKC 2010, 2013).

Research efforts at C/TFN have focussed primarily on fish passage and efficiency. Results from the YRP study by Twardek and Lapointe (2018a) also found a 2:1 ratio of males to females and were unable to tag any large females for the study. Their results showed that of 44 tagged salmon, 80% spawned in the M'Clintock River/Michie Creek system, either between M'Clintock River and Byng Creek (50% of these) or Michie Creek above Byng Creek (41% of these; Twardek and Lapointe 2018a; Figure E9). These results align with those from previous telemetry studies in the area, such as Cleugh and Russell (1980) who found that 88% of Chinook terminated at Michie Creek after passing the WFL, and Matthews (1999) who found that 74% of Chinook terminated in the same area. These research efforts have also shed some light on those salmon not terminating in Michie Creek, five of which spawned in the Wolf Creek area after migrating to Lewes Dam. A further five fish returned downstream of the WHP and were detected briefly at the Robert Service Way spawning grounds. Additionally, results showing hatchery-origin salmon terminating where no fry have been released, combined with similar findings from years of previous research have indicated that site fidelity may not be as exact as previously assumed (Twardek and Lapointe 2018b). Conclusions from two years of this study highlighted the confirmation of the importance of spawning areas in Michie Creek, identified the substantial importance of Wolf Creek as a spawning ground, and suggested that more attention be paid to the Robert Service Way spawning grounds.

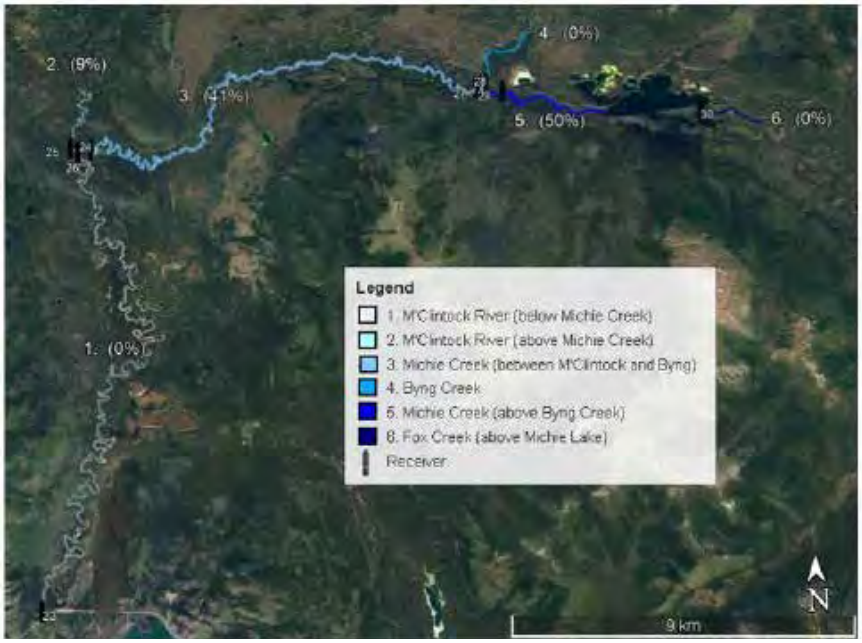

Figure E9. Map of terminal detection locations (inference for spawning) for Chinook salmon tagged at the fish ladder
From Twardek and Lapointe (2018a). Ninety-one percent of tagged fish spawned in Michie Creek, either between M'Clintock River and Byng Creek (41%) or above Byng Creek (50%).

Much additional research either relevant to or taking place in the Southern Lakes region has occurred over the past several decades (see Appendices C and D for comprehensive lists). Research subjects include multiple scales of genetic stock identification along the Yukon River (including microsatellite DNA loci), environmental and hydrological monitoring of the Yukon River system and major tributaries, and run size estimations and modelling.

Yukon River Inter-tribal Watershed Council

The relationship with salmon is part of the broader relationship with water. Traditional water sources are important to the Southern Lakes communities and contribute to overall well being (Wilson et al. 2019). Salmon are the proverbial canary in the coal mine for water quality because salmon require clean, cool, flowing water to thrive. KDFN, TKC and C/TFN are part of the Yukon River Inter-Tribal Watershed Council. This council also spearheads a community-based water quality monitoring program, wherein FN Citizens throughout the Yukon River watershed receive training in water sampling and then conduct sampling on a volunteer basis every two weeks (or more frequently; pers. comm., Coralee Johns, CTFN). Once gathered and collated, the data is sent to USGS for processing and data is returned to participant nations as spreadsheets (see Figure E10). The Yukon River Inter-Tribal Watershed Council aims to have drinkable water in the Yukon River by 2047.

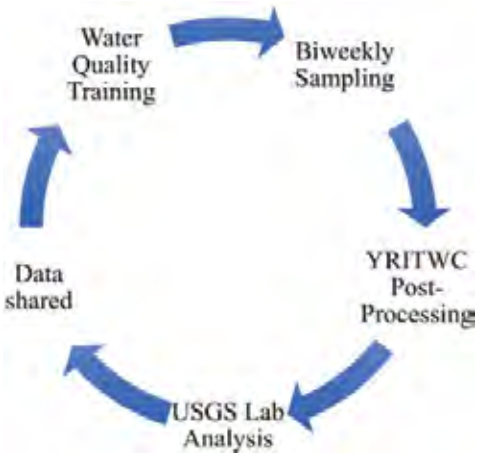

Figure E10. Processes used by the Yukon River Inter-Tribal Watershed Council
Source: Wilson et al. (2018); this diagram depicts the council's community-based water quality monitoring program

Knowledge gaps

The results of these research projects highlight a few key knowledge gaps pertaining to Chinook salmon populations in the Southern lakes region. In the research arena, knowledge gaps occur surrounding the mechanism(s) of failure to pass female Chinook at the WFL. Significant knowledge gaps also surround the juvenile life stages of Southern Lakes-origin Chinook. Specifically, the timing and success of their distribution past the WHP and the location and quality of their rearing habitats en route to the Pacific would afford crucial information to support returning salmon numbers. It should be noted that there have been studied conducted on these topics in the Southern Lakes area and in other parts of the Yukon River watershed, however the topic would greatly benefit from a comprehensive review in order to update information and strategize on how best to put recommendations into action.

