



TA'AN KWÄCH'ÄN COUNCIL

FOX CREEK CHINOOK SALMON RESTORATION PROJECT

CRE-25-18

FINAL REPORT - April 1, 2018 to March 31, 2019

Prepared for: The Yukon River Panel and the Pacific Salmon Commission

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ABSTRACT

Ta'an Kwäch'än Council Elders set the Fox Creek Chinook Salmon Stock Restoration project in motion to rebuild extirpated stocks in this historic traditional fishing stream. The project includes stewardship and restoration activities that are guided by both traditional and scientific knowledge. Planning began in 2006 with the duration of the project to span over two complete salmon life cycles, and the project is now in Phase II or the second salmon life cycle. The first fry were released into the Fox Creek in 2009 and adults have been returning to spawn since 2013. Spawning success has been confirmed with wild fry emerging from spawning redds since 2016. There are several annual project components that must be performed to complete and monitor this project and Ta'an Kwäch'än staff and citizens diligently perform all of them because they are very committed to ensuring success and rebuilding this stock.

ACKNOWLEDGMENTS

Ta'an Kwäch'än Council (TKC) would like to extend special thanks to Yukon River Panel for providing ongoing funding through the Restoration and Enhancement Trust Fund for this extensive restoration project.

Special thanks are also extended to Yukon Energy Corporation who have donated broodstock and eggs for the project since 2008. Yukon Energy Corporation owns and operates the Whitehorse Rapids Fish Ladder and the Whitehorse Rapids Fish Hatchery where broodstock is collected and eggs are reared to the eyed stage. The Ladder and Hatchery are managed by Lawrence Vano, and Warren Kapaniuk of Access Consulting provides technical support. Traditionally, TKC then transports the eyed eggs to McIntyre Creek Incubation Facility (which was operated by Yukon College, and managed by Darrell Otto) where they were raised, primarily by college students, until ready for release. Unfortunately, there was a fire at this facility in March 2018, so it is not currently operating.

TKC citizens; Elder Betsy Jackson and Coralee Johns are the founders of the project. Other TKC citizens and staff, and members of the public assist with the annual fry release. Trix Tanner (Department of Fisheries and Oceans) oversaw this years' project and provided mentoring and guidance on field techniques, biological sampling and adult carcass recovery. Al von Finster (AvF Research & Development) also provided experienced direction and advice.

TABLE OF CONTENTS

Introduction	1
Project Location	2
Training, Mentoring and Capacity Building.....	4
Project Planning and Implementation	4
Fox Creek Restoration Project - Methods & Results.....	5
Broodstock Collection and Incubation.....	5
Whitehorse Rapids Fish Hatchery and McIntyre Creek Incubation Facility.....	5
Annual Fry Release.....	6
Juvenile Chinook Monitoring	10
Hydrology and Water Quality	17
Monitoring Adult Salmon Returns & Barriers.....	21
Trail Maintenance	22
Redd Monitoring.....	23
Discussion.....	24
References	26
Appendix A - Supporting Documents.....	27
Monitoring Information and Maps 2018	27
Appendix B - FOX CREEK CHINOOK SALMON RESTORATION PLAN	31
Appendix A – Standards and Methods	32
Appendix B - Phase II Annual Implementation and Monitoring Plan	45

LIST OF TABLES

Table 1 - Juvenile Monitoring 2018 Results Summary.....	12
Table 2 - Juvenile Monitoring 2017 Results Summary.....	13
Table 3 - Fox Creek In-Situ Measurements 2018	18

INTRODUCTION

Ta'an Kwäch'än Council (TKC) initiated a Community Stewardship program in 2007, which focused on building capacity and increased involvement of TKC citizens in stewardship and restoration of wild salmon stocks and habitats within TKC's Traditional Territory. The Yukon River Panel Restoration and Enhancement Fund has supported the project since that time and what started as a stewardship program has evolved into Fox Creek Chinook Salmon Restoration (FCCSR) Program.

A restoration plan was developed in 2008 by EDI Environmental Dynamics Inc. to help restore an extirpated Chinook salmon stock in Fox Creek and improve harvest opportunities for TKC citizens. This plan covered one Chinook salmon life cycle to 2015 so the Fox Creek Chinook Salmon Restoration Plan (FCCSRP), Phase II – The Second Salmon Life Cycle was developed in early 2016 to cover the second salmon life cycle to 2021.

Major components of the project include:

- Training, Mentoring and Capacity Building
- Project Planning and Implementation
- Broodstock Collection and Incubation
- Annual Fry Release
- Juvenile Chinook Monitoring
- Hydrology and Water Quality
- Monitoring Adult Chinook Salmon Returns & Barriers
- Trail Maintenance
- Redd Monitoring

Annual activities and results are described throughout the report with supporting documents and maps displayed in Appendix A.

Methods, standards, and annual implementation activities are detailed in the Fox Creek Chinook Salmon Restoration Plan (FCCSRP), Phase II – The Second Salmon Life Cycle attached as Appendix B. In Appendix B of this plan, the "FOX CREEK– DETAILED ANNUAL ADAPTIVE MANAGEMENT PLAN (AMP)" activities are guided by lessons learned and adapted by TKC and the project partners annually.

PROJECT LOCATION

Fox Creek (*Kwätän'aya Chù*), is a third order stream in the western central portion of Ta'an Kwäch'än Council's Traditional Territory (Figure 1). It crosses the North Klondike highway approximately 50 kilometers north of Whitehorse, Yukon and flows from the southern end of Fox Lake southeasterly from an elevation of 2,525 feet through the Richthofen Valley then drains into the center portion of Lake Laberge, at the north end of Richthofen Island at an elevation of 2,025 feet.

The Creek is 21.3 km long and has a total drainage area of 399.4 square kilometers. A major tributary, Pilot Creek, enters from the west about 12.2 kilometers downstream from the outlet of Fox Lake. Other unnamed tributaries enter the stream from the west between Pilot Creek and the Klondike Highway crossing.

The terrain upstream of the bridge is flat marshland; it then flows downstream through rolling hills and a series of spruce stands, swamps and rock outcroppings to a flooded marshland at its mouth on Lake Laberge. Much of the watershed burned in the late 1950s and aspen is the dominant tree species in the drainage basin. The marshland areas are heavily populated by beaver where activity changes stream dynamics and creates barriers to fish passage. Land uses around the stream include; residential, agricultural, grazing and tourism.

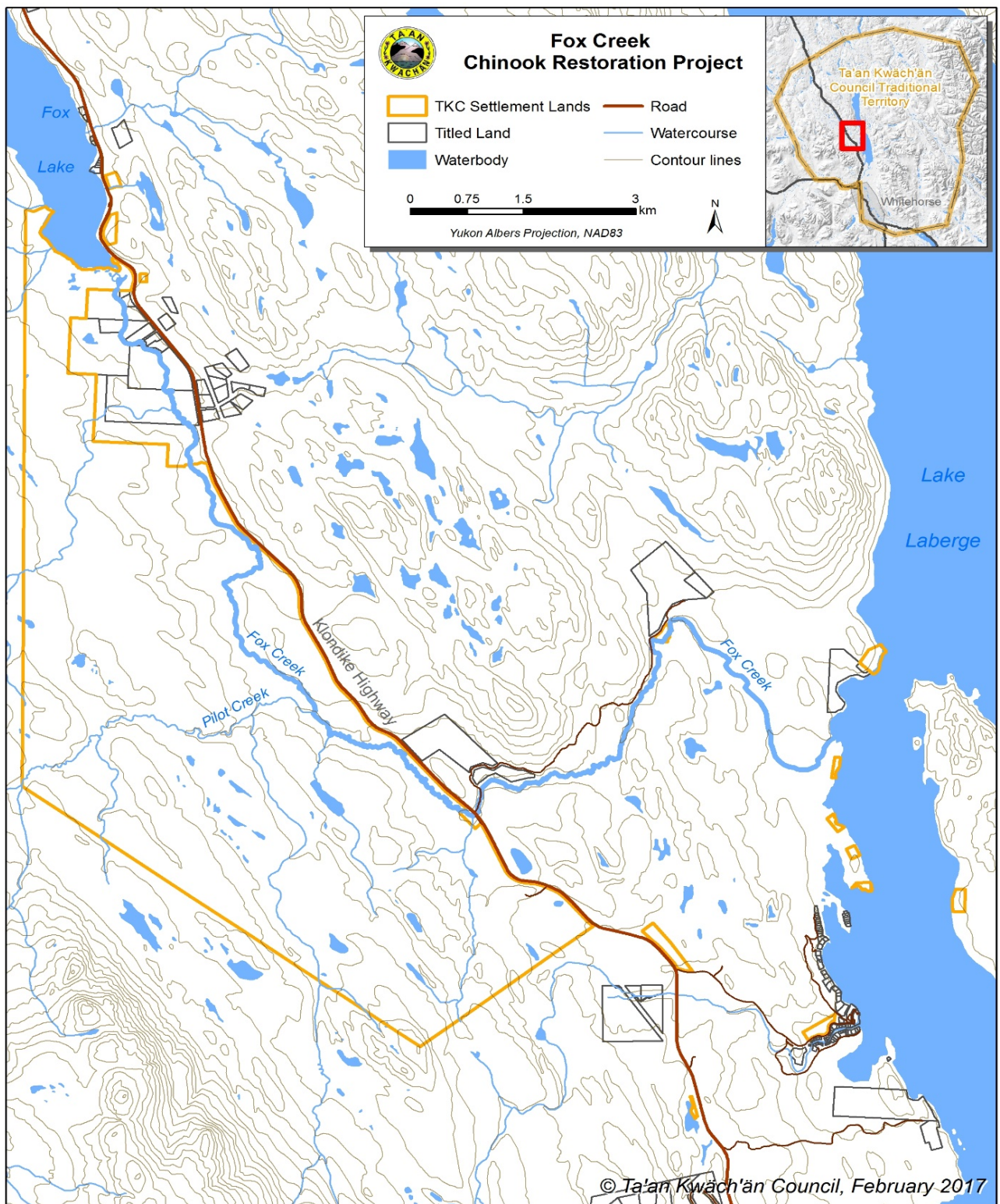


Figure 1: Fox Creek Chinook salmon Stock Restoration Project Location within Ta'an Traditional Territory

TRAINING, MENTORING AND CAPACITY BUILDING

Deb Fulmer was the project manager for the third consecutive year and Belit Peters was hired as a summer student to assist with Fox Creek field operations and the collection and input of data.

TKC Lands, Resources and Heritage Department, hired citizen Jenna Duncan as a summer student for the third consecutive year to conduct field and research work. Jenna is now a fourth-year undergraduate biology student who gained knowledge and experience in her field of study and is a great asset to the team. Jenna trained on and led the Fox Creek tagging efforts in 2017 and 2018. She also worked on the CWS project to assess spawning Chinook salmon migration through the Whitehorse Rapids Dam.

TKC has collected water temperature data from Fox Creek since 2006 as a complement to Al von Finster's long term Water Temperature Monitoring program. TKC recruited PhD student Ellorie McKnight to return and update this annual temperature data and her 2018 results are in the HYDROLOGY AND WATER QUALITY section of this report.

Yukon River Panel, Yukon Energy, Whitehorse Rapids Fish Hatchery, Department and Fisheries and Oceans, Yukon Salmon Sub-Committee (YSSC), and McIntyre Creek Incubation Facility supported TKC staff in; production, planning, scheduling and field efforts, data analysis and reporting. We thank our partners who bring excellent experience and value to this project, we couldn't do it without you.

PROJECT PLANNING AND IMPLEMENTATION

Project implementation was guided by Fox Creek Chinook Salmon Restoration Plan (FCCSRP), Phase II – The Second Salmon Life Cycle, March 2016.

The 2018 project was based out of the TKC Lands, Resources and Heritage (LRH) office in Whitehorse, field equipment was supplied by TKC from R&E and TKC contribution dollars. Deb Fulmer, TKC Fish and Wildlife Program Coordinator, coordinated project planning and supervised all activities. Other TKC LRH staff contributed to the project by assisting with monitoring and maintenance work throughout the year.

Project planning involves pre and post season planning meetings with the project partners, hosted by TKC. On May 8, 2018 all partners met at Yukon College to discuss operational changes and a path forward in light of the unfortunate burning of McIntyre Creek Incubation Facility in March of 2018 and to plan and coordinate the upcoming field activities, fry tagging and release.

TKC held a second McIntyre Creek incubation facility discussion and the post season meeting with all project partners on November 27, 2018 to; review the summary report, inform partners of annual project outcomes, update the partner contact list and responsibilities, review and update the annual schedule and, exchange technical information and advice. The agenda also included a discussion surrounding the rebuilding of the McIntyre Creek Incubation Facility.

Yukon River Panel protocols for Canadian R&E projects were adhered to, including those for the collection and reporting of data from the sampling of juvenile salmon (YRP 2009a). Protocols are described in detail in the FCCSRP in Appendix B.

FOX CREEK RESTORATION PROJECT - METHODS & RESULTS

Results and summarized methods are described in this section. Standardized methods are detailed in the Fox Creek Chinook Salmon Restoration Plan (FCCSRP), Phase II – The Second Salmon Life Cycle, March 2016, in Appendix B. Supporting documents and maps in Appendix A, and detailed 2018 monitoring data is available upon request from Ta'an Kwäch'än Council (TKC).

