TA'AN KWÄCH'ÄN COUNCIL
FOX CREEK CHINOOK SALMON RESTORATION PROJECT

CRE-25-17

FINAL REPORT 2017

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

Prepared By: *Ta'an Kwäch'än Council*
Deborah Fulmer
Lands Resources & Heritage Department

February 2018

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. There are stewardship and restoration activities that are guided by both traditional and scientific knowledge. Planning began in 2007 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. Their numbers have increased each year and spawning success was confirmed when wild fry emerged from spawning redds in 2016 and 2017. 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.

ACKNOWLEGMENTS

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. TKC then transports the eyed eggs to McIntyre Creek Incubation Facility (operated by Yukon College, and managed by Darrell Otto) where they are raised, primarily by college students, until they are ready to be released.

In 2017 TKC Elder Betsy Jackson and Coralee Johns (founders of the project), TKC citizens and staff, and members of the public assisted with the 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

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

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 to 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 (FCCSR) Plan, 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 and Capacity Building
Project Planning and Implementation
Broodstock Collection and Incubation
Support of daily maintenance and operations at the McIntyre Creek Incubation Facility
Annual Fry Releases into Fox Creek
Bio-physical Monitoring of Juveniles
Hydrology and Water Quality
Monitoring Adult Salmon Returns and Potential Barriers to Upstream Migration
Recording and Monitoring of Potential Redd Sites
Collection of Biological Adult Carcass Samples
Trail Maintenance
Beaver Management

Annual activities and results are described throughout the report with detailed monitoring data displayed in Appendix A, Supporting Documents – Maps and Monitoring Data 2017.

Methods, standards, and annual implementation activities are detailed in the Fox Creek Chinook Salmon Restoration (FCCSR) Plan, Phase II – The Second Salmon Life Cycle attached as Appendix B. In Appendix B of this plan "Phase II Annual Implementation and Monitoring Plan" activities are guide 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 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.

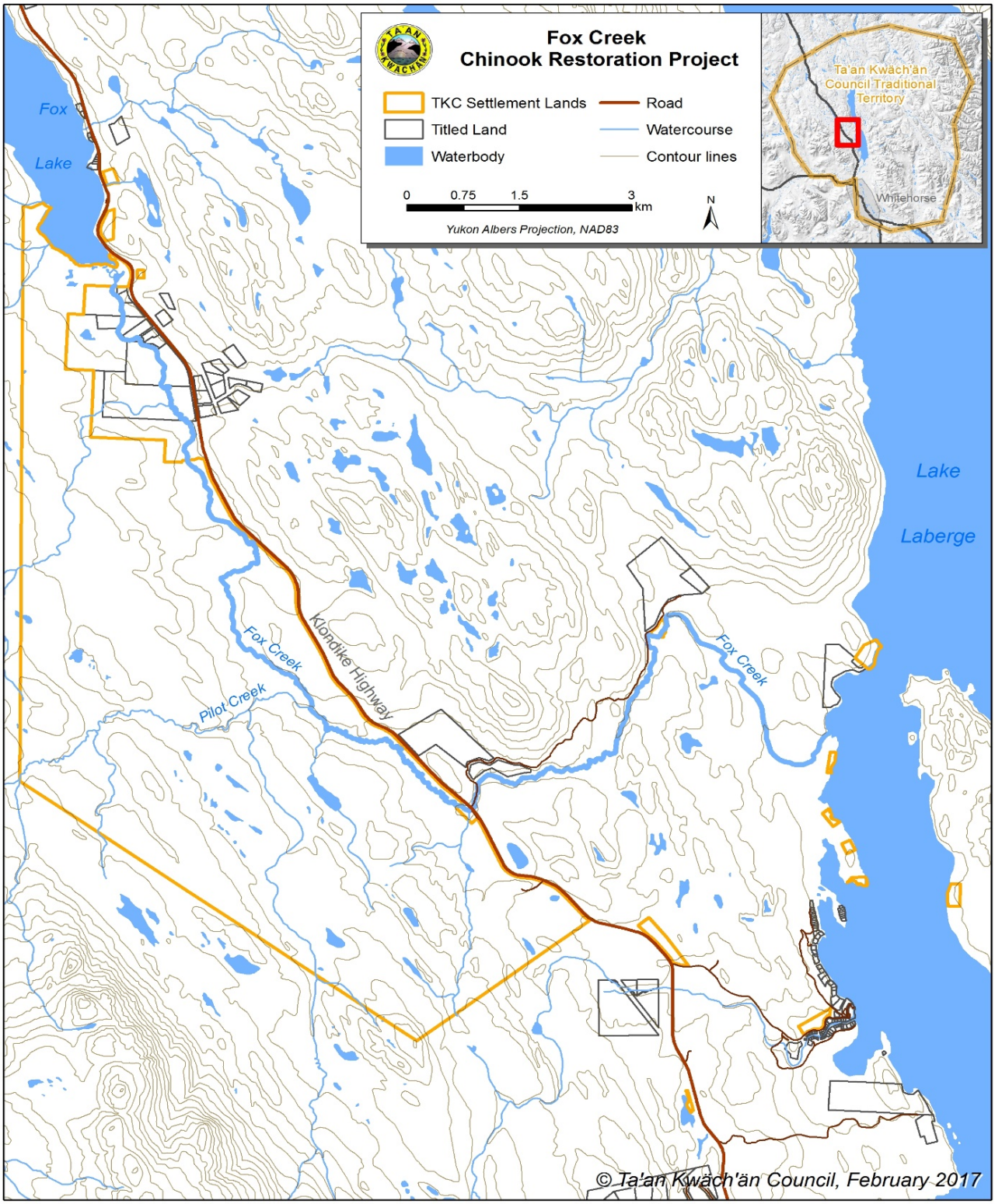


Figure 1: Fox Creek Chinook salmon Stock Restoration Project Location within Ta'an Traditional Territory

TRAINING, MENTORING AND CAPACITY BUILDING

Project training needs were determined on an individual basis, depending on existing credentials, certificates and experience. Opportunities for training included both formal (certifications, first aid and bear safety) and informal opportunities such as workshops, mentoring and experiential learning with professionals. All training opportunities were in kind contributions from TKC or other organizations.

Two of the staff members that successfully completed the Yukon Fisheries and Field Assistant Program in 2016; citizen Stan Clethroe, and Deb Fulmer were actively involved in the project. Deb was the project manager for the second consecutive year and Stan was hired as a summer student to assist with Fox Creek field operations and tagging efforts at the McIntyre Creek Incubation Facility.

TKC Lands, Resources and Heritage Department, hired citizen Jenna Duncan as a summer student for the second consecutive year to conduct field and research work. Jenna is now a third-year undergraduate biology student who gained knowledge and experience in her field of study and was a great asset to the team.

Whitehorse Rapids Fish Hatchery, Department and Fisheries and Oceans, Al von Finster, Ellorie McKnight and McIntyre Creek Incubation Facility supported TKC staff in; production, planning, scheduling, field efforts, data analysis and reporting.

PROJECT PLANNING AND IMPLEMENTATION

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

The 2017 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.

Ta'an Kwäch'än Council (TKC) held a 2017 spring meeting with McIntyre Creek Incubation Facility (MCIF) manager, Darrell Otto and Department of Fisheries and Oceans (DFO) biologist Trix Tanner to plan and coordinate the upcoming field season, fry tagging and release.

A post season meeting was held with all project partners on December 1, 2017 to; review the annual 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.

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 FCCSR Plan (Appendix B).

FOX CREEK RESTORATION PROJECT - METHODS & RESULTS

Results and summarized methods are described in this section. Standardized methods are detailed in Appendix B, (FCCSR) plan. Detailed field data, is displayed in Appendix A, Supporting Documents – Maps and Monitoring Data 2017.

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 26, 2016 they donated 34,147 eyed eggs to the Fox Creek project. TKC staff with support from WRFH and McIntyre Creek Incubation Facility (MCIF); transferred eyed eggs to MCIF where they were raised to the fry stage. TKC staff; Stan Clethroe, Deb Fulmer and Jenna Duncan, assisted MCIF with operations, maintenance and annual fry tagging.

TKC had an incredible opportunity to offer Jenna Duncan training to tag fry at WRFH in June. TKC was then contracted by DFO to tag the fry at MCIF. Jenna took the lead on this and used several TKC citizens and staff members to assist with adipose clipping. The team successfully tagged and clipped 31, 899 fry and clipped an additional 1061 that were too small to tag.

Figure 2 - TKC staff contracted to tag fry at McIntyre Creek Incubation Facility. July 2017

FRY TRANSPORT & RELEASE

Fry releases into Fox Creek have taken place annually from 2009 to present with a total of 235,600 fry being released to date (Figure 3).