In the management arena, we perceive an action gap. Much good quality research has been conducted throughout the Yukon River watershed and in the Southern Lakes area, and the work to reduce obstacles to migration on an annual basis is commendable. However, the risk of 'counting the books while the library burns' is a common issue in conservation work, and it appears to occur in this area as well. There will always be more information needed, but actions and responses to mitigate trends identified in research are necessary.

Findings from the Connors et al. (2016) technical review project also illustrate communication gaps among researchers, managers, and community members. In describing concerns and questions shared across Yukon First Nations' discussions, there were numerous questions and concerns related to the safety, propriety and effectiveness of numerous research methodologies. More frequent and open communication about salmon research, conservation and restoration efforts may alleviate some of these concerns and build avenues for improved communication across the board.

Ways forward for technical research in Southern Lakes

To address the knowledge gaps in the research arena, a few research questions could be prioritized in the Southern Lakes region. Specifically, the questions of sex-selective passage success and juvenile mortality throughout the rearing phase in Southern Lakes-origin Chinook salmon need to be addressed.

Based on results of carcass surveys by Twardek and Lapointe (2018b), 80/86 of the carcasses sampled were female and 80% of those were wild salmon. These salmon either spawned downstream of the WFL (fewer than 30% had spawned completely), approached the WFL and failed, or did not approach, or fell back. This is a crucial statistic that needs to be explored given that females face a much higher energetic burden and have less success migrating through areas of high flow (Burnett et al. 2014). It is equally important to acknowledge, however, that the timing of the carcass study occurred earlier in the season, and male salmon are known to terminate later in the season than females do, which could account for the discrepancy also. Thus, some questions we might ask are: Do more females fail to pass successfully than males? Do proportionally fewer females attempt passage than males? Do fewer females arrive at the WFL? If females are found to have lower passage success at the WFL than males, further mitigation options could be explored. For instance, mechanisms to increase attraction efficiency could be tested, as vertical slot ladders are known to have high passage efficiency but low attraction efficiency (Roscoe et al. 2010; Pon et al. 2012). Another option would be to test female passage with different flow rates. The Cleugh and Russell (1980) study found a passage delay range of 10 hours to 10 days, with an average delay of three days (but a small sample size of 12). Delays may also have a more significant negative impact on females than males. Finally, a follow-up comprehensive carcass study conducted later in the season to account for the delayed termination in males would be advisable.

There are numerous opportunities to study juvenile Chinook of Southern Lakes origin also. A good example is a recent YRP project (CRE 26-18) underway in collaboration between DFO and Metla Environmental to examine the relationship between juvenile and adult spawning stages, specifically, does juvenile survival and successful outmigration link to return numbers? How many juveniles does a known number of returning spawners produce? The project has been ongoing since 2015 on the Big Salmon River and will potentially yield a model to create estimates for juvenile recruitment and returning adults to a specific area. A complementary study is looking to examine the presence and body condition of juveniles in different streams/habitat types to see where they fare better. Similar studies could be performed in the Southern Lakes area that should additionally seek to identify rearing areas for Southern Lakes-origin juvenile Chinook and estimate mortality in juvenile Chinook at the WPS during redistribution. This latter

point is crucial given that hatchery Chinook are reared at the WPS hatchery to mitigate juvenile mortality in turbines yet are released at Michie Creek. If juvenile mortality in turbines is high, this process may be self-defeating, and alternatives may be required.

Conclusions

The research outcomes of projects initiated and supported by KDFN, TKC and C/TFN have generated some alarming results concerning the future of Chinook salmon in their Traditional Territories. Overall passage at the WFL is trending downward despite very low harvest in the Southern Lakes region. The downward trends in the number of successful passages in female Chinook and subsequent low redd counts are equally concerning and suggest that these trends are likely to continue. Coupled with the knowledge gaps surrounding Michie Creek-origin juvenile redistribution, rearing habitat and successful downstream passage of the WPS, it appears unlikely that number of returning Chinook are likely to rebound sufficiently to allow for pre-1950's harvest levels any time soon. Thus, we recommend that research into optimal restoration and conservation strategies continue, that technical research priorities identified in this review be addressed, and that efforts to re-engage with salmon culture focus on ceremonial, sharing and stewardship aspects of salmon harvest, until return numbers increase sufficiently to allow for more widespread fish camps and larger harvests.

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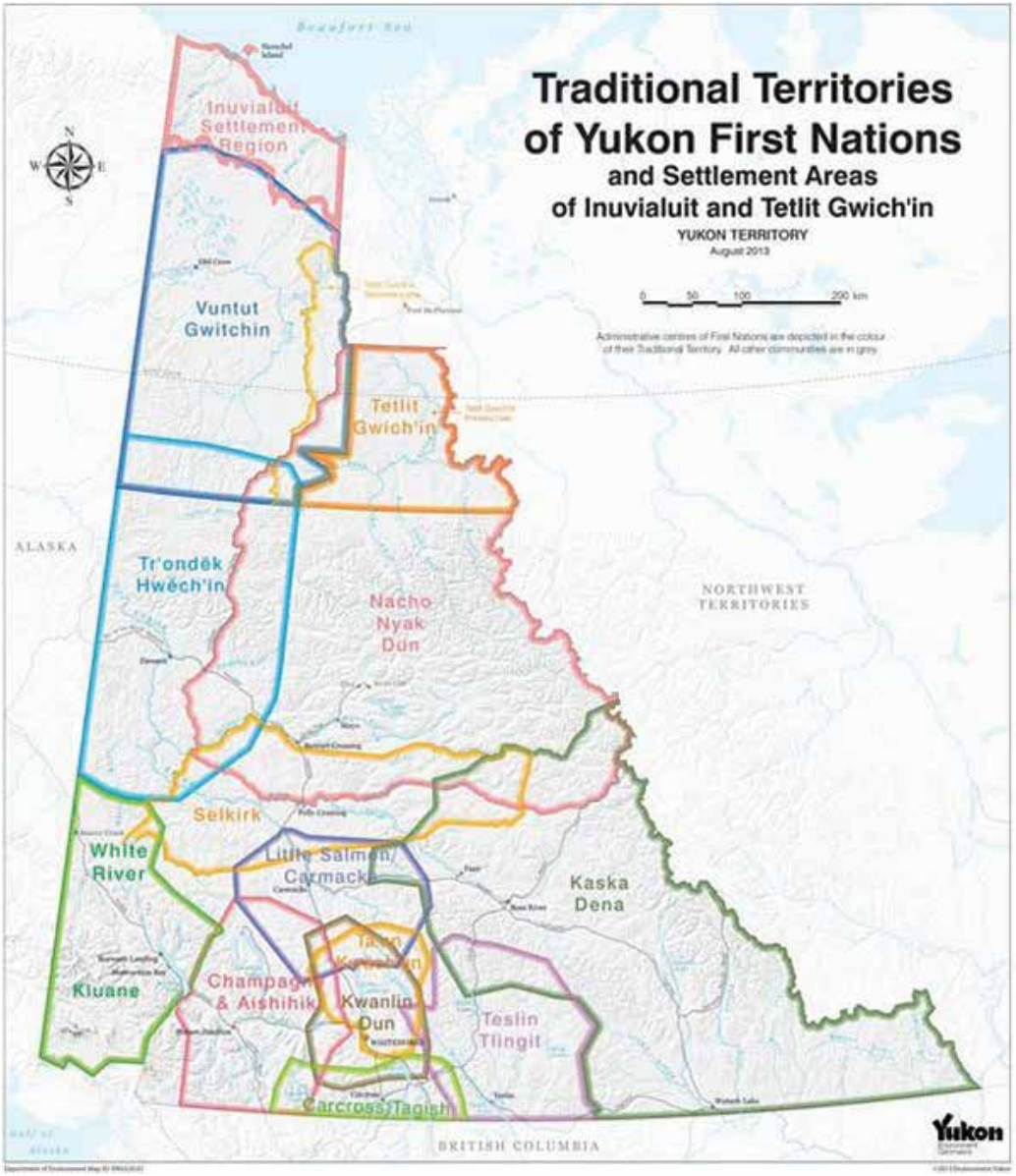
Sub-appendices, Appendix E

