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

CRE-25-16

FINAL REPORT 2016

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

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February 2017

ABSTRACT

Ta'an was very active in capacity building in 2016. Citizens and staff members, John Bunbury, Stan Clethroe, Clayton Kane, and employee Deborah Fulmer successfully completed the Yukon Fisheries and Field Assistant Program offered by Yukon College and funded by Council of Yukon First Nations. They assisted with operations, maintenance and tagging efforts at the McIntyre Creek Incubation Facility and Fox Creek field work. TKC Lands, Resources and Heritage (LRH) Department, hired citizen Jenna Duncan; a second-year undergraduate biology student, to conduct field and research work. Jenna gained knowledge and experience in her field of study and was a great asset to the team. TKC LRH Department, joined forces with University of Alberta and sponsored PhD student Ellorie McKnight through the CREATE Environmental Innovation internship project. Ellorie worked on our long-term temperature monitoring data from Fox Creek which complements Al von Finster's Water Temperature Monitoring of Yukon River Chinook Salmon Spawning and Migration Habitats in Canada program.

Both Department and Fisheries and Oceans (DFO), and Yukon Salmon Sub-Committee's (YSSC) Technical Team, mentored TKC staff in; reporting, planning, data analysis, scheduling and field efforts. The team focused on implementing Year 9 of the *Fox Creek Chinook Salmon Restoration (FCCSR) Plan* including*;* monthly bio-physical monitoring of juvenile Chinook salmon, monitoring adult returns, and participating the annual fry release where approximately 45,000 fry were released.

Juvenile Chinook salmon were documented utilizing Fox Creek as overwintering and rearing habitat and adult salmon returned to the creek during the spawning period. Stream walks increased to monitor and observe these returning adults. Beaver dam surveys were completed and potential redd sites were documented and geo-referenced. For the first time in the history of the project wild fry emerged from the 2015 spawning redds.

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 transported the eyed eggs to McIntyre Creek Incubation Facility (operated by Yukon College) where they were raised, primarily by college students, until they were ready to be released.

TKC Elder Betsy Jackson, Coralee Johns, TKC citizens and staff, as well as Sean Collins (DFO), Darrell Otto (Yukon College), McIntyre Hatchery staff, and members of the public assisted with fry releases. Sean Collins and Maggie Wright (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), Darrell Otto (manager of McIntyre Hatchery), Jake Montgomery (student manager of McIntyre Hatchery) also provided experienced direction and advice.

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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. 2016 represented Year 9 of the Restoration Plan, where returns of adult salmon released in 2010-2012 were anticipated to contribute to the return.

Major components of the 2016 project included:

Training and Capacity Building (formal and through mentorship opportunities)
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 Documenting Potential Barriers to Upstream Migration
Recording and Monitoring of Potential Redd Sites
Collection of Biological Adult Carcass Samples from Fox Creek
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 2016.

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 at 4 kilometers from the headwaters and just upstream of 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 much of 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.

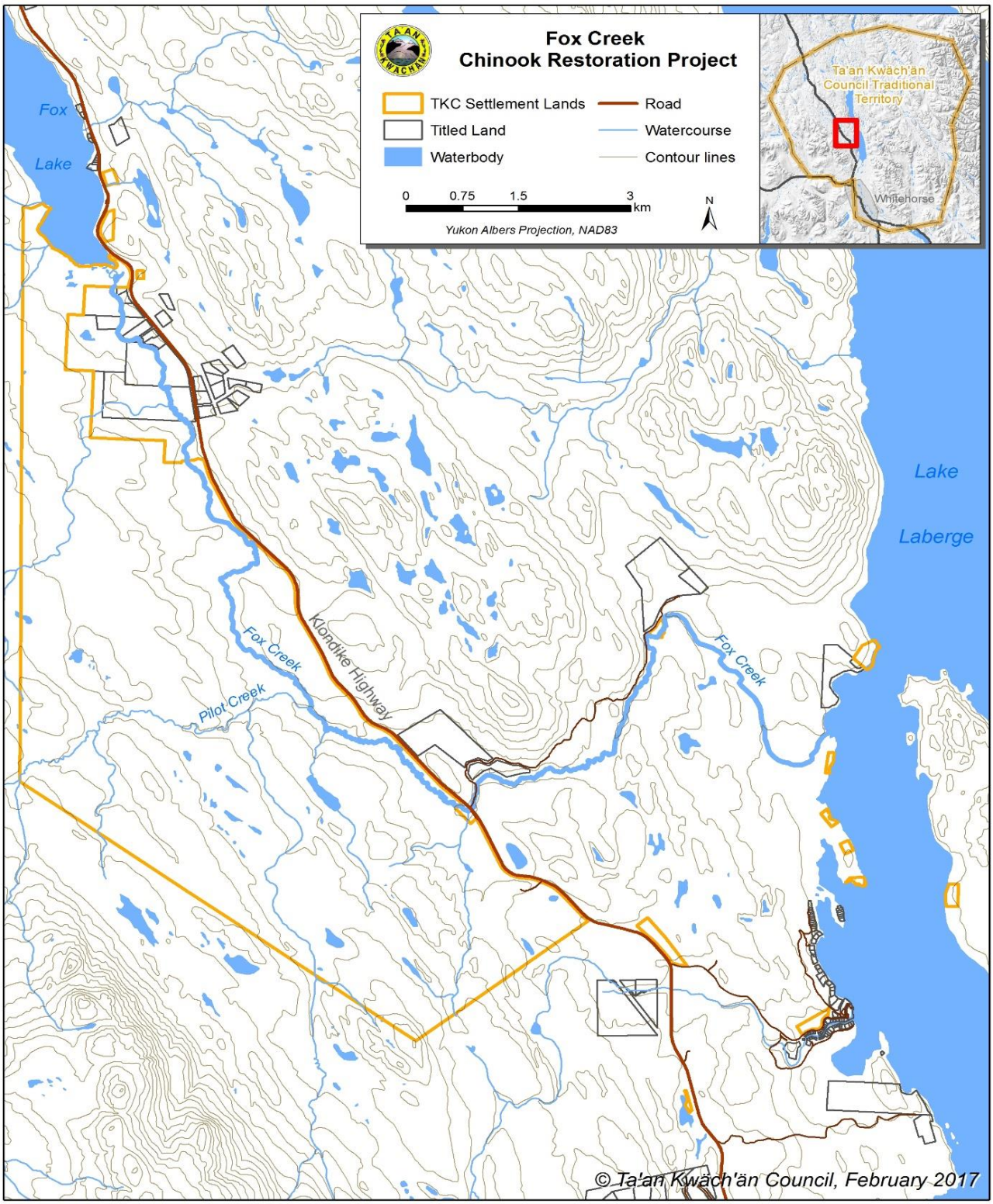

Figure 1: Fox Creek Chinook salmon Stock Restoration Project Location within Ta'an Traditional Territory

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 and or other organizations.

In 2016, four Ta'an Kwäch'än Council staff members; John Bunbury, Stan Clethroe, Clayton Kane, and Deborah Fulmer successfully completed the Yukon Fisheries and Field Assistant Program offered by Yukon College. These staff assisted with operations, maintenance and tagging efforts at McIntyre Creek Incubation Facility and Fox Creek field monitoring. Training opportunities also included; Yukon Trapping Certifications (for beaver management), Water Quality Monitoring, Predator Defence, Wilderness First Aid, Helicopter, ATV and Snow Mobile Safety.

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 (Appendix B) and activities were planned based on this plan.

The 2016 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. Deborah Fulmer, TKC Fish and Wildlife Program Coordinator, was the project manager, who 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.

A pre-season planning meeting was conducted by TCK and from this meeting the Restoration Team was directed to:

1. Complete all annual permitting.
2. Transfer eyed eggs from Whitehorse Rapids Fish Hatchery to McIntyre Creek Incubation Facility.
3. Assist at the McIntyre Creek Incubation Facility during the early salmon life stages of; eyed eggs, alevins, and fry (including coded wire tagging).
4. Focus on Fox Creek juvenile monitoring of wild and enhanced rearing.
5. And, conduct stream walk investigations for the presence of adult returns and spawners, at Fox Creek.

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

Methods and results are summarized in this section. Methods are detailed in Appendix B, Fox Creek Chinook Salmon Restoration (FCCSR) Plan, Phase II – The Second Salmon Life Cycle, March 2016. Results, or detailed field data, is displayed in Appendix A, Supporting Documents – Maps and Monitoring Data 2016.

WHITEHORSE RAPIDS FISH HATCHERY AND MCINTYRE CREEK INCUBATION FACILITY

The 2016 operations at the Whitehorse Hatchery were managed by Lawrence Vano with Warren Kapaniuk as the Environmental Technician. The McIntyre Creek facility was managed by Darrell Otto, Yukon College and Jake Montgomery the student manager.

Yukon Energy Corporation collected broodstock from the Whitehorse Rapid Fish Ladder during the summer of 2015; fertilized the eggs and raised them to the eyed stage at their Whitehorse Rapids Fish Hatchery (WRFH). On November 2, 2015, they donated 50,388 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, Clayton Kane, and Deborah Fulmer (who successfully completed the Yukon Fisheries and Field Assistant Program) and TKC summer student Jenna Duncan, assisted MCIF with throughout the year with operations, maintenance and annual fry tagging. MCIF staff cleaned trays daily, removed any discoloured (dead) eggs, monitored flows and water temperatures. During December 2015 and January 2016, the eyed-eggs hatched and developed into alevins. On March 19, 2016, Darrel Otto determined the fish were ready to be transferred to the troughs. In the troughs, they were fed daily and rates of flow, water levels and temperature were monitored. Approximately 45,000 fry were available for release in July 2016. Each Chinook salmon raised at the hatchery had a coded wire tag inserted and adipose fin clipped. TKC staff, Phil Emerson, Jenna Duncan and Deborah Fulmer assisted with the coded wire tagging and adipose clipping (Figure 2).

Figure 2 - TKC staff assisted in tagging fry at McIntyre Creek Incubation Facility. July 2016

FRY TRANSPORT & RELEASE

Fry releases into Fox Creek have taken place annually from 2009 to present with a total of 292,108 fry being released to date (Figure 3).

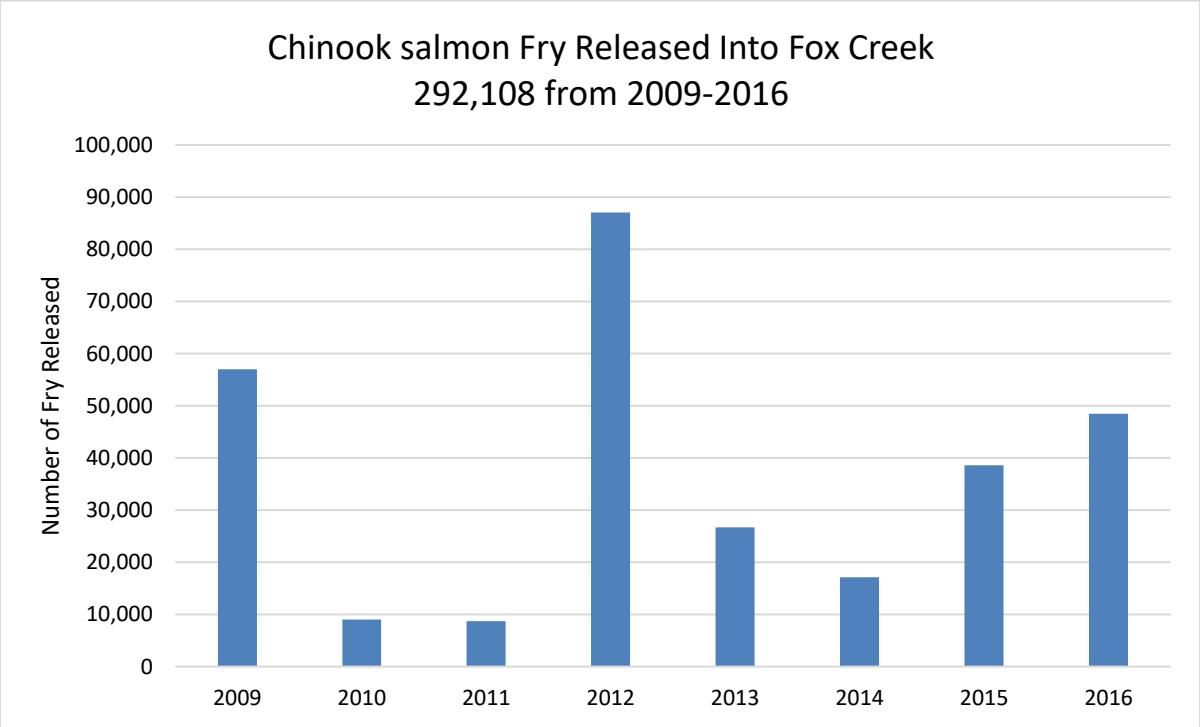

Figure 3: Chinook salmon Fry Released into Fox Creek 292,108 from 2009 - 2016

To reduce the number of fry in the tote to less than 20,000 there were a total of three releases over two days; July 17th and 18th.