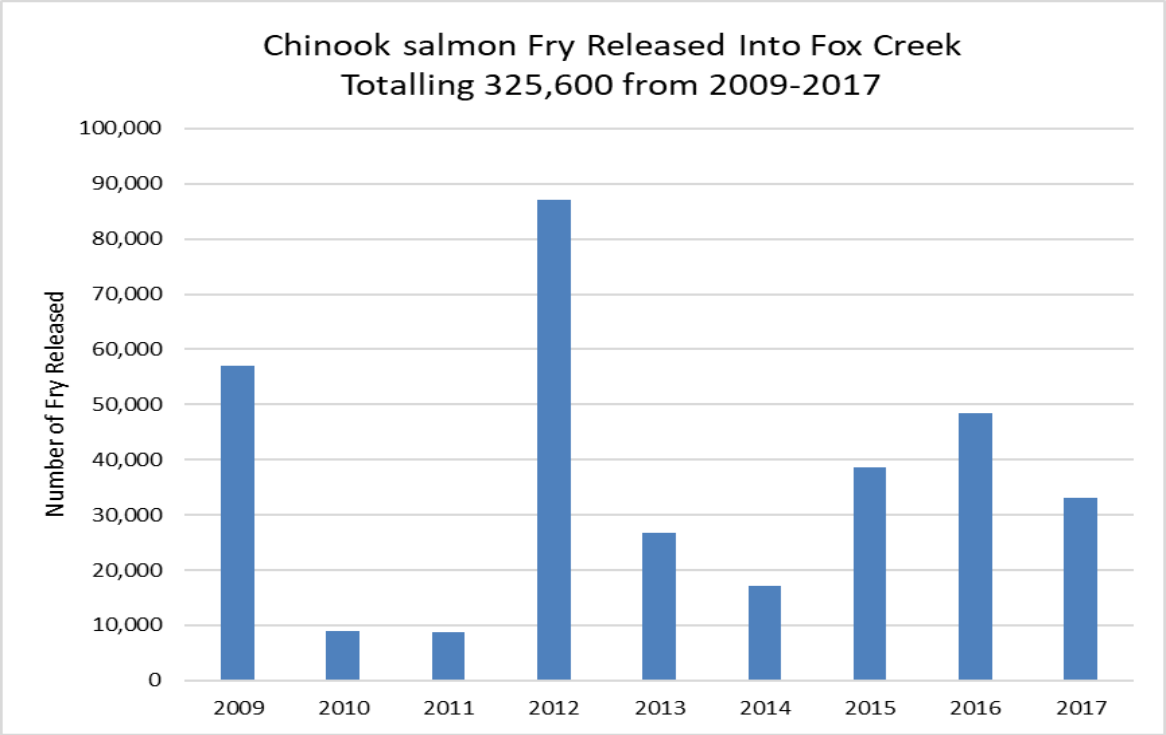


Figure 3: Chinook salmon Fry Released into Fox Creek from 2009 - 2017

The average weight of the fry prior to release was under the required one gram so DFO, TKC and MCIF technicians decided to proceed with tagging larger fish then wait a week for the remaining fish to grow. So, we released 32,960 Chinook salmon fry into Fox Creek on July 16th and July 21st, 2017.

Sunday July 16th, 2017

This was a public event to transport and release of approximately 22,000 Chinook salmon fry at the Fox Creek bridge on the Klondike Highway.

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.

Monday July 21th, 2017

On this second event we released approximately 11,000 fish slightly upstream of the bridge, at our bio monitoring site MS08-01. This was a staff only release as the hill leading down to the creek is very steep and requires careful footing whilst carrying the fish in buckets. This was our second consecutive year releasing the fry at this location.

Figure 4 - Elder Betsy Jackson releasing the first bucket of Chinook salmon fry. July 16, 2017

Figure 5 - TKC staff fry release at Biomonitoring Site 1. July 21, 2017

JUVENILE CHINOOK MONITORING

Our bio-physical monitoring focusses on the biological productivity of Fox Creek. It does so through monitoring of the young-of-year (age 0+) released juveniles. The implied abundance is determined through numbers of juvenile Chinook captured at each Monitoring Site. The biological productivity is determined through the rate of growth over the open water period. We measure juveniles shortly before release, at planned intervals through the open water period and early in the following year prior to the annual release of juveniles. The four Monitoring Sites (MS) are shown in Figure 18 on Page 32. In 2016 and 2017 releases of juveniles took place at MS08-01, located 1.5 km above the Klondike Highway Bridge and MS08-02, located immediately below the bridge. In 2017 there was a large beaver dam between the two sites which functionally isolated MS08-01 from immigration of the juveniles released at MS08-02. Juveniles released at MS08-01 could move downstream and were free to migrate upstream from MS08-01.

On July 16, 2017 approximately 22,000 age 0+ salmon from the McIntyre Hatchery were released at MS08-02 and on July 21, 2017 approximately 11,000 were released at MS08-01. The latter group was composed of fish which had grown more slowly at the McIntyre Hatchery and needed more time to grow to a size where tags could be applied. Average Fork Lengths (FL) of juveniles captured in post-release sampling on July 26 reflect this: the average FL of age 0+ juveniles captured at MS08-01 was 3.84 mm less than those captured at MS08-02. However, by September 14 the average length of age 0+ juveniles captured at MS08-01 was 0.9 mm longer than at MS08-02, and by October 18 they averaged 4.3 mm longer. Growth per day, expressed as average increase in FL divided by number of days between sampling periods provides a good measure of growth that is, for juvenile salmon, independent of initial differences in length. In 2017 age 0+ juveniles at MS08-01 grew at an average of 0.2 mm/day between July 21 and October 18 and those at MS08-02 grew at an average of 0.12 mm/day. Growth rates calculated between July 22 and October 14, 2016 were identical to those in 2017. The lower growth rates calculated for juveniles released at MS08-02 probably reflect the greater number of fish released there in 2016 and 2017, and the resulting increased density of juveniles. These findings will guide our 2018 release strategy. See Figures 6 and 7.

The lower two Monitoring Sites provide insight as to the origin (hatchery vs wild) and age (0+ vs 1+) of the fish using the lower creek. At MS08-03 in 2017, a single age 0+ hatchery juvenile was captured while none were captured at MS08-04. This is generally consistent with past years monitoring and indicates strongly that juveniles from the McIntyre Hatchery are not displaced downstream in any numbers after release. See Table 1 for details.

A single overwintered hatchery raised (age 1+) juvenile was captured at MS08-01 on May 19, 2017. No others were captured in subsequent sampling at this Monitoring Site. Four age 1+ hatchery juveniles were captured on May 19 at MS08-02, and none on June 9. One each was captured on July 26 and August 16, and are considered likely to be residuals (males that remain in fresh water throughout their lives) as outmigration is generally complete by early July. Four age 1+ were captured at MS08-03 on May 19, six age 1+ were captured on June 6 and there were no further captures at the Site. One age 1+ was captured at MS08-04 on May 19 and there were no further captures at the Site. This indicates that the downstream migration of overwintered juveniles started prior to the first sampling on May 19 and

was substantively complete at, and upstream of, MS08-02 by June 7. The overwintered juveniles captured on June 9 may have continued migrating downstream or have become residuals.

Almost all age 1+ juveniles captured at MS08-03 on and after July 26, 2017 were wild. These fish could have immigrated into Fox Creek from other spawning streams or have been the result of natural spawning within the creek. Numbers captured have tended to be relatively low. In the absence of competition, it is probable that food organisms were readily available. Growth of individual fish may have been rapid. This makes determination of the age of captured fish difficult unless invasive means such as scale removal is utilized. A swiftly growing 0+ can be longer than a slowly growing 1+ by mid-summer. In some years large(r) numbers of similarly sized juveniles allow informed speculation as to the source and age of the fish captured. This was not possible in in 2017.

Regardless of the age or origin of individual juveniles, the trend toward wild fish at MS08-03 continues. This trend started in 2015, was pronounced in 2016 when many juveniles considered to be of Fox Creek origin were sampled and in 2017, when only 1 of 15 juveniles that may have been age 0+ captured was of hatchery origin.

Residuals deserve a brief mention. As noted above, these are male fish that do not migrate to the ocean. Residual were first sampled in late summer 2010 and were of hatchery origin. Wild residuals were first captured in 2015, and both hatchery and wild residuals have been captured since. Wild residuals are seldom found in non-natal streams but may be common in some spawning streams in some years. Their presence in Fox Creek may indicate that they are native to the creek.

Table 1 - Juvenile Monitoring 2017 Results Summary

Monitoring Date	Parameter	MS08-01	MS08-02	MS08-03	MS08-04	*TOTAL # of Chinook*
May 19/17	# of Chinook	1	4	5	1	***11***
	Avg Weight (g)	5.6	4.1	4.7	3.9	
	Avg Length (mm)	80	74	79	75	
	Wild Number & %			1	1	***2 = 18%***
June 9/17	# of Chinook	0	0	6	0	***6***
	Avg Weight (g)	N/A	N/A	5.8	N/A	
	Avg Length (mm)	N/A	N/A	82	N/A	
	Wild Number & %					
July 26/17	# of Chinook	32	27	4	0	***63***
	Avg Weight (g)	1.4	1.8	3.9	N/A	
	Avg Length (mm)	52	57	71	N/A	
	Wild Number & %		1	4		**5 = 7.9%**
August 16/17	# of Chinook	41	119	1	0	***161***
	Avg Weight (g)	2.2	2.1	3.3	N/A	
	Avg Length (mm)	61	61	70	N/A	
	Wild Number & %	4				**4 = 2.5%**
September 14/17	# of Chinook	41	31	8	0	***80***
	Avg Weight (g)	2.9	3.0	6.1	N/A	
	Avg Length (mm)	67	66	84	N/A	
	Wild Number & %	6		8		***14 = 17.5%***
October 18/17	# of Chinook	31	26	2	0	***59***
	Avg Weight (g)	NT	NT	NT	N/A	
	Avg Length (mm)	71	67	87	N/A	
	Wild Number & %	1		2		***3 = 5%***
TOTAL		***146***	***207***	***25***	***1***	***379***
Total Unclipped		***11=8%***	***1=0.5%***	***15=60%***	***1=100%***	***27 = 7%***