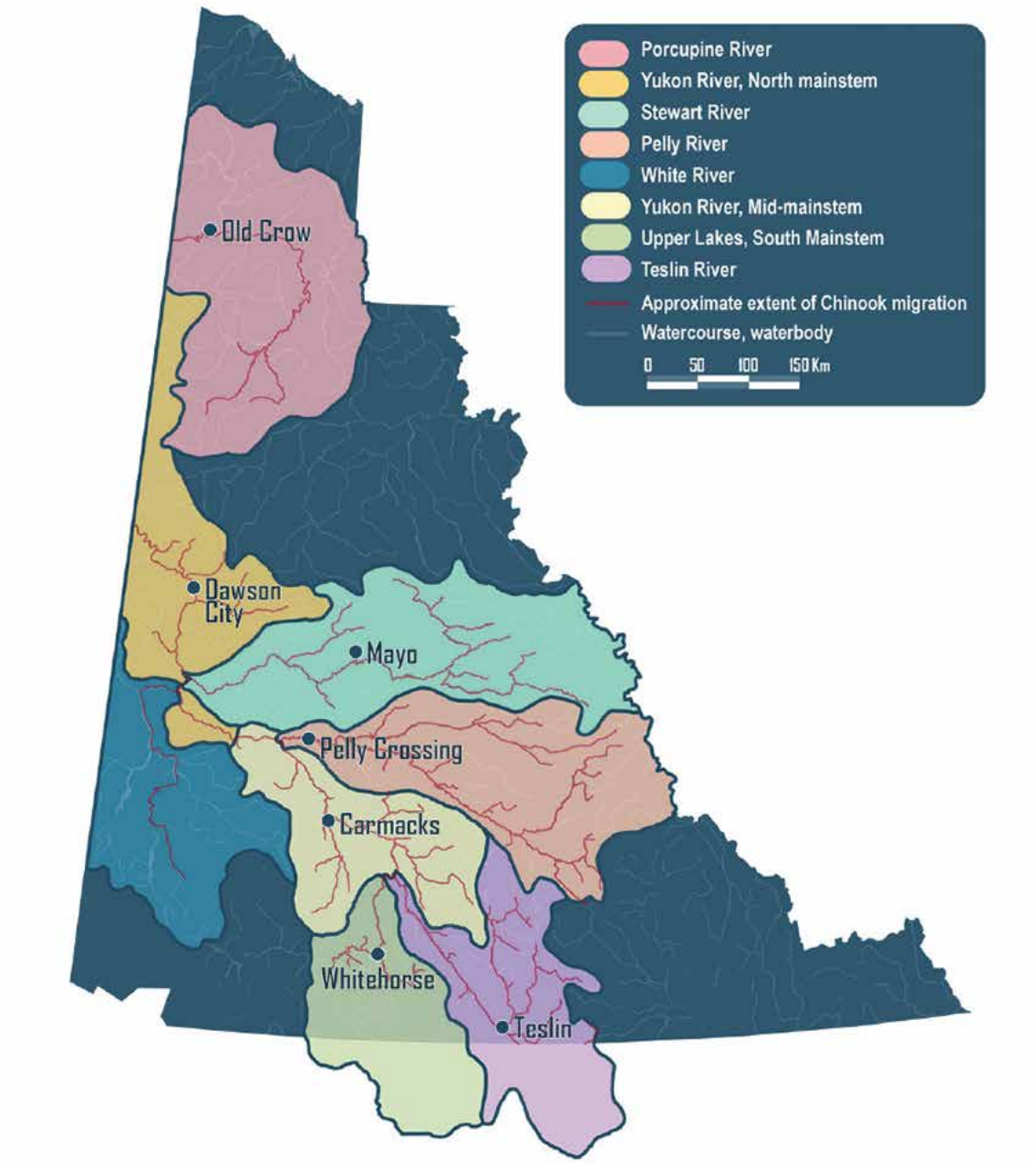
Appendix E1. Traditional Territories of Yukon First Nations