Sunday July 17th, 2016

This was a public event to transport and release approximately 15,000 Chinook salmon fry out of the McIntyre Creek Hatchery. The technical support group who assisted in the release consisted of: Coralee Johns, Deborah Fulmer, Jenna Duncan and Phil Emerson from TKC; Jake Montgomery, Jamie Thomas, Shannon Harvey from MCIF; Sean Collins from DFO; and Jes Fulmer independent. Betsy Jackson was the TKC elder who blessed the fry, lead the group in prayer and released the first bucket of fry into Fox Creek (Figure 4).

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 (Figures 5-7).

Monday July 18th, 2016

This day was a technical release with the transport and release of approximately 30,000 Chinook salmon fry out of the McIntyre Creek Hatchery in two trips. TKC and MCIF staff released 20,000 at the Fox Creek

Bridge and 10,000 upstream of bridge at juvenile monitoring site MS08-01 (Appendix A - Figure 16: Fox Creek Juvenile Chinook Salmon Monitoring Stations). This was the first year fry were released upstream of the bridge and it was noted during latter sampling events these fry had migrated further upstream and were in very good condition. More details of the 2016 fry releases are provided in Appendix A.

Figure 5: Elder Betsy Jackson blesses Chinook salmon fry prior to release. July 17, 2016

Figure 4: A Proud Participant

Figure 6: Technical Support Staff Assisting Attendees Release Fry into Fox Creek. July 17, 2016

Figure 7: Experiential Science

JUVENILE CHINOOK MONITORING

Methods

There are four juvenile Chinook monitoring stations on Fox Creek at the following locations. Appendix A - Figure 16: Fox Creek Juvenile Chinook Salmon Monitoring Stations is a map of these locations.

- MS08-01 – located upstream of the North Klondike Highway Crossing approximately 2 km.
- 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.
- MS08-03 – located approximately 4-5 km downstream of the highway crossing.
- MS08-04 – located 100 to 200 meters upstream of the mouth of the creek; dependent on the time of year and Lake Laberge water levels.

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.

Juvenile Chinook monitoring methods have been standardized and are detailed in Appendix B - FOX CREEK CHINOOK SALMON RESTORATION PLAN, Phase II – The Second Salmon Life Cycle. Methods, standards and the implementation process are reviewed and updated annually; the most resent update was February 2017.

Results

In 2016, five sampling events were conducted by TKC on; May 3rd, June 24th, July 22nd, August 23rd and October 14th. An additional sampling event took place on June 16th to monitor 0+ wild fry that emerged from 2015 redd locations and these results are detailed in the Redd Monitoring section below. At the beginning of the season both Sean Collins of DFO and Al von Finster from the YSSC Technical team accompanied TKC to observe and advise on sampling techniques.

The 2016 juvenile monitoring season saw many changes which included; wild fry emerging from the 2015 spawning redds (this was a very exciting outcome for TKC), fry upstream of the MS08-01 release location well upstream of the Fox Creek bridge, large Slimy Sculpin that were feeding on salmon fry, large numbers of 0+ hatchery fry captured (338 at MS08-02 and 105 at MS08-03) and large wild and hatchery 1+ fry at various locations confirming overwintering success. New monitoring tables were

constructed by TKC Housing Department and installed at the monitoring sites and new equipment made monitoring more efficient and effective.

Table 1 summarizes the 2016 monitoring results with the total number of fry captured at each station during each event, the average fork length in millimeters and weight in grams. More detailed monitoring results are provided in Appendix A. A maximum representative sample of 30 fry measured and weighed at each site determined the average length and weight. A total of 654 juvenile Chinook salmon were captured during the five monitoring events.

Table 1: Number of Juvenile Chinook salmon Captured at Each Monitoring Station, During each Monitoring Event, of the 2016 Bio-Physical Monitoring Program on Fox Creek

Monitoring Events	Parameter	MS08-01	MS08-02	MS08-03	MS08-04	*TOTAL # of Chinook*
May 03/16	# of Chinook	0	5	1	0	***6***
	Avg Weight (g)	Not Taken	Not Taken	Not Taken	Not Taken	
	Avg Length (mm)	N/A	72.8	87	N/A	
June 24/16	# of Chinook	0	0	0	4	***4***
	Avg Weight (g)	N/A	N/A	N/A	2.35	
	Avg Length (mm)	N/A	N/A	N/A	63	
July 22/16	# of Chinook	35	338	8	5	***386***
	Avg Weight (g)	1.7	1.4	9.8	3.0	
	Avg Length (mm)	56	48	92	64	
August 23/16	# of Chinook	33	79	105	1	***218***
	Avg Weight (g)	3.1	2.2	3.4	4.7	
	Avg Length (mm)	68	61	69	79	
October 14/16	# of Chinook	8	22	10	0	***40***
	Avg Weight (g)	3.9	2.8	3.4	N/A	
	Avg Length (mm)	72	68.8	67.9	N/A	
TOTAL		***76***	***444***	***124***	***10***	***654***

Of the 654; 25 were presumed to be wild fish with adipose fins present and the remaining 629 with clipped adipose fins were presumed to be of hatchery origin. There were 76 hatchery Chinook captured at site MS08-01 which was a new 2016 release site. These fish were slightly larger on average than site 2 and were in very good condition. At site MS08-02, 444 hatchery fish were captured; at site MS08-03, 16 of 124 were wild; and at site MS08-04 all 10 fish were wild and assumed to have migrated to Fox Creek from their natal streams. Other species captured included a total of 45 slimy sculpin (Cottus cognatus) distributed at all site locations, 2 burbot (Lota lota) fry, 1 longnose sucker (Catostomus catostomus) fry at MS08-04 only, and 2 unidentified species at MS08-03.

Figure 8 displays the changes in average fork length (potential growth rate) of all juvenile Chinook salmon at each site throughout the monitoring season. The length of wild salmon and fish that have

potentially overwintered is included in the dataset. Table 2 shows the calculations of the average fork length.

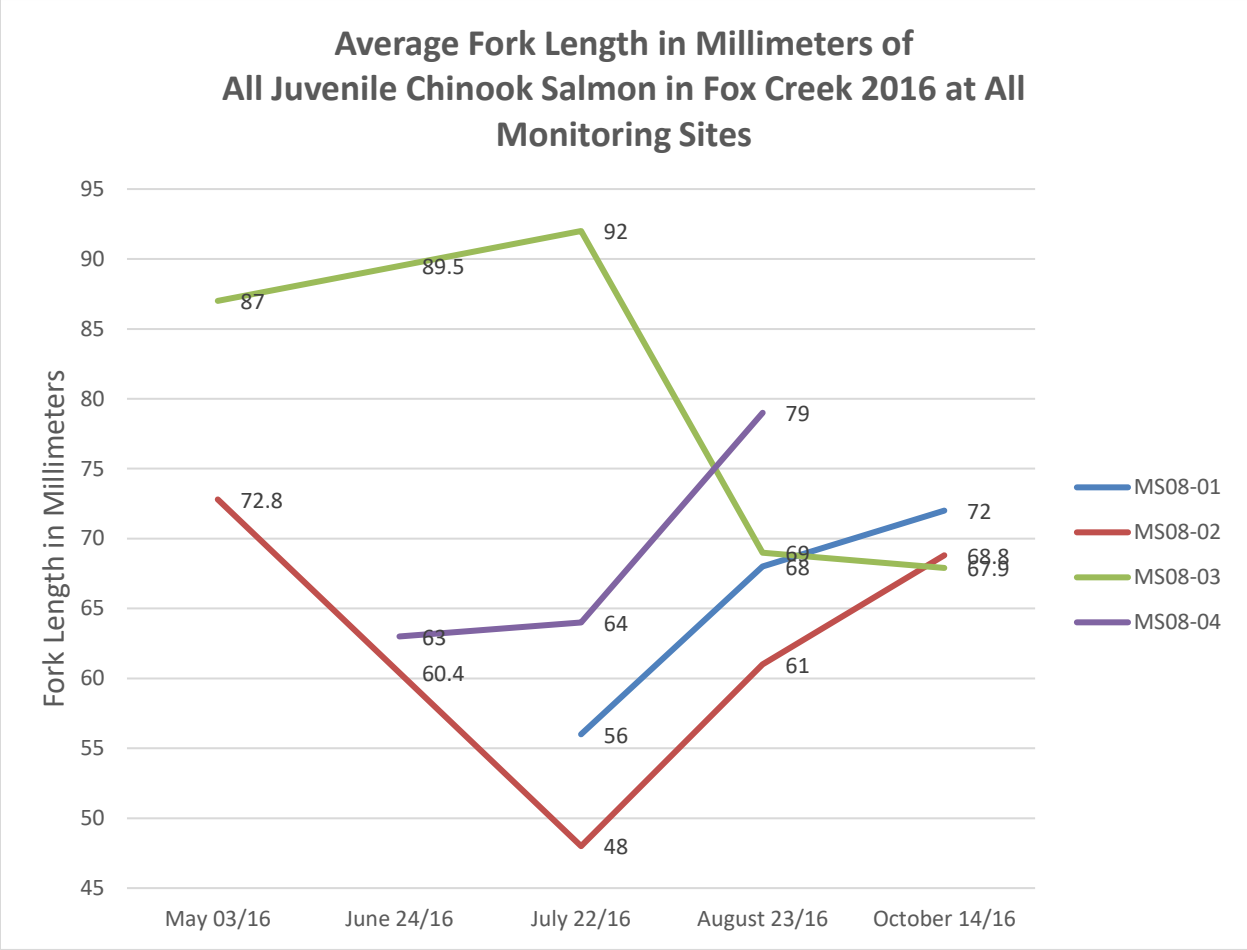

Figure 8: Average Fork Length of Hatchery and Wild Juvenile Chinook Salmon at All Fox Creek Monitoring Stations in 2016

Table 2: Average Fork Length (mm) of Fish at Each Site During Each Monitoring Event

Monitoring Events	*MS08-01*	*MS08-02*	*MS08-03*	*MS08-04*
May 03/16		72.8	87	
June 24/16		60.4	89.5	63
July 22/16	56	48	92	64
August 23/16	68	61	69	79
October 14/16	72	68.8	67.9	
No fish therefore average between May and July monitoring events calculated.				

Figure 9 displays the changes in average fork length (potential growth rate) of only the hatchery raised juvenile Chinook salmon at each site from the date of release to the end of the field season for MS08-01 and MS08-02 in 2016 and MS08-02 only in 2015.

In 2015 15,100 fry were released from the Whitehorse Rapids Hatchery on June 8th and 23,477 from McIntyre MCIF July 12th. Because the water temperature is higher at Whitehorse Rapids the fish grow faster and the average length in June was 55.5mm. The average length at time of release from McIntyre hatchery in July was 53.6. The longer average fork length on June 17, 2015 in Figure 9 could be reflecting the larger fry from WRFH.