NT = Not Taken **Overwintering** **Unclipped**

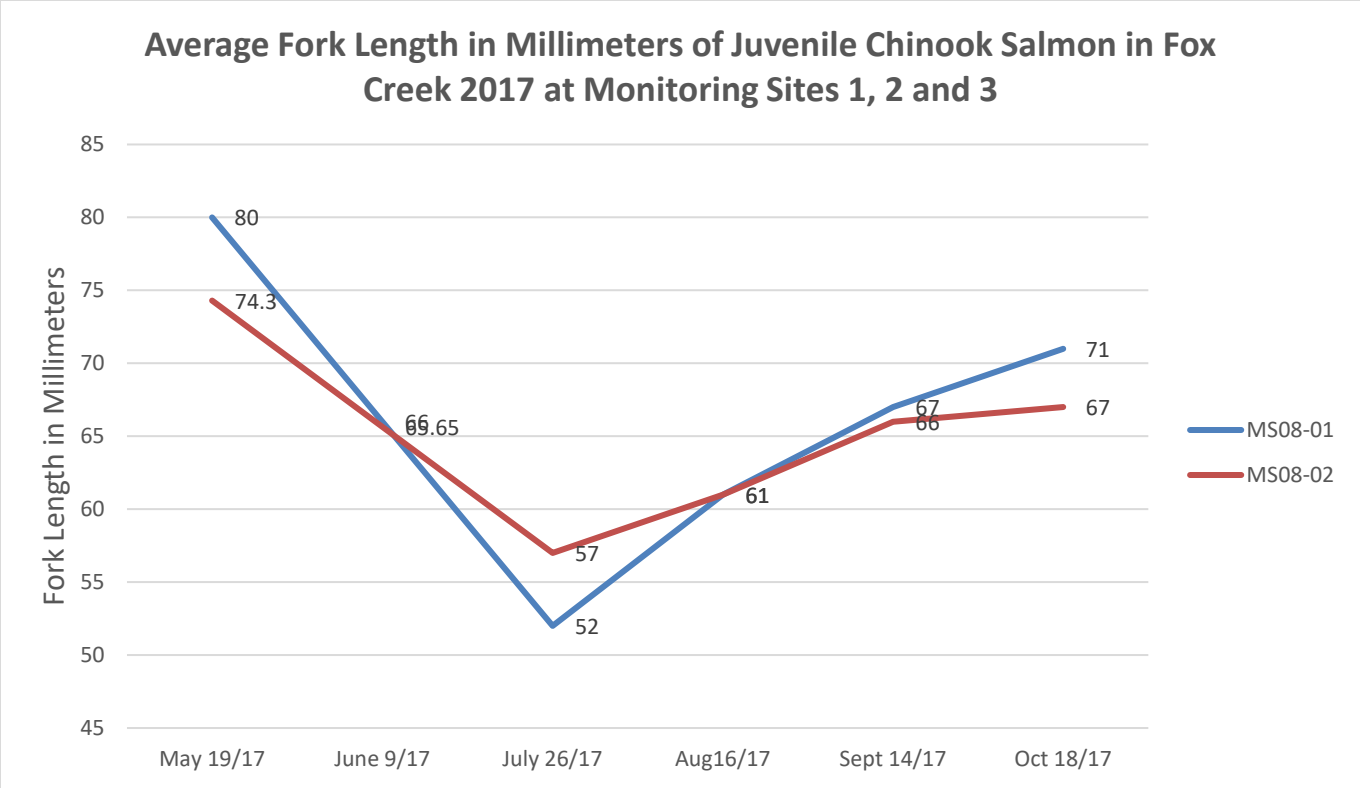


Figure 6 - In 2017, 22,000 Released at Site 2 and 11,000 at Site 1

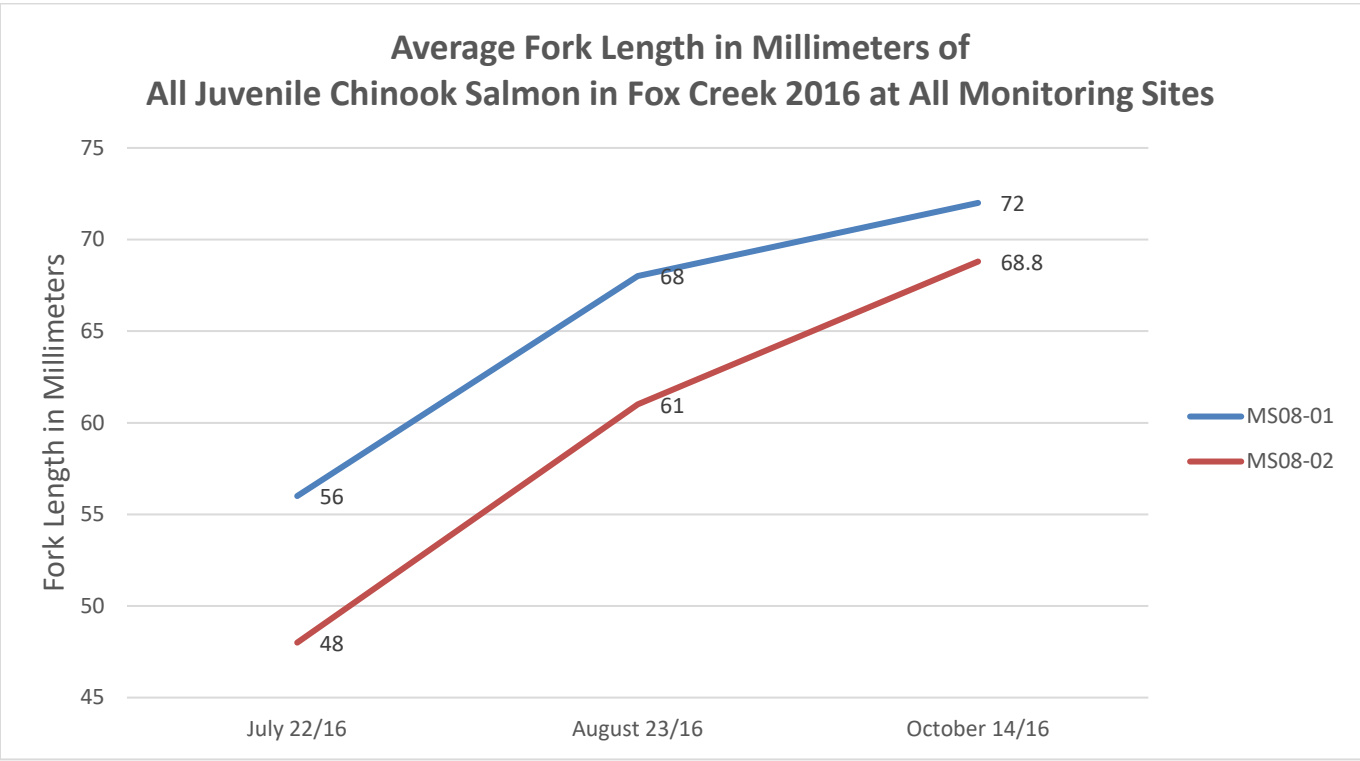


Figure 7 - In 2016, 35,000 Released at Site 2 and 10,000 at Site 1

Figure 8 - Testloa Smith recording Bio-physical Monitoring data at Site 1. August 16, 2017

HYDROLOGY AND WATER QUALITY

As part of our Phase II Fox Creek Chinook Salmon Restoration Plan; TKC committed to install a hydrometric station, including a staff gauge in the 2017 operating year. The goal of the hydrometric station is to develop a rating curve over time. We contracted Laberge Environmental Services who worked with TKC staff members to install the station and record results throughout the 2017 field season.

The installation took place on June 8th, 2017 and we conducted tandem discharge measurements with Laberge for comparison. We met again with Laberge on August 15th and October 17th to download the data loggers, conduct discharge measurements, and record staff gauge readings. Figures 9 and 10 below display preliminary Hydrograph and Rating Curve results.