BROODSTOCK COLLECTION AND INCUBATION

Whitehorse Rapids Fish Hatchery and McIntyre Creek Incubation Facility

Yukon Energy Corporation collected broodstock from the Whitehorse Rapid Fish Ladder; fertilized the eggs and raised them to the eyed stage at their Whitehorse Rapids Fish Hatchery (WRFH). On October 30, 2017 they donated 30,200 eyed eggs to the Fox Creek project. TKC staff with support from WRFH and McIntyre Creek Incubation Facility (MCIF); transferred eyed eggs to MCIF. TKC staff; Deb Fulmer, Claudia Wickert, Derek Cooke, Testloa Smith and Cody Bateman assisted MCIF with operations and maintenance.

On March 31, 2018 there was a very unfortunate incident at MCIF where the shed containing the Heath Stacks and Incubation Trays was destroyed by fire. The 30,000 Chinook eggs slated for the Fox Creek project plus approximately 20,000 Chum eggs being reared by Vuntut Gwichin First Nation Government all perished in the fire. From this point forward, the incubation facility closed, all work by TKC staff at the hatchery ceased, and a contractor was hired by Yukon College to safely and environmentally clean up the debris.

Yukon Energy Corporation graciously donated 6,000 fry from their Whitehorse Rapids Fish Hatchery operations to allow TKC to hold the annual fry release and carry-on with annual project activities. As mentioned in the "Training, Mentoring and Capacity Building" section above, TKC with Jenna Duncan as our lead was contracted to insert coded wire tags and clip the adipose fins of these fry. Other TKC staff and citizens, including Belit Peters were hired to assist with these efforts.



Figure 2 - Jenna Duncan (right) tagging fry at Whitehorse Rapids Fish Hatchery with support staff. June 2018

ANNUAL FRY RELEASE

Fry releases into Fox Creek have taken place annually from 2009 to present with a total of 332,100 fry being released to date (Figure 3).

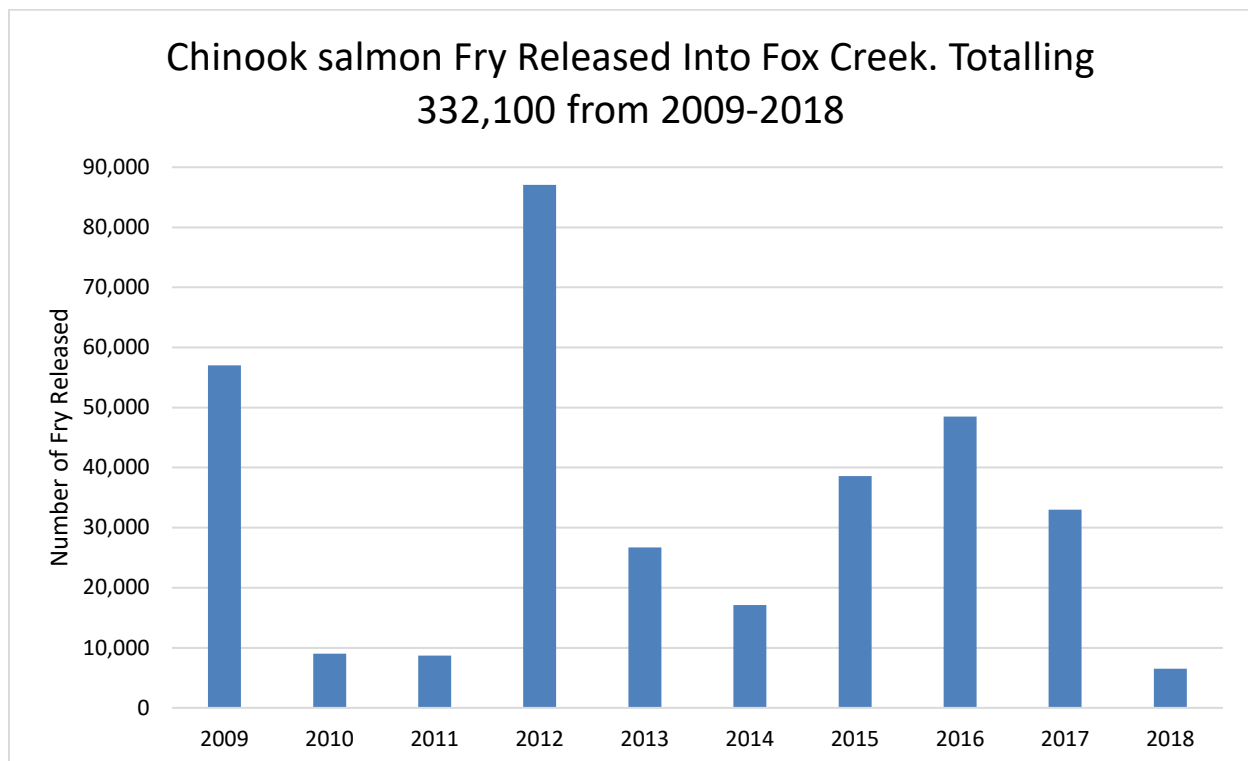


Figure 3 - Chinook Salmon Released 2009-2018

TKC released approximately 6,500 Chinook salmon fry into Fox Creek on Sunday, June 17th, 2018. Approximately 6,000 of the fish released were donated by Yukon Energy and the Whitehorse Rapids Fish Hatchery, and about 500 fish were from the Stream to Sea Program. The Stream to Sea Program raises Chinook salmon in Yukon schools that are annually tagged and released with the Fox Creek fry.

The release was a community event with members of Ta'an Kwäch'än Council (TKC) and the public coming together to help seed the fry into Fox Creek. Elder Frances Woolsey led a prayer for the fish and had help from her great granddaughter Jesse Capes to release the first bucket of Chinook! Then, kids and adults from the community released the remaining fish.

Attendees: Deb Fulmer, Jenna Duncan, Scott Paszkiewicz, Frances Woolsey, Derek Cooke, Lian Goodall, Cheyenne Bradley (KDFN), Members of Ta'an Kwäch'än Council and the Public.

The public fry release was a roaring success with approximately 50 people from all ages in attendance including TKC citizens and the public. It has become a very positive event for TKC who is proud to lead these restoration efforts and see positive, successful results.



Figure 4 - Elder Frances Woolsey with Cheryl Kates, at the annual Fry Release of Chinook. June 17, 2018



Figure 5 – Jesse Capes (Frances Woolsey’s granddaughter) released the first bucket of fry into Fox Creek. June 17, 2018

Figure 6 - Jenna Duncan and Cheyenne Bradley Distribute fry to youth for release. June 17, 2018
the Annual Fox Creek Fry Releases. June 17, 2018





Figure 8 - Deb Fulmer assists Ethan Sparks release fry into the creek as grandma Lynn Sparks takes photos. June 17, 2018



Figure 9 – Alex Laberge proudly and gently releases fry into the creek. Alex is a regular attendee at the Annual Fox Creek Fry Releases. June 17, 2018

JUVENILE CHINOOK MONITORING

Our bio-physical monitoring program focusses primarily on the presence of overwintered juvenile Chinook Salmon and the biological productivity of Fox Creek. The overwintered juvenile Chinook are sampled in the spring as an indicator of continued habitat viability. The biological productivity is monitored by calculating the rate of growth of young-of-year juvenile salmon from releases of Hatchery Salmon. In 2015 we captured the first wild 0+ juveniles that were clearly the progeny of spawning in Fox Creek. We have monitored Wild 0+ fry since then and have increased our sampling network to accommodate this. We continue to document the presence of “residual” Chinook Salmon. These are male salmon that do not migrate to the sea but may spawn with returning females. The Residuals may be fish from the preceding year’s release or those from previous releases. Any 1+ or older fish captured on or after July 1 is considered to be a residual. They are documented as Residual Hatchery or Residual Wild.

Our core long term sampling network comprises four Monitoring Sites (see Figure 18 - Fox Creek Juvenile Monitoring Sites Developed in 2008 in Appendix A). They were chosen in 2008 and have been maintained since. Sampling at the Monitoring Sites occurs at roughly monthly intervals, ideally from May through October. Sampling also occurs near Chinook Salmon spawning redds. Sampling at Redd locations does not follow the same schedule as the Monitoring Sites.

In 2018 we sampled at the Monitoring Sites on May 15, June 7, July 5, August 7 and September 11. Sampling occurred at the 2018 Redd sites on June 5, August 1 and August 28. We captured Wild and Hatchery 0+; Wild and Hatchery 1+; and Wild and Hatchery Residuals in 2018. There was a distinct separation between the origin of 0+ juveniles captured at the upstream Monitoring Sites (MS08-01 and -02) and the downstream Sites (MS08-03 and -04 and the Redd Site). The 0+ juveniles captured at the upstream sites were primarily Hatchery fish and the 0+ juveniles captured at the downstream sites were primarily Wild fish. See Table 1 - Juvenile Monitoring 2018 Results Summary below.

Young-of-year (0+)

The 0+ juveniles that were to have been released into Fox Creek in 2018 were destroyed in the fire at the McIntyre Hatchery. Yukon Energy donated 6,000 0+ juveniles to our project from the Whitehorse Rapids Fish Hatchery. Relatively warm ground water feeds this hatchery, allowing rapid growth of the juvenile Chinook. They are usually ready for coded wire tagging and out-planting by mid-June. The Whitehorse Rapids juveniles and 500 raised in classroom incubators were released on June 18, 2018 at MS08-02. Fork lengths were not measured immediately prior to release. Juveniles from the Whitehorse Rapids Fish Hatchery released to Michie Creek tend to migrate downstream soon after release. It was uncertain whether juveniles from the Whitehorse Rapids Hatchery would remain in Fox Creek until August. We found that juveniles did stay and were present in sufficient numbers to allow analysis. Of the released Hatchery juveniles, the rate of growth at MS08-02 was 0.16 mm/day between July 5 and August 7, and 0.2 mm/day between August 7 and September 11. Growth over the entire period was 0.19 mm/day, which compares well with the 0.12 mm/day calculated for 2016 and 2017. It is likely a result of the much lower stocking rate of juveniles in 2018: 6,500 vs 33,000 in 2017 and 45,000 in 2016. Some 0+ Hatchery juveniles moved upstream from MS08-02. On September 11 two 0+ Hatchery juveniles were captured at MS08-01. In downstream waters, three 0+ Hatchery juveniles were captured

at MS08-03 on August 7. None were captured at MS08-04. See, Table 1 - Juvenile Monitoring 2018 Results Summary and Figure 8 – Compares growth rates of 0+ Wild vs Hatchery juveniles captured at sites; MS08-02 (hatchery), MS08-04 (wild), and the 2017 Artificial Redd Sites (wild) during the 2018 summer monitoring season, below.

Three 0+ Wild juveniles were captured at MS08-01 on September 11. Two were captured at MS08-02 on August 11 and 3 on September 11. No 0+ Wild juveniles were caught at MS08-03 until August 7, when 28 were captured. An additional 31 were captured on September 11. Average fork lengths were 73.14 mm on August 7 and 74.45 mm on September 11, giving an apparent growth rate of 0.04 mm/day. At MS08-04, two 0+ Wild juveniles were captured on July 5, 21 on August 7 and 24 on September 11. Average fork lengths were 69.44 on August 7 and 76.87 on September 1, giving an apparent growth rate of 0.23 mm/day. Wild 0+ juveniles dominated the young-of-year catches at the 2018 Redd. Captures of 0+ Wild juveniles were 30 on June 5, 48 on August 1 and 30 on August 28. Average fork lengths were 35, 71.44 and 73.37 mm respectively. Apparent growth rates were 0.65 mm/day between June 5 and August 1, and 0.07 between August 1 and August 28. The large numbers captured and apparent rapid growth of the 0+ Wild juveniles in the lower Creek is worthy of notice. End of season sampling of the 0+ Wild juveniles resulted in average fork lengths that were similar to those of the 0+ Hatchery juveniles ((see, Figure 8 – Compares growth rates of 0+ Wild vs Hatchery juveniles captured at sites; MS08-02 (hatchery), MS08-04 (wild), and the 2017 Artificial Redd Sites (wild) during the 2018 summer monitoring season)).

Yearlings (1+)

Yearling Hatchery Chinook were present in low numbers at MS08-01 and MS08-02. Average fork lengths increased at each Site between sampling periods. Three 1+ Wild Chinook Salmon were captured on May 15, with 2 at MS08-01 and 1 at MS08-03.

Overall, rates of captures were consistent with past years sampling.

Residuals

Residual Hatchery juveniles were captured at MS08-01 on July 5 and August 7 and at MS08-02 on September 11. None were captured at MS08-03 or -04.

Residual Wild juveniles were captured at MS08-03 on August 7 and at the 2018 Redds on August 1.

Analysis of past high resolution juvenile Chinook sampling projects in the Whitehorse area was used to choose July 1 as boundary between yearling and residuals (Moody et al, 1993; Bradford and Grout, 2001; von Finster and MacKenzie- Grieve, 2006 & 2007). Residuals were first sampled in Fox Creek in 2010 and have been captured in most years since then.

