Collection and Analysis of Yukon River DNA Baseline Samples in Alaska and Canada – Canadian Collections

CRE-78-11

Prepared for: The Yukon River Panel

Prepared by: Elizabeth MacDonald
Stock Assessment Division
Fisheries and Oceans Canada
Yukon/Transboundary Rivers Area
100-419 Range Road
Whitehorse, YT Y1A 3V1

Table of Contents

Table of Contents ..... - 2 -
Abstract ..... - 3 -
Introduction ..... - 4 -
Methods ..... - 4 -
Results ..... - 5 -
Discussion ..... - 8 -
Acknowledgements ..... - 9 -
References ..... - 9 -

Appendices

Appendix 1. JTC Priorities for Additional Tissue Collections in Canada of Adult Chinook for the Genetic Baseline ..... - 10 -
Appendix 2. JTC Priorities for Additional Tissue Collections in Canada of Adult Chum for the Genetic Baseline ..... - 11 -
Appendix 3. Big Kalzas River Chinook Tissue Sampling Report. ..... - 12 -
Appendix 4. Kluane Lake Chum Tissue Sampling Report. ..... - 13 -
Appendix 5. Mayo River Chinook Tissue Sampling Report. ..... - 14 -
Appendix 6. McQuesten River Chinook Tissue Sampling Report. ..... - 15 -
Appendix 7. McQuesten River Chum Tissue Sampling Report. ..... - 16 -
Appendix 8. Miner River Chinook Tissue Sampling Report. ..... - 17 -
Appendix 9. Teslin River Chinook Tissue Sampling Report. ..... - 18 -

Abstract

The primary focus of this project is to develop the genetic baselines for Chinook and chum salmon stocks within the Yukon River drainage for increased stock resolution from mixed stock analysis. Collections within Canada included 230 Chinook samples and 60 chum samples. Chinook samples were collected from the Klondike, Big Kalzas, Miner, Mayo, McQuesten, Morely, Teslin and Tincup River. Chum samples were obtained from Kluane Lake. All samples were mailed to the Pacific Biological Station in Nanaimo for inclusion into the Fisheries and Oceans Canada (DFO) baselines and were shared with Alaska Department of Fish & Game (ADF&G) for inclusion into their genetic baselines.

Introduction

Genetic Stock Identification (GSI) is used by researchers and fishery managers to identify the stock of origin, in mixed stock analysis. GSI data is used by fishery managers to determine stock timing and stock status by using stock ID estimates in conjunction with abundance estimates. Improving and maintaining the Yukon River Chinook and chum genetic baselines will improve fishery management and stock assessment.

Objectives

Objective 1: To collect baseline Chinook and chum samples in Canada

Samples were collected to address baseline deficiencies which were deemed priorities by the Joint Technical Committee (JTC) Genetics Sub-Committee in conjunction with environmental conditions and logistical constraints and opportunities.

Objective 2: Inclusion of the samples into the existing ADF&G and DFO baselines.

Methods

Populations targeted for tissue samples were selected based on the JTC Genetics Sub-Committee's priorities for Canada (Appendix 1 & Appendix 2), inseason factors and logistical constraints and opportunities. Inseason factors included, but were not limited to, water levels, turbidity, forest fires, run abundance, weather and a narrow window of opportunity.

Tissue samples were predominately collected from live fish or recently deceased (red gilled) fish. A portion of the right and left axillary appendage was removed from each fish sampled using guillotine clippers. The axillary clips were placed, on in each of a labelled pair of sample vials containing 95% ethyl alcohol. The right and left axillary appendage from a single fish were kept paired so that duplicate individuals are not assayed in any one baseline. The proportion of ethyl alcohol to tissue ration was at least 3:1 to ensure the preservation of the tissue. The paired sample vials is to facilitate the sharing of all DNA samples collected between Canadian and U.S. genetic laboratories. Tissue samples vials were labelled with the location of collection, fish number, name of samplers and the date of collection. Sample collections were predominately contracted to consultants and their methods are described in greater detail in their attached reports (Appendix 3 to 9). The Klondike, Miner and Fishing Branch collections took advantage of existing projects for the tissue collections.

The tissue samples were submitted to DFO's genetics lab and were processed and added to their mircrosatellite baseline. The tissue samples were shared with the ADF&G's genetics lab.

Results

Big Kalzas
White Mountain Environmental Consulting sampled the Big Kalzas River, a tributary of the Pelly River, for Chinook tissue samples. In total 20 samples were collected along with 19 scale samples. Redd locations were also recorded. Environmental conditions included high water levels (90% bank full) at the initiation of the project; however rainfall during the project caused a significant increase in flow resulting in flooding conditions and an increase in turbidity. More detail is provided in Appendix 3.

Fishing Branch
Fishing Branch River is a tributary of the Porcupine River. The Fishing Branch weir is operated jointly by DFO and Vuntut Gwitchin Governement for the enumeration of chum salmon. During regular operations, any Chinook encountered would have been sampled; however no Chinook salmon were encountered.

Klondike
A sonar was operated on the Klondike River by B. Mercer and Associates Ltd (CRE-16-11) to enumerate Chinook passage. During the carcass pitch component, 36 Chinook tissue samples were collected and provided to DFO for the genetic baseline (Mercer, 2012).

Kluane Lake
J. Wilson & Associates collected 60 Chum tissue samples and age, sex and length data (

Appendix 4). The unusually calm lake conditions were ideal for observing the chum at this site.

Mayo

Na Cho Nyak Dun First Nations collected tissue samples from the Mayo River, a tributary of the Stewart. Eleven tissue samples were obtained in addition to ASL data as outline in Appendix 5.