Credit: env.gov.yk.ca



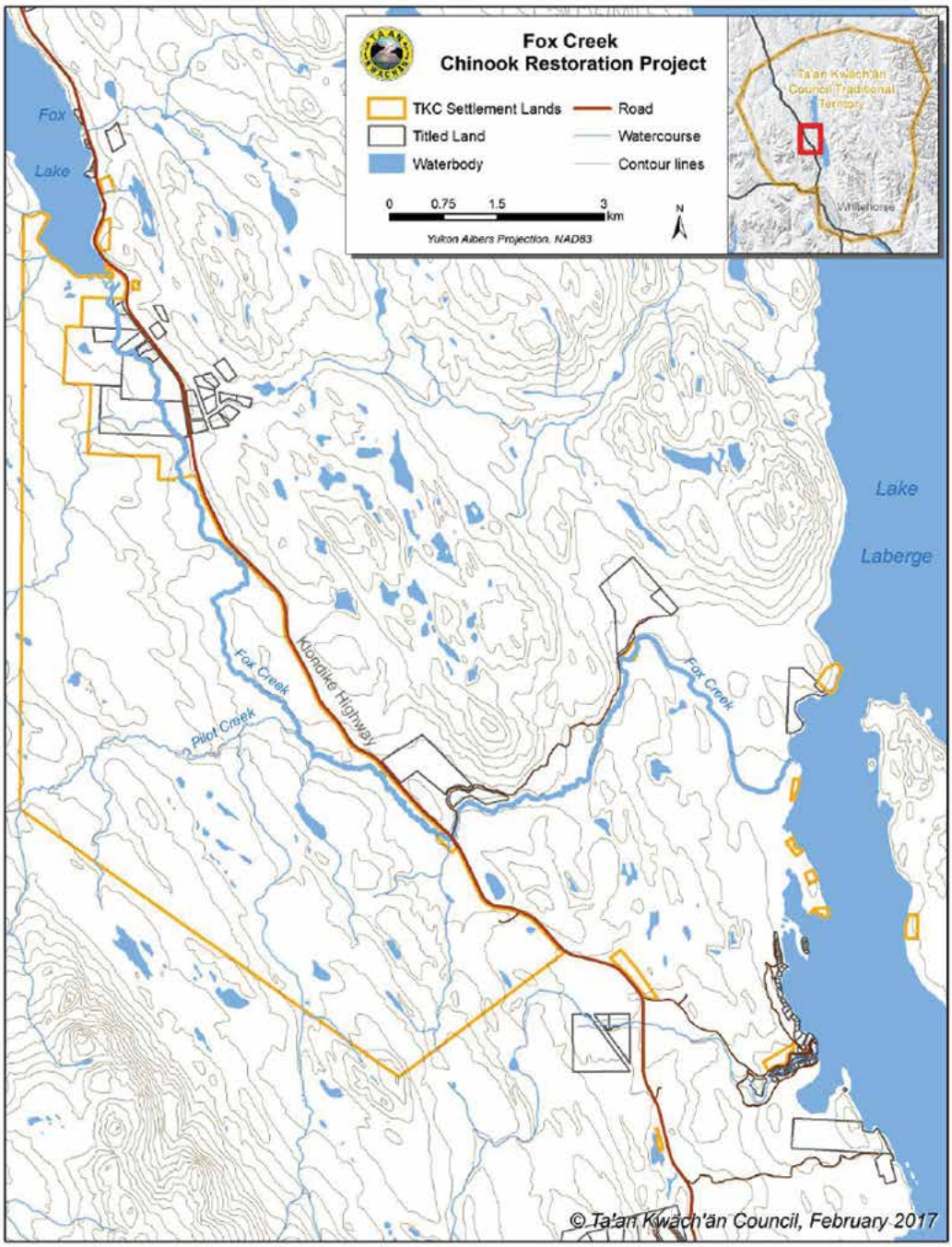
Appendix E2. The eight sub-basins of the Yukon River watershed

Source: Connors et al. 2016



Appendix E3: Map of TKC traditional territory and the site for the Fox Creek Salmon Restoration Project

Source: TKC 2020



Appendix E4, Part 1: Library

The following list of resources was compiled by N.W.R. Lapointe, with contributions by N. de Graff, and provided by N. de Graff.

Author	Year	Title
Barton, L.H.	1984	A catalog of Yukon River salmon spawning escapement surveys
Beacham, T. and Candy, J.R.	2006	Stock identification of Yukon River Chinook and Chum Salmon using Microsatellite DNA Loci
	2007	Stock Identification of Yukon River Chinook and Chum Salmon using Microsatellite DNA Loci
	2008	Stock Identification of Yukon River Chinook and Chum Salmon using Microsatellite DNA Loci
	2009	Stock Identification of Yukon River Chinook and Chum Salmon using Microsatellite DNA Loci
	2010	Stock Identification of Yukon River Chinook and Chum Salmon using Microsatellite DNA Loci
	2011	Stock Identification of Yukon River Chinook and Chum Salmon using Microsatellite DNA Loci
	2012	Stock Identification of Yukon River Chinook and Chum Salmon using Microsatellite DNA Loci
	2013	Stock Identification of Yukon River Chinook and Chum Salmon using Microsatellite DNA Loci
	2014	Stock Identification of Yukon River Chinook and Chum Salmon using Microsatellite DNA Loci
	2015	Stock Identification of Yukon River Chinook and Chum Salmon using Microsatellite DNA Loci
	2016	Stock Identification of Yukon River Chinook and Chum Salmon using Microsatellite DNA Loci
Beacham, T.D., Murray, C. B. and Withler, R.E.	1989	Age, morphology and biochemical genetic variation of Yukon River Chinook salmon
Beacham, T.D., Wetklo, M., Wallace, C., Olsen, J.B., Flannery, B.G., Wenburg, J.K., ... Seeb, L.W.	2008	The application of Microsatellites for stock identification of Yukon River Chinook salmon
Bernard, D.R., Hasbrouck, J.J. and Fleischman, S.J.	1999	Handling-induced delay and downstream movement of adult Chinook Salmon in rivers
Brabets, T. P., Wang, B. and Meade, R.H.	2000	Environmental and hydrologic overview of the Yukon River basin, Alaska and Canada
Bradford, M.J., Duncan, J. and Jang, J.W.	2008	Downstream migrations of juvenile salmon and other fishes in the upper Yukon River
Bradford, M.J., Grout, J.A. and Moodie, S.	2001	Ecology of juvenile chinook salmon in a small non-natal stream of the Yukon River drainage and the role of ice conditions on their distribution and survival
Brannian, L.K.	1990	Estimates of total abundance, exploitation rate, and migratory timing of chinook salmon runs in the Yukon River 1982–1986