Table 1 - Juvenile Monitoring 2018 Results Summary

Ratio and Percent of Wild to Total 0+ Juveniles Captured at Four Fox Creek Monitoring Sites from May 15 to Sept 11, 2018						
Monitoring Date	Parameter	MS08-01	MS08-02	MS08-03	MS08-04	TOTAL # of Chinook
May 15/18	# of 0+ Chinook		0	0	0	0
	Avg Length Hatchery					
	Avg Length Wild					
	# Unclipped & %	*				
June 7/18	# of 0+ Chinook		0	0	0	0
	Avg Length Hatchery					
	Avg Length Wild					
	# Unclipped & %	*				
July 5/18	# of 0+ Chinook		20	0	2	22
	Avg Length Hatchery		71			
	Avg Length Wild				55	
	# Unclipped & %	*	0/20 = 0%	0	2/2 = 100%	
August 7/18	# of 0+ Chinook		19	31	21	71
	Avg Length Hatchery		76	88		
	Avg Length Wild		81	73	69	
	# Unclipped & %	*	2/19 = 11%	28/31 = 90%	21/21 = 100%	
September 11/18	# of 0+ Chinook	5	28	31	24	88
	Avg Length Hatchery		83			
	Avg Length Wild		83	74	77	
	# Unclipped & %	*2/5	3/28 = 11%	31/31 = 100%	24/24 = 100%	
TOTAL			67	62	47	181
TOTAL UNCLIPPED			5/67 = 7%	59/62 = 95%	47/47 = 100%	111/176 = 63%

Table 2 - Juvenile Monitoring 2017 Results Summary

Ratio and Percent of Wild to Total 0+ Juveniles Captured at Four Fox Creek Monitoring Sites from May 19 to October 18, 2017						
Monitoring Date	Parameter	MS08-01	MS08-02	MS08-03	MS08-04	TOTAL # of Chinook
May 19/17	# of 0+ Chinook	0	0	0	*	0
	Avg Length Hatchery					
	Avg Length Wild					
	# Unclipped & %					
June 9/17	# of 0+ Chinook	0	0	0	*	0
	Avg Length Hatchery					
	Avg Length Wild					
	Unclipped & %					
July 26/17	# of 0+ Chinook	32	27	4	*	63
	Avg Length Hatchery	52	57			
	Avg Length Wild			71		
	Unclipped & %	0/32 = 0%	0/27 = 0%	4/4 = 100%		
August 16/17	# of 0+ Chinook	30	28	1	*	59
	Avg Length Hatchery	61	60	70		
	Avg Length Wild					
	Unclipped & %	0/30 = 0%	0/28 = 0%	0/1 = 0%		
September 14/17	# of 0+ Chinook	30	30	8	*	68
	Avg Length Hatchery	67	66			
	Avg Length Wild			84		
	Unclipped & %	0/30 = 0%	0/30 = 0%	8/8 = 100%		
October 18/17	# of 0+ Chinook	30	26	2	*	58
	Avg Length Hatchery	71	67			
	Avg Length Wild			87		
	Unclipped & %	0/30 = 0%	0/26 = 0%	2/2 = 100%		
TOTAL		122	111	15		248
TOTAL UNCLIPPED		0/122 = 0%	0/111 = 0%	14/15 = 93%		14/248 = 6%
<i>* Stn 4-Does not have enough #s to analyse % of 0+ Wild to hatchery fry</i>						

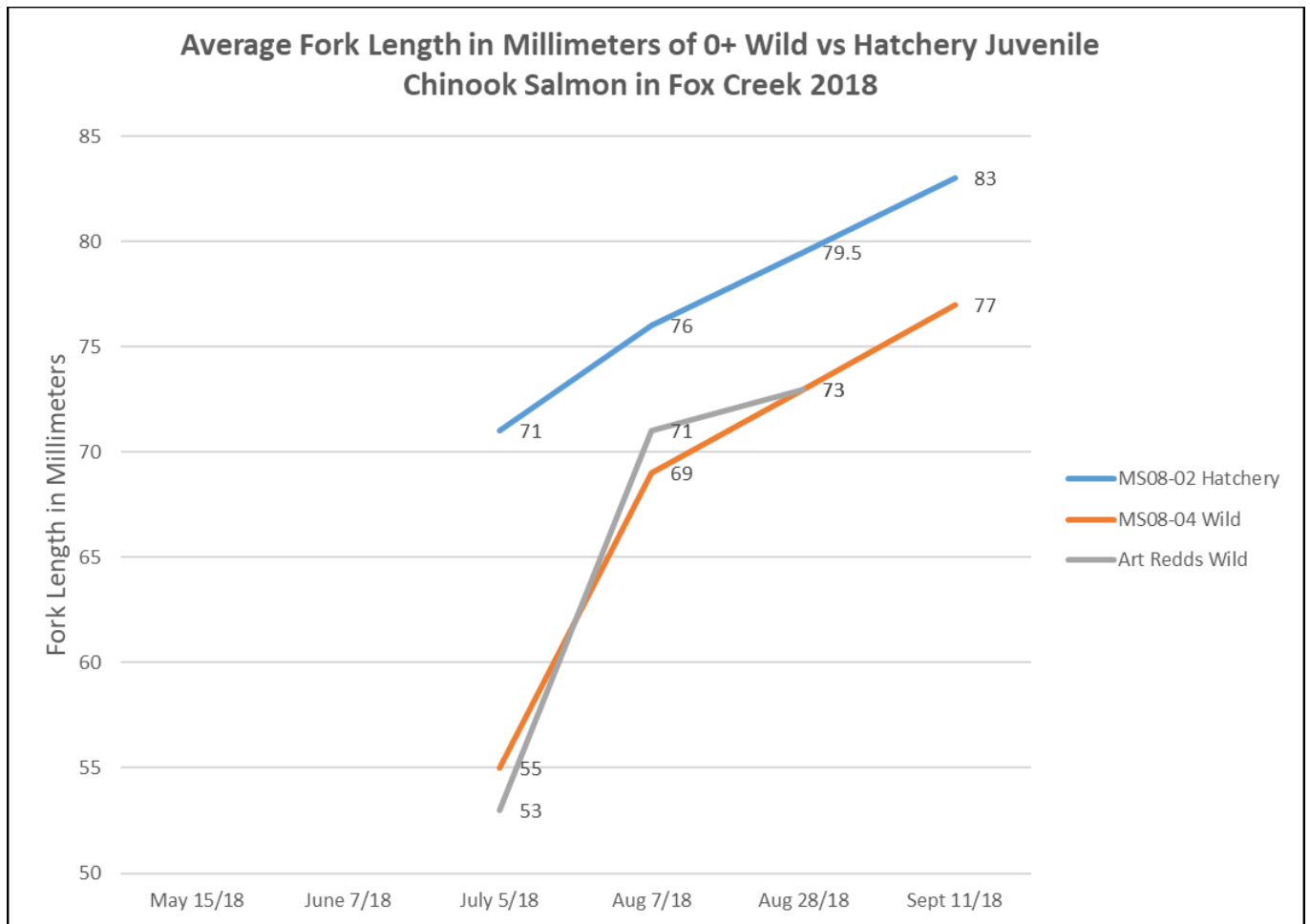


Figure 10 – Compares growth rates of 0+ Wild vs Hatchery juveniles captured at sites; MS08-02 (hatchery), MS08-04 (wild), and the 2017 Artificial Redd Sites (wild) during the 2018 summer monitoring season.

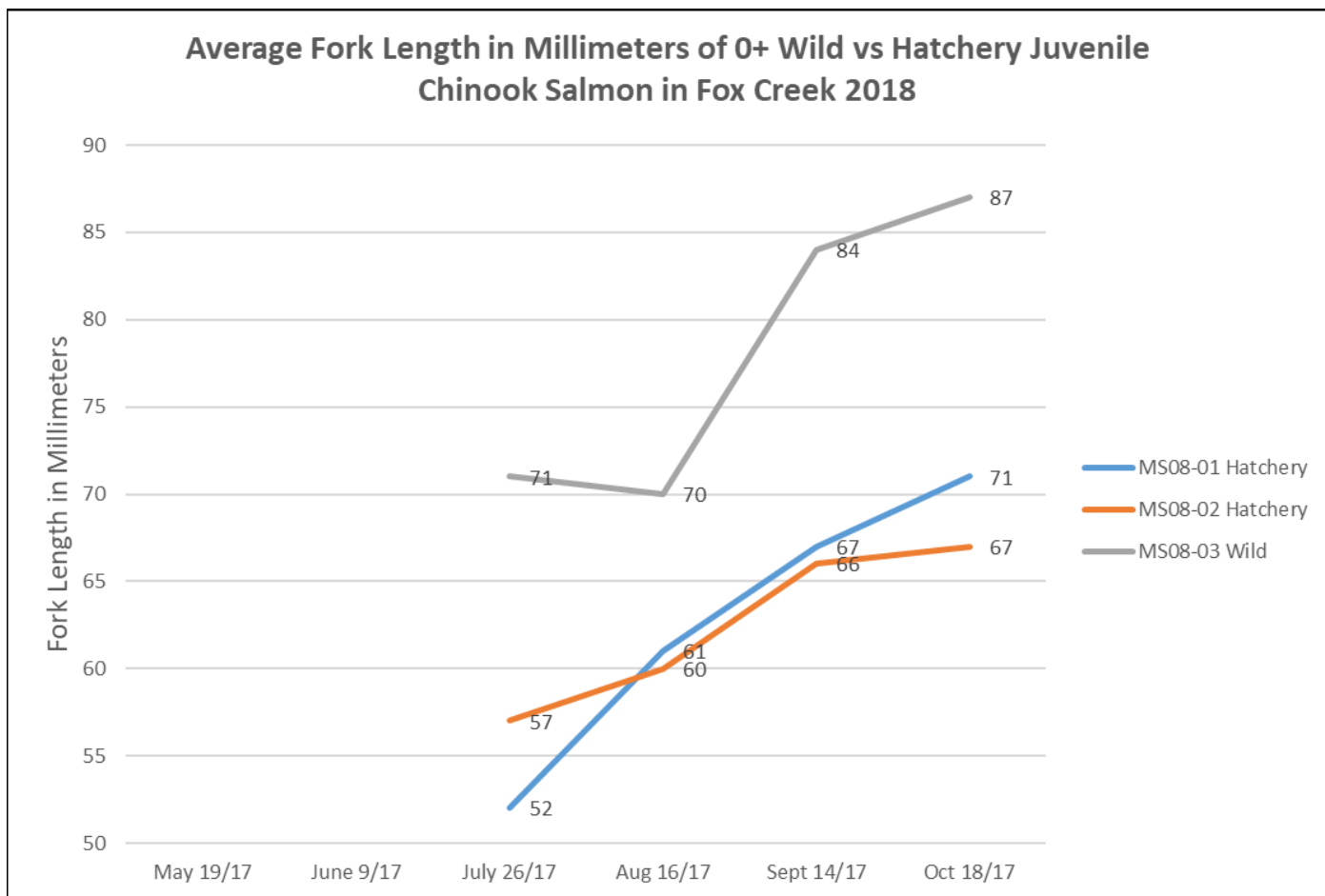


Figure 11 – Compares growth rates of 0+ Wild vs Hatchery juveniles captured at sites; MS08-01 (hatchery), MS08-02 (hatchery), and MS08-03 (wild) during the 2018 summer monitoring season.



Figure 12 - Deb Fulmer training Kadin Hare on bio-monitoring methods.

HYDROLOGY AND WATER QUALITY

TKC installed a hydrometric station, including a staff gauge on June 8th, 2017. The goal of the hydrometric station is to develop a rating curve over time so TKC staff members will only need to read a staff gauge to determine discharge opposed to conducting a manual measurement using a flow meter. TKC project staff conduct manual discharge measurements each month in conjunction with the juvenile Chinook monitoring as well as a winter under ice salt slug discharge measurement.

We contracted Laberge Environmental Services who worked with TKC staff members to install the hydrometric station and record results throughout the 2017 field season. They were contracted again in 2018 to; review the data, update and summarize the results, and improve on the rating curve. Figures 11 and 12 below display updated Hydrograph and Rating Curve results for 2018.