McQuesten-Chinook

Na Cho Nyak Dun First Nations (NNDFN) and Can-Nic-A-Nick Environmental Sciences sampled Chinook salmon on the McQuesten River (Stewart River tributary). A total of 51 Chinook tissue samples were obtained in addition to scales samples and sex and length data. During the project heavy rainfall, turbidity, swift current and wide channel limited visibility as discussed in Appendix 6**.**

McQuesten-Chum

NNDFN and Can-Nic-A-Nick Environmental Sciences also attempted a chum sampling event on the McQuesten River. The sampling conditions were satisfactory as the water levels were moderate, turbidity low and generally ice free side channels and sloughs. The chum run abundance was above average; however no chum salmon were encountered during the sampling event. The sampling event appeared to be perfectly timed, based on observations at Big Creek slough near Minto (Appendix 7).

Miner

Vuntut Gwitchin Government and Environmental Dynamics Inc. had obtained funds from the Polar Continental Shelf Program for an aerial survey of the Crow and Miner Rivers and agreed to obtain some Chinook tissue samples. One sample was obtained on the Miner River and no Chinook were observed on the Crow River (

Appendix 8).

Morely
Trix Tanner (DFO) and Jane Wilson (J. Wilson & Associates) obtained one Chinook tissue sample from a beached carcass on the Morely River. The high water levels and turbidity prevented further sampling.

Teslin
B. Mercer and Associates conducted a Chinook genetic sampling project on the Teslin River. Age (scales), sex and length data was collected in addition to 55 tissue samples (Appendix 9).

Tincup and Nisling
Sixty-one Chinook tissue samples were collected from the Tincup River (Kluane tributary) by DFO personnel. Sampling Chinook in the Nisling River was prevented by the high turbidity and water levels.

Sample Site	Samples Obtained	Species
Klondike	32	Chinook
Big Kalzas	20	Chinook
Fishing Branch	0	Chinook
Miner	1	Chinook
Mayo	11	Chinook
McQuesten	51	Chinook
Morely	1	Chinook
Teslin	55	Chinook
Nisling	0	Chinook
Tincup	61	Chinook
Kluane Lake	60	chum
McQuesten	0	chum

Table 1. Tissue samples collected in 2011 for inclusion into DFO's genetic baseline for Chinook and chum salmon.

Discussion

Environmental Conditions

The environmental condition during the Chinook sample collections was extremely wet. High rainfall created streams that were turbid and bank full or flooding. The increase water flow created conditions that were hazardous for samplers at some sites and created poor sampling conditions which resulted in the cancelling of the Nordenskoild and Nisling Rivers' sampling. The less than ideal environmental conditions experienced likely resulted in a lower number of Chinook tissue samples being collected, than if favourable environmental conditions had existed.

Contractors and Personnel

This year, as with previous years, working with local consultants and First Nation Governments proved to be a successful method of obtaining tissue samples. One contractor had to cancel due to logistical constraints and a First Nations Government decided to forgo sampling due to low Chinook abundance. Even with the two cancellations, the benefits, such as decreased travel costs and community involvement, of using local samplers far out weigh the risk of last minute cancellations.

In addition to taking advantage of local contractors when possible, this project also took advantage of existing projects and DFO personnel. DFO personnel were used to sample at Tincup, Morely (along with a contractor) and would have sampled the Nordenskoild, if sampling conditions had improved. Utilizing existing projects (Fishing Branch) and DFO personnel (when available) also reduced the costs associated with tissue sample collection.

Budget Utilization

The full amount of the budget was allocated to sampling projects. With the cancellation of the four Chinook sampling events, two due to environmental conditions, some funds remained. In an attempt to utilize the full amount of funds and obtain the maximum amount of tissue samples, a last minute sampling event on the Morely River was initiated. This resulted in funds remaining after the Chinook sampling season that could have been utilized for additional chum sampling, but due to limited DFO staff availability, additional chum sampling did not occur.

Additions to the Genetic Baseline

This season, almost 300 new samples were added to the Yukon River Chinook and chum genetic baselines for Canadian stocks as shown in Table 1.

Acknowledgements

Funding for this project was provided by the Yukon River Panel Restoration and Enhancement Fund. This project would not have been possible without the contractors: B. Mercer and Associates, Can-Nic-A-Nick Environmental Sciences, Environmental Dynamics Inc, J. Wilson and Associates, Na Cho Nyak Dun First Nations, Vuntut Gwitchin Government and White Mountain Environmental Consulting. For managing this project and assisting with the writing of this report, a special thank you to Trix Tanner (Acting Stock Assessment Biologist, DFO).

References

Mercer, B. 2012. 2011 Klondike River Sonar Project. B. Mercer and Associates Ltd. Doc. 18-11. Project CRE-16-11, Yukon River Panel.

Appendix 1. JTC Priorities for Additional Tissue Collections in Canada of Adult Chinook for the Genetic Baseline

Location		Priority	Comments
Porcupine River			
	Fishing Branch	1	High priority
	Miner River	1	
Chandindu River		2	Some samples exhausted
White River			
	Tincup Creek	1	High priority
	Nisling	1	High priority
Stewart River		2	Some samples exhausted
	Mayo River	2	Some samples exhausted
	Janet River	2	
	Minto	2	
	Hess		
	McQuesten	1	One of few Stewart systems with appreciable population size
Pelly		1	All samples exhausted at ADFG
	Mica	1	All samples exhausted at ADFG
	Blind Creek	2	Some samples exhausted
	Ross	2	
	Earn River	1	
	Big Kalzas River	1	
	Little Kalzas River	1	
	Hoole River	1	
Glenlyon River		2	
Nordenskiold River		2	
Little Salmon		2	
Big Salmon		3	ADFG samples exhausted
Whitehorse		1	ADFG samples exhausted
Mainstem Yukon		3	179 samples collected in 2006-07
Michie		1	ADFG samples exhausted
Nisutlin		2	ADFG samples exhausted
Wolf Creek		1	ADFG samples exhausted
Morley River		1	
Teslin Lake aggregate		3	not desirable because mixed stock
Teslin Mainstem		1	High priority
Gladys River		2	
JenningsR		2	
Bearfood		3	
Big Campbell Creek		3	
Crow River		3	
Ollie Lakes		3	