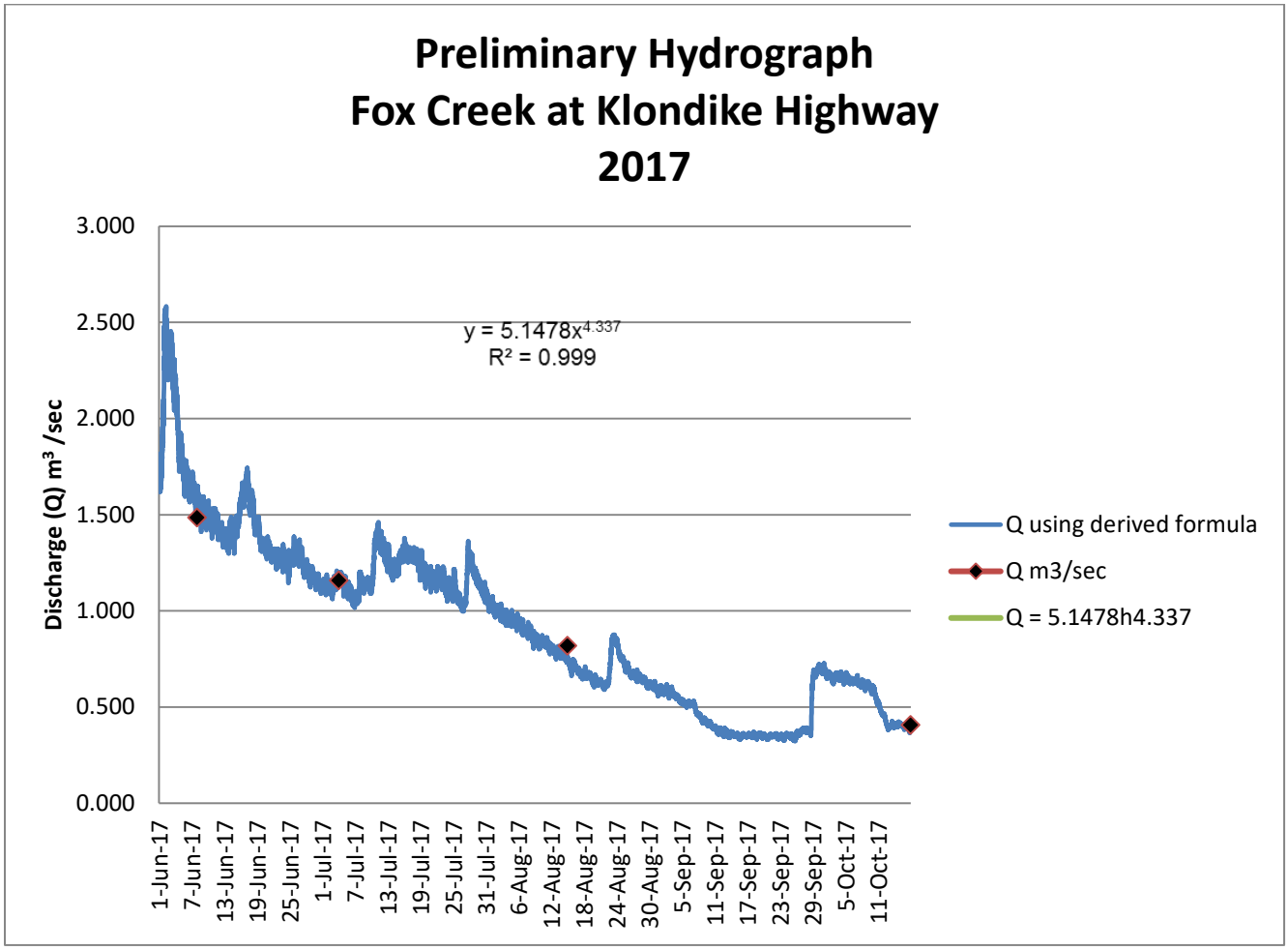


Figure 9 - Preliminary Hydrograph Fox Creek Hydrometric Station 2017

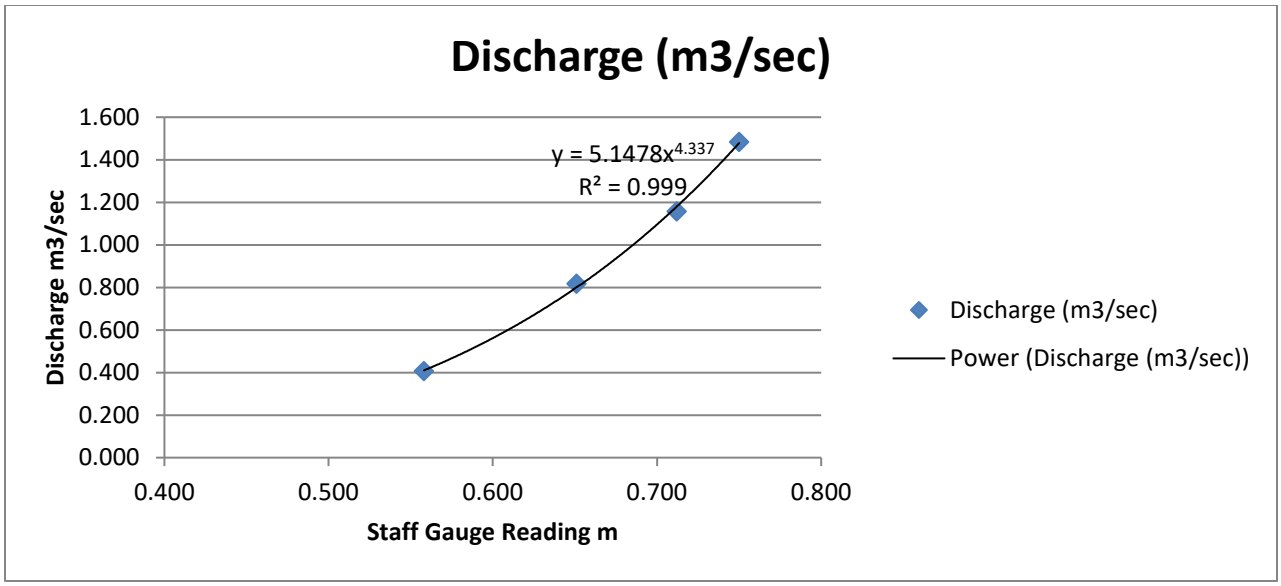


Figure 10 - Preliminary Rating Curve at Fox Creek Hydrometric Station 2017

Figure 11 – Fox Creek Hydrometric Station after installation. June 8, 2017

We also conducted an under-ice salt slug discharge measurement on January 26, 2017 and collected water quality samples. Discharge in January was 0.315 m^3/sec and the water quality sample results can be obtained from TKC Lands Department.

In-situ water quality measurements were taken in conjunction with discharge measurements. These results are displayed in Table 2.

Table 2 - Fox Creek In-Situ Measurements 2017

Date 2017	Time	H2O Temp	Oxygen % Sat	Oxygen mg/L	pH	Cond. Spec.	Cond.	ORP	TDS
26-Jan-17	11:55	0.0	88	12.9	7.81	296	154	-	154
18-May-17	15:25	9.2	100.9	11.96	7.87	250.7	175.2	246.7	
25-Jul-17	12:47	15.1	92.7	9.32	8.13	353.1	286.4		
14-Sep-17	11:16	5.2	90.2	11.50	8.19	339.2	210.2	154.4	
17-Oct-17	12:18	1.1	96.4	13.60	8.11	339.5	184.6	225.8	

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 is part of a larger project on creek, groundwater and river thermal regimes throughout Yukon River watershed in relation to climate change and salmon habitat.

In 2016 and 17 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. Her results are displayed in Figures 12 to 14. The data is indicating there may be an increasing trend in average monthly temperatures in spring.

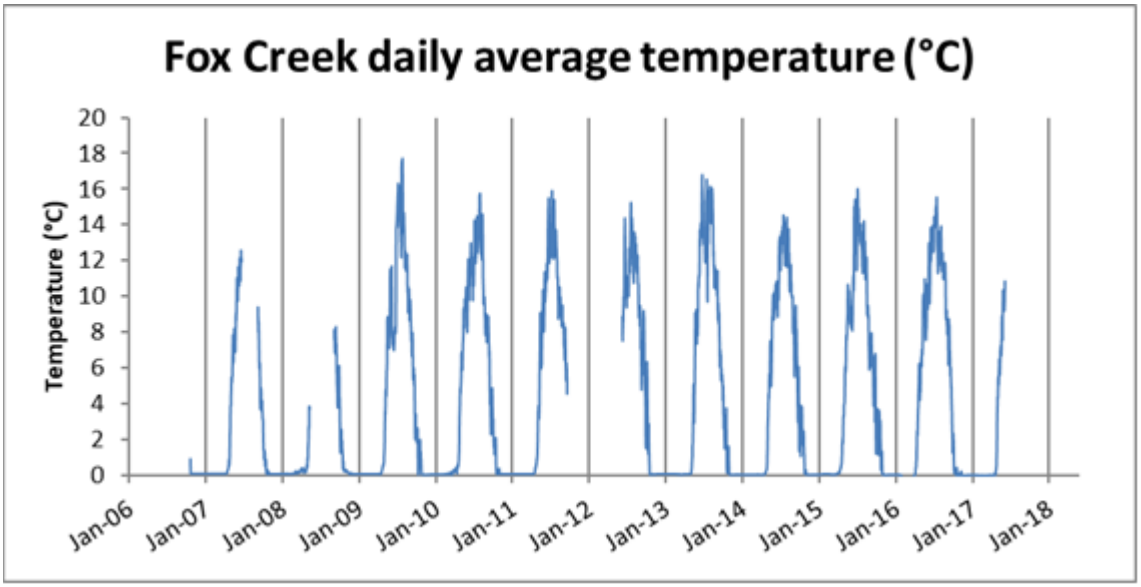


Figure 12: Fox Creek Daily Average Temperature (°C) from 2006 to 2017

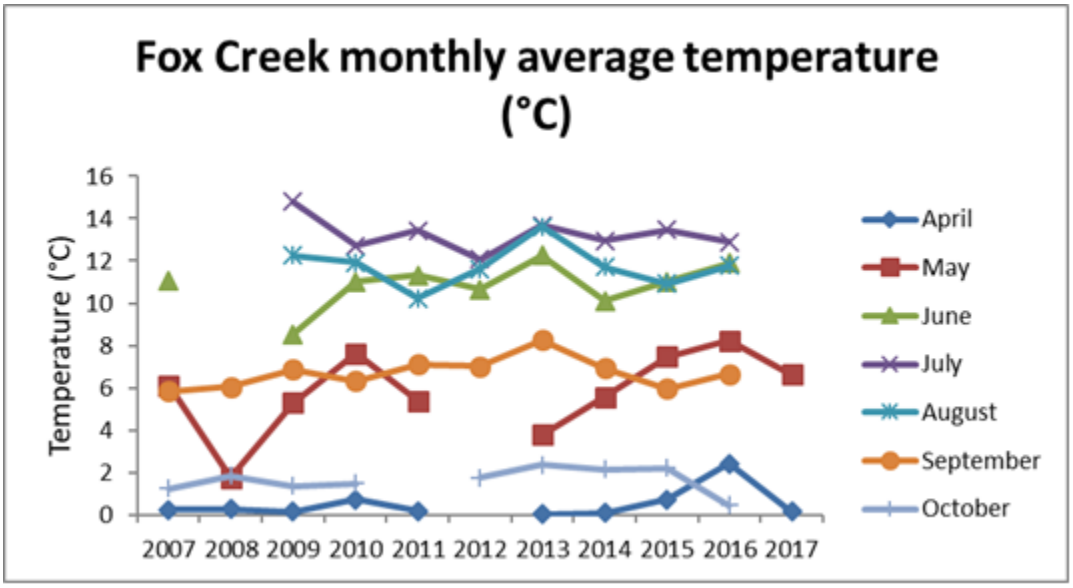


Figure 13: Fox Creek Monthly Average Temperature (°C) from 2007 to 2017

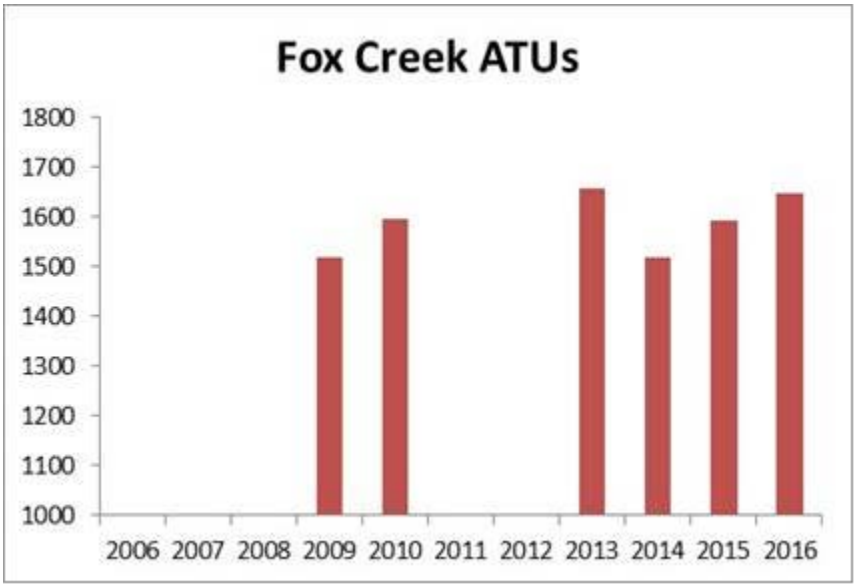


Figure 14: Fox Creek Annual Accumulated Thermal Units (ATU's) 2009 to 2016

MONITORING ADULT SALMON RETURNS & BARRIERS

Barriers

Stream surveys to record active beaver dams that are potential barriers to upstream migration have been conducted annually with a focus on the lower portion of the creek from BD315 downstream (approximately 3.5 km). See Active Beaver Dam Map in Appendix A.