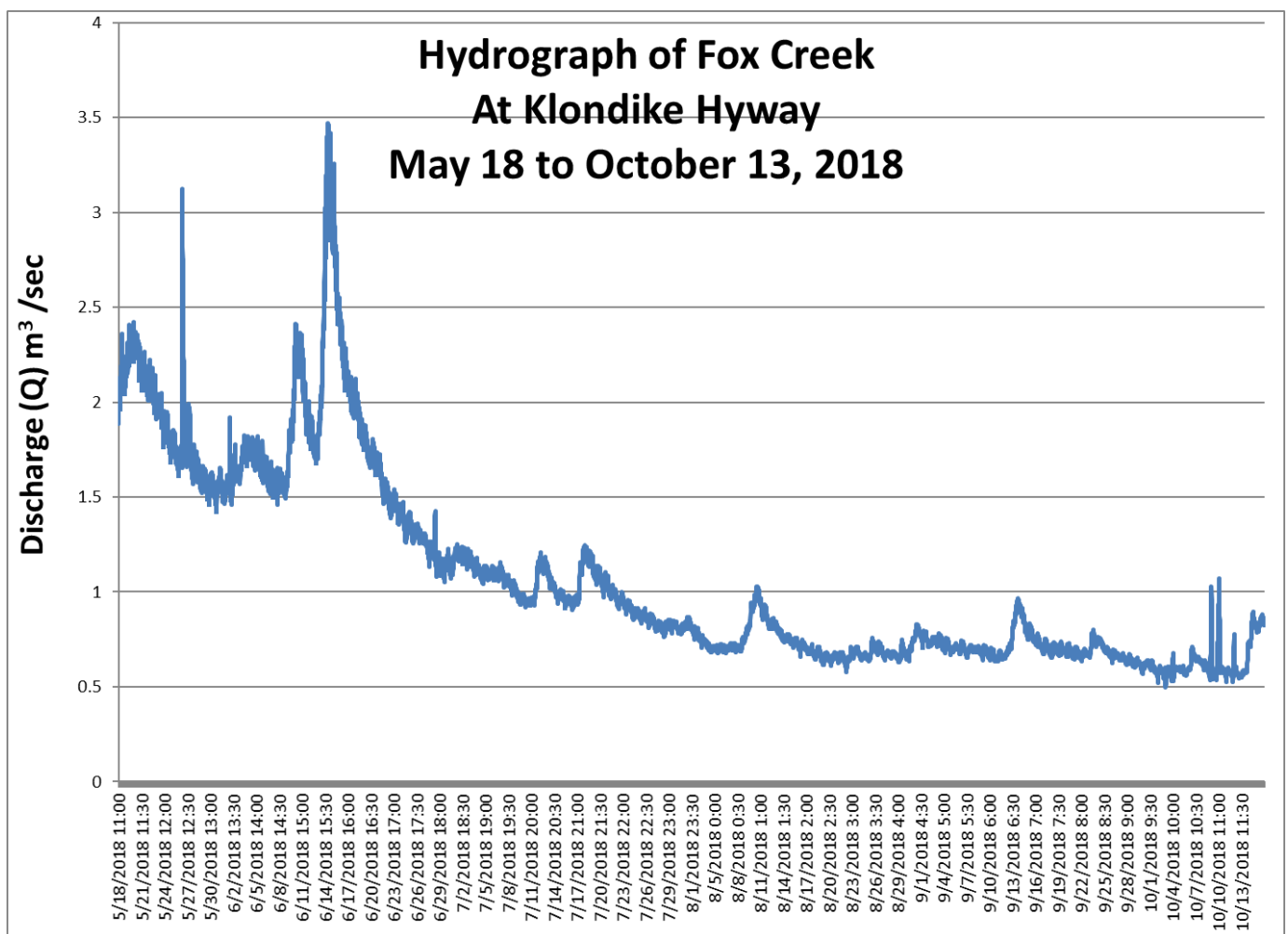


Figure 13 - Hydrograph results at Fox Creek Hydrometric Station 2018

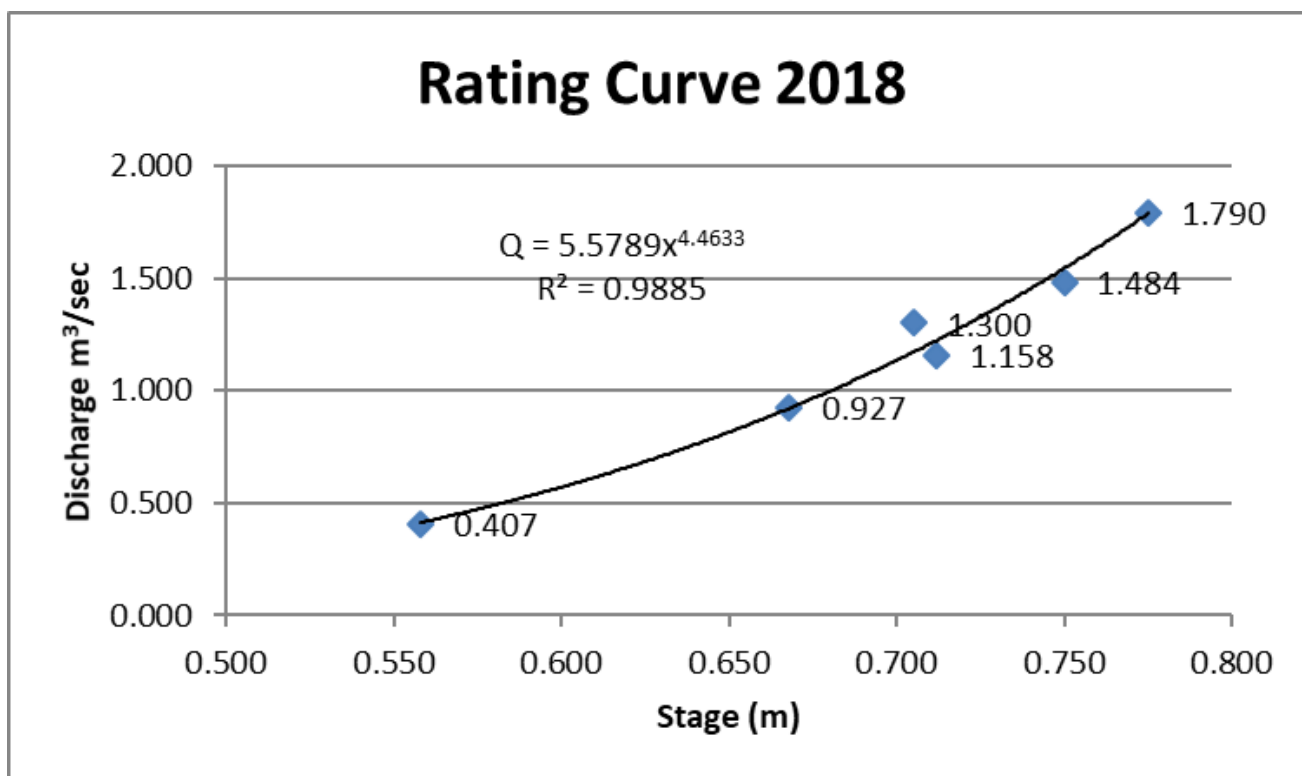


Figure 14 – Updated Rating Curve at Fox Creek Hydrometric Station 2018

We also conducted an under-ice salt slug discharge measurement on March 29, 2018. Unfortunately, the discharge calculation is inconclusive, but the under-ice water quality sample results are available upon request and in-situ measurements are displayed in Table 3 below.

Table 3 - Fox Creek In-Situ Measurements 2018

<u>Date</u> 2018	<u>Time</u>	<u>H2O Temp</u>	<u>Oxygen %</u> <u>Sat</u>	<u>Oxygen</u> <u>mg/L</u>	<u>Cond.</u> <u>Spec.</u>	<u>Cond.</u>	<u>pH</u>	<u>ORP</u>	<u>Hg</u>
3/29/2018 Ground Water	9:15	3.3	30.9	4.16	464.2	270.9	7.63	69.7	
3/29/2018 Surface Water	9:15	0.0	90.8	13.27	293.5	153.2	7.83	89.2	
15-May-18	Water was too deep and unsafe to measure discharge.								
7-Jun-18	13:30	10.5	103.3	11.43	320.5	231.4	8.61	137.5	689.7
5-Jul-18	13:30	14.5	101.0	10.15	340.9	272.5	8.24	27.4	696.7
29-Aug-18	YSI Gauge was not working								
10-Sep-18	12:41	7.2	100.3	11.98	341.1		8.14	192.1	

From 2006 to present TKC, with support from Al von Finster, has been very diligent at monitoring surface water temperature in Fox Creek using in-stream Tidbit temperature data loggers. This temperature monitoring complements a larger project on creek, groundwater and river thermal regimes throughout Yukon River watershed in relation to climate change and salmon habitat.

In 2016 TKC hired University of Alberta PhD student Ellorie McKnight under Natural Sciences and Engineering Research Council (NSERC)'s Collaborative Research and Training Experience (CREATE) program. Ellorie was tasked to organize, synthesize, and analyse TKC's long term temperature data and she has updated it annually since. Her 2017-18 results are displayed in Figures 13 to 15 below.

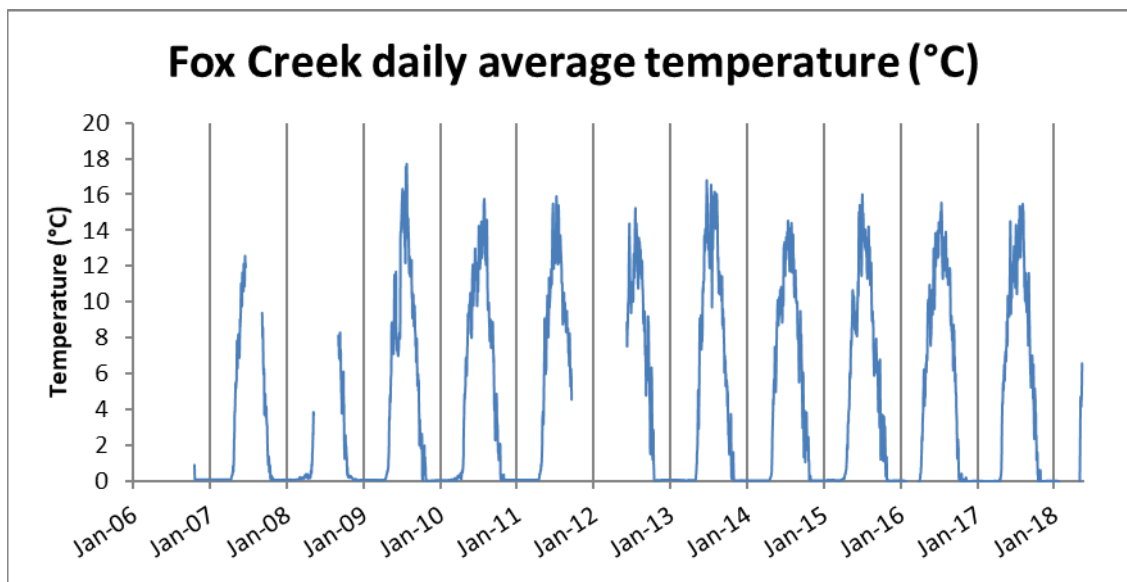


Figure 15: Fox Creek Daily Average Temperature (°C) from 2006 to 2018

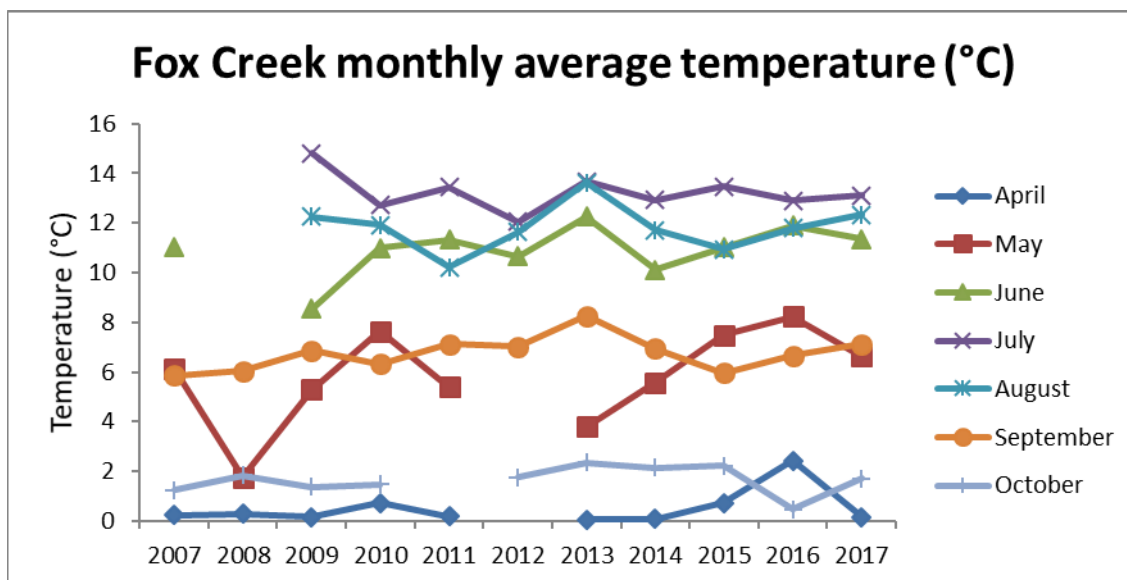


Figure 16: Fox Creek Monthly Average Temperature (°C) from 2007 to 2018

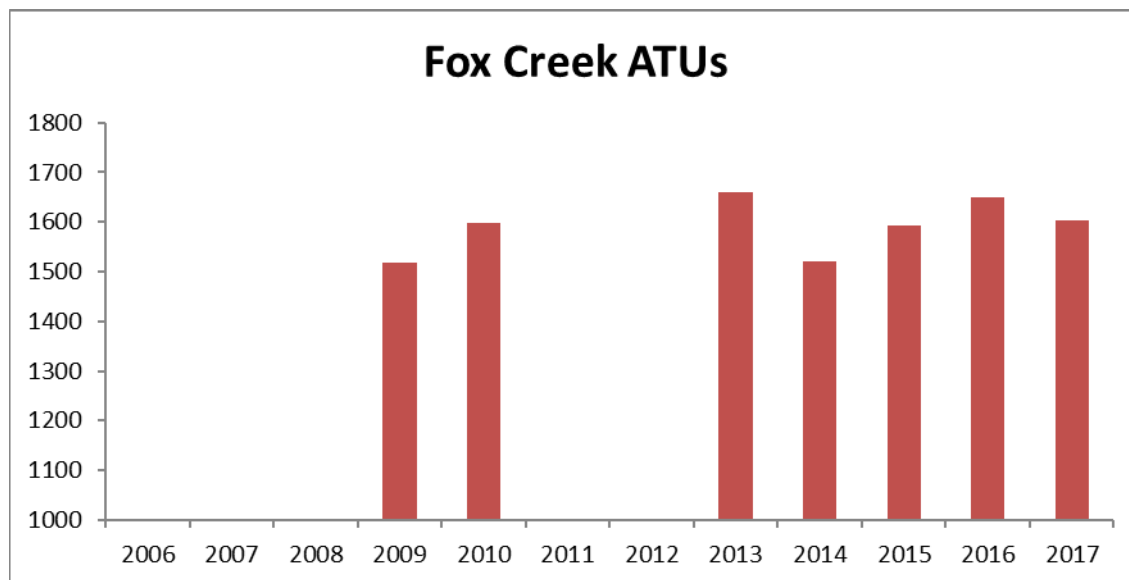


Figure 17: Fox Creek Annual Accumulated Thermal Units (ATU's) 2009 to 2016

MONITORING ADULT SALMON RETURNS & BARRIERS

Barriers

Stream surveys to record active beaver dams that are potential barriers to upstream spawning migration have been conducted annually with a focus on the lower section of the creek downstream from juvenile monitoring Site MS08-03 which is approximately 5.5 km upstream from the creek's mouth at Lake Laberge. See Figure 18 - Fox Creek Juvenile Monitoring Sites Developed in 2008 and Figure 19 - Fox Creek Active Beaver Dam Barrier Map 2016-2018 in Appendix A.