Appendix 2. JTC Priorities for Additional Tissue Collections in Canada of Adult Chum for the Genetic Baseline

Location			Priority
	Fishing Branch		
Chandindu			2
Klondike			1
Pelly			1
Stewart			1
Big Creek			1
Minto			1
Tatchun			1
White			
	Kluane		3
		Kluane Lake	3
	Donjek		3
	Teslin		3

Appendix 3. Big Kalzas River Chinook Tissue Sampling Report.

WHITE MOUNTAIN ENVIRONMENTAL CONSULTING

P.O. Box 10140 Whitehorse, Yukon Y1A 7A1
Phone: (867) 399-7019 cell: (867) 332-1685
Email: psparling@gmail.com

Big Kalzas River, Adult Chinook Salmon, Genetic Collection Program August 2011

1.0 Introduction

The Big Kalzas River was navigated from its origin at Big Kalzas Lake to the outlet at the confluence with the MacMillan River between August 19 and August 24, 2011. During this navigation adult chinook salmon were collected for the purpose of retaining genetic samples. The samples were collected under the Authority of Collection License # XR 314 2011, issued by the Department of Fisheries and Oceans, Whitehorse.

This project had several objectives; primary among them was to collect genetic materials from adult chinook salmon. Secondary objectives were to map spawning areas, provide an understanding of the spawning times within this system and to determine the navigability of the Big Kalzas River.

2.0 Methods

The crew for this project consisted of Paul Sparling as lead with Brad Finnson as an assistant. The crew flew via floatplane from Mayo, Yukon on August 18, 2011, to Big Kalzas Lake. Travel down the river was initiated on August 19 in a 10' Zodiac inflatable boat with a 9.9 hp outboard. The crew exited the Kalzas River on August 24. The crew continued down the MacMillan River to the Pelly River then on to Pelly Crossing on August 25 to complete the trip.

All salmon observed on the Big Kalzas River were noted and the GPS location was recorded. Adult salmon for samples were captured either by snagging or by retrieval of carcasses. For each salmon captured the axillary appendages located at the pelvic fin were removed, the samples were stored in 2 separate sample bottles (one for each appendage) with ethyl alcohol. Additionally for each sample; the location of capture, a scale sample, the fork length, the post orbital-hypural length, the mid-eye-fork length, the sex, spawning condition and method of capture were recorded. Water temperatures were recorded daily and at spawning locations.

3.0 Results

Water levels in the river were high at the start of the trip with the river being 90% bank full. The water in the upper reaches was clear and provided good visibility. Heavy rains occurred in the surrounding mountains on the night of August 19 and continued on the August 20 and 21 over the entire drainage basin, this caused significant increases in flow and the river quickly went into a flood stage with over bank flow in the forest. Visibility into the river decreased steadily with rising waters and input from several small highly turbid feeder creeks.

Visibility was down to less than 0.4 meters by August 22 and basically precluded locating salmon on the redds. The heavy spawning area upstream of Sideslip Creek was investigated during the peak of the turbidity. Sideslip Creek provides a heavy sediment load to the Kalzas River, and was also turbid in previous encounters with this river (2002 and 2005), and no spawning areas downstream of this tributary have been located. Suitable flow rates were uncommon downstream of Sideslip and it seemed unlikely that many spawning areas occur below this tributary.

Water temperature on Big Kalzas Lake on August 19 was 13.0°, by 1 km downstream of the lake the temperature was 12.5°, water temperatures dropped slowly and consistently and had fallen to 11° by August 23. Daily variations were less than 0.5°.

Chinook salmon spawning was mostly complete at the start of the investigation; all the fish captured were either spent or retaining only vestigial eggs or sperm. Based on the condition of the fish, peak spawn was likely near to or earlier than August 12.

A total of 91 adult chinook salmon were observed, all above Sideslip Creek and a total of 20 adult chinook salmon were sampled for genetic materials during this investigation, scale samples were obtained from 19 of these fish (table 1). Most of the samples were obtained in the upper reaches of the river were visibility was excellent. A single carcass was recovered downstream of Sideslip Creek.

Redds were recorded within 1 km of Big Kalzas Lake but were spread out in smaller areas with only 1 or 2 redds per location.

Figure 1: Flood conditions on the Kalzas River at the time of the survey created dangerous conditions for boat travel and increased the turbidity of the water making salmon observations difficult

4.0 Discussion/ Recommendations

The Kalzas River should not be considered for float surveys in the future. At the time of this survey with flood conditions, the river was very dangerous, the numerous sweepers and logjams would be even more of an impediment to travel at lower water levels. There are at least 3 sections of the river with class 3 rapids bounded by long stretches of class 2 rapids. The crew was forced to portage past at least 10 log jams, a further 10 log jams were skirted in flood channels and a further 10 large sweepers with debris were skirted by the crew with a short drag of the boat across a sand spit or tree tip. One of the most dangerous aspects of this river was encountering logjams in high velocities with little opportunity to react as they appeared around the next bend of the river.

Potential methods of procuring genetic samples from chinook salmon in this river will depend on flow conditions in the Kalzas River at the time of the investigation. There would be little chance of collecting samples when the water levels are high.