In 2016 approximately 45,000 fish were released on July 18th and 18th from the McIntyre Hatchery. Approximately 35,000 were released at MS08-02 and 10,000 at MS08-01 The average fork length was 52mm at the time of release. The density of fish in the stream and competition for nutrients was potentially higher at MS08-02 and this could b reflected in the average fork length being smaller at this site in 2016 in Figure 9.

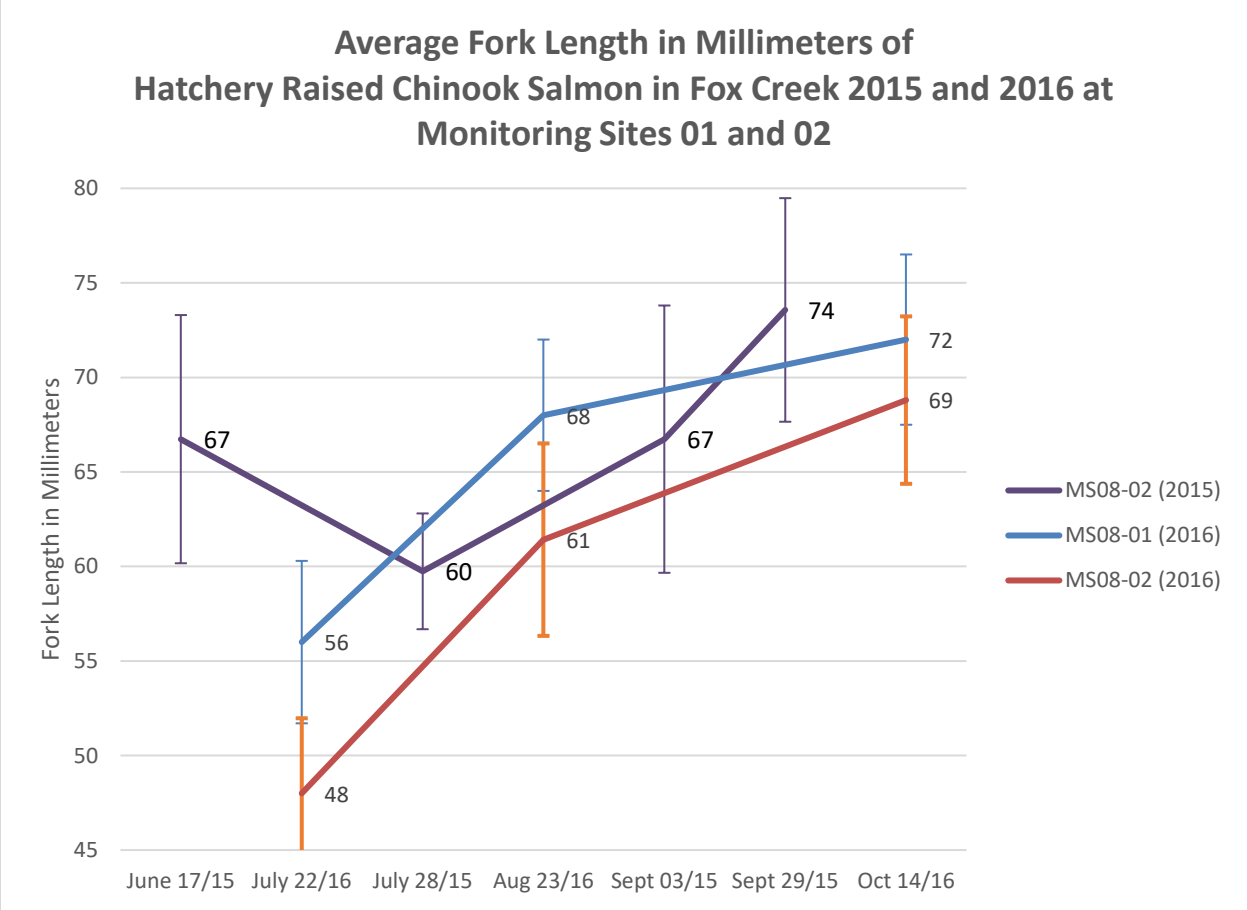

Figure 9: Average fork length (potential growth rate) of only the hatchery raised juvenile Chinook salmon at each site from the date of release to the end of the field season for MS08-01 and MS08-02 in 2016 and MS08-02 only in 2015.

HYDROLOGY AND WATER QUALITY

Discharge measurements were taken on 5 different occasions this year, on the same day as each of the juvenile monitoring events (except October 14th) and water level on the staff gauge was recorded each time TKC visited the creek. There was an additional discharge measurement taken on August 12th because it was reported by residents and Al von Finster that a beaver dam (BD516) just downstream of Fox Lake was reducing flows in the creek. Adequate flow is important for adult upstream migration, adequate spawning and rearing habitat and providing hydration and oxygen to eggs.

Deborah Fulmer and Jenna Duncan visited beaver dam site BD516 with Al von Finster on August 11th and completely removed the dam to restore adequate flows to the creek. TKC staff again returned and removed the dam on August 19th, Sept 16th and October 4th and 14th. Flow measurements throughout the season, displayed in Table 3, reflect the effects of this dam on water levels in the creek. Figure 3 depicts a graph of 2016 staff gauge readings.

Table 3: Discharge and Staff Gauge Measurements at Fox Creek Bridge in 2016.

Date	Discharge (m^3/s)	Staff Gauge (m)
May 3, 2016	1.59	0.308
June 16, 2016		0.345
June 17, 2016		0.310
June 23, 2016		0.265
June 24, 2016	1.20	0.358
July 21, 2016		0.245
July 22, 2016	0.94	0.240
August 8, 2016		0.150
August 9, 2016		0.150
August 12, 2016	0.44	0.150
August 16, 2016		0.195
August 19, 2016		0.196
August 23, 2016	0.75	0.205
August 23, 2016		0.250
September 1, 2016		0.270

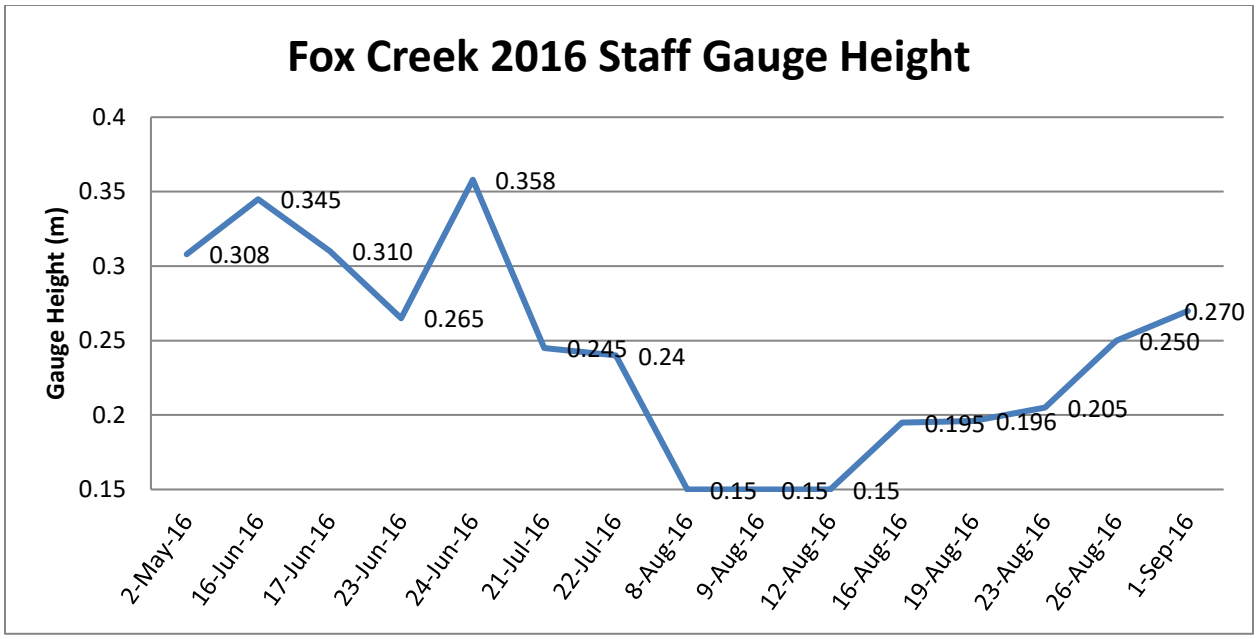

Figure 10: Fox Creek Staff Gauge Height (m) from May to September 2016

Along with discharge and staff gauge measurements, water quality in-situ measurements of; dissolved oxygen, pH, turbidity, and conductivity were also taken using our new YSI instrument. In addition to this, total metals plus an under-ice discharge measurement using the salt slug method were taken in February. The salt slug discharge was 0.315 m^3/s which appears accurate but needs to be verified by experts. The water quality results have not yet been received by the lab. The in-situ measurements are displayed in Table 4 below.

Table 4: In-situ Water Quality Measurements in Fox Creek, 2016.

Date	Time	H2O Temp	Oxygen % Sat	Oxygen mg/L	pH	Cond	TDS
2-May-16	12:20	5.9	99*	11*	7.65	331	165
24-Jun-16	14:30	15.1	93	8.4	7.52	332	165
21-Jul-16	15:07	12.8	94	9.1	7.75	321	NT
12-Aug-16	10:50	11.4	92	9.2	7.82	NT	150
23-Aug-16	15:10	13.0	104	10.0	7.82	345	172
26-Jan-17	11:55	0.0	88	12.9	7.81	296	125

*YSI Oxygen Not Calibrated
NT=Not Taken

From 2006 to present TKC, with support from Al von Finster, TKC 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 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 below in Figure 11 and 12. The data is indicating an increase in average monthly temperatures in April and May in recent years.