In 2015 only three active beaver dams were recorded, but due to a large pond behind BD115 (downstream of BD717), monitoring staff could not access a large section of the creek. In 2016, BD115 was inactive and this pond had drained enabling TKC to survey the area. An additional seven active beaver dams were found bringing the total for 2016 to eleven dams downstream of BD315. It was extremely difficult and time consuming to navigate through this area and we spent most of our time moving adult salmon past these obstructions. It was also extremely difficult to determine the creek channel, so we visited the stream again during the winter where we found the main channel, flagged and georeferenced it. There was an additional beaver dam in 2016 at the outlet of Fox Lake (headwaters of Fox Creek). This dam caused a reduction in overall flow, so it had to be breeched multiple times late in the field season.

The 2017 surveys were conducted prior to and during the spawning period from July 7 to September 11. The number of active beaver dams recorded in 2017 was fourteen, which is an increase from twelve the year before. Six of the dams were still active from 2015 and 2016 but 8 new ones were found in 2017.

TKC has been very active at reducing the beaver 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 staff 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 fall of 2017 we hired additional professional trappers who will again work throughout this trapping season from October 1, 2017 to May 31, 2018. On January 31, 2017 these trappers confirmed a harvest of 12 beaver. They will continue to trap and TKC staff are planning a traditional beaver hunt after spring break up.

Figure 15: Large Beaver Dam (BD315) Barrier on Fox Creek 2017. Photo taken July 2016

Returns

We have confirmation of adult Chinook salmon returning to Fox Creek in 2013, 2015, 2016, 2017 and we speculate they returned in 2014. In 2017 they were observed from August 1 to 22. Throughout this period a total of 42 salmon were observed. Because we did not frequent the creek daily this year and we notched dams to move salmon upstream, we assume these to be different individuals. The total numbers of adults observed at one time, at one location, were 18 on August 11, 2017 near beaver dam barrier BD116. (See Active Beaver Dam Map in Appendix A). Although not always visible, we did not observe adipose fins on any of the fish so assume all were of hatchery origin.

DFO trained TKC to collect Age Sex and Length (ASL) data from returning adult carcasses. The data along with heads are submitted to DFO annually for analysis. The results of the 2016 ASL data is in appendix A. There was an increased presence of predators along the creek this year including; grizzly and black bear plus a large wolf. Because of this, only one adult carcass was recovered. It was quite decomposed so no scale or ASL data could be collected. The entire fish was submitted to DFO on September 11, 2017 and the results show this as a male (based on the kype) that was released into Mitchie Creek in 2013. We find this to be very interesting information! Two other carcasses were observed along the streambank, but they were too decomposed to recover. These may have been preyed upon by a large wolf because we observed tracks in the streambank sediment adjacent to them and the water was very shallow at this location.

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 the fall of 2016, TKC cut an ATV trail into Site 4 at the mouth of the creek at Lake Laberge. The new route was to divert the trail off privately owned land. Staff now utilize ATVs instead of trucks to conduct juvenile Chinook monitoring.

REDD MONITORING

The purpose of redd monitoring at Fox Creek is to determine the viability of Chinook salmon spawning. 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, with the data loggers to be retrieved the following springs. Using methodologies developed from our temperature monitoring program we have achieved some preliminary results shown in Figure 17 below.

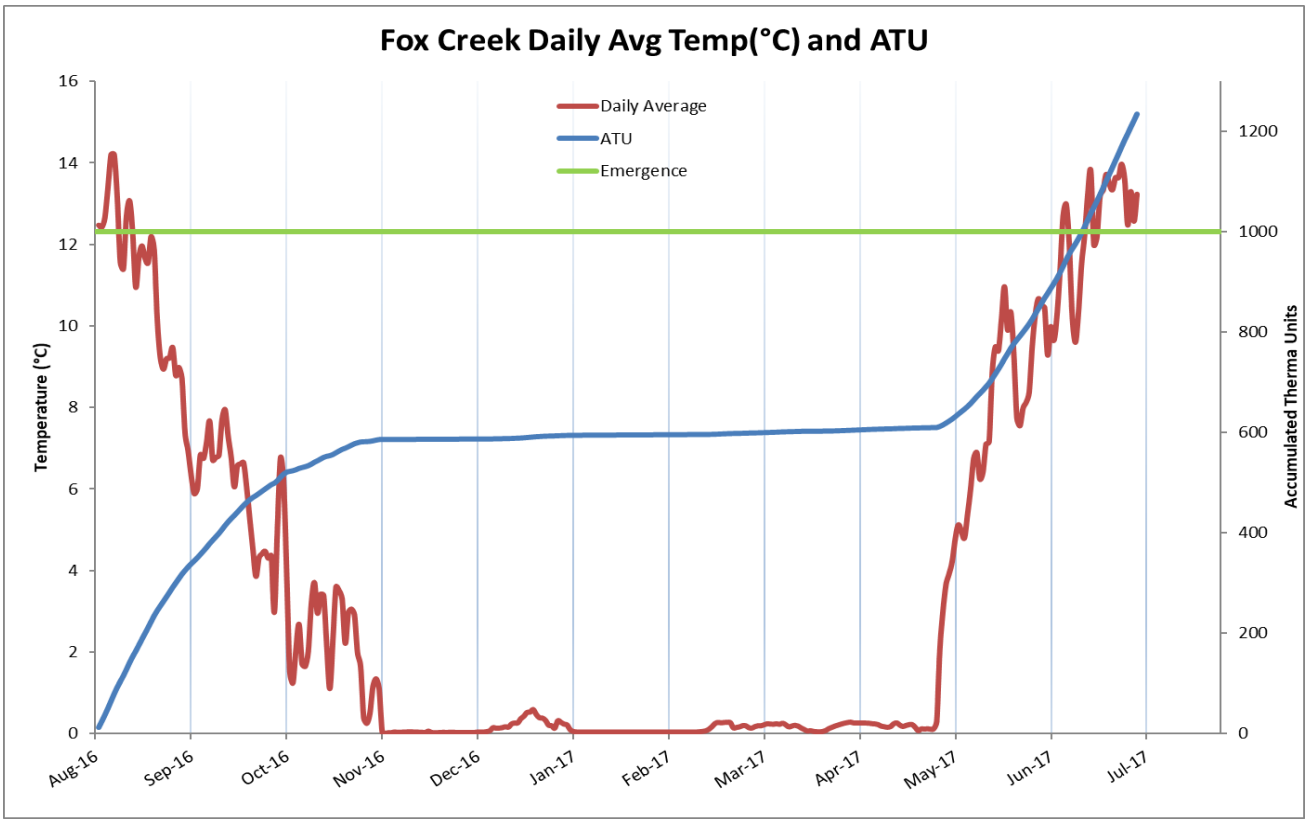


Figure 17 - Fox Creek Daily Average Temperatures and Accumulated Thermal Units from Aug 2016 to July 2017

Using data and the graph; eyed eggs would develop late August and early September at approximately 300 ATU's, alevins at approximately 540 ATU's in early October, and 0+ fry emergence estimated at 1000 ATU's mid June in Fox Creek. This emergence timing corresponds with 0+ fry observations and bio-sampling in the creek in mid June of 2016 and 2017.

In 2016, we set traps on June 16 and retrieved them June 17. We saw many Chinook fry in the area on both days but most of fish inside of the fry traps were larger Chinook and Slimy Sculpin. Because of the sparse numbers of 0+ Chinook in the traps, we assumed these larger fish preyed on them. So, we cut open a few sculpins and there were 3 - 5 Chinook fry in each. We did not sacrifice any of the larger Chinook to see their stomach contents.

There were eleven 0+ fry inside the traps and we netted more to measure and weigh as many as possible. We caught 19 0+ Chinook fry altogether; the average fork length was 41.3 millimeters (mm) and average weight 0.6 grams. All the Chinook had adipose fins which gives us good indication that there was successful spawning in this part of the creek.

On June 14, 2017 we observed many fry along the banks in back eddies however we did not capture any in our traps. So, we returned a few days later with nets and only managed to capture one which was approximately 35 mm long.

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 both through stewardship and restoration efforts.

TKC is achieving the stewardship portion of our goal. From 2006 to 2017 the Fox Creek project has been a high priority, and both staff and citizens are very aware and involved in its progress. Throughout these 11 years, many TKC members have received valuable training and experience in salmon restoration. These members now either work directly or have moved on to other jobs that are related to the project. The project has also built the capacity of youth in our community through public events and educational experiences and 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 from the 2017 season indicate we are moving in the right direction.

Through our bio-physical monitoring, the additional fry release location in 2016 and 2017 potentially indicates growth rates of hatchery fry in the creek are dependent on the density of fry released as both years results showed that the average growth rates were higher at MS08-01 than MS08-02. TKC will continue to release fry at various locations, then monitor and analyze the data with the support of partners and experts to confirm this assumption and adjust release numbers and locations as necessary. Analysis must ensure that overwintering and wild fry information is not included to allow valid comparisons. The bio-physical monitoring is also indicating an increasing ratio of wild to hatchery fry and an increase in the number of fish overwintering in the stream. These results will also continue to be monitored, analyzed, and reported on.

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. The negative effects include potential for disease, parasites, reduction in spawning and increased stress on returning adults if temperatures increase during migration and spawning. TKC acknowledges the importance of sufficient water quantity and quality for salmon habitat and therefore installed a hydrometric monitoring station in the 2017 field season. Water quality will continue to be monitored in accordance with our Restoration Plan.

Redd monitoring in 2017 both through determining the ATUs in artificial redds adjacent to potential redds; and conducting bio-physical monitoring of the emerging 0+ YOY has shown this stream is viable for sustaining Chinook. The 2015 and 2016 spawning redds were successful at producing wild YOY from adult hatchery raised Chinook. 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.

Monitoring adult returns, and barrier management is a very important component of this project. Adults have now been observed in the creek for 4 years and it appears the numbers of returning spawners is increasing. 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. 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 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. This appendix is entitled, “Phase II Implementation and Monitoring Plan” and 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.

REFERENCES

Anderton, I. 2008. *Chinook Salmon Stock Restoration Plan for Fox Creek.* Ta'an Kwäch'än Council. Yukon River Restoration and Enhancement Project CRE-52N-07. Completed by EDI Environmental Dynamics. February 2008.

Marjanovic, M. 2008. *Ta'an Kwäch'än Council Community Stewardship 2008*. Ta'an Kwäch'än Council. Yukon River Restoration and Enhancement Project. CRE-25-08. Completed by EDI Environmental Dynamics. November 2008.