In 2015 only three active beaver dams were recorded, in 2016 an additional nine active beaver dams were found for a total of twelve. Staff found it extremely difficult and time consuming to navigate through this area to notch dams and move adult salmon past these obstructions. The number of active beaver dams recorded in 2017 was fourteen, which is an increase from twelve the year before. Of the 2017 dams; six were still active from 2015 and 2016 but 8 new ones were found.

Throughout this time, TKC remained very active and diligent about continuing beaver trapping efforts to reduce the population in this lower portion of the creek. We held a beaver trapping workshop in April 2015 where 5 beavers were trapped. In 2016 TKC supported several staff and citizens to complete a trapping course and become certified. We hired professional trappers to work with staff and trapped 8 beavers during this winter season. In 2017 we hired additional professional trappers who worked throughout the trapping season from October 1 to May 31 and confirmed a harvest of 14 beaver. All these trapping efforts appear to be paying off because only 6 active dams were recorded the summer of 2018. TKC has hired citizens and other First Nation trappers who are actively trapping the creek this winter season. Pelts from trapping efforts are tanned and donated to the TKC sewing group to make traditional garments and the meat is utilized by Elders and interested citizens.

Adult Returns

We have confirmation of adult Chinook salmon returning to Fox Creek from 2013 on. In 2018 they were observed from August 6 to 27. Throughout this period a total of 29 salmon were observed and we assume these to be different individuals. The total numbers of adults observed at one time, at one location, were 11 on August 21, 2018. Although not always visible, we did not observe adipose fins on any of the fish so assume all were of hatchery origin. Adults migrated to the highest upstream location to date with one observed upstream of BD318 (Figure 19 - Fox Creek Active Beaver Dam Barrier Map 2016-2018 in Appendix A).

TKC collects data and recovers the heads of returning adult carcasses to contribute to DFO's Age Sex and Length (ALS) program. The data along with heads are submitted to DFO each fall, and the results are displayed in appendix A. There was a decreased presence of predators along the creek this year and 5 adult carcasses were recovered.



Figure 18 - Update Photos from 2018 Figure 16: Spawning Salmon Just Downstream of BD215. Photo taken August 2016

TRAIL MAINTENANCE

The Fox Creek trail represents approximately 14 km of rugged trail directly adjacent to the creek from the North Klondike Highway crossing to the mouth at Lake Laberge. It is used to access the creek from several locations, to allow safe monitoring activities for all project components. From 2007 to 2009 and again in 2012, this foot path was developed and maintained by TKC Stewards with assistance from Y2C2 crews.

Because a well-maintained trail allows safe access to the creek and better sight lines for detecting bears and preventing close encounters, it is imperative it is well maintained. In 2015 trail maintenance was a priority because many sections of the trail, especially the lower portion dominated by riparian vegetation, had become overgrown.

In 2018 the trails were maintained by Resources staff and summer students. Existing trails were de-brushed including; the ATV trail into Juvenile Monitoring Site MS08-04, the adult monitoring trail on the lower portion of the creek, and the access trails to Juvenile Monitoring Sites MS08-01 and 04. The remaining trails downstream of Juvenile Monitoring Site MS08-03 were all still in great condition.

REDD MONITORING

The purpose of redd monitoring at Fox Creek is to determine the viability of Chinook salmon redds. TKC mimicked natural redds by burying temperature data loggers adjacent to potential redds to record the temperature of the substrate. We then downloaded the data to calculate the accumulated thermal units (ATUs) and estimate the time of emergence at approximately 1000 ATUs.

These “artificial redds” were installed the fall of 2015, 2016 and 2017 and retrieved the following springs. Using methodologies developed from our temperature monitoring program results are shown in Figure 17 below.

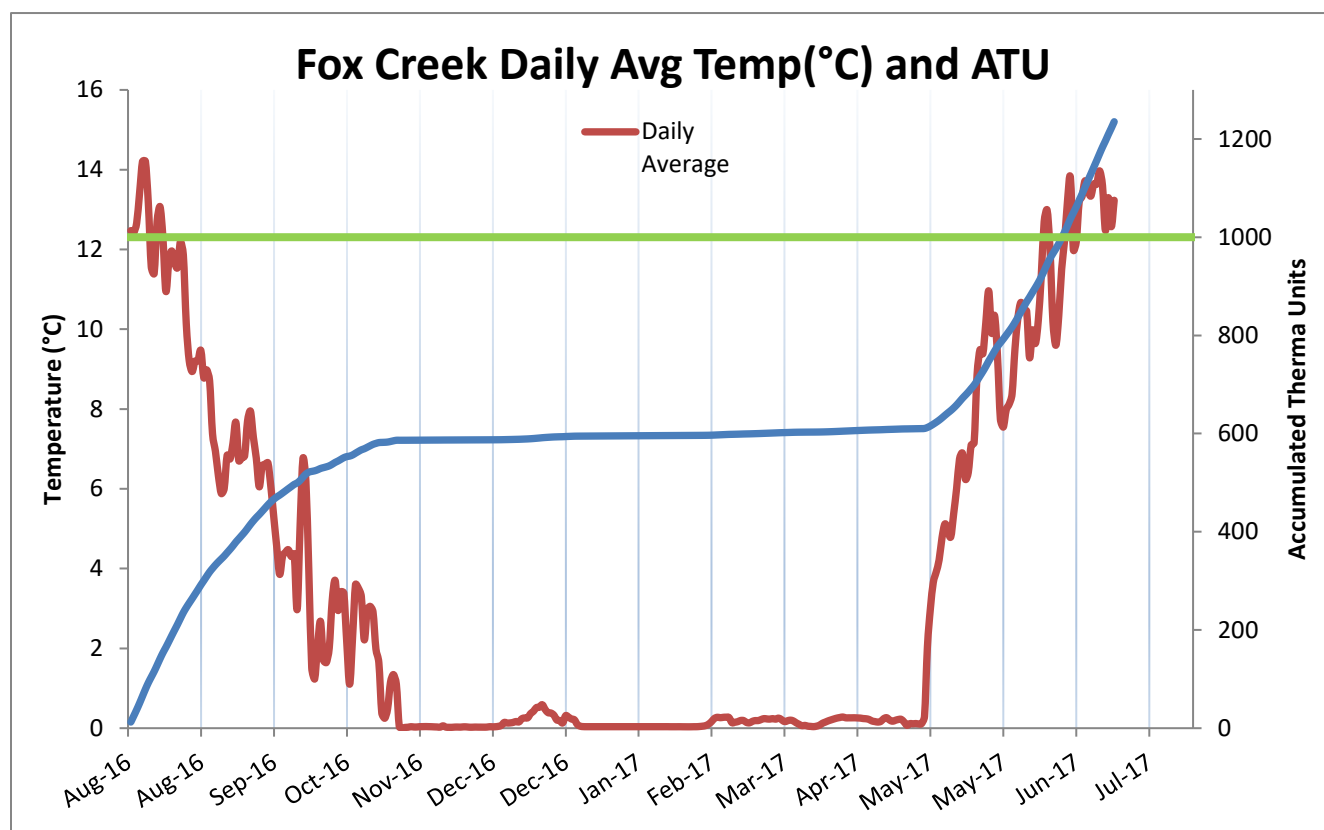


Figure 19 - Fox Creek Daily Average Temperatures and Accumulated Thermal Units from Aug 2016 to Aug 2017

Using data and the graph; eyed eggs would develop in mid September, alevins in early November and 0+ fry emergence in early June. This emergence timing corresponds with 0+ fry observations and bio-sampling in the creek for the past 3 years.

In 2018 we observed many 0+ wild fry along the banks in back eddies in the area of the redds and these fry remained in the creek until late August. This allowed us to trap them in June, July and August and develop the growth curve in Figure 8 above. The total number of fry captured was 60 on June 6th, 47 on August 1st, and 56 on August 28th however not all were sampled. Because we have successfully determined the emergence timing for 3 consecutive years, a decision was made at the annual fall partner meeting artificial redds are no longer required so none were installed in the fall of 2018.

DISCUSSION

The goal of Ta'an Kwäch'än Council's Fox Creek Chinook Salmon Restoration Project is to re-establish a self-sustaining natural population of Chinook with sufficient spawners for long-term persistence; abundant enough to contribute to a sustainable harvest for current and future generations as part of our natural culture and heritage. This goal must be realized through both stewardship and restoration efforts.

TKC is achieving the stewardship portion of our goal. From 2006 to 2018 the Fox Creek project has been a high priority, and both staff and citizens are very aware and involved in its progress. Throughout these 12 years, many TKC members have received valuable training and experience in salmon restoration. The project has also built the capacity of youth in our community through public events and educational experiences. Because the TKC community has been so involved in this program Traditional Ecological Knowledge (TEK) is continually being fed into management decisions.

The restoration portion of the goal will be realized more on a scientific basis with biological indicators such as; the numbers returning spawners and/or redds, ratios of wild vs hatchery salmon and male vs female. The project team has not yet determined what biological indicators will indicate the achievement of our goal, however, many results in the last few seasons indicate we are moving in the right direction. The most prominent results are our observations of strong adult populations returning to spawn and an abundance of wild fry at the redd locations. The ratio of wild to hatchery 0+ juvenile Chinook captured at our monitoring stations is very promising, in 2018 the ratio is 63% wild to hatchery compared to 6% in 2017. We are also observing a trend of wild juveniles at the two lower monitoring sites where spawning is occurring and hatchery juveniles at the upstream sites where we are seeding the creek. The wild juvenile growth rates appear to be as productive as the hatchery stock however there are many factors to consider especially the potential for out migration of larger fry in late summer.

Broodstock collection, incubation and rearing has been challenging throughout the program. Limited numbers of returning spawners to the Yukon River watershed make it difficult for Yukon Energy to provide the estimated number of eggs required for the program because they have a commitment to the number of spawners passing through the dam. The program estimate in 2009 was 100,000 eggs per year however the average has been 33,000 per year with a maximum in 2013 of close to 90,000. With the burning of McIntyre Incubation Facility and loss of fry in 2018, only 6,500 fry were seeded. Because of these and other factors, a confirmed number of fry is not available and TKC annually questions if fry will be received.

To replace McIntyre Incubation Facility and determine other methods of broodstock collection, incubation and rearing TKC was a successful proponent and will lead a feasibility study for Chinook salmon stock restoration throughout Yukon which will determine the overall interest of Yukon First Nations and create a toolbox of broodstock collection, incubation and rearing methods.

Continuous water temperature data which TKC has been collecting from 2006 to present is showing some trends in the results as spring temperatures appear to have increased over the years. This could have both positive and negative effects. The positive effects are; it has the potential to increase the

ATUs resulting in fry emergence earlier in the year and larger, stronger smolts migrating to the ocean earlier in the following year. The negative effects include potential for disease, parasites, reduction in spawning and increased stress on returning adults if temperatures also increase in the late summer during migration and spawning. This however does not at present seem to be a trend. TKC acknowledges the importance of sufficient water quantity and quality for salmon habitat and therefore installed a hydrometric monitoring station in the 2018 field season. Water quality will continue to be monitored in accordance with our Restoration Plan. This information can potentially be extrapolated to other watersheds and other restoration projects.

Monitoring adult returns, and barrier management is a very important component of this project and abundant numbers of adults have been observed in the creek for the past 4 consecutive years. While the stream walks have successfully observed spawners, this method is not the most effective for enumerating adult salmon returns, as there is a high probability some fish are missed. Therefore, TKC is committed to installing a cost effective and efficient enumerating system in the 2019 summer season. Program staff visited the Klukshu weir in 2018 to learn the system and is working with DFO to install the same system in Fox Creek. Stream walks would still be required to locate spawning areas, manage obstructions, and collect carcasses. Beaver activity in this system is high and creates barriers to returning adults. TKC is actively trapping beaver to reduce their numbers with 25 harvested from the winter of 2015 to date. The result of these efforts are reducing the number of barriers in the lower portion of the creek.

Redds have shown that this stream is viable for sustaining Chinook. Since the spring of 2016, spawning redds were successful at producing wild 0+ YOY. This is a very big step in the achievement of our goal and this monitoring strategy will continue for the remainder of the second salmon life cycle. Successive captures of Juveniles at the redds in 2018 allowed TKC to determine a growth curve to compare growth rates with hatchery stock.