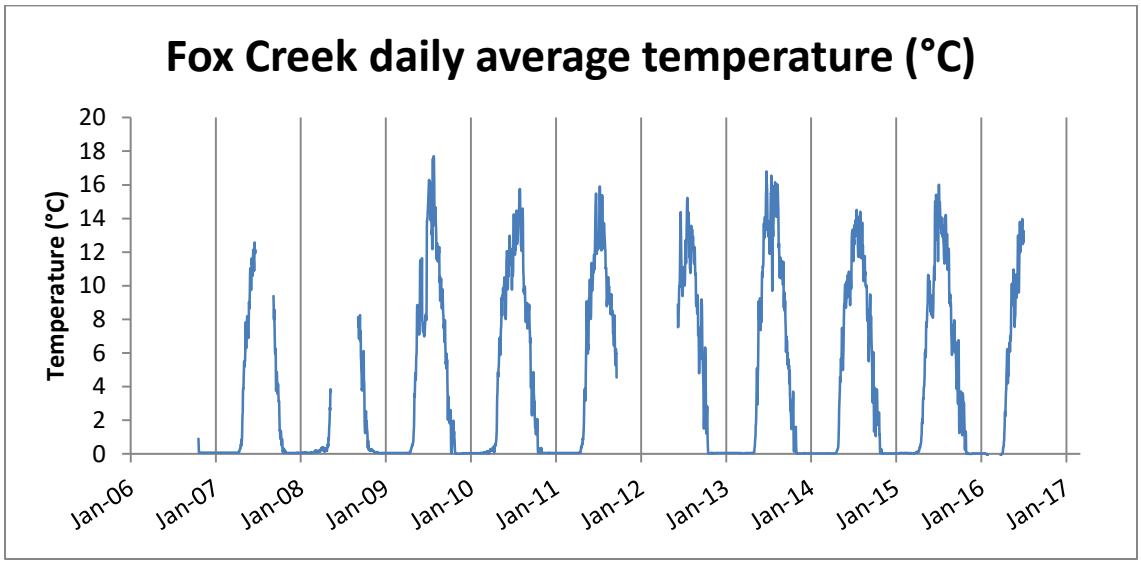

Figure 11: Fox Creek Daily Average Temperature (°C) from 2006 to 2017

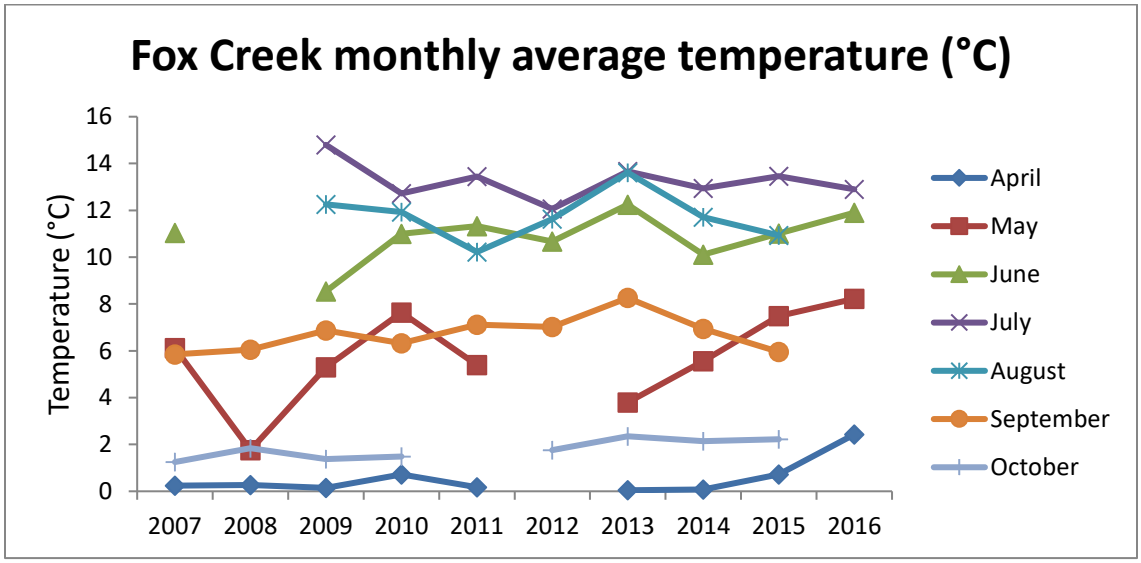

Figure 12: Fox Creek Monthly Average Temperature (°C) from 2007 to 2017

MONITORING ADULT SALMON RETURNS & BARRIERS

Barriers

To prepare for and observe returning spawners, creek surveys were conducted on foot along the monitoring trail by TKC staff Phil Emerson, Claudia Wickert, Deborah Fulmer, Testloa Smith and Jenna Duncan, John Bunbury, Andre Eckert-Maret, Ellorie McKnight, and Al von Finster of YSSC tech team. Expected return is from August 1 to September 1 so adult surveys were conducted from July 7 to September 1 to ensure returning spawners had unimpeded access up the creek, they were enumerated, spawning locations recorded, and carcasses recovered.

On July 7th and 8th, 2016 a stream survey of the lower portion of the creek from the BD315 (see map of beaver dams in Appendix A) to the mouth was completed to identify potential barriers. This survey confirmed there were 3 beaver dam barriers (BD116, BD216, and BD316) blocking access. There was a section of the creek that was extremely braided and difficult to navigate so throughout the monitoring period we surveyed this area and determined there were multiple beaver dams BD416 and BD616 to BD1216) (BD516 is located upstream at the outlet of Fox Lake). It was extremely difficult and time consuming to navigate through this area therefore we then spent most of our time moving adult salmon past these obstructions. The creek was more turbid this year making it difficult to enumerate and determine hatchery verses wild. The extensive beaver dams may have contributed to this sediment loading.

Although TKC held a beaver trapping workshop in April 2015 where 5 beaver were trapped, the beaver population appeared to increase as evidenced by the number of dams. The increase in beaver dam activity is displayed the beaver dam map attached in Appendix A. In 2015 (yellow font) there were three active beaver dams (BD115, BD215 and BD315) impeding upstream access to returning adults. This 2016 season there were 12 new dams impeding access (BD116 through DB1216) and BD215 from last season was still active.

To combat this increased beaver activity TKC supported several staff to complete a trapping workshop and become certified trappers. We have now hired a professional trapper to lead a trapping operation in strategic areas of the creek. The results of these efforts will not be available until April or May of 2017.

Figure 13: Large Beaver Dam (BD316) Barrier on Fox Creek 2016

Returns

We have confirmation of adult Chinook salmon returning to Fox Creek in 2013, 2015, this 2016 season and we speculate they returned in 2014. In 2016 they were observed from August 4 to 26. Throughout this period a total of 101 salmon were observed. As the same fish was likely observed more than once, we utilized individual markings and sighting locations to estimate a total of 30-35 adult returns to the stream this year. The total numbers of adults observed at one time, at one location, were 17 on August 24, 2016 just downstream from beaver dam barrier BD215. Due to high turbidity levels in the creek this season, it was extremely difficult to observe the presence of adipose fins and only one was confirmed.

Biological samples were taken from 4 carcasses. Three were males and one spawned female and all were near of beaver dam barrier BD215. Staff collected scale samples; measured fork and post orbital hypural length, then collected and tagged heads. The heads were submitted to DFO for further analysis and these results will be provided to TKC.

Areas of Chinook salmon spawning behaviour was observed, recorded, photographed and geo-referenced. Temperature data loggers, known as artificial redds, were again installed this season to determine the success of these redd sites. TKC will return mid-June 2017 to retrieve and analyse these loggers and monitor any 0+ fry that may emerge from the substrate.

Figure 14: Spawning Salmon at Salmon Siting (SS)416 Just Downstream of BD215

Figure 15: Three Male Carcasses Found in Beaver Dam (BD215)

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 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. The 2016 trail maintenance program cleaned up sections of the trail that were opened in 2015 then developed a new access trail into JCS monitoring site 4 for more expedient and efficient access. The section of the creek between BD115 ad BD215 that is very difficult to access was revisited in winter by Deborah Fulmer and Phil Emerson. The original channel was located, geo-referenced and flagged so a trail can be opened adjacent to it.

REDD MONITORING

On June 16, when TKC staff Deborah Fulmer and Jenna Duncan along with DFO staff Sean Collins and Maggie Wright went out to retrieve the temperature data loggers they were extremely excited to see YOY wild juvenile Chinook salmon fry in the back eddies near the 2015 redd sites. This confirmed successful spawning in the creek.

They set a series of traps near each redd site to capture, enumerate, measure and weigh the juveniles as follows;

Area Around Artificial Redd 1, 2 and 3 - (Traps R1- R11)
Area Around Artificial Redd 3 and 4 - (Traps R12- R14)
Area Around Artificial Redd 4 and further downstream - (Traps R15- R21)

When Deborah, Jenna and Phil Emerson returned and retrieved the traps the following day they were disappointed at the low number of YOY compared to what was observed in the creek. There were several 1+ Chinook salmon juveniles and Slimy Sculpin in the traps so it was assumed they were consuming the younger fish. This confirmed by dissecting two Slimy Sculpin and finding 3-5 partially digested fry in each. The 1+ salmon fry were not dissected because we did not want to sacrifice them.

Of the 21 traps set we captured 24 Slimy Sculpin, 19 YOY Chinook salmon, and 18 – 1+ Chinook juveniles. The average fork length of the YOY was 41 millimeters and the 1+ juveniles was 106 millimeters. Detailed data of this monitoring event is in Appendix A.

On November 2016 TKC staff Deborah Fulmer and Ellorie McKnight installed artificial redds using Tidbit 2 temperature data loggers at potential redd sites from the 2016 return. The sites are; Redd 116, 216 and 316 and are all located approximately 50 meters downstream of BD215.

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 their 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 2016 the Fox Creek project has been a high priority for TKC and both staff and citizens are very aware and involved in its progress. Throughout these 10 years, many TKC members have received valuable training and experience in fisheries 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 to female. The project team has not yet determined what biological indicators will indicate the achievement of our goal however, many results from the 2016 season indicate we are moving toward achieving it.

Through our bio-physical monitoring, the additional fry release location in 2016 potentially indicates growth rates of hatchery fry in the creek are dependent on the density of fry released because the 2016 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 removed to make a valid comparison. 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 with DFO and Al von Finster from 2006 to present is showing some trends in the results. Spring temperatures specifically April and May have increased in the creek in recent years. This could have both positive and negative effects. The positive effects are it has the potential to increase the ATU's resulting in fry emergence earlier in the year and larger, stronger smolts migrating to the ocean. The negative effects include disease, parasites, reduction in spawning and increased stress on returning adults if temperatures also increase in the fall. TKC acknowledges the importance of hydrology and water quality for salmon habitat therefore plans to install a hydrometric monitoring station during the 2017 field season.

Redd monitoring in 2016 both through determining the ATU's (accumulated temperature) in artificial redds adjacent to potential redds; and conducting bio-physical monitoring of the emerging YOY has shown this stream is viable for sustaining Chinook. The 2015 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 3 years and it appears the numbers of returning spawners is increasing each year. While the stream walks have successfully observed returning spawners in 2016, this method may not be the most effective for monitoring and enumerating adult salmon returns, as there is a high probability that observers could miss spawners or carcasses. Therefore, this coming 2017 field season TKC is committed to installing an effective enumerating system near the mouth of the creek to effectively observe returning adults and provide a better means of enumerating returning salmon. Stream walks would still be required to attempt to locate spawning areas, document obstructions and collect carcasses before they are removed by wildlife. Beaver activity in this system is high and could hamper access to spawning grounds. TKC is actively trapping beaver to reduce the number of barriers in the creek with 5 being captured in 2015 and 4 to date in 2016.

The Fox Creek project is the first Chinook salmon restoration project in Yukon therefore 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 Annual Implementation and Monitoring Plan” and the project partners meet bi-annually to discuss potential changes to project implementation based on monitoring outcomes and lessons learned. This section is updated on an annual basis and attached to the annual report (Appendix B). It will guide this pioneer project and future Yukon restoration efforts.

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APPENDIX A - SUPPORTING DOCUMENTS

Maps and Monitoring Data 2016

FOX CREEK FRY RELEASES 2016

Date		July 17, 2016	July 18, 2016 (at the bridge)	July 18, 2016 (at site 1)
Arrival Time at Hatchery				
Transportation Start Time				
Arrival Time at Release Site				
Start of Release Time		12:15	11:30	14:30
End of Release Time		12:35	11:50	14:55
Number of Fry		Approx. 15,000	Approx. 20,000	Approx. 10,000
Hatchery oxygen and temperature		6.5˚C, 8.4 mg/L	6.2˚C, 8.3 mg/L	6.5˚C, 8.4 mg/L
Oxygen Concentration and Temperature in Tote	Initial	6.0˚C, 10 mg/L	6.1˚C, 10.0 mg/L	6.8˚C, 9.9 mg/L
	Before Transport	6.2˚C, 16.2 mg/L	5.9˚C, 8.0 mg/L	6.6˚C, 10.6 mg/L
	During Transport	6.3˚C, 16.6mg/L	6.0˚C, 14.1 mg/L	6.7˚C, 12.8 mg/L
	Arrival at Site	6.4˚C, 14.7 mg/L	6.1˚C, 16.5 mg/L	6.8˚C, 14.9 mg/L
	Before the Release	12.1˚C, 13.2 mg/L	11.2˚C, 7.4 mg/L	6.8˚C, 15.4 mg/L
Tote Used		722 L	722 L	722 L
Bubbler Was in Good Working Order		Yes	Yes	Yes
Fox Creek Temperature and Oxygen Concentration		13.9˚C 8.9 mg/L	13.5˚C 9.0 mg/L	13.5˚C 9.0 mg/L
Average Weight of Fry		1.55 g	1.55 g	1.55 g
Average Length of Fry		52 mm	52 mm	52 mm
Weather		Sunny/Partly Cloud	Cloudy	Sunny/Partly Cloud
Staff Gauge		0.250	0.245	0.245