Marjanovic, M. 2009. *Ta'an Kwäch'än Council Community Stewardship 2009*. Ta'an Kwäch'än Council. Yukon River Restoration and Enhancement Project. CRE-25-09. Completed by EDI Environmental Dynamics. November 2009.

Ta'an Kwäch'än Council (TKC). 2010. Community Stewardship Project: CRE-25-10 Final Report. Yukon River Restoration and Enhancement Project. CRE-25-10. January 2011.

TKC. 2011. Ta'an Kwäch'än Council Community Stewardship Project: CRE-25-11 Final Report. Yukon River Restoration and Enhancement Project. CRE-25-11. January 2012.

TKC. 2012. Ta'an Kwäch'än Council Community Stewardship Project: CRE-25-12 Final Report. Yukon River Restoration and Enhancement Project. CRE-25-12. January 2013.

TKC. 2013. Ta'an Kwäch'än Council Community Stewardship Project Final Report. Yukon River Restoration and Enhancement Project. CRE-25-13. January 2017.

von Finster, A. 2010 for Ta'an Kwäch'än Council. *Monitoring Fresh Water Thermal Regimes, A Technical Context*. Downloaded from http://taan.ca/files/uploads/2015/06/MonitoringFreshWaterThermalRegimes.pdf February, 2017.

APPENDIX A - SUPPORTING DOCUMENTS

Monitoring Information and Maps 2017

Table 3 - Transport data collected during the Fox Creek annual fry releases on July 17 and 18, 2016.

Fox Creek Fry Release 2017			
Date		7/16/2017 (at the bridge)	July 21, 2017 (at site 1)
Arrival Time at Hatchery		9:15	9:15
Begin Filling Tote with Water		10:15	9:25
Tote Filled		?	9:50
Begin Loading Fry in Tote		11:20	9:50
Fry Loaded (~22,000 July 16th, ~11,000 July 21st)		12:25	10:30
Transportation Start Time		12:45	10:40
Arrival Time at Release Site		13:25	11:10
Acclimatize Start Time		13:30	11:20
Start of Release Time		14:00	11:55
End of Release Time		14:35	12:10
Number of Fry		Approx. 22,000	Approx. 11,000
Hatchery oxygen and temperature		5˚C, 7.66 mg/L	6.2˚C, 8.3 mg/L
Oxygen Concentration and Temperature in Tote	Initial	16 mg/L 5.8˚C	10.85 mg/L, 5.4˚C
	Before Transport	14.28 mg/L 6.2˚C	14.74 mg/L, 5.6˚C
	During Transport	14.02 mg/L 6.3˚C	15.14 mg/L, 5.7˚C
	Arrival at Site	10.94 mg/L 7.8˚C	13.85 mg/L, 5.7˚C
	Before the Release	10.92 mg/L 10.9˚C	11.32 mg/L, 11.4˚C
Tote Used		722 L	722 L
Bubbler Was in Good Working Order		Yes	Yes
Fox Creek Temperature and Oxygen Concentration		13.4˚C, 9.58 mg/L	13.4˚C, 9.58 mg/L Assumed
Average Weight of Fry		1.30 g	1.30 g
Average Length of Fry		51 mm	51 mm
Weather		Cloudy and Cool	Sunny and Warm
Staff Gauge		Not Available	Not Available
Notes to Remember:			
Make sure you have all necessary permits (icluding fish transplant license)			
Check release site for adequate flow level and temperature prior to release			
Take fry off of feed at least 24 hours before release			
Make sure all equipment and tools are available and functioning			
Follow loading density guidelines			
Ensure oxygen level is adequate for transport			
The ideal oxygen levels should be between 8 and 12			
Transport fry carefully and gently!			
Put velcroe on bottom of tote and stone			
Make 2 big holes in top of tote for oxygen meter and tube to go through			

ADULT MONITORING

Date	Staff	# of Chinook	Weather	Notes
27-Jul-17	Deb & Jenna		partly cloudy, 15°C	**12:20-** arrived at site 4. We found an active dam at the mouth of the creek earlier in the week while we were doing our biomonitoring. The dam is still there and looks active. We started walking upstream and saw 1 grayling.
				Saw an area where there was a significant amount of sediment in the creek. We walked to a gps location labeled 'beaver dam' which is no longer a barrier. Took a photo.
				2:30- arrived back at site 4. This length of the creek looks in good condition and appears to have suitable spawning habitat. Notched the beaver dam at the mouth.
28-Jul-17	Deb & Nathan			**BD315-** The dam is open. Took a photo. Just upstream there is a major dam that is active and blocking the channel. This is 2017 upstream migration goal.
				BD117- Old creek channel is diverted. The dam appears active. Took a photo.
				BD217- Active beaver dam; took a waypoint and a photo. Down stream there is a log jam that is open. Took a photo.
				BD317- Active beaver dam; took a waypoint and photo
				BD215- This dam is still very active. Took a photo
				BD1116-Beaver dam is open. Took a photo
				BD716- Dam looks longer than last year. Dam is still active and the trail has flooded. Took a photo.
				BD1216- Old dam and old channel. Suggest opening this dam completely.
31-Jul-17	Deb, Jenna, Stan & Nathan		Sunny	**10:15-** arrived at Fox Creek bridge and toured YSSC & DFO on site 1 and 2 and stream restoration project. We split up in pairs. Jenna and Nathan started at the mouth of the creek and worked theire way up. Stan and Deb started at BD115 and worked their way up to BD1217.
				Nathan & Jenna- Dam at the mouth of the creek was not rebuilt. Took a few more sticks out of the middle of the dam to clear it so that the salmon have a better access up the creek. Started walking upstream.
				1:10- Stumbled upon a dam. (possibly the same one from July 27.) It was not active and salmon looked like they could get up. Took photos.
				1:50- beaver dam that is not active. Cleared it out to ensure passage by chinook. There was also a beaver dam directly downstream that blocks the stream but the creek rerouted itself. Check if we want to put the creek back in the original channel. Saw a grayling. Saw a chinook fry that overwintered.

				1:55- Slightly upstream there is a dam that does not look active. Unsure if salmon can get up through it or not. Took a Photo. There was another bevear dam slightly upstream that is fully constructed. We notched the dam.
				2:30- Another huge beaver dam upstream. Did not notch this dam.
				2:50- Arrived at BD115. The dam appears open.
				Deb & Stan- arrived at the field at 12:20 and geared up.
				BD115- appears open on the west side
				BD417- Dam is open. Took a photo. This is on a old channel which is now open.
				BD517- Old dam but new cuttings. Dam looks open.
				BD617- Dam not active
				BD717- Big active dam. Took 2 photos and a waypoint. Observed lots of juveniles that appear to be chinook.
				BD817- Active beaver dam. Took 2 photos and a waypoint.
				BD917- Active dam, took a photo and waypoint. At this dam we found our winter flagging. Phil and Deb stayed right going downstream closer to the cliff and Stan and Deb came up on the left channel.
				BD1017- Active and blocking the channel. Took 2 photos.
				BD117- Dam is open
				BD1217- Dam is open
				BD1016- Dam is open
1-Aug-17	Nathan & Stan	**1**		**BD1016- Spotted one salmon!** Dam is open
				BD1216- Dam Open
				BD1217- Dam is open
				BD716- Active beaver dam
				BD1317- Beaver dam open
				BD1417- Beaver dam open
				BD1517- Beaver dam open
				BD215- Active beaver dam
				Arrived back at truck at 2:45
8-Aug-17	Jenna, Nathan & Stan		23°C and Sunny	**Site 4-** Arrived at 10:45. Saw bear and deer tracks on the drive in and took photos of the tracks. The dam at the mouth of the creek has not been rebuilt and it look like salmon can get past easily.
				beaver dam'- Dam is not active and salmon can swim up the notch easily. Saw bear tracks and scat on the walk here between here and BD115.

		7		**BD416-** Dam is not active. There is still a notch in the dam but it seems to be fairly steep. Salmon can still make it up. **Saw 7 possibly 8 salmon** on the upstream side of the dam. No adipose fin on any of the salmon. All look in great shape. One has 2 spots by it's dorsal and its tail looks marked up (possibly a female). Another has a white stripe down it's back (possibly a male).
				BD1617- Fully constructed and active beaver dam. Took a new waypoint. Only about 15 m away from BD416 and is holding the salmon between the dams. Did not notch. Took photos. 2 grayling seen just upstream of the dam.
				BD116- Active beaver dam and flooding out the upstream area. Took a photo. Grayling just upstream.
				BD115- Water is flowing around the old dam but we may need to think about taking out the beaver dam and getting the stream back into the original channel. Old bear track in the mud. Took photo of track.
11-Aug-17	Deb & Jenna		22°C and overcast	**Site 4-** Arrived with ATV at 13:05
		1		**SS317-** Saw **a white nosed salmon** swimming downstream as we were walking up the creek. Marked the way point.
		18		**BD416- 3 salmon on downstream side. All do not have an adipose. 1 has a white spot on its side. Note: open this dam. 1 has a black tail. 1 salmon on upstream side of dam hanging out. Small white stripe. 4 just upstream of that. 5 more up from that with no adipose. 4 more at base of the next dam.**
				BD1617- Dam active. Notch on Monday.
				BD116- Active beaver dam.
14-Aug-17	Deb, Nathan & Trix			**12:30-** Arrived at trail head
		1		**BD416-** 1 fish down stream
		2		**BD1617-** 1 male and 1 female. Cleared a side channel LH bank 5 m downstream of 1617
				BD116- Notched beaver dam at 14:50
				BD1016- arrived at 15:40. No fish. Not active.
15-Aug-17	Deb & Testloa	**4**		**BD816-** beaver dam is open. **Saw 4 fish** about 70m upstream. No spawning habitat in sight. 1 Female no adipose. 1 white stripe on dorsal displaying spawning behaviour. Some cobble in a deep pool. Took photo.
				BD716- Opened channel on east side of BD716
18-Aug-17	Deb & Jenna		Mainly Cloudy 15°C	**staff ~~guage~~ gauge 0.630**
		1		**SS517-** Taking a water break on a small beach. **Saw a salmon** swimming past a log. Took a waypoint.