Spawning areas were located in the reaches of the river well above Sideslip Creek, however places to land a helicopter are limited and mostly located away from the sampling areas. The only area with suitable landing locations occurs upstream of Sideslip Creek with the best location immediately adjacent to the outlet of Sideslip.

The most likely chance of success will be through the use of a helicopter, traveling to Sideslip Creek then either walk or use a small zodiac to collect samples from the large spawning area that extends for approximately 2.5 km immediately upstream of Sideslip Creek. Sampling in this manner will require careful logistic planning for fuel caches and helicopter downtime. This methodology will likely be expensive.

Table 1: Data collected from chinook salmon from Big Kalzas River between August 19 and 22, 2011.

#	Date	FL*	MEFL	POHL	Sex	Cond.	scale	Capture method	Scale Card	Scale Number
1	Aug 19	910	860	775	F	Spent	no	Angle	95580	None
2		905	820	720	F	90% spent	Yes	Angle	95580	2-42
3		940	845	744	M	90% spent	Yes	Angle	95580	3-43
4		710	670	595	M	Spent	Yes	Angle	95580	4-44
5		730	660	600	M	90% spent	Yes	Angle	95580	5-45
6		810	740	660	F	Spent	Yes	Angle	95580	6-46
7		960	855	750	M	90% spent	Yes	Angle	95580	7-47
8		1010	900	850	M	Running	Yes	Angle	95580	8-48
9		955	830	740	M	Running	Yes	Angle	95580	9-49
10		960	850	730	M	Spent	Yes	Angle	95580	10-50
11	Aug 20	900	830	750	F	Spent	Yes	Carcass	95561	1-41
12		830	745	660	F	Spent	Yes	Carcass	95561	2-42
13		800	750	680	F	Spent	Yes	Angle	95561	3-43
14	Aug 21	830	755	630	F	Spent	Yes	Carcass	95561	4-44
15		950	885	820	F	Spent	Yes	Angle	95561	5-45
16		810	720	620	M	Spent	Yes	Angle	95561	6-46
17		1030	925	830	F	Spent	Yes	Carcass	95561	7-47
18		895	825	740	F	Spent	Yes	Angle	95561	8-48
19	Aug 22	800	710	630	M	Spent	Yes	Carcass	95561	9-49
20		805	690	620	M	Spent	Yes	carcass	95561	10-50

L= fork length, MEFL=mid-eye fork length, POHL= post-orbital hypural length, measured in mm

Table 2. GPS locations of main spawning areas in the upper reaches of Big Kalzas River, mapped during August of 2011.

Latitude	Longitude	Comments
63° 12.081’	135° 46.560’	1st redd 320 m d/s of Kalzas Lk
63° 12.587’	135° 47.238’	1st group of several redds
63° 11.136’	134° 54.083’	Group of 6 redds

63° 10.934’	134° 54.621’	Grouping of several redds
63° 10.349’	135° 02.389’	Single redd, followed by at least 3 more single redds 200m apart
63° 08.127’	135° 07.313’	2 redds, followed by 2 more 100m apart
63° 05.432’	135° 13.802’	Sideslip Ck. Known set of redds for 1.8 km upstream of ck outlet.

Appendix 4. Kluane Lake Chum Tissue Sampling Report.

COLLECTION OF DNA SAMPLES FROM CHUM SALMON SPAWNING IN KLUANE LAKE.

Prepared for: Fisheries & Oceans Canada
Whitehorse, Yukon

Prepared by: Jane Wilson

J. Wilson & Associates
31 Donjek Road
Whitehorse, Yukon
Y1A 3P8

December, 2011

Introduction

A study to document various habitat and biological characteristics of a chum salmon spawning area located at the southeast end of Kluane Lake was conducted in 2002 (Restoration & Enhancement Fund project, CRE-57-02. Wilson 2006). Upwelling groundwater at this site is a critical hydrologic feature supporting a chum salmon spawning environment.

During the 2002 study, 31 tissue samples for genetic analysis were collected from Chum salmon spawners at the Kluane Lake site. Genetic information is used by fisheries managers to identify specific salmon stocks in mixed stock samples in the Yukon River for the purpose of estimating population sizes. J. Wilson & Associates was contracted by Fisheries & Oceans Canada (DFO) to resume the collection of tissue samples in 2011 to augment the genetic baseline for this stock. Age, sex and size (ASL) data was also obtained to supplement data collected in the Upper Yukon River used to characterise the 2011 Chum run. Funding for this project was provided by the Yukon River Panel, Restoration and Enhancement (R&E) Fund under project CRE-98 administered by DFO. This report describes the sampling methods used and field results.

Study Site

The spawning site is located in Kluane Lake between the outlets of Christmas Creek and Silver Creek, near the historic site of Silver City (Figure 1). A 'Bed & Breakfast' owned and operated by Doug and Cecile Sias is located next to the Chum spawning area. Access to the site can be gained from the Alaska Highway about 58 km north of Haines Junction. Take the turn off east at the Silver City and Bed & Breakfast road sign on a gravel road approximately 5 km. The lake shore can be accessed from a pullout immediately west of the entrance to the Bed & Breakfast. Boat access can be obtained from a public boat launch located approximately 2.5 km north of the Sheep Mountain Visitor Centre.

Methods

Run timing of chum salmon to the Kluane area was estimated from DFO in-season run timing data. The presence of Chum spawners at the lake site was confirmed through communications with Cecile Sias. Site visits were made on October 23 and October 27.