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

JUVENILE MONITORING

Date	MS08-01	MS08-02	MS08-03	MS08-04
May 3, 2016	No Chinook at this location only 2 Slimy Sculpin.	5 Chinook Salmon at 72.8 mm average length; no adipose fins. Note: no weight taken.	One Chinook at this location at 87 mm in length. No adipose fin. Note: no weight taken. 4 Slimy Sculpin.	No fish caught at this site.
June 24, 2016	No Chinook at this location only 1 Slimy Sculpin.	No Chinook Salmon. 5 Slimy Sculpin at 64 mm average length. Note: no weight taken.	No Chinook at this location only 5 Slimy Sculpin and 2 unknown juvenile species.	4 Chinook Salmon at 2.35 g weight and 63 mm average length All with adipose fin. 1 Slimy Sculpin, 1 suckers and 1 Burbot.
July 22, 2016	35 Chinook Salmon at 1.7 g average weight and 56 mm average length. No salmon with adipose fin. 4 Slimy Sculpin	338 Chinook Salmon Sampled 30 at 1.4 g average weight and 48 mm average length. No salmon with adipose fin. 3 Slimy Sculpin	8 Chinook Salmon at 9.8 g average weight and 92 mm average length. Large healthy smolts all with adipose fins. 2 Slimy Sculpin.	5 Chinook Salmon at 3.0 g average weight and 64 mm average length. All salmon with adipose fins. One Burbot.
August 23, 2016	33 Chinook Salmon at 3.1 g average weight and 68 mm average length. No salmon with adipose fin. 1 Slimy Sculpin	79 Chinook Salmon Sampled 30 at 2.2 g average weight and 61 mm average length. 4 Slimy Sculpin	105 Chinook Salmon Sampled 30 at 3.4 g average weight and 69 mm average length. 23 of 30 with adipose fins. 4 Slimy Sculpin.	One wild Chinook at this location at 4.7 g in weight and 79 mm in length. One Slimy Slulpin.
October 14, 2016	8 Chinook Salmon at 3.9 g average weight and 72 mm average length. All wild salmon with adipose fins. 1 Slimy Sculpin	22 Chinook Salmon at 2.8 g average weight and 68.8 mm average length. 1 Slimy Sculpin	10 Chinook Salmon at 3.4 g average weight and 67.9 mm average length. All wild salmon with adipose fins. 3 Slimy Sculpin.	No fish caught at this site.

ADULT MONITORING

Date	Staff	# of Chinook	Weather	Notes
7-Jul-16	Phil and Claudia		partly cloudy, rained overnight, 23˚C	Mouth of creek had 4-6 old dams of various ages. Some of the newer broken dams had cuttings that were sprouting roots
				Old dam (small) beaver tracks in the mud and some signs of fresh cut vegetation. Should return to this area to check activity. Waypoint 38
				Waypoint 39 **(BD416)**, new signs of dam. Photos taken. Still an active channel, brown and green foliage on building material, not a lot of sediment being held back by the dam.
				BD116- Full Dam located 40m upstream water sieving through but not enough for fish passage. Water is diverting around main channel and flowing through grassy section of the creek. Sediment is visible behind dam, rocks and sticks (Covered in sediment) are visible on the bottom therefore there may not be as much sediment as appears being held up.
				BD115- Beaver dam from 2015 season (upstream of the main holding pool) has been broken and there appears to be enough water flowing for fish to pass.
				Short section between two active dams in 2015 has clean gravel substrate
				BD215- Beaver Dam from last year, water is now running around and through the dam. Sediment is holding behind the dam. Clean gravel in small channel from draining water.
8-Jul-16	Phil		partial cloud, 24C, light wind	**BD315-** Below site 3 (staging area for the beaver trapping workshop) there is a newly constructed dam upstream from the large dam created in 2015. 5 beavers were removed from this area over the trapping workshop and the area still appears to have an active beaver population. Green and brown leaves on dam material, freshly cut poplar on the hill side, beaver tracks in the mud. Water is sieving through the dam in sections but there does not appear to be an active channel that would be passable for fish. Clean gravel below the dam and the main channel is flowing on the downstream left hand side along the cliff/rocky bank.
				BD315- Old (large) Dam constructed in 2015 is no longer being used (broken). Water levels in the area have dropped about 2 feet, old lodge no longer has underwater access. Creek channel is flowing on the downstream right hand side. Decent flow through broken section of dam, but may require maintenance to allow fish passage. (pictures taken)

				Walking below beaver trapping dam there is rocky gravel and along the downstream right side of the creek is a steep bank with coniferous forest, clean gravel.
				BD215- waypoint 222, beaver dam water in area is at vegetation line, no signs of lower water. Water is currently sieving through dam and there are brown and green leaves on vegetation used in dam construction. This is also the end of the cut trail along the creek.
4-Aug-16	Jenna, Deborah, Testloa		Sunny with mild wind approx 20˚C	**BD315-** We got to this dam at 10:50. There are 2 dams at this site. The downstream dam seems to have a channel on the left side that the salmon could swim through. We took a photo and will confirm this with Claudia and Phil. There is minimal water level change at this dam. The upstream dam appears active (we took a picture and again will confirm with phil and Claudia). There is a major water level change and we can see green vegetation on the dam. There were no fish visible from either side of the downstream dam when we were looking down from the bank. We saw fresh beaver cuttings. We took a waypoint of the dam.
				BD215- We got to this dam at 12:15 and took a way point. We took a photo downstream and upstream of the dam. There were new grizzly tracks at this location but the bear looks small. The damn completely blocks the creek and there were no fish directly downstream of dam.
				2015 Holding Pond- We did not see any salmon here yet. There were some old bear tracks (Testloa thinks they are from a black bear). The beaver dam upstream of the pond is drained.
				BD116- Is completely blocking the channel and there is a large elevation change. It is a small dam but appears active. There were no salmon at the base of the dam. We took a waypoint and photos upstream, at the dam and downstream
				The area where the redds were last year is now flooded…
		5		**BD416**- This is a new dam that is very active and blocking the channel. We saw 2 salmon at the base of the dam and 2 about 10 m downstream of the dam. There was a lot of sediment in the water which made it very hard to see the fish clearly. We did not get any genders and could not figure out if they had adipose fins or not. There is a major elevation change and we decided to notch the dam. While notching the dam, there was another fish that kept bumping into Deborah's leg. We saw unidentified minnows on each side of the dam. We also saw 2 adult grayling on the downstream side of the dam.

				After notching the dam, we sat for approx. 15 minutes upstream of the dam in various spots to see if we could see any chinook coming over the 1st dam. We did not see any and Testloa mentioned that the fish usually don't move until the evening when the air and water temperature begins to cool.
8-Aug-16	Jenna and Phil	7	cloudy and windy 15˚c	**2015 Dam not Active (BD115NA)-** there is a side channel U/S that we saw 7 salmon holding in. 3 were in a group in the middle one was upstream about 50 m and the other 3 were downstream about 75m. We noticed 2 of the salmon in the middle group did not have adipose fins but were unable to tell on the others as there was lots of sediment in the water.
		2		**2015 holding area-** we saw 2 salmon in this area. We scared them off before we could look for adipose fins
				BD116- Appeared to still be notched enough for fish to swim through. There was no sign of the beavers being around. We did not see any fish directly upstream of dam
		1		there was one salmon downstream of BD1
				BD416- Beavers started to rebuild the dam but there was still some flow coming through. We decided to re-notch the dam. We did not see any salmon directly downstream of the dam
		2		**BD115NA-** saw 2 salmon in a grassy area where the creek forks off into different directions. Took photos of the junction.
				BD1016- Found a BD in the valley where the creek separates. There was an elevation change in the water. We notched this dam in case it was effecting the salmon. Took a waypoint of the dam (BD valley)
				BD1216- Found another BD upstream of the valley. It has pooled up significantly in the area and will probably need to be revisited to be notched. Although the dam did not appear to be still active it was blocking the creek. Took a waypoint (BD Pool)
				The area in between BD115NA and BD215 needs to be explored so we can map out where the main channel of the creek goes so that we can ensure the salmon will make it through. The creek seems to fork off into many different directions so it will take some time to map these out. So, that we can tell which direction the main channel goes.
				Staff gauge was below 0.15 m. The bottom of the gauge is very rusty so we could not read the gauge correctly.

9-Aug-16	Jenna and Deborah		partly cloudy with some showers 18˚c	**Upstream of BD215-** We were trying to go to BD215 but got on a wrong trail and came out of the trail a bit upstream. There were 2 fences on each side of the trail with a gate that was open. There was a big rut in the side of the bank where it looked like maybe someone had pulled in a boat? We took some photos of the area.
				BD215- We saw some ATV tracks on the ridge on the way to BD215. We did not see any salmon downstream of the dam. The water level in the area was low.
		7		**U/S of BD115 (in drained pond)-** We saw 7 salmon possibly the same from the previous day. One salmon had a white stripe on the dorsal fin and tail. Another had a white mark on its head and all the way down it's body and did not have an adipose fin. The other fish appeared to not have any markings and we could not tell if they had adipose fins. The fish appear to be holding there so we assume there is another dam further upstream. We saw a cow moose and calf tracks. There is a small start of a dam about 50m upstream of where the salmon are holding. We notched the dam in case that is what is holding the fish in the area. We created a waypoint of the dam and took a photo. (saw possible beaver tracks in area and took photo)
		1		**Old 2015 holding pond-** saw movement of one large fish possibly a salmon. There was too much sediment in the pond to see clearly.
		3		**BD416-** We saw 3 salmon on the d/s side of the dam. They were staying together and it looked like they were trying to make it over the dam. There were no adipose fins on any of the fish. We saw 2 salmon make it over the dam. We decided to notch the dam to make it easier for any other fish to make it over. There were deer tracks at this site and we also saw some beaver tracks. Although there was minimal activity at the notch from yesterday.
				We found another possible fish barrier dam approximately 100m d/s from BD416. We did not look to see if the dam was holding up any salmon but will go back and check
				BD116- There has been no beaver activity at the notch and we did not observe any fish u/s or d/s of the dam.
				Staff gauge was at approx. 0.15 m at 14:10. The gauge is rusty at the bottom so reading is approximate.
11-Aug-16	Deborah, Jenna, Al		sunny and partly cloudy with some showers	**BD516-** went upstream of bridge to where they hold horses and we completely took down a beaver dam that may have been blocking the flow into the creek. We took some photos and Al took info on the dam.
		5		**U/S of BD115-** Saw 5 salmon in the holding area. 3 at first then one by itself downstream and one by itself upstream

				where we took down a small beaver dam on Tuesday. One fish had a white stripe down it's back and on the top of the tail. And one had white on its front. It doesn't look like any have spawned yet the spots are just from moving through the creek. They also don't seem to be the same fish that we saw on Tuesday. We cleaned up some logs at the u/s side of the holding pool incase that is causing them difficulty to move on.
				2015 holding pond- No fish and we noticed that the water was significantly clearer last year than it is this year.
				BD116- The water level u/s of the dam seems to have dropped back down to what it was last year. There does not seem to be any fresh beaver activity at the dam. We did not see any fish on either side of the dam.
		1		**BD416-** There was a small amount of rebuilding at the notch so we took it down and cleared out a bigger area. There was one fish on the d/s side of the dam that looked a bit rough. It did not seem to be moving but could have been just holding in the area. There were white almost brown marks on the top of the fish. It could be a female but there were no white spots on the sides of the tail so she has not spawned yet. We went d/s a bit and when we got back the fish was gone.
				We went d/s of BD416 to check out a possible beaver dam we noticed on Tuesday. It does not seem to be blocking a channel so we left it the way it was.
				BD215- No fish have made it to this dam yet. There must be something blocking the fish before this dam.
				We saw a lot of deer tracks throughout the area but did not see any new bear tracks.
				Staff gauge was at approx 0.16m
12-Aug-16	Deborah and Jenna		Windy, overcast 15˚c	Took a flow of the creek at 10:50. Staff Gauge was at approx. 0.15m. Saw possible wolf tracks in the area.
				We noticed many more dams in the area between BD215 and BD116 than we had anticipated. We decided to walk downstream from BD215 today to hopefully map out where the creek goes and where the beaver dams in the area are located.
				BD1115- There was a big blockage in this area but it did not look fresh. It did not seem to be the original channel but the original channel had a very small amount of water leading to it and this area seemed to be fine for the salmon to swim up. Notched a big area.