		1		**SS617- saw a salmon** with a white tail. (could be the same one from before) took gps coordinates.
		4		**BD416- 4 salmon** on upstream side of dam.
				BD1617- Side channel majorly built up. Took a photo. Active dam. Notched the middle of the dam and flagged off. The gps coordinates are accurate.
				BD116- Rebuilt active beaver dam. Started notching at 14:40 and finished at 15:15. Flagged the dam and checked the gps coordinates.
				Redd117- 2 salmon just upstream of BD116. Possible redd. Male fish protecting the area with no adipose. Took a photo. Possible female got to close to the location and got chased off by the male. Took gps coordinates.
				Redd217- 1 salmon and a possible redd downstream of last redd site. Took gps coordinates.
				BD517- Beaver dam open therefor not active. Cleared the side channel up a bit more to ensure passage by salmon.
				BD917- Active dam. Looks like there is a side channel. Did not notch.
				BD1016- Beaver dam not active. Did not notch.
22-Aug-17	Stan & Jenna		Cloudy & Raining 13°C.	**BD1016-** Water can still flow through dam (open). Saw a fairly fresh bear print just upstream and also some possible wolf tracks. Took photos.
				BD1217- No notch. Fish might be able to swim up the side channel. No salmon.
		2		**BD716-** Dam rebuilt. **2 salmon** on the downstream side of the dam. Large white marks on both salmon. No adipose fins. Notched the dam. Started notching at 11:30 and finished at 11:55.
				BD215- Area is flooded out. No salmon on either side of the dam. Fish might be able to swim up the side channel. Maybe hike upstream to see if any salmon got up.
1-Sep-17	Deb		Sunny and clear. 16°C	**Staff gauge 0.613**
				BD 315 to 215 Return Intent was to hike this section but there were no other staff to accompany Deb so she decided not to go and instead worked with YSSC and Al von Finster to produce a beaver dam removal video.

11-Sep-17	Deb & Stan		2 carcasses too mutilated to recover	Mainly overcast with some sun ~12dec C. 11:30 Beaver action took 2 photos + GPS waypoint named Beaver Actn17. Followed beaver trail to BD116 which was totally repaired. 11:47 found 2 fish carcasses and one is un or partially spawned female. Took photo and GPS waypoint FishCarcass17. Found wolf tracks by carcasses and Redd 317. Redd 317 (Actual not potential) Right beside carcasses, took photo and GPS waypoint. Set Art Redd loggers 117 at this site. Note on LH bank gravel too fine so we tried RH band and dug up an egg so we set logger back on LH bank. 3:17 Arrived at Redd 217 set Art Redd in stream on LGB just beyond overhanging bank (see Redd Monitoring for more details). Just u/s from Redd 217 we looked at the Redd Trix had pointed out; beside this was flagging on a tree that N61.11266 W135.22415 Redd 1&2 from 2015.

42

Fox Creek Age Sex and Length (ASL) Chinook return sampling 2016

Fox Creek (tributary to Lake Laberge)

September 08, 2016

Deb Fulmer, Jenna Duncan (TKC) and Sean Collins, Maggie Wright (DFO)

Location

Between: 61.12143° and 61.12036° N
and: 135.23227° and 135.23082° W

Fox Creek 2016 Head Recovery. CWT Release Data

Recovery Data														Release Information				
Head Label	CWT Tag Code	Fish #	Date of Recovery	Sex	Adipose	FL (mm)	POHL (mm)	MEF (mm)	Scale Card	Scales	Note	Tag Placement	Tag Condition	Age at Recovery	Brood Year	Egg Source	Tag Code	Release Site	Release Date
1070966	201020708	1	8-Sep-16	M	N	720	690	na	06605	1-5	Good Head	Nares	Normal	5	2011	Whitehorse Fishway	02-01-02-07-08	Fox Creek (Laberge)	7/11/2012
1070968	201020705	2	8-Sep-16	M	Y	700	655	na	06605	11-15	Good Head	Normal	Normal	5	2011	Whitehorse Fishway	02-01-02-07-05	Fox Creek (Laberge)	7/18/2012
1070969	201020608	3	8-Sep-16	M	N	710	675	na	06605	21-27	Good Head	Normal	Mechanical Scratch	5	2011	Whitehorse Fishway	02-01-02-06-08	Fox Creek (Laberge)	7/18/2012
1070986	201020706	4	8-Sep-16	M	N	670	na	590	06601	1-10	Good Head	Normal	Normal	5	2011	Whitehorse Fishway	02-01-02-07-06	Fox Creek (Laberge)	7/24/2012

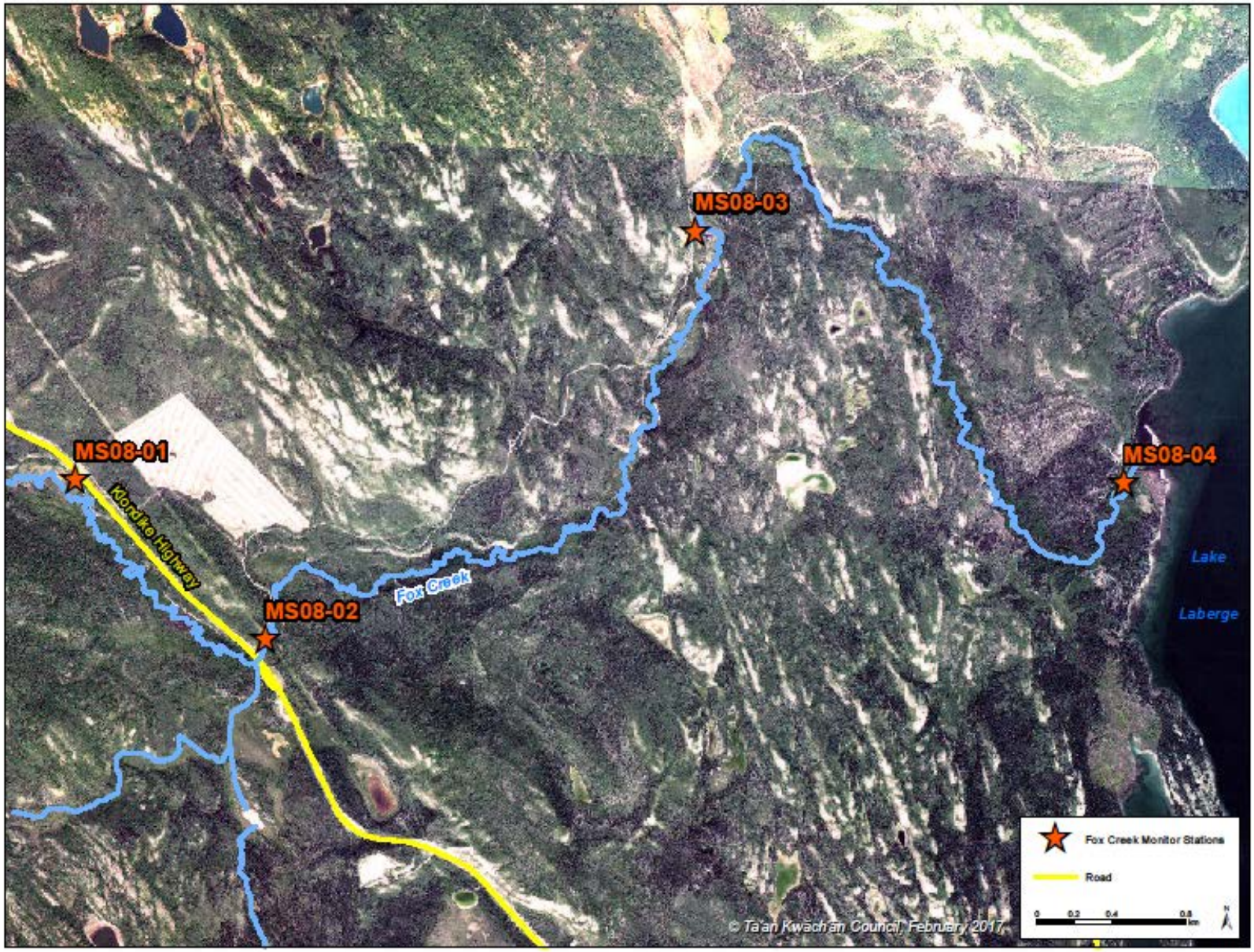
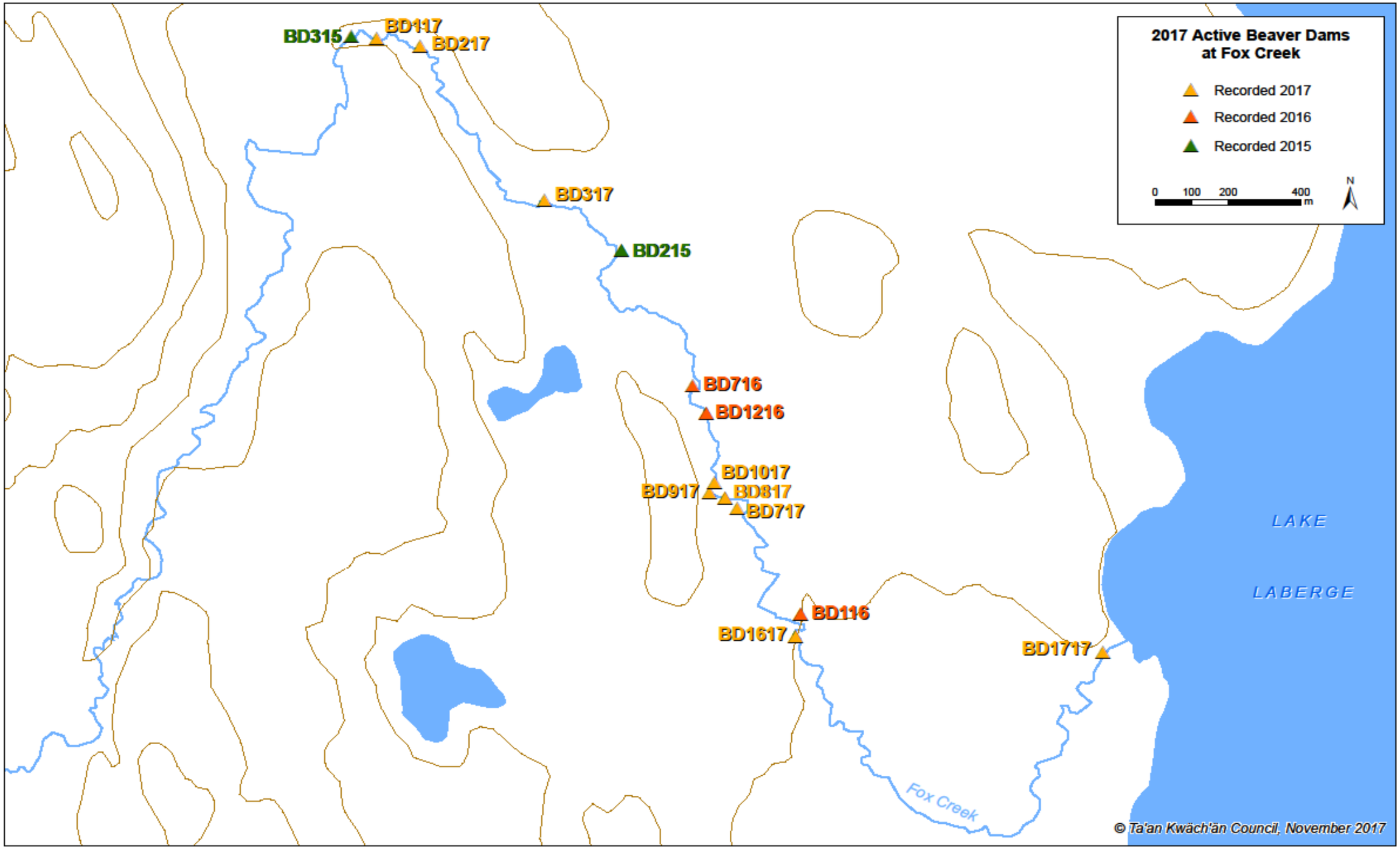