The spawning site was accessed by boat on October 23 using a 6.0 m open skiff powered by a jet motor. A count of Chum spawners at the site was conducted from the boat by the contract proponent and Brian Mercer (B. Mercer & Associates). To obtain a count, one observer wearing polaroid sunglasses stood on the bow of the skiff while another person operated the boat. Positions were switched for a second pass along the periphery of the spawning area for an independent count. Counts of live and dead chum were recorded. An attempt was also made to count Chum from the shoreline on foot to determine if it was possible to obtain a count similar to that observed from the boat.

The spawning site was revisited on October 27 in order to obtain more DNA samples. Access to the site was by road. Collection of Chum spawners for sampling was conducted by the project proponent and George Johnston, Lands Manager, Kluane First Nation.

Tissue samples were obtained from carcasses with red gills and from live post-spawned Chum. A small mesh (11.4cm) multi-filament gill net was used to capture live fish. The netting procedure involved one person walking one end of the net out from shore to the outer limit of the spawning area (about 20 m) while another person held the other end on shore. The net was walked perpendicular to the shore and looped back into shore after capturing a few fish. The adipose fin was clipped to identify recaptured fish. Fish were immediately sampled and then released. A portion of both the left and right axillary appendages was removed using guillotine clippers and placed in paired vials containing 95% ethyl alcohol[1]. Two length measurements (mid-eye fork (MEF) and post orbital hypural (POH)) were obtained from each sampled fish and the sex and spawning condition recorded. Five scales per fish were taken for age determination. All data, scale cards and DNA samples were delivered to DFO for analysis.

On October 27, water temperatures were taken in the lake near substrates at the spawning site and at seven different sites on shore where groundwater upwelled from gravels using an Oxyguard® Handy Beta Oxygen/Temperature Meter.

Results

The results of the two independent counts from the boat were 110 and 102 Chum salmon with an average estimated count of 106. Eighteen carcasses were also observed for an estimated total count of 124 Chum salmon. During both passes with the boat, visibility was good as lake conditions at the time of the survey were calm and clear. A few fish could be seen during the on shore survey, however, an accurate count could not be obtained due to glare at the low angle of view and the tendency for fish to move out into deeper water where it was impossible to see them.

A total of 60 Chum salmon was sampled for genetic material and ASL data over the two site visits (Appendix 1). Of these, 16 were female and 44 were male. The mean mid-eye fork length of females and males sampled was 570 mm and 596 mm, respectively. The majority of the fish sampled (93%) were obtained during the first site visit on October 23. Of the fish captured on this day, 48 were in post-spawn condition, nine were in mid-spawn condition and three were carcasses that had recently washed up on shore. Approximately 20 Chum were captured in the net on October 27, however, only four of these had not been previously sampled. There were no carcasses observed on the shore or in the lake during the second visit. All fish captured in the net during the second visit were in post-spawn condition. DNA and age analysis was not completed at the time of writing this report.

[1] One of each pair of samples is sent to both the Pacific Biological Station in Canada and the Alaska Department of Fish & Game (ADF&G) Gene Conservation Laboratory for analysis.

Temperatures taken from upwelling water sites on shore ranged from 2.4°C to 3.7°C. Lake temperatures in the vicinity of spawning fluctuated between 4.0°C and 4.1°C.

Discussion

The main objective of this project to collect DNA samples was achieved with a sizeable number of fish captured using a small meshed gillnet. The composition of the catch, however, was not representative of the run as males were more likely to become entangled in the net by their protruding jaws and large teeth. In addition, the capture method was likely selective for the slower post-spawned fish based on the number of fish observed during the boat survey.

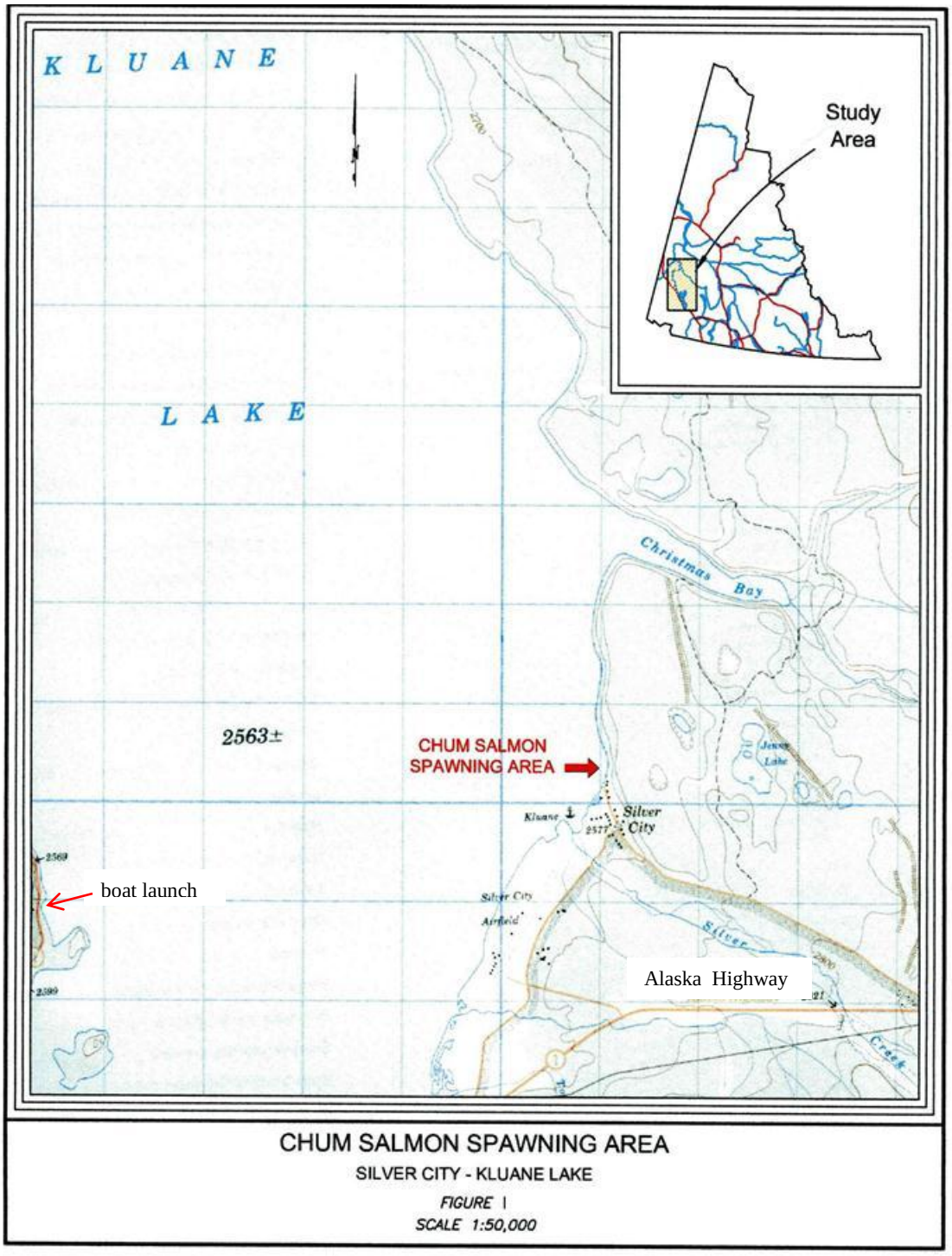
The calm lake conditions on October 23 were ideal for observing Chum salmon at this site. During past surveys by the project proponent and DFO personnel it has been difficult to see fish utilising this site because of rough water conditions (Wilson 2006). The use of the open skiff afforded a high vantage point from which to observe fish from the outer extent of the spawning area. The enumeration survey was conducted after peak spawning based on the number of observed carcasses and post-spawned fish captured as well as the observance of vacant redds.