Author	Year	Title
Brock, D.N.	1974	Distribution and abundance of Chinook
	1976	Distribution and abundance of Chinook
Bromaghin, J.F., Evenson, D.F., McLain, T.H. and Flannery, B.G.	2011	Using a Genetic Mixture Model to Study Phenotypic Traits: Differential Fecundity among Yukon River Chinook Salmon
Bromaghin, J.F., Nielson, R.M. and Hard, J.J.	2011	A Model of Chinook Salmon Population Dynamics Incorporating Size-Selective Exploitation and Inheritance of Polygenic Correlated Traits
Brown, R.F., Elson, M.S. and Steigenberger, L.W.	1976	Catalogue of aquatic resources of the upper Yukon River drainage
Bue, F.J. and Hayes, S.J.	2009	2009 Yukon Area Subsistence, Personal Use, and Commercial Salmon Fisheries Outlook and Management Strategies Retrieved from Anchorage, Alaska
Buklis, L.S. and Wilcock, J.A.	1984	Age, sex and size of Yukon River salmon catch and escapement 1983
	1986	Age, sex and size of Yukon River salmon catch and escapement 1985
Celewycz, A.G., Berger, J.D., Cusick, J., Davis, N.D., Fukuwaka, M. and Malecha, P.W.	2006	High seas salmonid coded-wire tag recovery data, 2006
	2009	High seas salmonid coded-wire tag recovery data, 2009
Celewycz, A.G. and Moss, J.H.	2011	High seas salmonid coded-wire tag recovery data, 2011
Chilton, D.E. and Bilton, H.T.	2011	New method for ageing chinook salmon
Cleugh, T.R. and Russell, L.R.	1980	Fisheries and Fish Related Publications in the Yukon Territory
	1980	Radio tracking Chinook Salmon to determine migration delay at the Whitehorse Rapids Dam
Cooke, S.J., Hinch, S.G., Crossin, G.T., Patterson, D.A., English, K.K., Healey, M.C., ... Farrell, A. P.	2006	Mechanistic basis of individual mortality in Pacific salmon during spawning migrations
Cox, J.	1997	Archival research - salmon in the upper lakes region, Yukon Territory
Crane, P.A., Templin, W.D., Eggers, D.M. and Seeb, L.W.	2000	Genetic stock indentification of Southest Alaska Chinook Salmon fishery catches
Crozier, W.W., Schön, P.J., Chaput, G., Potter, E.C., Maoiléidigh, N.Ó. and MacLean, J.C.	2004	Managing Atlantic salmon
Daum, D.W. and Flannery, B.G.	2011	Canadian-Origin Chinook Salmon Rearing in Nonnatal US Tributary Streams of the Yukon River, Alaska
Can-nic-a-nick Environmental Sciences	2003	Michie Creek Chinook Salmon Field Investigations 2003
	2004	Géis Tóo'e': King Salmon River Michie Creek Chinook Salmon Field Investigations 2004
	2005	Géis Tóo'e': King Salmon River 2005 Michie Creek Chinook Salmon Field Investigations
	2006	Géis Tóo'e': King Salmon River 2006 Michie Creek Chinook Salmon Field Investigations
	2007	Géis Tóo'e': King Salmon River 2007 Michie Creek Chinook Salmon Field Investigations

Author	Year	Title
de Graff, N.M.	2007	Supplimental Juvenilte Chinook Plantings Study, Michie Creek, Yukon
	2008	Géis Tóo'e': King Salmon River 2008 Michie Creek Chinook Salmon Field Investigations
	2008	Supplemental juvenile Chinook Plantings and Sex Ratio Study: Michie Creek, Yukon
	2009	KDFN Michie Creek Monitoring Project
	2010	KDFN Michie Creek Monitoring Project
	2011	KDFN Michie Creek Monitoring Project
	2012	KDFN Michie Creek Monitoring Project
	2013	KDFN Michie Creek Monitoring Project
	2014	KDFN Michie Creek Monitoring Project
	2015	KDFN Michie Creek Monitoring Project
	2016	KDFN Michie Creek Monitoring Project
	2017	KDFN Michie Creek Monitoring Project
	2018	KDFN Michie Creek Monitoring Project
DeCovich, N. and Templin, W.D.	2009	Genetic stock identification of Chinook Salmon harvests on the Yukon River, 2007
Decovich, N.A. and Howard, K.G.	2011	Genetic stock identification of Chinook Salmon harvests on the Yukon River, 2010
DeCovich, N.A., Templin, W.D. and Evenson, D.F.	2010	Genetic stock identification of Chinook Salmon harvests on the Yukon River, 2008
Decovich, N.A. and Howard, K.G.	2010	Genetic stock identification of Chinook Salmon harvests on the Yukon River, 2009
DFO	2012	Long-term monitoring protocols for new and upgraded hydropower projects in British Columbia and Yukon Territory
DuBois, L., Berger, J.M., De-Covich, N. and Templin, W.D.	2009	Origins of Chinook Salmon in the Yukon River Fisheries, 2004
DuBois, L. and DeCovich, N.	2008	Origins of Chinook salmon in the Yukon River Fisheries, 2005
Duncan, J. and Bradford, M.	2004	Yukon River Juvenile Chinook and Chum Salmon Out-Migration Timing and Sampling Characteristics as Determined Using a Rotary Screw Trap, 2003. Retrieved from Tr'ondëk Hwëch'in
Eiler, J.H.	2013	Distribution and movements of Chinook salmon, *Oncorhynchus tshawytscha*, returning to the Yukon River basin
Eiler, J.H., Evans, A.N. and Schreck, C.B.	2015	Migratory Patterns of Wild Chinook Salmon *Oncorhynchus tshawytscha* Returning to a Large, Free-Flowing River Basin
Eiler, J.H., Masuda, M.M., Spencer, T.R., Driscoll, R.J. and Schreck, C. B.	2014	Distribution, Stock Composition and Timing, and Tagging Response of Wild Chinook Salmon Returning to a Large, Free-Flowing River Basin
Eiler, J.H., Spencer, T.R., Pella, J.J. and Masuda, M.M.	2006	Stock composition, run timing, and movement patterns of Chinook Salmon returning to the Yukon River Basin in 2003
	2006	Stock Composition, Run Timing, and Movement Patterns of Chinook Salmon Returning to the Yukon River Basin in 2004