The Fox Creek efforts are guided by outcomes and lessons learned. TKC and our partners have therefore devised a very effective adaptive management strategy in Appendix B of the Fox Creek Chinook Salmon Restoration Plan, Phase II – The Second Salmon Life Cycle. The project partners meet bi-annually to discuss results and strategic operational changes. This section is then updated on an annual basis and guides this project and will inform future Yukon restoration efforts.

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APPENDIX A - SUPPORTING DOCUMENTS

Monitoring Information and Maps 2018

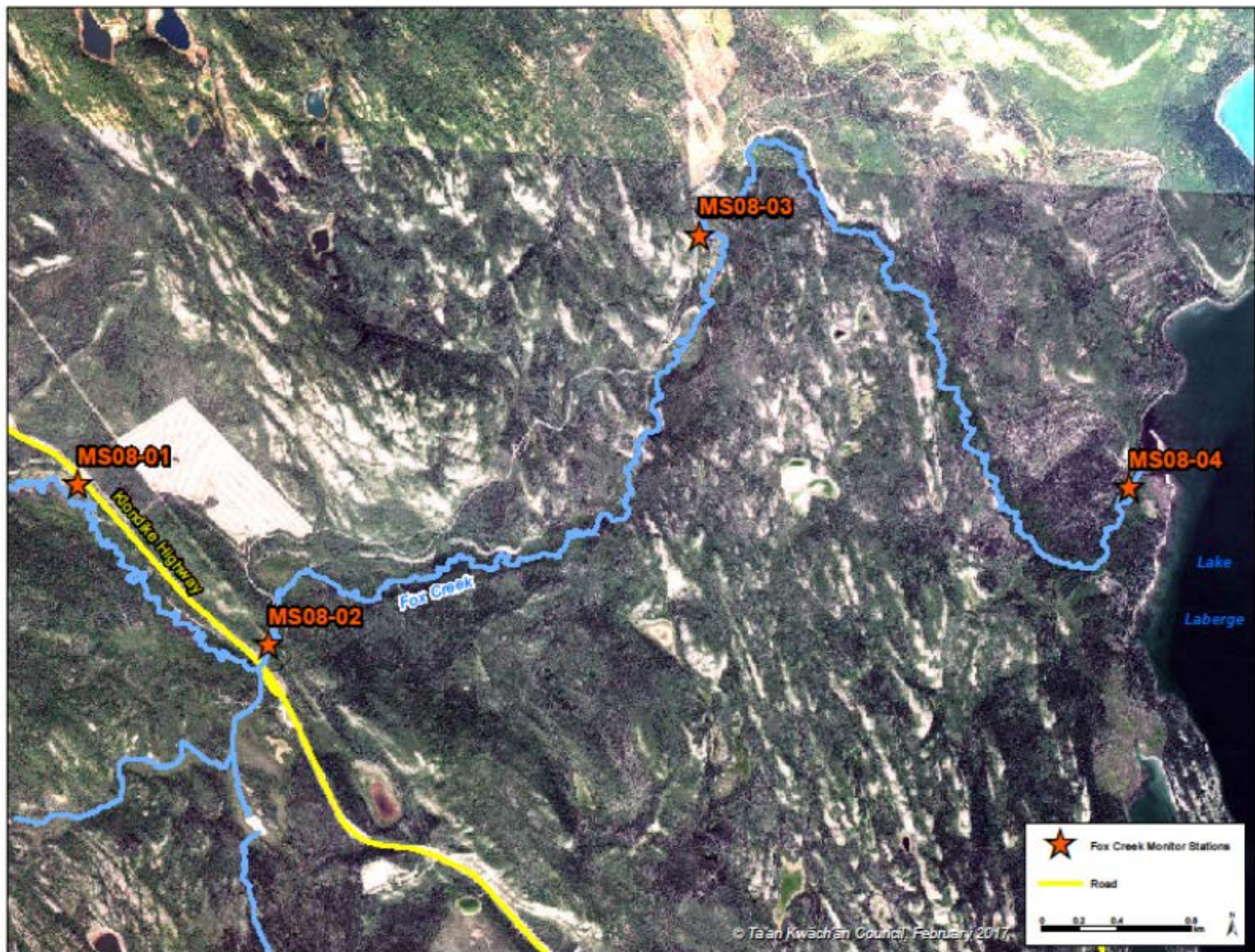


Figure 20 - Fox Creek Juvenile Monitoring Sites Developed in 2008

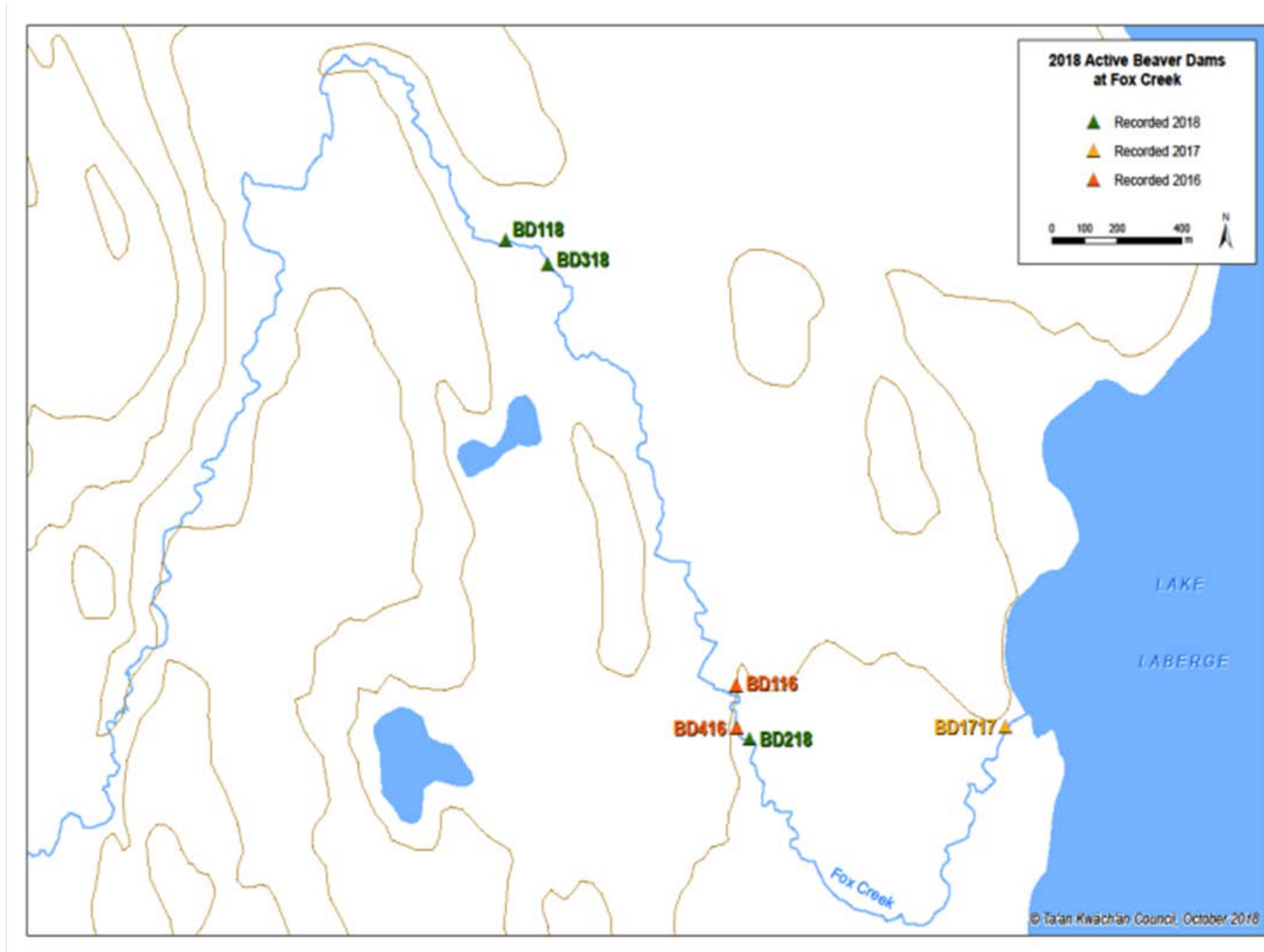


Figure 21 - Fox Creek Active Beaver Dam Barrier Map 2016-2018

Fox Creek Age Sex and Length (ASL) Chinook return sampling 2018

Age Sex and Length (ASL) Chinook return sampling 2018																
Fox Creek (tributary to Lake Laberge)																
September 06, 2018																
Deb Fulmer, Jenna Duncan, Serge Sawranko (TKC)																
Location																
Between: 61.12143° and 61.12036° N																
and: 135.23227° and 135.23082° W																
Fish #	Sex	Adipose (Y/N)	FL (mm)	POHL (mm)	Date yymmdd	Scale Card	Scales	Note	head tag #	AGE result	Aging Problem	Age Note	Head Result	Location (waypoint)	Lat.	Long.
1	F	N	830	680	180813	11831	1-10	Found at BD416 in a side blocked channel that had dried up. She was 100% unspawned.	1070987					BD416	N 61.11121°	W 135.22223°
2	M	N	750	620	180821	11832	1-10	In mid stream at a shallow location between BD1417 and BD1116 Bear Habitat area. Note: new GPS failed so this is not an exact location. Spawned.	1070988					N/A	N 61.11976°	W 135.23018°
3	M	N	940	720	180827	11832	11-20	Large male carcass directly d/s of BD1116 at Carcass318. Unspawned	1070971					Carcass318	N 61.12030°	W 135.23096°
4	F	N	830	690	180904	11832	21-30	Found ~100m d/s of BD215 at Redd116 in deep pool with a dead tree across it. 100% spawned	1070990					Redd116	N 61.12083°	W 135.23148°
5	F	N	770	660	180904	11832	31-40	Found ~130m d/s of BD215 at Redd216 in LHB in woody debris. 100% spawned.	1070970					Redd216	N 61.12081°	W 135.23120°
Not an exact location																

APPENDIX B - FOX CREEK CHINOOK SALMON RESTORATION PLAN

PHASE II – THE SECOND SALMON LIFE CYCLE

DEVELOPED MARCH 2016, UPDATED FEBRUARY 2019

APPENDIX A – STANDARDS AND METHODS

BROODSTOCK QUANTITY AND COLLECTION

In the 2008 Fox Creek Restoration Plan, the method for determining target numbers of fry release as provided by Fisheries and Oceans Canada was based upon available rearing habitat, with 1 m² of stream area per juvenile Chinook salmon in the upper Yukon River watershed. In order to calculate the area of habitat available in Fox Creek, the average wetted width of the stream, 5.5m (from data provided by Grady, 1997) was multiplied by the estimated 16,300 m length of the stream from its mouth at Lake Lebarge to the confluence of Pilot Creek. This calculation resulted in an estimated 89,650 m² of available juvenile Chinook rearing habitat. However, this estimation is based upon very limited wetted width data. Therefore, improved estimates should be generated through monitoring of wetted width as part of the ongoing implementation and monitoring strategy. In consideration of dynamic annual adult returns through the Whitehorse Rapids Fishway, the limitations of available data, and other operational limitations, the target number of fry for release into Fox Creek was 50,000 to 100,000 (Anderton 2008).

To achieve these target numbers, an estimated production of 4,000 fry per adult female (brood stock) was used for reference. Fecundity and egg to fry survival rates vary from year to year and between fish. Therefore, this is considered a conservative estimate based upon an estimated average fecundity of 5,000 eggs per female and an 80% egg to fry survival (Tanner pers. com., 2008).

To achieve a target of 50,000 to 100,000 fry for release, 12 to 25 adult females are required. The number of adult males required for fertilization is generally double that of the females taken in order to achieve a matrix spawning approach in which two males are used to fertilise an individual female's eggs, therefore increasing genetic variance in the resulting hatchery production of fry (Anderton 2008).

FRY TRANSPORT AND RELEASE

Fry transport and release is guided by the following publication:

Habitat and Enhancement Facts and Figures handbook, 4th Edition, Salmonid Enhancement Program. Fisheries and Oceans Canada.