Acknowledgements

Field assistance for this project was provided by Brian Mercer (B. Mercer & Associates) and George Johnston (Lands Manager, Kluane First Nation).

References

Wilson, J., 2006. Preliminary Investigation of Chum Salmon Spawning in Kluane Lake. Prepared for the Yukon River Panel, CRE project 57-02.



CHUM SALMON SPAWNING AREA

SILVER CITY - KLUANE LAKE

FIGURE 1

SCALE 1:50,000

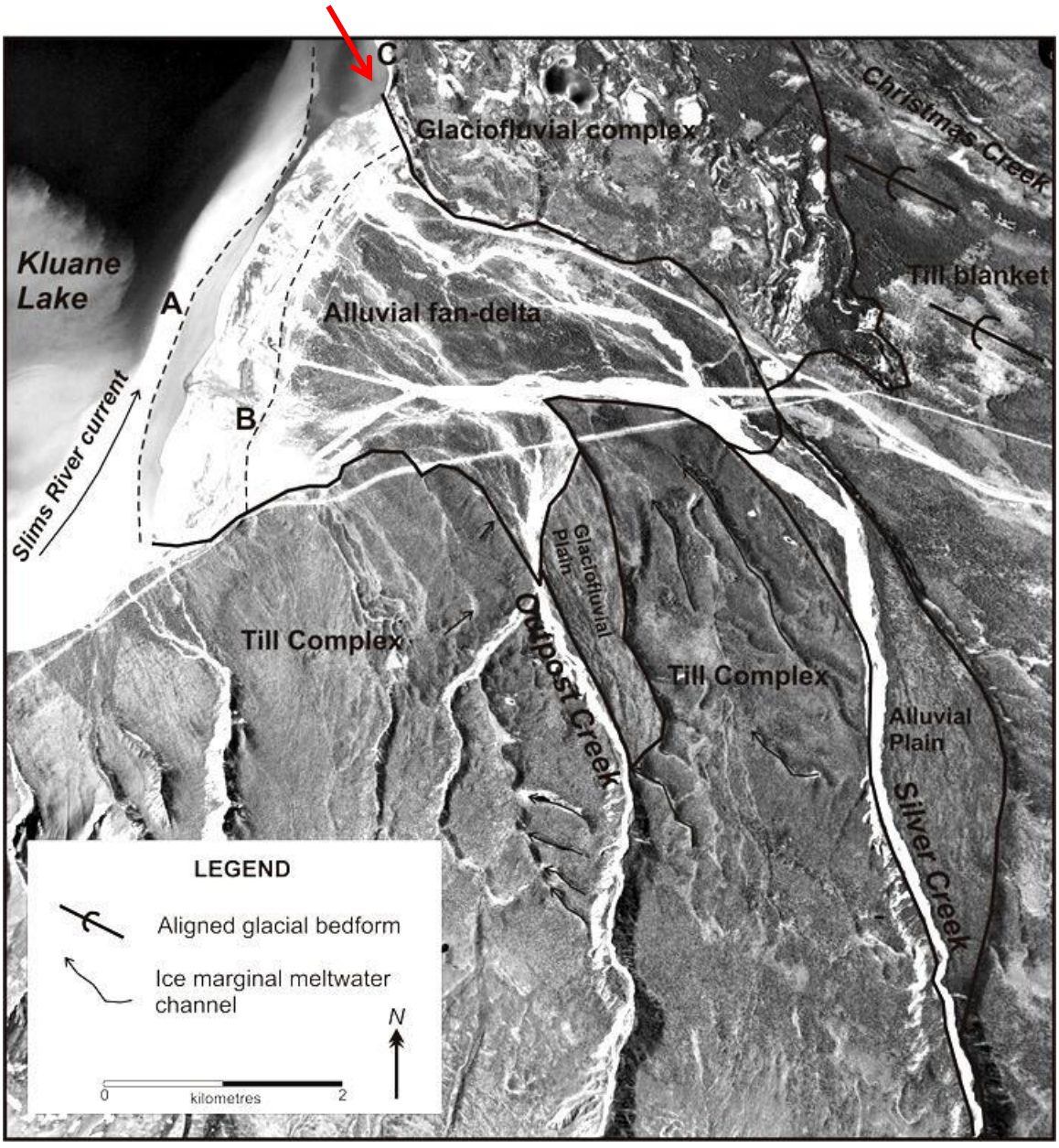


Figure 2. Annotated air photograph (NAPL A27478-85) showing geomorphic features at the southeast end of Kluane Lake. Outpost and Silver creeks originate in the Kluane Ranges immediately to the south.