Author	Year	Title
Eiler, J.H., Spencer, T.R., Pella, J.J., Masuda, M.M. and Holder, R.R.	2004	Distribution and movement patterns of Chinook Salmon returning to the Yukon River Basin in 2000–2002
Farley, E.V., Murphy, J.M., Middleton, A., Eisner, L., Moss, J., Pohl, J., . . . Yaska, C.	2004	Eastern Bering Sea
Farley, E.V., Murphy, J.M., Moss, J., Feldmann, A. and Eisner, L.	2009	Marine ecology of Western Alaska juvenile salmon
Farley, E.V., Murphy, J.M., Wing, B.M., Moss, J.H. and Middleton, A.	2005	Distribution, migration pathways, and size of Western Alaska juvenile salmon along the eastern Bering Sea shelf
Fenkes, M., Shiels, H.A., Fitzpatrick, J.L. and Nudds, R.L.	2016	The potential impacts of migratory difficulty, including warmer waters and altered flow conditions, on the reproductive success of salmonid fishes
Flannery, B., Beacham, T., Wetklo, M., Smith, C., Templin, W., Antonovich, A., . . . Wenburg, J.K.	2006	Run timing, migratory patterns, and harvest information of Chinook Salmon stocks within the Yukon River
Flannery, B.G., Crane, P.A., Eiler, J.H., Beacham, T.D., Decovich, N.A., Templin, W.D., . . . Wenburg, J.K.	2012	Comparison of Radiotelemetry and Microsatellites for Determining the Origin of Yukon River Chinook Salmon
Gharrett, A.J., Shirley, S.M. and Tromble, G.R.	1987	Genetic relationships among populations of Alaskan Chinook Salmon
Gilbert, C.H.	1922	The salmon of the Yukon River: US Government Printing Office
Gilbert, C.H. and O'Malley, H.	1921	Investigation of the salmon fisheries of the Yukon River
Gordon, R. N., Crouter, R.A. and Nelson, J.S.	1960	The fish facilities at the Whitehorse Rapids power development, Yukon Territory
Guthrie, C.M., Nguyen, H.T. and Guyon, J.R.	2012	Genetic stock composition analysis of Chinook Salmon bycatch samples from the 2010 Bering Sea Trawl Fisheries
	2013	Genetic stock composition analysis of Chinook Salmon bycatch samples from the 2011 Bering Sea and Gulf of Alaska trawl fisheries
	2014	Genetic stock composition analysis of Chinook salmon bycatch samples from the 2012 Bering Sea and Gulf of Alaska trawl fisheries
	2015	Genetic Stock Composition Analysis of the Chinook Salmon Bycatch from the 2013 Bering Sea Walleye Pollock
Guthrie III, C.M., Nguyen, H.T. and Guyon, J.R.	2016	Genetic Stock Composition Analysis of the Chinook Salmon Bycatch from the 2014 Bering Sea Walleye Pollock
Guyon, J.R., Guthrie, C.M. and Nguyen, H.	2010a	Genetic stock composition analysis of Chinook Salmon bycatch samples from the 2008 Bering Sea pollock fishery
	2010b	Genetic Stock Composition Analysis of Chinook Salmon Bycatch Samples from the 2007 "B" Season and 2009 Bering Sea Trawl Fisheries

Author	Year	Title
Guyon, J.R., Guthrie III, C.M., Munro, A.R., Jasper, J. and Templin, W.	2014	Extension of genetic stock composition analysis to the Chinook Salmon bycatch in the Gulf Alaska Walleye Polluck trawl fisheries 2012 Retrieved from
Guyon, J.R., Nguyen, H.T., Guthrie III, C.M., Bonney, J., McGauley, K., Hansen, K. and Gauven, J.	2015	Genetic stock composition analysis of Chinook Salmon bycatch samples from the rockfish and Arrowtooth Flounder 2013 Gulf of Alaska trawl fisheries and the Gulf of Alaska salmon excluder device test
Hamazaki, T. and DeCovich, N.	2014	Application of the Genetic Mark-Recapture Technique for Run Size Estimation of Yukon River Chinook Salmon
Hamazaki, T., Kahler, E., Borba, B.M. and Burton, T.	2013	Impact of Ichthyophonus infection on spawning success of Yukon River Chinook Salmon
Hancock, M.J. and Marshall, D.E.	1984	Catalogue of Salmon Streams and Spawning Escapements of Sub-Districts 110 and 120
Hayes, S.J., Bue, F.J., Borba, B.M., Boeck, K.R., Carroll, H.C., Boeck, L., . . . Busher, W.H.	2008	Annual management report, Yukon and northern areas, 2002–2004
Healey, M.C. and Heard, W.R.	1984	Inter- and intra-population variation in the fecundity of Chinook Salmon
Herkes, J.	2015	Carcross/Tagish traditional knowledge of salmon in the upper Yukon River
Horne-Brine, M.H., Bales, J. and DuBois, L.	2009	Salmon age and sex composition and mean lengths for the Yukon River area, 2007
Isaak, D.J., Thurow, R.F., Rieman, B.E. and Dunham, J.B.	2007	Chinook Salmon use of spawning patches: relative roles of habitat quality, size and connectivity
Jasper, J.R. and Evenson, D.F.	2006	Length-girth, length-weight, and fecundity of Yukon River Chinook Salmon
Johnson, Y., Boyce, I. and Waugh, B.	2002	Estimation of the abundance of Chinook Salmon
JTC.	2011	Yukon River salmon 2010 season summary and 2011 season outlook
	2013	Yukon River salmon 2012 season summary and 2013 season outlook
	2014	Yukon River salmon 2013 season summary and 2014 season outlook
	2015	Yukon River salmon 2014 season summary and 2015 season outlook
	2016	Yukon River salmon 2015 season summary and 2016 season outlook
Karpovich, S. and Dubois, L.	2007	Salmon age and sex composition and mean length for the Yukon River area, 2004
Kocan, R., Hershberger, P. and Winton, J.	2004	Ichthyophoniasis: An emerging disease of Chinook Salmon in the Yukon River
Kocan, R.M., Hershberger, P.K. and Winton, J.	2004	Effects of Ichthyophonus on survival and reproductive success of Yukon River Chinook Salmon
Kwanlin Dün First Nation	2003	Géis Tóo'e': King Salmon River M'Clintock River Watershed Management Planning
	2005	Géis T'o'e': King Salmon River M'Clintock Waterhsed Planning Final Report 2004/05
	2007	Géis T'o'e': King Salmon River 2007 Michie Creek Chinook Salmon Retrieved from Kwanlin Dün First Nation http://yukonriverpanel