				We saw some bear habitat on the way to BD616 and we took a waypoint. There was some bear feces and a clear-cut area there the bear has likely been eating and spending time. The feces looked somewhat old but we decided to mark the area anyways.
				BD716- New beaver dam farther d/s. The dam looks new as there was green leaves on top of the dam. We took a waypoint of the dam. We also found some good spawning habitat on and off throughout the walk from BD215 to BD616.
				BD716- This is a huge beaver dam that is holding up a huge amount of water that is flooding the area. We took a picture and a waypoint of the dam. We anticipate there is another beaver dam not too far downstream of this one as the water below the dam does not seem to be flowing and is also flooding the area. We notched a big hole in the dam.
				BD816- We did see another beaver dam downstream of BD716 but we did not have time to notch the dam.
16-Aug-16	Deborah, Jenna, Phil		overcast, showers, 15˚C	The staff gauge at 9:50 was 0.195 m so the water level is increasing a bit from when we broke the beaver dam upstream of the bridge.
				We left the truck at 10:15. Phil headed to BD416 to work upstream from there checking for fish and making sure the beaver dams were still notched. Jenna and Deborah went to BD716 to work downstream to check for more beaver dams and make sure the big beaver dam was still notched. We brought walkie talkies to make sure we stayed in contact with each other and that everyone was safe.
				BD716- The beavers have completely rebuilt this dam and it still seems to be holding up a great deal of water. We re-notched the dam. We took a picture of the dam and of a beaver dam house that was upstream in the pool of water.
				BD816 and 1216- We found two dams not too far down stream of BD716. The whole area is flooded and difficult to navigate around. We notched both dams and took waypoints and pictures.
		4		**BD1016-** There was another dam farther downstream in an area Phil and Jenna were trying to navigate through on the 8th. We marked the waypoint on the 8th but didn't have time to notch the dam. We saw 4 salmon at the base of this dam! One salmon jumped out of the water and had a hooked nose so was probably a male. We notched this dam significantly, the dam is very tall and we wanted to make sure the salmon could get up and over it. There is a very strong flow through the notch as there was a lot of built up water. We took a picture of the dam.

19-Aug-16	Jenna and Deborah		overcast, 13˚c	**BD516-** went to upper dam at horse packing adventures to check if the dam has been rebuilt. There has been some activity at the dam. We completely took down the dam and took photos of the dam upstream and downstream
		1		**BD215-** 1 salmon with white stripe all along the dorsal that is wide. Took a waypoint (SS416). Took a photo of pool. Walked u/s of pool to check for more salmon. Notched the dam. There was some green foliage of the dam. There is lots of water flowing through the notch. The dam is old.
				BD616- Dam is still open but there were some fresh cuttings so we cleared it up and took pictures.
				BD716- The dam has been completely built up. There are lots of wasps around. Started notching at 13:04 and finished notching at 13:39. Took photos.
				BD816- Dam has been rebuilt. There is a muddy bottom in the area. Started notching at 13:50. Took photo. Found an unknown fish skin probably from last year. Finished notching at 14:05.
				BD1216- Dam is still open. We wanted to clear the notch out some more. Marked a waypoint. Started clearing at 14:18. Finished cleanup at 14:33. Took photos.
		11 (1 Wild)		**BD1016-** Saw 5 fish one that had no red and was almost grey with spots and no adipose fin. One red with white on top of head and sides of tail. One fish with no markings but with an adipose. One with a white stripe all the way down the dorsal and one big with no markings. There were three more fish farther downstream of the dam 2 red and one with white markings. We observed a total of 11 fish but we could not get a good look because there was so much sediment in the water. The dam was still notched but too high for fish to jump. Took dam down further at 15:00 and finished at 15:30.
		1		Found a dead salmon carcass on the way out. Did not take a sample as it was already too rotted.
				Staff gauge was at 0.196
22-Aug-16	Deborah, Jenna, John, Andre		Sunny with wind	Deborah and Jenna went upstream to BD215 and John and Andre went downstream to BD416. We communicated over a walkie talkie
		8		**BD215-** 3 salmon were together under a dead tree approx. 100m downstream of dam. Water was cloudy so it was hard to see the details of the fish. There was another fish slightly farther downstream in a back eddy. Another was upstream and had intermetal white spots on dorsal. Found a possible redd and marked waypoint redd116. The notch in the dam had been fixed and since there seemed to be quite a few fish backed up here we decided to notch the dam. We started notching the dam at 11:30 and finished at 12:10.

				While notching the dam we found 3 salmon wrapped around a stick that was sticking straight up at the bottom of the dam. We took samples of the fish.
				BD315-Checked dam to see if there were any salmon there yet. We did not see any from up on the bank.
				Notes from John and Andre- didn't see any fish. Saw tracks from a bear and a moose. Dams were rebuilt but that did not re-notch.
24-Aug-16	Deborah and Jenna	17	Cloudy 18˚c	**BD215-** There were 3 salmon where our trail comes out to the creek. One with varied spots on body, one with an arrow shape on its head, and one with a white head and scraped up tail. All look like small males. Doesn't look like there is any spawning activity. Another has 3 distinct spots on its head each about 2cm in diameter. Another had a large spot on its nose and a strip down it's back. Marked waypoint SS416 and Redd116. Saw some gravel in the area that looked like a possible redd. Took a photo. Saw another fish with a white spot on the left when looking from the tail and it had almost a grey tinge to its red colouring. Saw another fish holding farther upstream possibly a female with not many markings but 7 small spots on top of head. One has a huge white spot on head leading to dorsal. This one and previous seem to be paired up. Previous is not moving much. Another fish has a 3 cm diameter spot on head and to dorsal fin. Saw another further upstream with 2 spots on the top of its head, one big about 1.5 cm in diameter and a smaller spot right behind it at 1cm in diameter. No adipose on this fish and the spots are oblong shaped. Have another fish in area with 2 spots on top of head but the first spot is larger about 3cm in diameter with the smaller behind being about 1cm in diameter and the spots are circular. The dam is fixed but we did not notch it. There seems to be a secondary dam being built about 10m downstream of main dam. There is a possible redd there and we took a photo. We saw a bunch more fish in a hole at the edge of the creek but they were too deep too deep to determine markings and how many there were. Saw another with a stripe starting at its neck with no markings on its head. Saw possibly 4 fish in a pool under a big dead tree. Pool is deep with lots of sediment so it was hard to determine how many were in there. One fish was large with lots of white on its head and tail with grey on the nose and a stripe down it's back. Seemed to be protecting a possible redd (waypoint redd216). There is a possible female in the pool that was large and had spots on the sides and a white tail. Arrow head was also in the pool.
				BD616- Dam still clear

				BD716- Dam rebuilt. Took photo
				BD816- Dam rebuilt. Took photo
				BD1216- Still open. Good spawning habitat downstream of dam. Newer bear tracks downstream
		2		**BD1016&SS316-** 2 fish at the base of the dam with no markings. Dam is still open but there may be a couple of sticks in the way of the salmon getting up the dam. Saw some dog prints downstream. Lots of bear activity in this area. It stunk from fish being pulled out of the creek and the remains rotting. There were semi fresh track and bear scat.
				SS216- lots of moose tracks in this area. Saw some bear tracks. Saw a possible fish. (just saw movement)
				Marked waypoint of BD115NA
				BD116- Dam is still open
				BD416- There is still a small amount of flow getting through the side of the dam but not enough for salmon to be able to get up. We did not see any fish at the base of the dam.
25-Aug-16	Phil, John			**BD916**- Marked a waypoint. Found a new dam downstream of BD315. Good flow through the dam but no channels for fish to move through. Did not see fish below.
		11		**BD215-** Found 2 fish carcasses downstream of BD from the 22nd. Walked down 50m and found a red and 4 salmon close to it. Water was a little mark. One with lots of white. 7 salmon around redd 316.
				potential redd at log jam downstream of reddd316 in the main channel of the creek.
26-Aug-16	Deborah, Jenna	9	Cloudy with showers 11°C	**Redd316-** 9 fish here. One with a grey head staying still (female) and one with white on the tip of the head and on the nose chasing the other fish away. One smaller with worn down head almost to the bone and biting a larger fish with spots on the head with a white tail. Possible female that has got bitten multiple times by different fish. The fish is staying close to the bank. Arrow head is back in this area. All fish are very active and chasing each other around
		3		**Redd216&SS416-** 3 fish in area 2 around the pool and one staying away. The larger fish seems to be protecting the area so there is likely a female in the pool.
				bear activity by the redds
				Found the starting of a dam about 100m upstream from BD215 (waypoint 224 Garmin Dakota 20)
				Found old BD916 in same location as BD816 so deleted the waypoint BD916 from the GPS
				Staff Gauge 0.25m
26-Aug-16	Phil		overcast, light/moderate rain, 12C	Started walking upstream from the mouth at 10:30, found an old log jam and water has diverted around it, with good fish access

				Cut willow (with green leaves) on the river right side of the creek waypoint 002 Garmin 76, approximately 30meters upstream of the log jam. no debris in the water.
				BD116 dam has been partially repaired (fully blocked for fish passage), water is sieving through the new repair and there are no other channels in the area. No fish were seen below the dam and approximately 30 minutes above and below the dam looking for fish. walked back downstream from this site.
1-Sep-16	Deborah, Phil		Cloudy, cool, 8°C, heavy low cloud cover.	10:00 left truck, 10:30 BD516 no live fish visible. Found one carcass at BD1116 and took samples. Did not have a scale card so placed them on the back of the Jaw card and transferred them at the office. Scale samples may be compromised by this transfer. Back at truck at 11:40. 12:00 staff gauge reading 0.270. Suggested no more creek walks because no more live or carcasses found.
16-Sep-16	Deborah, Ellorie		12C, overcast	Left office @ 2PM, back @ office at 4:30PM (@ creek between ~2:45 and ~3:45pm). Site visit BD516. Purpose: dismantle beaver dam. Several fish seen downstream of dam (5-6) all about 15-20cm long, did not see them well enough to determine species but could they be salmon smolts? Creek flow rose significantly after dismantling of dam.
5-Oct-16	Phil, Ellorie		sunny, cool	Dismantle same beaver dam as above + smaller dams just under bridge that had been built since the Sept 16 visit
13-Oct-16	Deborah, Stan		minus 9C in morning, sunny no clouds, 2C @ 4PM	Hike to BD215 to flag trail up stream to connect to 2015 trail. Flag d/s to BD1116. Very tough going and does not make sense to flag dense sections. Instruct trail blazers to stay close to creek in these areas. Back at truck at 1pm. Site 1 @ 15:20 (4 Gee traps), Site 2@ 14:20, Site 3 @ @ 14:40, Site 4 @ 13:40, site iced over moved u/s and looked @ trail. Mandy from Yukon Backpacker Adventures called again to say beaver dam at site BD215 was rebuilt.
14-Oct-16	Deborah, Stan		cloudy -3C	Deborah and Stan fox creek biomonitoring. 9:20AM drove to Mandy's BD516 to clear dam. 11:20AM site 1 - pulled traps - see data sheet. 8 chinook, 1 slimy sculpin, 12:20 - check out BD 315 to show Stan trailhead to BD215. 12:52: site 4 - pulled traps no fish 13:23 left site. 13:50 - site 3 (10-ck, 3-ccg) 14:30 - left site; 14:43 site 2 21-ck, 1ccg 15:30 left site. 15:5- 0.2m ice around bottom.