Upwelling groundwater along lakeshore at chum salmon spawning site.

Netting Chum salmon on October 23.

Chum salmon captured in net.

George Johnston with catch on October 27.

Appendix 1. Kluane Lake Chum salmon sampling data, 2011

DATE	FISH #	SEX	MEF	POH	CONDITION*
23-Oct	1	F	590	535	C
23-Oct	2	F	530	495	C
23-Oct	3	M	590	415	P
23-Oct	4	M	610	550	P
23-Oct	5	M	580	525	P
23-Oct	6	M	530	495	P
23-Oct	7	M	570	510	P
23-Oct	8	M	545	505	P
23-Oct	9	M	585	545	P
23-Oct	10	M	595	530	P
23-Oct	11	M	575	515	P
23-Oct	12	M	585	525	P
23-Oct	13	M	615	550	P
23-Oct	14	F	615	560	P
23-Oct	15	M	590	535	P
23-Oct	16	M	640	580	P
23-Oct	17	M	575	525	P
23-Oct	18	M	605	560	P
23-Oct	19	F	550	505	P
23-Oct	20	M	590	520	P
23-Oct	21	M	560	520	P
23-Oct	22	M	655	595	C
23-Oct	23	M	635	570	P
23-Oct	24	M	595	545	P
23-Oct	25	F	595	545	M
23-Oct	26	M	575	520	P
23-Oct	27	M	545	495	M
23-Oct	28	M	645	570	P
23-Oct	29	M	590	545	P
23-Oct	30	M	570	520	P
23-Oct	31	F	575	515	M
23-Oct	32	F	595	535	M
23-Oct	33	M	600	535	P
23-Oct	34	F	570	510	P
23-Oct	35	F	570	515	M
23-Oct	36	F	545	505	P
23-Oct	37	M	570	510	M
23-Oct	38	M	550	485	M
23-Oct	39	M	690	615	P
23-Oct	40	M	625	560	M

DATE	FISH #	SEX	MEF	POH	CONDITION*
23-Oct	41	M	595	525	M
23-Oct	42	F	580	510	P
23-Oct	43	M	605	545	P
23-Oct	44	M	590	525	P
23-Oct	45	M	595	525	P
23-Oct	46	M	670	595	P
23-Oct	47	M	590	525	P
23-Oct	48	M	580	525	P
23-Oct	49	F	535	480	P
23-Oct	50	M	595	540	P
23-Oct	51	F	575	520	P
23-Oct	52	M	625	560	P
23-Oct	53	M	605	540	P
23-Oct	54	F	555	495	P
23-Oct	55	M	620	555	P
27-Oct	56	M	585	530	P
27-Oct	57	M	565	500	P
27-Oct	58	F	625	565	P
27-Oct	59	M	630	565	P
27-Oct	60	F	515	445	P

* P: post-spawned; M: mid-spawn; C: carcass

Appendix 5. Mayo River Chinook Tissue Sampling Report.

Mayo River Chinook Spawner Data Collection

August 24-27, 2011

*All scales mounted in book # 9545

Aug 24

Fish Number	Time Sampled	Sex	Post Orbital-Hypural Length (mm)	Condition	Dead/Alive	UTM Location (Zone 08V)	Scales
1	13:42	M	720	Spent	Alive	454717, 7058197	1-41

Fish 1

Aug 25

Fish Number	Time Sampled	Sex	Post Orbital-Hypural Length (mm)	Condition	Dead/Alive	UTM Location (Zone 08V)	Scales
2	11:55	M	**745 (Mid-Eye to Fork)	Spent	Alive	454790, 7058283	2-42

No photo of fish 2.

Aug 26

Fish Number	Time Sampled	Sex	Post Orbital-Hypural Length (mm)	Condition	Dead/Alive	UTM Location (Zone 08V)	Scales
3	10:34	F	780	Spent	Dead	454886, 7054934	3-43
4	13:01	F	755	Spent	Dead	455439, 7054273	4-44
5	13:01	F	740	Spent	Dead	455439, 7054273	5-45
6	13:01	F	N/A, too degraded	Spent	Dead	455439, 7054273	N/A, too degraded
7	15:10	F	690	Spent	Dead	455641, 7053023	6-46
8	16:19	M	590	Spent	Dead	455576, 7052657	7-47
9	16:19	F	710	Spent	Dead	455576, 7052657	8-48
10	16:19	F	670	Spent	Dead	455576, 7052657	9-49

Fish 3

Fish 4

Fish 5

Fish 6 no photo available.

Fish 7

Fish 8 to 10, 8 at bottom of photo, 10 at the top.

Aug 27

Fish Number	Time Sampled	Sex	Post Orbital-Hypural Length (mm)	Condition	Dead/Alive	UTM Location (Zone 08V)	Scales
11	16:40	F	710	Spent	Alive	454064, 7056120	10-50

Fish 11

Appendix 6. McQuesten River Chinook Tissue Sampling Report.