Author	Year	Title
Kwanlin Dün First Nation and Sciences, C.-n.-a.-n. E.	2007	Géis T'o'e': King Salmon River 2007 Michie Creek Chinook Salmon field investigations - status report
Larson, W.A., Utter, F.M., Myers, K.W., Templin, W.D., Seeb, J.E., Guthrie, C.M., . . . Seeb, L.W.	2013	Single-nucleotide polymorphisms reveal distribution and migration of Chinook Salmon
Lingnau, T.L. and Bromaghin, J.F.	1999	Origins of Chinook salmon in the Yukon River fisheries 1997
Maddigan, K.A.	1999	Chinook Salmon Utilization and Restoration Options for Monkey Creek, Tributary to Marsh Lake
Masuda, M.M., Celewycz, A.G., Fergusson, E.A., Moss, J.H., Orsi, J.A., Tuttle, V.J. and Holland, T.	2015	High seas salmonid coded-wire tag recovery data, 2012–2014
Matthews, I.	1999	Radio tagging adult Chinook Salmon returning to the Whitehorse Fishway 1998
McBride, D. N., Hanner, H.H. and Buklis, L.S.	1983	Age, sex and size of Yukon River salmon catch and escapement 1982
Milligan, P.A., Rublee, W.O., Cornett, D.D. and Johnston, R.A.	1985	The distribution and abundance of chinook salmon
Moodie, S., Grout, J.A. and von Finster, A.	2000	Juvenile Chinook Salmon
Mossop, B. and Bradford, M.J.	2004	Importance of large woody debris for juvenile Chinook Salmon habitat in small boreal forest streams in the upper Yukon River basin, Canada
Mundy, P.R. and Evenson, D.F.	2011	Environmental controls of phenology of high-latitude Chinook Salmon populations of the Yukon River, North America, with application to fishery management
Munro, A.R. and Volk, E.C.	2011	Summary of Pacific Salmon Escapement Goals in Alaska with a Review of Escapements from 2002 to 2010
	2013	Summary of Pacific Salmon Escapement Goals in Alaska with a Review of Escapements from 2004 to 2012
Murphy, J.M., Templin, W.D., Farley, E.V. and Seeb, J.E.	2009	Stock-structured distribution of Western Alaska and Yukon juvenile Chinook Salmon
Murray, C. B., Henderson, M.A. and Beacham, T.D.	1990	Size and scale characteristics of upper Yukon River juvenile Chinook salmon
Myers, K.W., Davis, N.D., Celewycz, A.G., Farley, E.V., Morris, J.F.T., Trudel, M., . . . Shubin, A.O.	2005	High seas salmonid coded-wire tag recovery data, 2005
Myers, K.W., Walker, R.V., Davis, N., Armstrong, J.L. and Kaeriyama, M.	2009	High seas distribution, biology and ecology of Arctic-Yukon-Kuskokwim salmon: direct information from high seas tagging experiments 1954–2006

Author	Year	Title
Neuswanger, J.R., Wipfli, M.S., Evenson, M.J., Hughes, N.F. and Rosenberger, A.E.	2015	Low productivity of Chinook Salmon strongly correlates with high summer stream discharge in two Alaskan rivers in the Yukon drainage
Olsen, J. B., Beacham, T.D., Wetklo, M., Seeb, L.W., Smith, C.T., Flannery, B.G. and Wenburg, J.K.	2010	The influence of hydrology and waterway distance on population structure of Chinook Salmon
Payne, T.R.	2011	Yukon River instream flow Chinook Salmon passage and spawning Retrieved from https://yukonenergy
Pella, J. and Geiger, H.J.	2009	Sampling considerations for estimating geographic origins of Chinook salmon bycatch in the Bering Sea pollock fishery
Ruggerone, G.T., Nielsen, J.L. and Agler, B.A.	2009	Climate, growth and population dynamics of Yukon River Chinook Salmon
Scribner, K.T., Crane, P.A., Spearman, W.J. and Seeb, L.W.	1998	DNA and allozyme markers provide concordant estimates of population differentiation: analyses of U
Seeb, J.E., Crane, P.A. and Templin, W.	1995	Genetic stock identification of Alaska Chinook Salmon
Slaney, T.L., Hyatt, K.D., North-cote, T.G. and Fielden, R.J.	1996	Status of anadromous salmon and trout in British Columbia and Yukon
Smith, C.T., Templin, W.D., Seeb, J.E. and Seeb, U.W.	2005	Single nucleotide polymorphisms provide rapid and accurate estimates of the proportions of US and Canadian Chinook Salmon caught in Yukon River fisheries
Steigenberger, L.W. and Elson, M.S.	1977	Northern Yukon Fisheries Studies 1972 - 1974
Sweitzer, O.	1974	Distribution and abundance of chinook
Templin, W.D., Barclay, A.W., Berger, J.D., Seeb, L.W. and Moffitt, S.D.	2011	Genetic stock identification of Copper River Chinook Salmon harvests, 2005–2008
Templin, W.D., Berger, J.D., DeCovich, N.A. and Seeb, L.W.	2006	Genetic stock identification of Chinook Salmon harvests on the Yukon River, 2004
Templin, W.D., DeCovich, N.A. and Seeb, L.W.	2008	Genetic stock identification of Chinook Salmon harvests on the Yukon River, 2006
Templin, W.D., Seeb, J.E., Jasper, J.R., Barclay, A.W. and Seeb, L.W.	2011	Genetic differentiation of Alaska Chinook salmon: the missing link for migratory studies
Templin, W.D., Wilmot, R.L., Guthrie, C.M. and Seeb, L.W.	2005	United States and Canadian Chinook Salmon populations in the Yukon River can be segregated based on genetic characteristics
Thorstad, E. B., Rikardsen, A.H., Alp, A. and Økland, F.	2013	The use of electronic tags in fish research—an overview of fish telemetry methods
von Finster, A.	2005	Pre-spawn Chinook Salmon mortalities - downstream of Whitehorse, Yukon
	2006	Utilization of habitats by Chinook, Chum and Coho Salmon in the Yukon River Basin in Canada

Author	Year	Title
Walker, C.E.	1976	Studies on the freshwater and anadromous fishes of the Yukon River within Canada: Department of the Environment, Fisheries and Marine Service
Walker, R.V. and Myers, K.W.	2009	Behavior of Yukon River Chinook Salmon in the Bering Sea as inferred from archival tag data
Weidner, J.	1972	Upper Yukon River Fishery Investigations 1971
Yukon Energy	2011	Yukon Energy Charette Report
Yukon Energy, M. a. R. and C/TFN	2015	Tagish local area plan - building bridges
Yukon River Panel	2007	Protocol for the collection of carcass/pre-spawning mortality data
Zuray, S., Kocan, R. and Hershberger, P.	2012	Synchronous Cycling of Ichthyophoniasis with Chinook Salmon Density Revealed during the Annual Yukon River Spawning Migration

Appendix E4, Part 1: Reports and Grey Literature

The following list of resources was compiled and provided by N. de Graff.