FIELD PREP:

One week in advance read the DFO publication and note desired oxygen levels and temperatures

- Minimum 2 weeks before scheduled event ensure notification is sent to citizens and partners
- One week before release check in with MCIF and examine equipment
- Both oxygen tanks must be full. Use large tank and small one for back-up
- Ensure valves, regulator and flow meter are in good working order
- Micro bubbler plate diffuser is cleaned and working properly (looking for a cloud of fine bubbles)
Make sure the micro bubble plate is submerged in water first or it can explode if its run dry
- Check for leaks
- Bucket for oxygen tank with padding around it. Bungie down both tanks.
- Tote is cleaned with iodine
- Tote fits in truck – 42 x 48 x ____ make sure drain faces back
- Have 4 sets of ratchet straps, dip nets, buckets, etc.
- Ensure there are volunteers to assist with transfers at pick up and release locations
- Check seal on the tote and replace if necessary
- Clean, test and calibrate dissolved oxygen (DO) meter and replace battery
- Attach a hanger for the DO probe so it hangs in the ideal spot away from oxygen diffuser.
- Bolt two 2x4's to the floor of the box 43 inches long and spaced as wide as the base of the tote
- Ensure you have someone to photograph and someone to document the operation

EQUIPMENT:

Tote 48 x 42"	Hose and clamps	Bear spray, bangers and horn
Ratchet Straps 4 thin, 2 thick	Chest waders and boots	Two 2 x 4's 43" long
Buckets 10L, 12 and screening for buckets	Smaller buckets and zip lock baggies	Padding for oxygen tank to hold it securely inside the bucket
2 oxygen tanks (full), regulator and flow meter	Florescent flagging, caution and duct tape	Camera, field note books, pencils, sharpies
YSI meter calibrated	Weather stripping	GPS
Zap straps and bungie cords	Tree snips	Dip nets 5 small and one large
Micro bubble plate diffuser or air stone	Snacks, water, hot dogs, buns, condiments, fire starter, wood.	Hat and other personal gear, change of clothes

JUVENILE MONITORING

METHODS:

Monitoring at four stations conducted prior to and monthly after release. The stations include:

- MS08-01 – located upstream of the North Klondike Highway Crossing approximately 2 km.
 - Coordinates: N61.10868, W135.31239
- MS08-02 – previously located at the North Klondike Highway Crossing where the staff gauge is but has been moved to approximately 100 meters downstream of the bridge where there is a pull out off the Fox Creek road.
 - Coordinates: N61.10133, W135.29282
- MS08-03 – located approximately 4-5 km downstream of the highway crossing.
 - Coordinates: N61.12205, W135.25172
- MS08-04 – located 100 to 200 meters upstream of the mouth of the creek; dependent on the time of year and Laberge Lake water levels.
 - Coordinates: N61.11069, W135.20796.

Monitoring events are conducted monthly both before and after the annual fry releases as follows:

- On or about mid-May to sample 1+ overwintering JCS as ice leaves;
- Prior to the first release; on or about mid-June and at approximately 1000 ATU's to determine whether any 1+ plus remain and if 0+ wild fish are present;
- A representative sample of hatchery JCS at time of release to establish a baseline against which growth will be assessed;
- Mid-August, to determine growth and distribution of 0+ wild and hatchery fish;
- Mid-September, to determine growth and distribution of 0+ wild and hatchery fish at end of annual growing season.
- Mid-October if weather permits

The monthly monitoring event at each station to include:

- Juvenile Chinook sampling using four baited Gee-fry traps per station (1/8 mesh to June and 1/4 mesh traps once the fish are over 48-50 mm fork length larger mesh thereafter),
- Determination of species and if adipose fin is present,
- Measurements of fish fork length (mm) as primary metric and weight (nearest 0.1 gram) as a secondary metric,
- Collection of water temperature, in situ measurements,
- Flow measurements and water level reading from the staff gauge (located just downstream from the Klondike Highway Bridge).

For each juvenile Chinook captured, trained TKC staff anaesthetize them and record whether the fish is hatchery raised (adipose fin clipped) or wild (adipose fin present). They are then measured and weighed.

JUVENILE MONITORING

PROTOCOLS:

2009 YUKON RIVER PANEL

Protocol for collection and reporting of data from juvenile salmon sampled in Canadian R&E Projects.

May 1, 2009

This Protocol is to encourage standard methods of collection and reporting of data from juvenile salmon captured in projects funded by the Yukon River Panel within the Canadian Sub-basin. The “Juvenile Chinook Salmon Sampling Form” is suggested for routine sampling of streams and rivers. Specific data reporting requirements for other types of sampling, such as downstream migration traps, etc, should be agreed to with the Technical Contact assigned to your project.

Salmon Species and Number (SPP/# on the Juvenile Salmon Sampling Form)

Note the species of each juvenile salmon caught. If large numbers are captured, record the total number and measure a subset. A minimum subset of 30 salmon of a given species per sampling site is recommended.

Length measurements – mandatory

If less than 30 juvenile salmon are captured at a sampling site, measure the fork lengths of all. If more than 30 are captured, measure at least 30. Record the measurement to the nearest millimetre (mm).

Weight Measurements - optional

If juvenile salmon are weighed the following standards are to be followed:

Scales/balances are to be calibrated as per the manufacturer’s recommendations prior to weighing fish at each station;

Excess water should be removed from the surface of the fish by blotting with a cloth or paper towel

Scales/balances must be located on flat surface during use;

Weights are to be recorded to the nearest 0.1g;

Reporting

The data must be presented by date and site. The sites must be described by UTM or Latitude/Longitude co-ordinates, or shown clearly on a map located in the report or in an appendix. The data collected is to be presented in an appendix to your final report. If this is not possible, it may be submitted either electronically or as hard copy to the Technical Contact for your project.

HYDROLOGY AND WATER QUALITY

Hydrology and Water Quality is guided by the following publication:

Manual of British Columbia Hydrometric Standards, BC Min. of Environment for the Resources Information Standards Committee, 2009

https://www.for.gov.bc.ca/hts/risc/pubs/aquatic/hydrometric/man_BC_hydrometric_stand_V1.0.pdf

Going forward the following monitoring is recommended as per the 2015 plan and recent discussions with YRP tech team and current project partners.

Stream Stage:

- Monitor flow via pressure transducer(s) from Mid-July to Mid-September
- A stream gauge and flow monitoring station is developed at a discrete and accessible location along the creek.
- Discussions with Yukon Government Water Resources expand WQ monitoring program in TKC TT
- Development of a rating curve.

Water Quality:

Develop a water quality sampling station, at or near the stream stage sampling site. With the following parameters measured two times during winter months, and whenever feasible during summer months;

- Dissolved oxygen
- pH
- turbidity
- conductivity
- total metals

MONITORING ADULT CHINOOK SALMON RETURNS & BARRIERS

METHODS:

Barriers will be surveyed in mid June (in conjunction with redd and bio-monitoring) to indicate areas that can prevent or potentially limit passage. Reaches of stream morphology, barriers, spawning and rearing habitat have been documented, photographed and geo-referenced. These locations will be referenced during the expected adult return period to assess passage success, assist in recording annual adult distribution, and document obvious changes in stream morphology – such as landslides, etc.

TKC staff will observe, locations of all adult Chinook and whether they are migrating or displaying obvious spawning activity and developing Redds. If possible, staff will describe and record, individual returning adults including; markings, injuries, size, sex and behaviour. When carcasses are found, the length will be measured, scale samples taken, and heads collected for submission to DFO for further analysis. The locations of any potential spawning sites will be geo-referenced and flagged.

FOX CREEK ADULT SURVEY PROTOCOL

(Draft v.3, Aug 2015)

General guidance:

A HAT and POLARISED sunglasses are necessary to complete a successful survey.

Live adult and carcass survey results are very important to determine the success of the project.

Upon observing salmon in Fox Creek, the following guidance should be followed to record the observation and to detail enough information to be able to report on the observation and to accurately return to the site for further investigation.

This information is necessary to document the behaviour of the fish observed to determine if the area was used for spawning or if they are still migrating within the stream.

Notify DFO immediately upon conclusion of the days survey if salmon (live or carcasses) are observed in the stream. We will make every effort to return to the site with you to document everything that can be learned at this point and to ensure further investigation of restoration at Fox Creek. Continue to survey the entire stream on subsequent days to ensure that all salmon that may have returned are located. This will ensure we have documented all locations that spawning has, or may have, taken place for later investigation.

1. Live Adults

Points to record:

1. Count how many at location, try to stay back somewhat to not disturb their behaviour as this is important to record as per below
2. Describe fish observed: Do they have any white markings/injuries on them (Usually near the tail, this results from digging and defending territory), Are they large or small Chinook? Is an adipose fin present or not on each fish? Are you confident that you can record the sex of the fish observed, if unable to tell record as such.
3. GPS location of observation, save on GPS and write in notebook and affix labeled ribbon to nearby tree at eye level as a back-up.
4. Photograph as much as is necessary to represent the stream location, take notes on photograph identification numbers
5. Observe and record behaviour:
 - Are they below an obstruction and either not able to pass or in the process of attempting to pass? OR
 - Are they in pairs or groups of 3 so that are occupying a spawning site Redd or specific area of the stream. A Redd will appear to be a cleaned off area of gravels. May or may not be obvious depending on the amount of digging that may have been done. A giveaway is if you see them defending an area against other fish or if you see them turn on their side and dig at the bottom briefly. OR
 - Are they in deeper water like a pool or behind logs and appear to be hiding/holding. This is observed when fish are not yet ready to spawn either because they are still migrating, looking for mates or awaiting appropriate conditions (flow, temp). They will hold in areas where they can hide and or get refuge out of the stronger currents.

NOTE sometimes you can surprise them and they will move to refuge to hide. If you suspect this has occurred watch them for about 15 minutes from a distance and see if they return to a redd area or what they do. Fish that are ripe for spawning will usually return to their redd within this time.

2. Carcasses

Points to record:

1. Record the location and number of carcasses as you do with the live adults.
2. Take pictures of the carcass and stream area found.
3. Check for adipose clip and note if clipped or not.
4. Remove the head, gills, attach head tag to jaw with zip tie and store in individual labelled bags whether the adipose is clipped or not. Freeze or bring to DFO after the days survey completed.

5. If it is a female cut it open to determine how many, if any eggs, are still within the salmon. This tells us the proportion of eggs that the salmon likely spawned. (e.g. If no eggs observed then it is a 100% spawned fish). A basic estimate of the number is all that's needed. Less than approximately 30-50 eggs still within the salmon is not unusual.
6. Collect/record Age/Sex/Length (ASL). Record sex, Collect scale samples as per scale card instructions for age analysis, measure the fork length and post orbital hypural length (bring field book, scale cards, tape measure and tweezers) See diagrams below for length descriptions. To find the hypural plate for accurate measurement you may have to slice away the skin covering it. Take a picture of carcass with head tag visible or some identifier.

Summary of equipment for adult surveys:

<ul style="list-style-type: none"> • Polarized sunglasses and hat • GPS • Camera • Field Notebook/Pencil • Map • Ribbon • Zip ties 	<ul style="list-style-type: none"> • Knife (for removing head) • Zip locks or garbage bags for heads • Permanent marker • Scale Cards • Sharp tweezers • Tape Measure • Labels for each head
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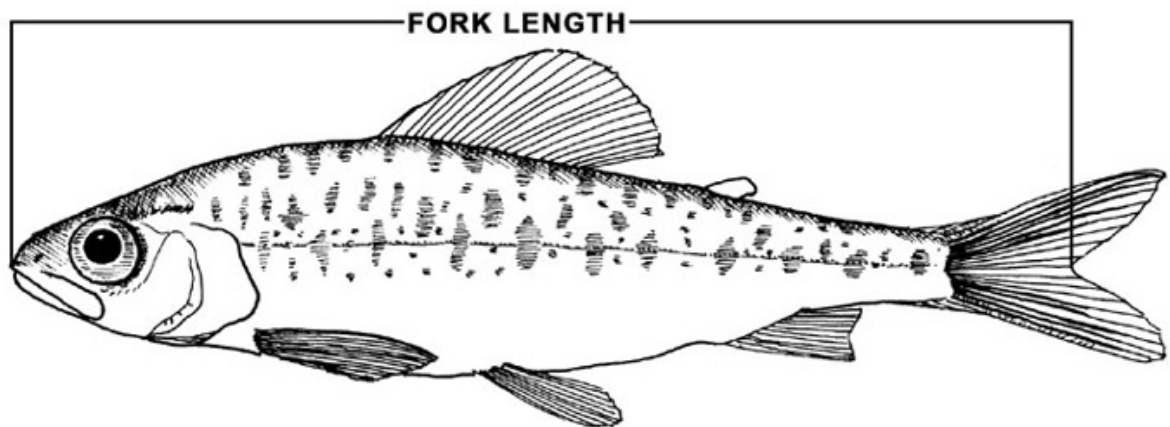