REDD MONITORING

FOX CREEK YOY JUVENILE MONITORING AT 2015 ARTIFICIAL REDD LOCATIONS

CH= Chinook
CCG= Slimy Sculpin

	Set June 16, retrieved June 17, 2016 - 1/8 inch mesh Gee traps					
Site Number	**Fish #**	**Length (mm)**	**Weight (g)**	**Adipose Clip**	**Species**	**Total # of Chinook**
Area Around Artificial Redd 1,2 &3 (Traps R1-R11)	1	115	12.1	No	CH	**8**
	2	96	10.4	No	CH	(4 over winters, 4 fry)
	3	109	10.7	No	CH	
	4	40	0.4	No	CH	
	5	37	0.3	No	CH	
	6	37	0.3	No	CH	
	7	108	13.9	No	CH	
	8	35	0.4	No	CH	
	9	87	N/A	N/A	CCG	
	10	76	N/A	N/A	CCG	
	11	56	N/A	N/A	CCG	
	12	74	N/A	N/A	CCG	
	13	68	N/A	N/A	CCG	
	14	70	N/A	N/A	CCG	
	15	69	N/A	N/A	CCG	
	16	83	N/A	N/A	CCG	
	17	60	N/A	N/A	CCG	
	18*	92	N/A	N/A	CCG	
Area Around Artificial Redd 3&4 (Traps R12-R14)	19	78	2.2	No	CH	**7**
	20	108	10.2	No	CH	(All over winter)
	21	100	9.2	No	CH	
	22	118	14.2	No	CH	
	23	78	2.8	No	CH	
	24	130	19.9	No	CH	
	25	112	11.6	No	CH	
	26	approx. 100	N/A	N/A	CCG	
	27	approx. 100	N/A	N/A	CCG	
	28	<70	N/A	N/A	CCG	
	29	<70	N/A	N/A	CCG	
Area Around Artificial Redd 4 and	30	116	12.4	No	CH	**22**
	31	115	14.5	No	CH	(7 over winter, 15fry)
	32	116	8.6	No	CH	
	33	115	13.1	No	CH	

further downstream (Traps R15-R21)	34	40	0.6	No	CH	
	35	44	0.8	No	CH	
	36	113	N/A	No	CH	
	37	112	N/A	No	CH	
	38	64	N/A	No	CH	
	39	43	0.6	No	CH	
	40	45	0.8	No	CH	
	41	40	0.4	No	CH	
	42	39	0.5	No	CH	
	43	45	0.8	No	CH	
	44	38	0.5	No	CH	
	45	43	0.7	No	CH	
	46	36	0.3	No	CH	
	47	35	0.4	No	CH	
	48	43	0.6	No	CH	
	49	44	0.8	No	CH	
	50	46	0.9	No	CH	
	51	55	1.5	No	CH	
	52	93	N/A	N/A	CCG	
	53	88	N/A	N/A	CCG	
	25	87	N/A	N/A	CCG	
	55	83	N/A	N/A	CCG	
	56	83	N/A	N/A	CCG	
	57	65	N/A	N/A	CCG	
	58	62	N/A	N/A	CCG	
	59	76	N/A	N/A	CCG	
	60	83	N/A	N/A	CCG	
	61*	80	N/A	N/A	CCG	
Averages	**Slimy Sculpin**	76.8	N/A			**24**
	Chinook (General)	72.6	5.2			**37**
	Chinook fry	41.3	0.6			**19**
	Chinook (Overwinters?)	105.7	11.1			**18**
	All fish					**61**

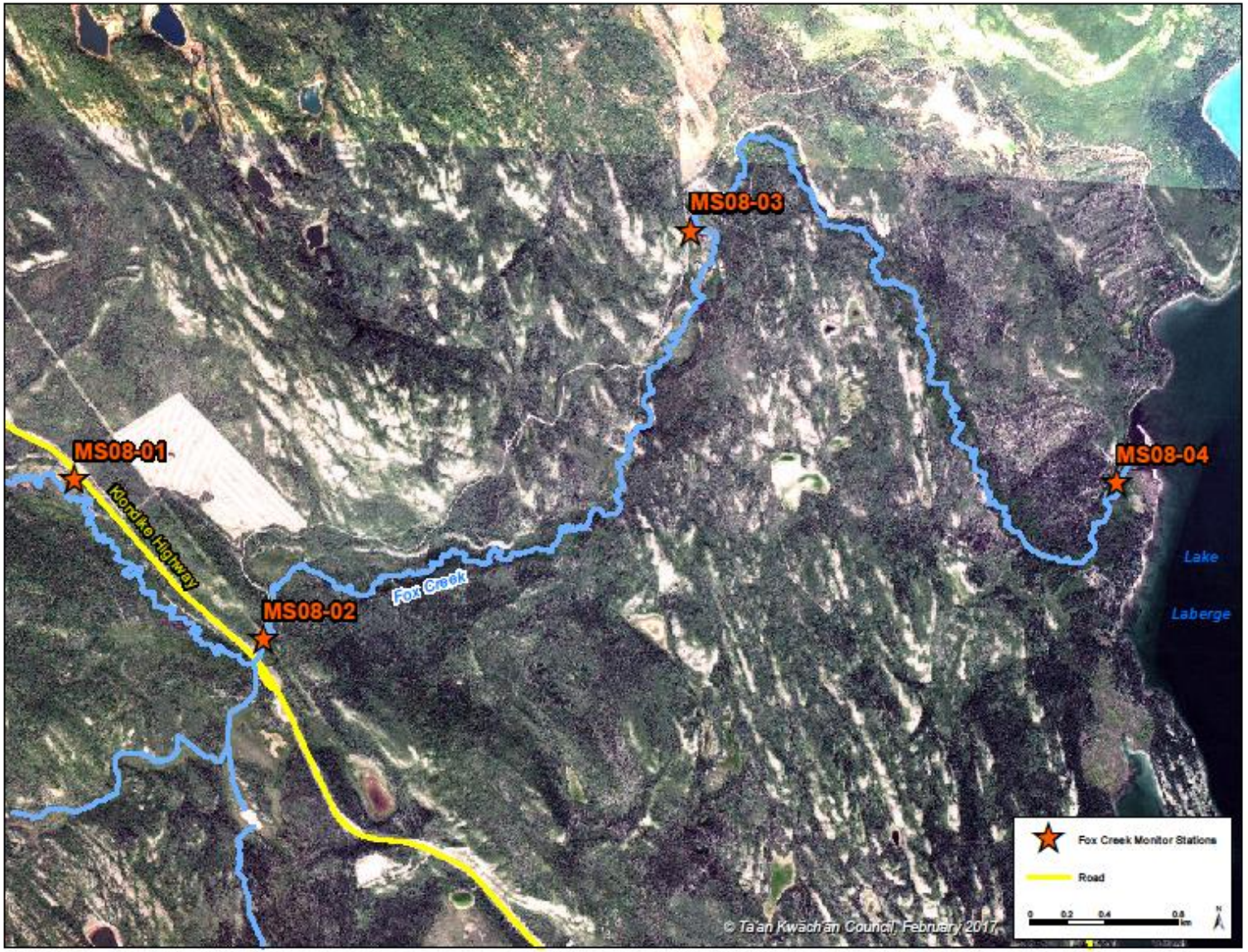
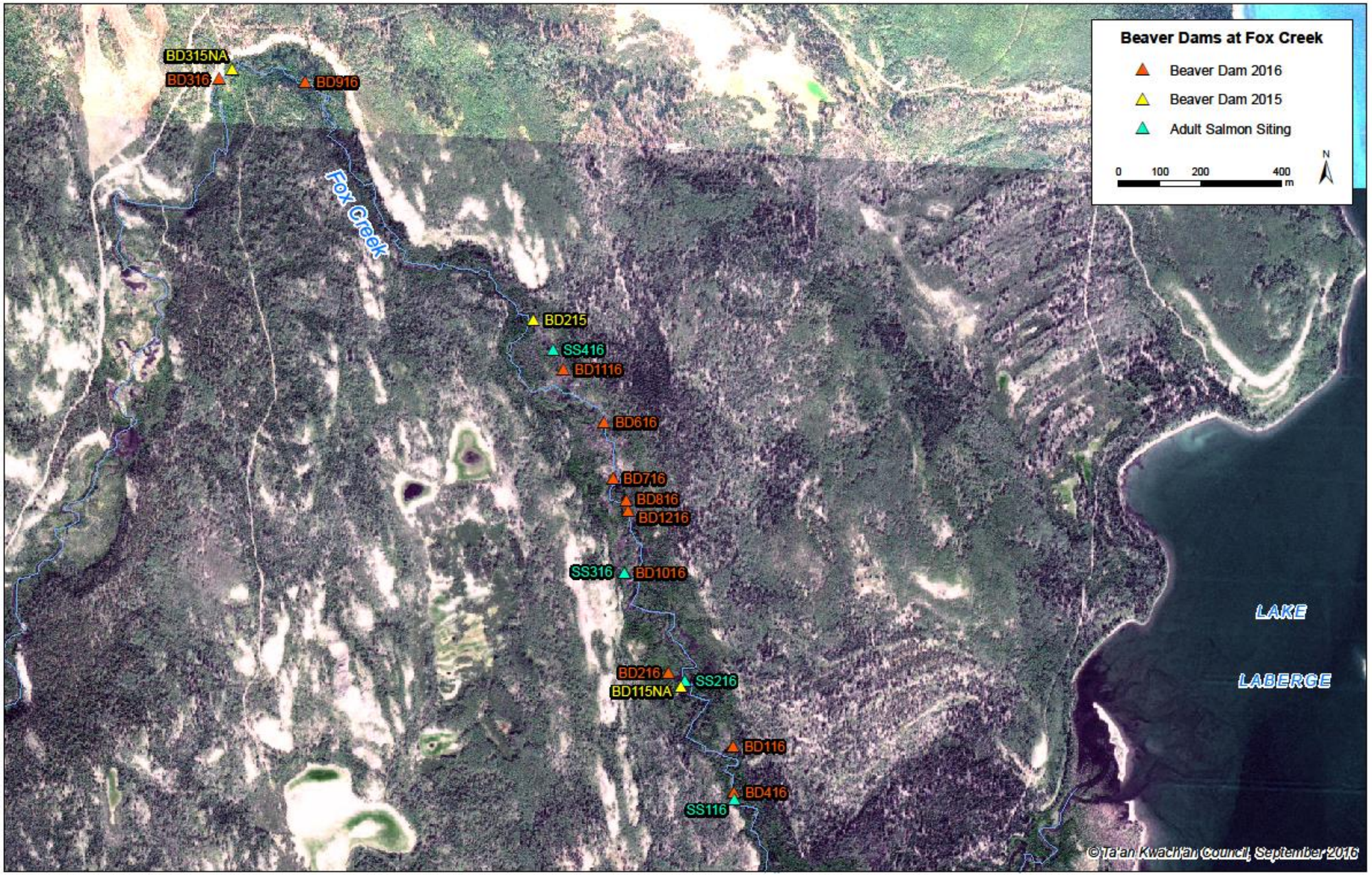


Figure 16: Fox Creek Juvenile Chinook Salmon Monitoring Stations

Figure 17: Fox Creek 2015 & 16 Beaver Dams and 2016 Adult Chinook Salmon Siting Locations



APPENDIX B - FOX CREEK CHINOOK SALMON RESTORATION PLAN

PHASE II – THE SECOND SALMON LIFE CYCLE

DEVELOPED MARCH 2016

APPENDIX A, STANDARDS AND METHODS

AND

APPENDIX B, PHASE II ANNUAL IMPLEMENTATION AND MONITORING PLAN

UPDATED FEBRUARY 2017

FOX CREEK CHINOOK SALMON RESTORATION PLAN

PHASE II – THE SECOND SALMON LIFE CYCLE

APPENDIX A – STANDARDS AND METHODS

Updated: February 2017

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 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 females 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

- At least two weeks before the scheduled event ensure notification is sent to citizens
- One week before release check in with MCIF and examine equipment
- Oxygen tank level must be full and preference is large tank
- 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
- Tote is cleaned with iodine
- Tote fits in truck
- Have enough 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 pipe clamp to the tot lid 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 (Eckert-Maret, 2016)

EQUIPMENT:

Tote 48 x 43"	Hose and clamps	Bear spray and bangers
Ratchet Straps 4 thin, 2 thick	Chest waders and boots	Two 2 x 4's 43" long
Buckets 10L, 12 (1 for oxygen & 1 with screen top)	Florescent flagging	Padding for oxygen tank to hold it securely inside the bucket
Oxygen tank (full)	Caution and duct tape	Camera, field note books, pencils
Regulator	Weather stripping	GPS
Flow meter	Tree snips	Dip nets 5 small and one large
Micro bubble plate diffuser or air stone	Snacks and water	Hat and other personal gear, change of clothes
– (Eckert-Maret, 2016)		

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.