Figure 18: Fox Creek Juvenile Chinook Salmon Monitoring Stations

Figure 19: Fox Creek 2015, 16 and 17 Active Beaver Dams



APPENDIX B - FOX CREEK CHINOOK SALMON RESTORATION PLAN

PHASE II – THE SECOND SALMON LIFE CYCLE

DEVELOPED MARCH 2016, UPDATED JANUARY 2018

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 m^2 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 Laberge 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 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:

• Polarized sunglasses and hat • GPS • Camera • Field Notebook/Pencil • Map • Ribbon • Zip ties	• Knife (for removing head) • Zip locks or garbage bags for heads • Permanent marker • Scale Cards • Sharp tweezers • Tape Measure • Labels for each head

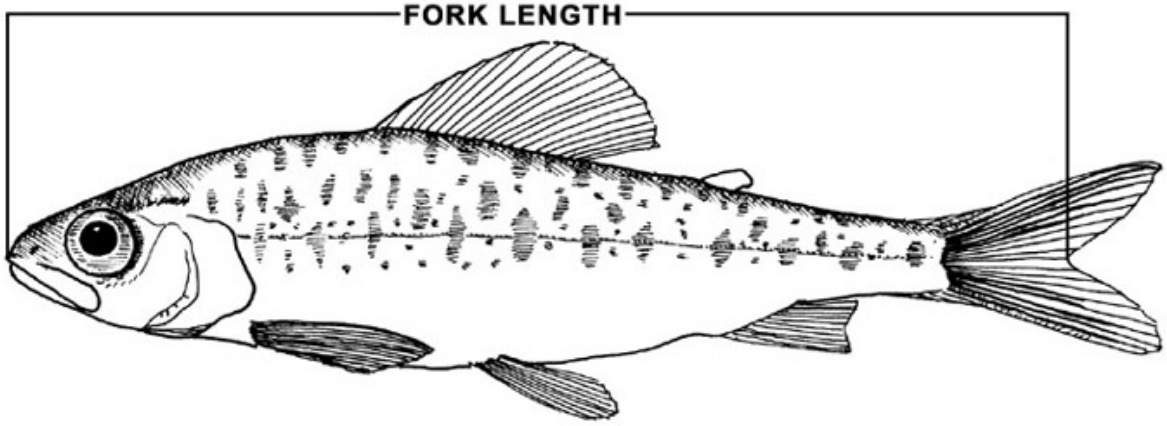


Photo courtesy juvenilefishid.com

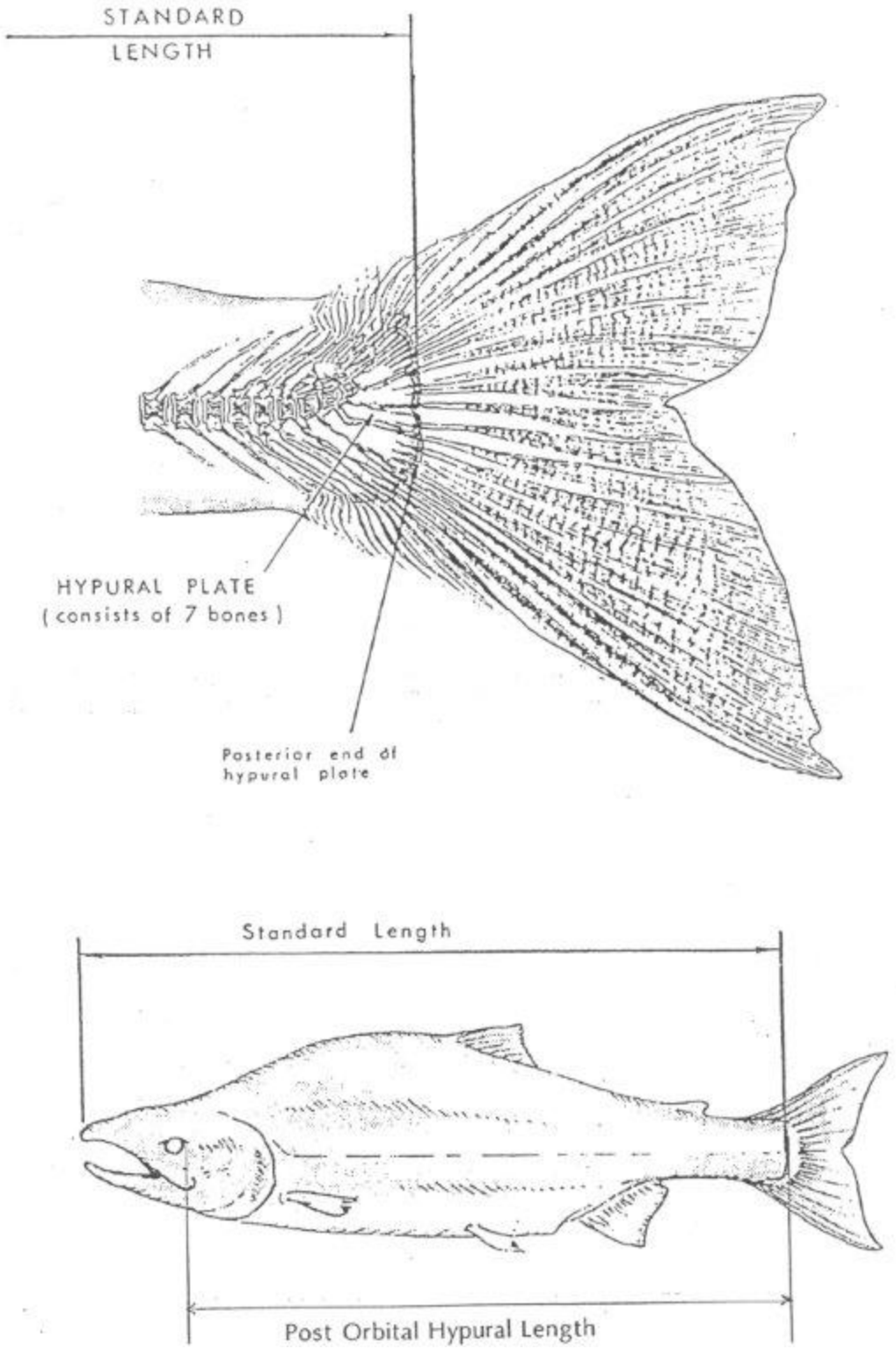


Image courtesy of Pacific Streamkeepers Federation

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.

Figure 1. Head with excess flesh and gills removed

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.

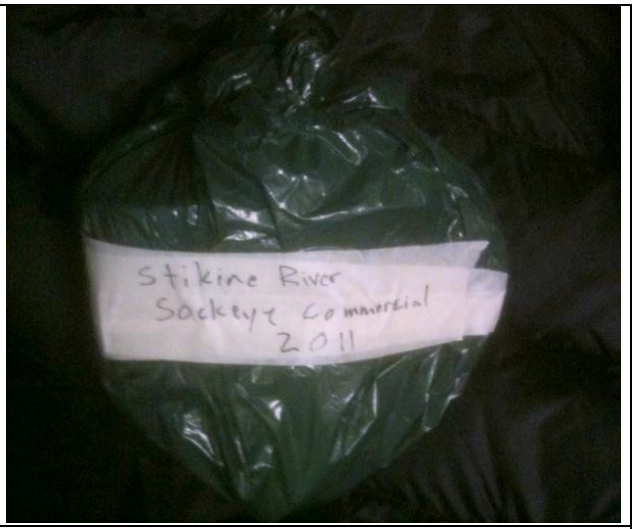
Required information includes:

- **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.

FOX CREEK CHINOOK SALMON RESTORATION PLAN

PHASE II – THE SECOND SALMON LIFE CYCLE

APPENDIX B - PHASE II ANNUAL IMPLEMENTATION AND MONITORING PLAN

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 – IMPLEMENTATION AND MONITORING PLAN (IMP)– UPDATED JANUARY 2018

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	Coordinate with DFO, to conduct a workshop of past and current restoration projects to compare methods and results. 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. Stagger release dates and add more upstream locations. 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	Annual IMP activities	Consider collecting broodstock from Fox or nearby creek for either or both hatcheries.	Annual IMP activities	Annual IMP activities	Annual IMP activities	Conduct a Streamkeepers Habitat Survey of Chinook spawning habitat upstream of BD 315	Annual IMP activities
13 (2020)	2016	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
14 (2021)	2017	Annual IMP activities	Annual IMP activities	Annual IMP activities	Annual IMP activities	Annual IMP activities	Annual IMP activities	Annual IMP activities