Photo courtesy juvenilefishid.com

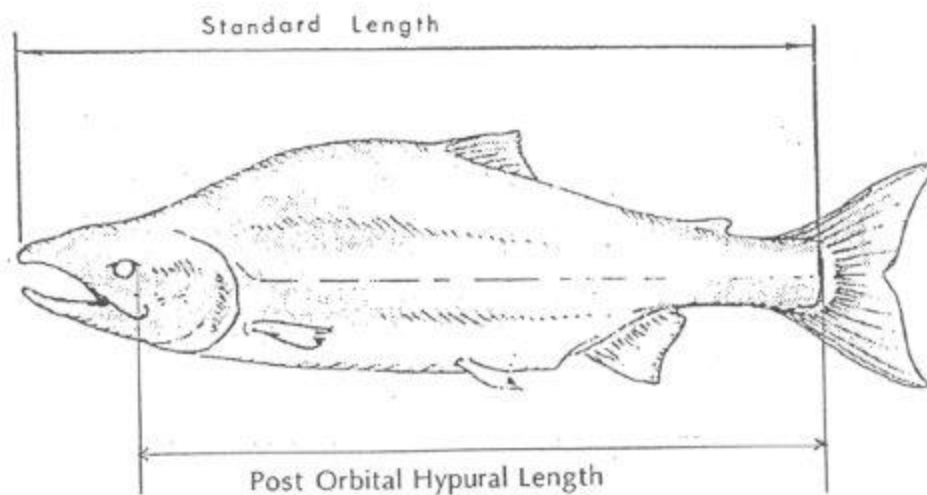
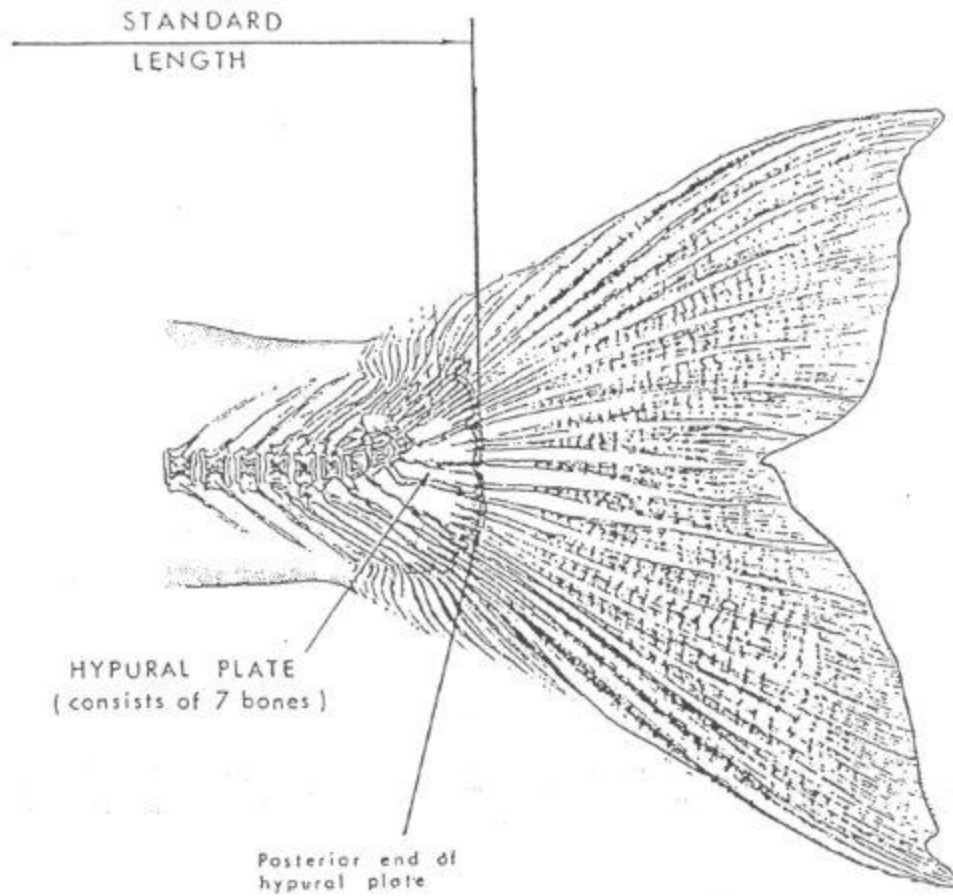


Image courtesy of Pacific Streamkeepers Federation

Labelling and head preparation for CWT Samples

In The Field

In some cases, during transport heads may thaw so it is important that all heads shipped to the Whitehorse office should have gills and any excess flesh removed to help slow the rotting process.



1. Head with excess flesh and gills removed

Figure



Figure 2. Properly packaged head

A jaw tag should be filled out (if applicable) using a pencil and attached to the jaw. In some cases, a jaw tag will be supplied to you that does not have a spot to fill out the required information. This makes it very important to ensure the jaw tag number is referenced in the dataset. The heads are stored in a communal freezer until shipped for analysis and if not labelled properly it will become hard (if not impossible) to identify them. If you do not have a jaw tag handy write down the required information on a piece of waterproof paper and slip it in with the head and tag.

Required information includes:

- **Date (month, day, and year)** ie August 15, 2019 (spell the month)
- **Drainage** ie Yukon
- **Project** ie Fox Creek
- ***Sample collector names:***
- **Jaw tag #** (make one up and reference it in the sample data)
- **Species** ie Chinook
- **Project Manager Name**

Before freezing the head, place the head in a Ziploc freezer bag and ensure the **jaw tag # is visible from the outside**. If putting more than one head in a freezer bag, ensure that each jaw tag number can be easily read (Figure 2). When shipping to Whitehorse, keep heads separated by project. Properly label the shipping container with the year, drainage, species, project name and project manager name. Try to keep all the heads from a project in the same container(s). If you use garbage bags as containers, wrap up all excess plastic and label the bag as to what is in it.

Lab Storage

A freezer has been dedicated for storage of CWT heads until they are ready to be shipped south for analysis. The freezer is in the lab and will be labelled for easy identification. Before storing any heads in the freezer, ensure that they are all labelled as per instructions above.



BAD ☹



GOOD ☺

BEAVER MANAGEMENT

The TKC resources manager technician conducts an annual trapping program to control beaver populations and activities in this area. The program involves both traditional and non-traditional methods. Traditional methods include workshops to teach traditional ways, trapping with elders and traditional annual hunts. Local trappers, both citizens and non-citizens, are hired to trap using current non-traditional methods.

REDD MONITORING

METHODS:

Based on the observation of adults displaying spawning behaviour and disturbed substrate, redd locations will be recorded for future reference. Additional temperature data loggers will be placed at some of the potential redd sites to determine if incubation temperatures near established redds are similar to winter surface water measurements and assist in determining emergence timing of fry for subsequent bio-monitoring.

Methods to evaluate the rate of development of alevins or swim up fry prior to or at the expected time of emergence or shortly thereafter will be determined by flow conditions occurring at the time that sampling is necessary. Methods available may include; fyke net sampling to capture drifting emerged fry, use of an emergence trap, electrofishing, redd excavation, 1/8 mesh juvenile Gee-trapping or a combination of approaches.

APPENDIX B - PHASE II ANNUAL IMPLEMENTATION AND MONITORING PLAN

Updated: February 2019

Phase II Ongoing Annual Activities

Training and Capacity Building

- Employ young TKC citizens in restoration positions.
- Provide formal training opportunities to meet career development goals of current LRH staff.
- Build, mentorship and training opportunities for TKC staff/citizens with partners and other agencies.
- Ensure TKC staff are trained in predator defense and certified for firearm use prior to each field season.
- Identify opportunities for other department staff to contribute skills, expertise and time to the project.
- Build linkages between project activities and goals, and existing TKC programs such as Culture, Family, and Fish Camps.
- Encourage TKC staff to communicate information about Yukon River salmon and the project to TKC citizens through presentations, newsletters, and website and by including citizens in project activities (e.g. fry release into Fox Creek).
- Provide education and awareness about the Chinook salmon decline, best practices and conservation efforts towards tangible results with TKC Citizens, youth and the public.

Planning and Implementation

- Coordinate pre-and post-season meetings with project partners.
- Work with project partners and experts to increase TKC knowledge and experience.
- Attend Yukon River Panel meetings and DFO teleconferencing.
- Gain knowledge and understanding of the marine ecology, Yukon River system and Alaskan Tribal communities.

Incubation and Releases

- Incubation and hatchery rearing strategy should be carried out in a way that maximizes opportunity to mimic natural conditions in the Yukon and imprinting juveniles to Fox Creek. This could include exclusive rearing at McIntyre Creek and release into Fox Creek at earliest possible stage post adipose fin clip.
- Releases should be physically spread out in Fox creek to the extent it is logistically feasible.
- Use preliminary analysis of biophysical monitoring to advise fry release strategies.

- The number of fish releases should consider the predicted abundance of naturally produced fry to minimize potential for negative effects on wild fry due to competition caused by excess fry releases in fully seeded habitats.

Bio-physical Monitoring of Juveniles

- Continue baited G-trap monitoring at Bio-physical Sampling Stations both before and after releases.
- Use 1/8 mesh traps to ensure Young of Year (YoY) can be captured. Fork Length is primary metric, weight considered secondary metric.
- Use 1/4 mesh traps once the fish are over 48-50 mm fork length.
- Include targeted baited trap monitoring at higher frequency downstream of known spawning locations to determine if successful fry emergence has occurred, and the timing of it.
- Provide training, maintain equipment and follow protocols to ensure consistency of data collected for long term monitoring.

Hydrology and Water Quality

- Monitor water temperature via loggers year-round.
- Ensure water quality (particularly DO) measurement occurs at least twice in winter.
- Monitor flow via pressure transducer(s) from mid-July to mid-September.
- Collect additional water quality and discharge information as feasible.

Monitoring Adult Returns and Barrier Management

- Record beaver activity and potential obstructions to migrating adult salmon prior to the spawning period.
- Remove obstructions that would limit potential spawning ability.
- Monitor adult salmon returns through stream walks.
- Collect adult carcass samples and deliver to DFO for analysis.

Redd Monitoring

- Document and map potential spawning habitat in the lower reaches of Fox Creek
- Record and monitor potential redd sites
- Install artificial redds using data loggers to calculate ATU's to 1000
- Conduct bio-physical monitoring in June to monitor emerging Young of Year

Trail Maintenance

- Ensure the Fox Creek access trail remains open through ongoing trail maintenance as easy and safe access to the creek is required for all project components (particularly line of sight for early detection of bears).

FOX CREEK— DETAILED IMPLEMENTATION AND MONITORING PLAN (IMP)— UPDATED FEBRUARY 2019

Project Year	Year of Fry Release	Planning and Implementation	Broodstock Collection, Incubation and Rearing	Releases	Bio-physical Monitoring of Juveniles	Hydrology and Water Quality	Monitoring Adult Returns and Barriers	Redd Monitoring
9 (2016)	2012	Develop data collection sheets for project components. Develop spreadsheets or database to house all monitoring data. A central location for all data to allow easy access for multi-year analysis.	Maximize genetic diversity by utilizing Whitehorse Rapids Fish Hatchery for broodstock collection and rearing to the eyed stage. Utilize MCIF for rearing to fry stage and assist with monitoring, daily maintenance and operations.	Consider staggering release dates and possibly re-evaluating release locations to accommodate the numbers of fry.	Ongoing annual activities guided by implementation and monitoring plan. (IMP).	Conduct winter water quality monitoring with parameters; dissolved oxygen, pH, turbidity, ORP, conductivity, Nitrates, and total metals. As per the Restoration Plan 2008 recommendations, stream gauging and flow measurements should be conducted during regular monitoring events to improve discharge data.	Conduct stream walk surveys both before spawning period and daily during and after. Digitize and map reaches of stream morphology including barriers, spawning and rearing habitat that have been photographed and geo-referenced	Conduct daily stream walk surveys during spawning period.
10 (2017)	2013	Move toward digital data entry in the field with appropriate instruments.	Maximize genetic diversity by utilizing Whitehorse Rapids Fish Hatchery for broodstock collection and rearing to the eyed stage. Utilize MCIF for rearing to fry stage and assist with monitoring, daily maintenance and operations	Approach to estimating rearing capacity of the system should be developed and refined. (IE: assumption of 1m2/fry is likely reasonable but total habitat needs to consider beaver activity, creek length and width). Develop methods using Streamkeepers Handbook	Add data from 2017 biophysical monitoring to 2009 – 2016 analysis document.	Continue year-round water quality, temperature, and discharge measurements. Determine water quality standards to be used. Install a hydrometric station, including a staff gauge to develop a rating curve over time.	Conduct stream walk surveys and develop interim additional methods to enumerate returning adults. Actively manage beaver to restore unimpeded Chinook access to the bridge and consider pros and cons of facilitating access further upstream. Meet with FN Elders to determine historical Chinook population size.	Develop redd monitoring protocols specific to Fox Creek.
11 (2018)	2014	Move toward digital data entry in the field with appropriate instruments.	Develop criteria for determining when hatchery intervention/contribution to Fox Creek should cease. Discuss option of thermal marking opposed to coded wire tagging.	Conduct a Streamkeepers Habitat Survey of juvenile Chinook rearing habitat from BD 315 to the mouth. Supply Fry Release posters to all partners.	Add data from 2018 biophysical monitoring to 2009 – 2017 analysis document. To track wild to hatchery ratio and overwintering activity. Calculate average unclipped, clipped and standard deviation. Utilize a slot detector to confirm wild fry.	Continue year-round water quality, temperature, and discharge measurements. Refine rating curve. Work with Water Resources to develop a water quality monitoring network. Compare results over time to assess trends.	Conduct a Streamkeepers Habitat Survey of Chinook spawning habitat from BD 315 to the mouth. Develop methods to enumerate returning adults. Coordinate with DFO projects to assess options. Actively manage beaver. Meet with FN Elders to determine historical Chinook population size.	Refine redd monitoring protocols specific to Fox Creek with support of experts.
12 (2019)	2015	Move toward digital data entry in the field with appropriate instruments. Support DFO, to host annual workshops of past and current restoration projects.	Conduct a feasibility study for the rebuild of MCIF and other restoration methods with Yukon First Nations.	Yukon Department of Highways and Public works is replacing the Fox Creek Bridge so work in partnership with them to coordinate fry release.	Continue monitoring at regular sites plus 2018 redd locations and cumulate results with existing data.	Yukon Department of Highways and Public works is replacing the Fox Creek Bridge so work in partnership with them to maintain water quality. Refine rating curve.	Install a weir to monitor and record returning adults.	GPS redd locations to monitor wild juveniles.
13 (2020)	2016	Annual IMP activities		Annual IMP activities	Annual IMP activities	Annual IMP activities	Annual IMP activities	Annual IMP activities
14 (2021)	2017	Annual IMP activities	Consider phasing out of hatcheries and relying on the natural system to recover.	Annual IMP activities	Annual IMP activities	Annual IMP activities	Annual IMP activities	Annual IMP activities