The monthly monitoring event at each station to include:

- Juvenile Chinook sampling using four baited Gee-minnow traps per station (1/8 mesh to June and 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 and water quality sampling if required and ,
- Flow measurements and water level reading from the staff gauge (located just upstream from the Klondike Highway Bridge).

For each juvenile Chinook captured, trained TKC staff anaesthetize them using clove oil 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 2008 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 be developed at a discrete and accessible location along the creek.
- Discussions with Yukon Government Water Resources to reinstall a hydrometric station at the above location.
- Eventual 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 July to indicate areas that can prevent or potentially limit passage. Reaches of stream morphology, barriers, spawning and rearing habitat have been be 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. Observers will also document and manage new obstructions or barriers to adult upstream migration.

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 just so as 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 or 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) • Ziplocks or garbage bags for heads • Permanent marker • Scale Cards • Sharp tweezers • Tape Measure • Labels for each head

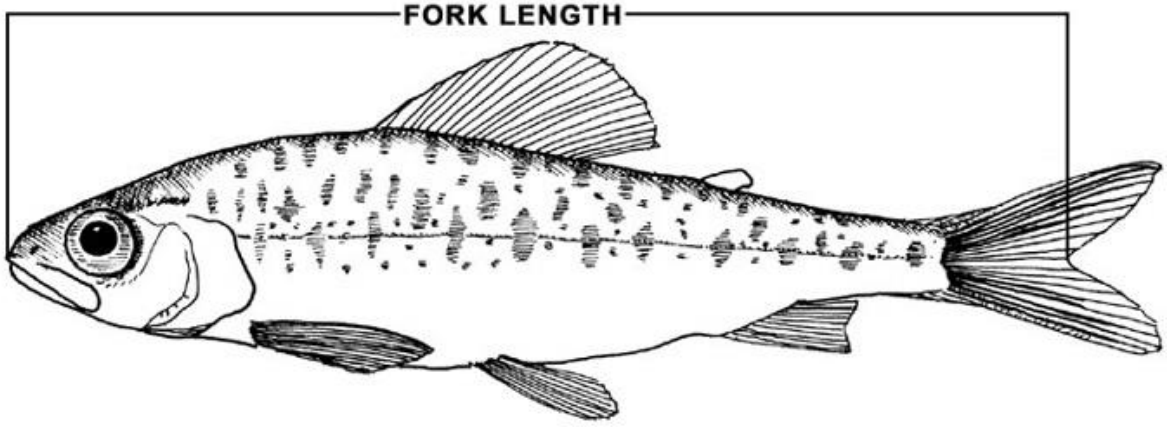


Photo courtesy juvenilefishid.com

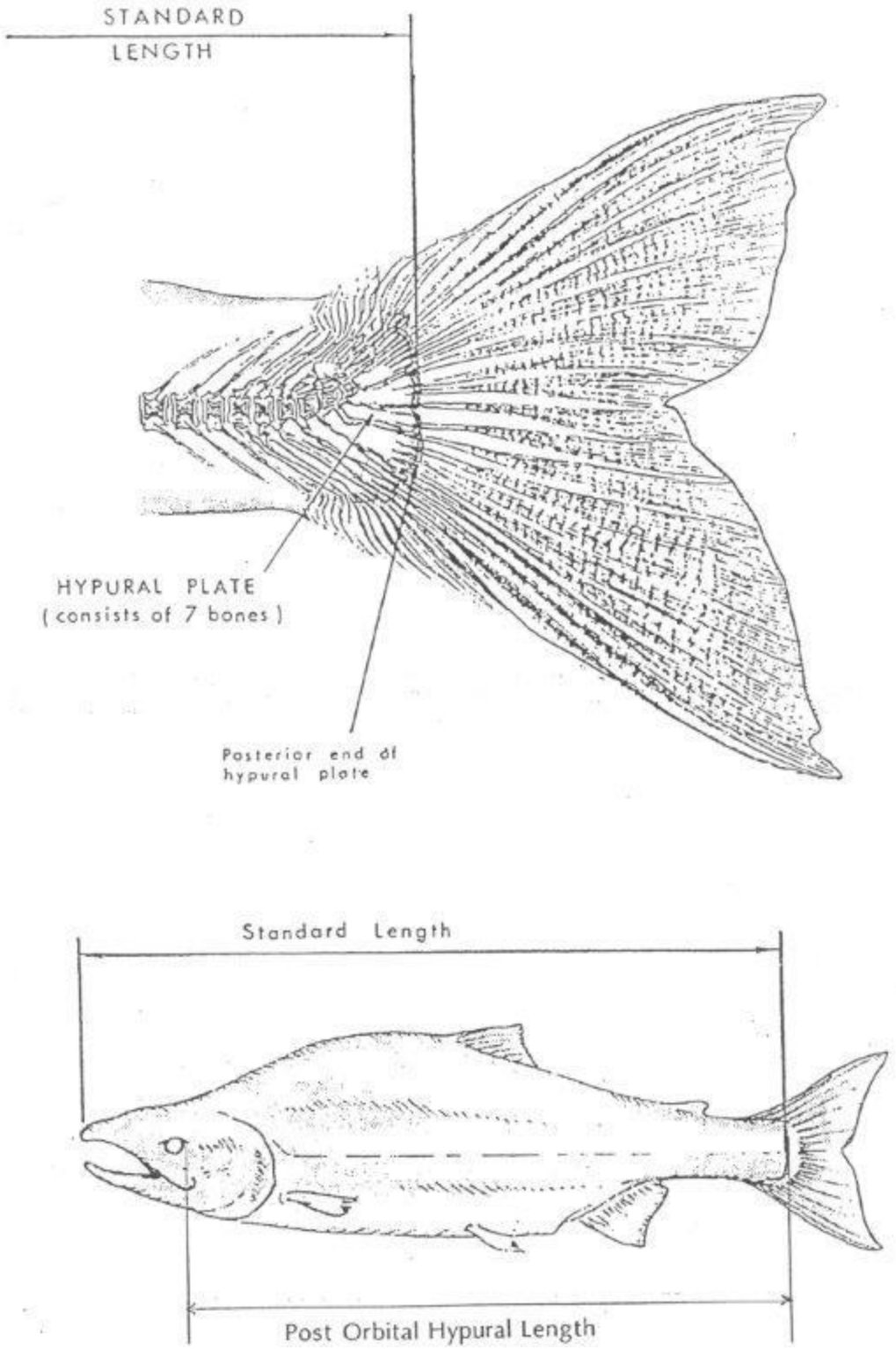


Image courtesy of Pacific Streamkeepers Federation

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

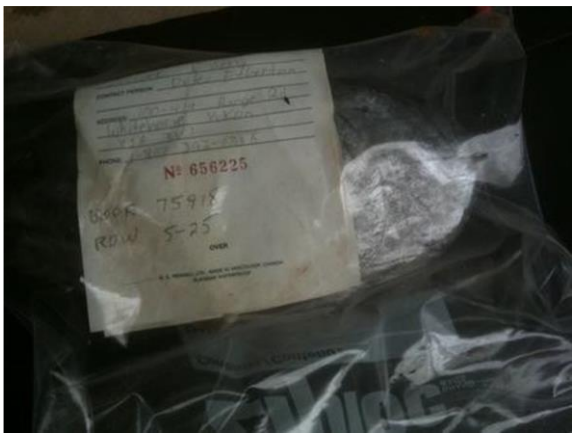


Figure 2. Properly packaged head

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.

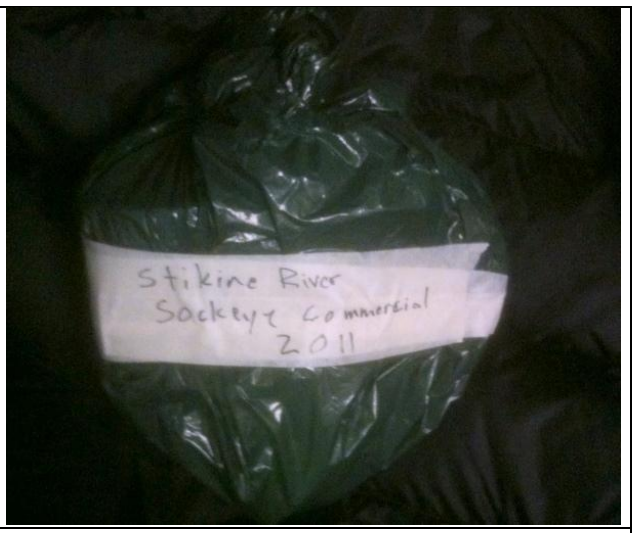
Required information includes:

- **Date (month, day, and year) ie** April 15, 2011 (spell the month)
- **Drainage ie** Stikine
- **Project ie** Lower Stikine Commercial
- **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 located 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

TKC is developing a trapping program to control beaver populations and activities in this area.

REDD MONITORING

METHODS:

Based on the observation of adults in a paired 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 like winter surface water measurements and assist in determining emergence timing of fry for subsequent assessment.

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

Updated: February 2017

PHASE II ONGOING ANNUAL ACTIVITIES – UPDATED FEBRUARY 2017

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.
- Review or develop safety protocols specific to project activities and update as required.
- 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 general public.

Planning and Implementation

- Coordinate pre-and post-season meetings with project partners.
- Work with the YSSC Technical Team to increase TKC knowledge and experience.
- Attend Yukon River Panel meetings and DFO teleconferencing.

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 (if permission is granted to not CWT the fish).
- 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 targets.
- 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
    - On or about mid-May to sample overwintering juveniles 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 whether any 0+ wild fish are present;
    - A representative sample of hatchery juvenile Chinook salmon (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 fry;
    - Mid-September, to determine growth and distribution of 0+ wild and hatchery fry at end of annual growing season.

- 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. Calibrate with standard flow estimation methodology.
- 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 at redd sites
- 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 CHINOOK SALMON RESTORATION PROGRAM PHASE II – SCHEDULE OF EVENTS – UPDATED FEBRUARY 2017

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. Gain knowledge and understanding on the marine ecology, the Yukon River system and Alaskan Tribal communities.	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	Discuss option of not inserting Coded Wire Tags with agencies. Stagger release dates and locations to accommodate the numbers of fry. 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)	Annual IMP activities Add data from 2017 biophysical monitoring to 2009 – 2016 analysis document.	Continue year-round water quality 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. Due to bear activity in the area this is a safety issue therefore high priority. 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	Work with DFO, YSSC Tech Team and other experts to determine, and where possible, quantify project success outcomes.	Develop criteria for determining when hatchery intervention/contribution to Fox Creek should cease.	Re-calculate the wetted width of the stream and potential juvenile Chinook rearing habitat from the Klondike Highway bridge to the mouth at Lake Laberge.	Annual IMP activities	Ongoing annual activities guided by implementation and monitoring plan. (IMP).	Adult enumeration feasibility assessment of alternative methods of enumerating returning salmon (e.g., resistivity counters, mark-recapture, weir, etc.) and collecting bio-physical data (e.g., sex, length, age, etc).	Ongoing annual activities guided by IMP
12 (2019)	2015	Ongoing annual activities guided by implementation and monitoring plan. (IMP).	Consider collecting broodstock from Fox or nearby creek for either or both hatcheries.	Annual IMP activities	Annual IMP activities	Annual IMP activities	Calculate current and future spawning area.	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