. Yukon River Salmon Agreement of 2001. (2001) (pp. 14).

. McIntyre Creek salmon incubation project 2002–2003. (2003) (pp. 15).

. McIntyre Creek salmon incubation project 2003–2004. (2004) (pp. 30).

. McIntyre Creek salmon incubation project 2004–2005. (2005) (pp. 43).

. McIntyre Creek salmon incubation project 2005–2006. (2006) (pp. 49).

. McIntyre Creek salmon incubation project 2006–2007. (2007) (pp. 33).

. McIntyre Creek salmon incubation project 2007–2008. (2008) (pp. 32).

. Study of relationship between chinook incubation success and thermal regime of incubation. (2008) (pp. 15).

. McIntyre Creek salmon incubation project 2008–2009. (2009) (pp. 33).

. McIntyre Creek salmon incubation project 2009–2010. (2010) (pp. 31).

. McIntyre Creek salmon incubation project 2010–2011. (2011) (pp. 24).

. McIntyre Creek salmon incubation project 2011–2012. (2012) (pp. 17).

. McIntyre Creek salmon incubation project 2012–2013. (2013) (pp. 14).

. McIntyre Creek salmon incubation project 2013–2014. (2014) (pp. 8).

. McIntyre Creek salmon incubation project 2014–2016 and project extension. (2016), 8 pp.

Access Consulting Group. (2015). Chinook Salmon Yukon River mainstem outplant program spawning success evaluation (pp. 29).

AECOM Canada Ltd. (2012). Southern Lakes enhanced storage concept aquatic and terrestrial effects workshop (pp. 130). Whitehorse, YT: Yukon Energy Corporation

AECOM Canada Ltd. (2013). Marsh Lake storage project - preliminary aquatic effects (pp. 8). Whitehorse, YT: Yukon Energy Corporation.

Alaska Department of Fish and Game Chinook Salmon Research Team. (2013). Chinook Salmon stock assessment and research plan, 2013 (D. o. S. F. a. C. Fisheries, Trans.) Special Publication (pp. 62). Anchorage, AK: Alaska Department of Fish and Game.

Alexco Environmental Group. (2016). Chinook Salmon Yukon River mainstem outplant program spawning success evaluation (pp. 27). Whitehorse, YT.

Anderton, I. (2003). Chinook radio tracking/telemetry pilot project final report (pp. 20): North Yukon Renewable Resources Council (RRC) and the Vuntut Gwitchin First Nation.

Anderton, I. (2005). Ta'an salmon information gathering workshop summary report (pp. 38). Whitehorse, YT: Ta'an Kwäch'än Council.

Anderton, I. (2008). Ta'an Kwäch'än community stewardship (pp. 34). Whitehorse, YT: Ta'an Kwäch'än Council.

Antcliffe, B.L. and von Finster, A. (1999). Dissolved gas supersaturation monitoring at three hydroelectric generating facilities in the Yukon, Canada, in August of 1997 and 1998. Canadian Technical Report of Fisheries and Aquatic Sciences, 2275, 41.

Applied Ecosystem Management Ltd. (2003). Development of a fish and fish habitat GIS database and restoration plan for the city of Whitehorse, Yukon (pp. 62).

Arctic-Yukon-Kuskokwim Sustainable Salmon Initiative. (2006). Arctic-Yukon-Kuskokwim Salmon Research and Restoration Plan (pp. 93). Anchorage, AK: Bearing Sea Fishermen's Associatoin.

Barton, L.H. (1984). A catalog of Yukon River salmon spawning escapement surveys (D. o. C. Fisheries, Trans.) ADF&G Technical Data Report (pp. 482). Fairbanks, AK: Alaska Department of Fish and Game.

Beacham, T. and Candy, J.R. (2006). Stock identification of Yukon River Chinook and Chum Salmon using microsatellite DNA loci (P. B. Station, Trans.) (pp. 15). Nanaimo, B.C.: Department of Fisheries and Oceans.

Beacham, T. and Candy, J.R. (2007). Stock identification of Yukon River Chinook and Chum Salmon using microsatellite DNA loci (P. B. Station, Trans.) (pp. 14). Nanaimo, B.C.: Department of Fisheries and Oceans.

Beacham, T. and Candy, J.R. (2008). Stock identification of Yukon River Chinook and Chum Salmon using microsatellite DNA loci (P. B. Station, Trans.) (pp. 16). Nanaimo, B.C.: Department of Fisheries and Oceans.

Beacham, T. and Candy, J.R. (2009). Stock identification of Yukon River Chinook and Chum Salmon using microsatellite DNA loci (P. B. Station, Trans.) (pp. 19). Nanaimo, B.C.: Department of Fisheries and Oceans.

Beacham, T. and Candy, J.R. (2010). Stock identification of Yukon River Chinook and Chum Salmon using microsatellites (P. B. Station, Trans.) (pp. 19). Nanaimo, B.C.: Department of Fisheries and Oceans.

Beacham, T. and Candy, J.R. (2012). Stock identification of Yukon River Chinook and Chum Salmon using microsatellites (P. B. Station, Trans.) (pp. 19). Nanaimo, B.C.: Department of Fisheries and Oceans.

Beacham, T. and Candy, J.R. (2013). Stock identification of Yukon River Chinook and Chum Salmon using microsatellites (P. B. Station, Trans.) (pp. 19). Nanaimo, B.C.: Department of Fisheries and Oceans.

Beacham, T. and Candy, J.R. (2014). Stock identification of Yukon River Chinook and Chum Salmon using microsatellites (P. B. Station, Trans.) (pp. 19). Nanaimo, B.C.: Department of Fisheries and Oceans.

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