ENUMERATION AND IDENTIFICATION OF SPAWNING HABITAT OF CHINOOK SALMON IN THE McQUESTEN RIVER, YUKON TERRITORY (AUGUST 2011)

Prepared for:

FIRST NATION OF NA-CHO NYÄK DUN
and
FISHERIES AND OCEANS CANADA

Prepared by:

CAN-NIC-A-NICK ENVIRONMENTAL SCIENCES

August 2011

INTRODUCTION

The McQuesten River is known to support spawning populations of both Chinook and chum salmon. The river is also utilized by at least 9 species of freshwater fish in addition to providing valuable spawning habitat for salmon (EDI 2010). Chinook salmon are an important food fish for Na-Cho Nyäk Dun (NND) people and contribute an important component to the natural capital of the central Yukon and the community of Mayo. Significant mining activity, spanning over decades, has occurred in the headwaters of the South McQuesten River near the historic mining communities of Elsa and Keno City. The effects of mining on the McQuesten River have never been fully quantified.

Attempts to enumerate spawning Chinook salmon in the McQuesten River have been sporadic over the last several decades. Gormican (1992) enumerated 294 adult salmon in the mainstem of the McQuesten River in 1992 as part of a larger study related to effects characterization of placer mining. An overflight in August of 1998 enumerated 94 adult Chinook salmon and 36 carcasses all along the mainstem of the McQuesten River (Smith 1998). Radio telemetry tracking of Chinook salmon in the Canadian portion of the Yukon River watershed suggested that the McQuesten River received the largest number of radio-tagged fish in the Stewart River watershed (Osborne *et al* 2003). Radio-tagged fish were all located in the lower reaches of the McQuesten River. EDI (2010) conducted a sonar pilot program in 2010 that enumerated 198 adult salmon migrating upstream past a sonar positioned on the McQuesten River just upstream of the Stewart River confluence. This project was initiated specifically to collect genetic information for the purpose of in-season stock management of spawning migrations of Chinook salmon in the Yukon River basin. Additional information was collected that included age, sex and length data and geo-referencing spawning locations throughout the study area.

STUDY AREA

The McQuesten River watershed encompasses an area of approximately 4,800 km^2. It is a tributary to the Stewart River, a major tributary to the Yukon

River basin. The major tributaries of the McQuesten River are the South McQuesten, the North McQuesten and the East McQuesten Rivers. The entire watershed lies within the Traditional Territory of the First Nation of Na-Cho Nyäk Dun (NND).

The focus of this assessment was the mainstem river reaches from the Dublin Gulch access road bridge on the South McQuesten downstream to the bridge located on the Klondike Highway on the McQuesten River. The North and East McQuesten Rivers were not surveyed during this assessment.

METHODS

The project commenced on August 11 and continued to August 15, 2011. A 3.6 m inflatable boat and 5.2 m canoe was used for the survey and to transport the crew and equipment downstream. Each boat drifted along opposing banks and visually enumerated all live salmon in the water and carcasses along the banks. The sampling crew wore polarized sunglasses to reduce glare on the surface of the water. Fish were sampled by either angling or by simply stopping and retrieving carcasses in the water or along the banks. Spawning areas, as noted by one or several redds, were geo-referenced using a hand held Garmin GPS.

The priority was for the collection of the maximum number of Chinook genetic samples. Both axillary appendages were removed from each sampled fish and deposited in separately labeled sample bottles containing ethyl alcohol. A total of 51 genetic samples were collected. Additionally, five scale samples were procured from the preferred area from each sampled fish for subsequent age determination. Sex was determined from examination of external characteristics, and/or gonads of spawned out carcasses, where necessary. Four length measurements (nearest 0.5 cm) were taken from each fish and included fork length (FL), mid-eye to fork length (MEF), post-orbital hypural length (POH), and girth. Each sampled fish was adipose clipped to avoid duplication. After marking, all sampled live fish were released at site of capture. Carcasses were sampled generally where they were found. Genetic samples

were provided to DFO biologist in the Whitehorse office at the end of the sampling trip. Scale aging will be completed by DFO depending on relevance and budget.

RESULTS AND DISCUSSION

Environmental Conditions

Water levels in the McQuesten River were at a moderate stage during the project. The dark bottom substrate, turbidity, glare, swift current and wide channel limited visibility especially in the lower reaches of the river. At times, periods of heavy rainfall also hampered visibility in the upper reaches. Many fish likely escaped enumeration by using cover of the deeper pools, cutbanks or debris piles that were numerous in the river.

Enumeration, Run Timing and Genetic Sampling

It is believed that the run into the Canadian portion of the Upper Yukon River was about 50,000 in 2011, suggesting a below average run (DFO 2011). A total of 104 Chinook salmon adults and carcasses were enumerated in the McQuesten River during this survey. Carcasses were more prevalent in the lower reaches of the McQuesten River. Spawning locations are presented in Figure 1 and coordinates for each are noted in Appendix I. The majority of spawning sites in the lower McQuesten River, below Vancouver Creek confluence, could not be delineated due to poor visibility and excessive water depth.

Based on observations of sampled fish, the survey period appeared to be well after peak spawning. Female spawners were typically holding over redds with generally very few males, presumably drifting downstream. Nearly all of the observed spawning sites were in the mainstem of the McQuesten River below the confluence of the North McQuesten River. Only one spawning site was observed in the South McQuesten River. A total of 51 genetic samples were collected from Chinook salmon in the McQuesten River (Table 1). All of the sampled fish were spent. Sampled fish ranged in fork length from 67.0 to 109.0 cm. the sex ratio was female biased and determined to be 0.52 males to each female.

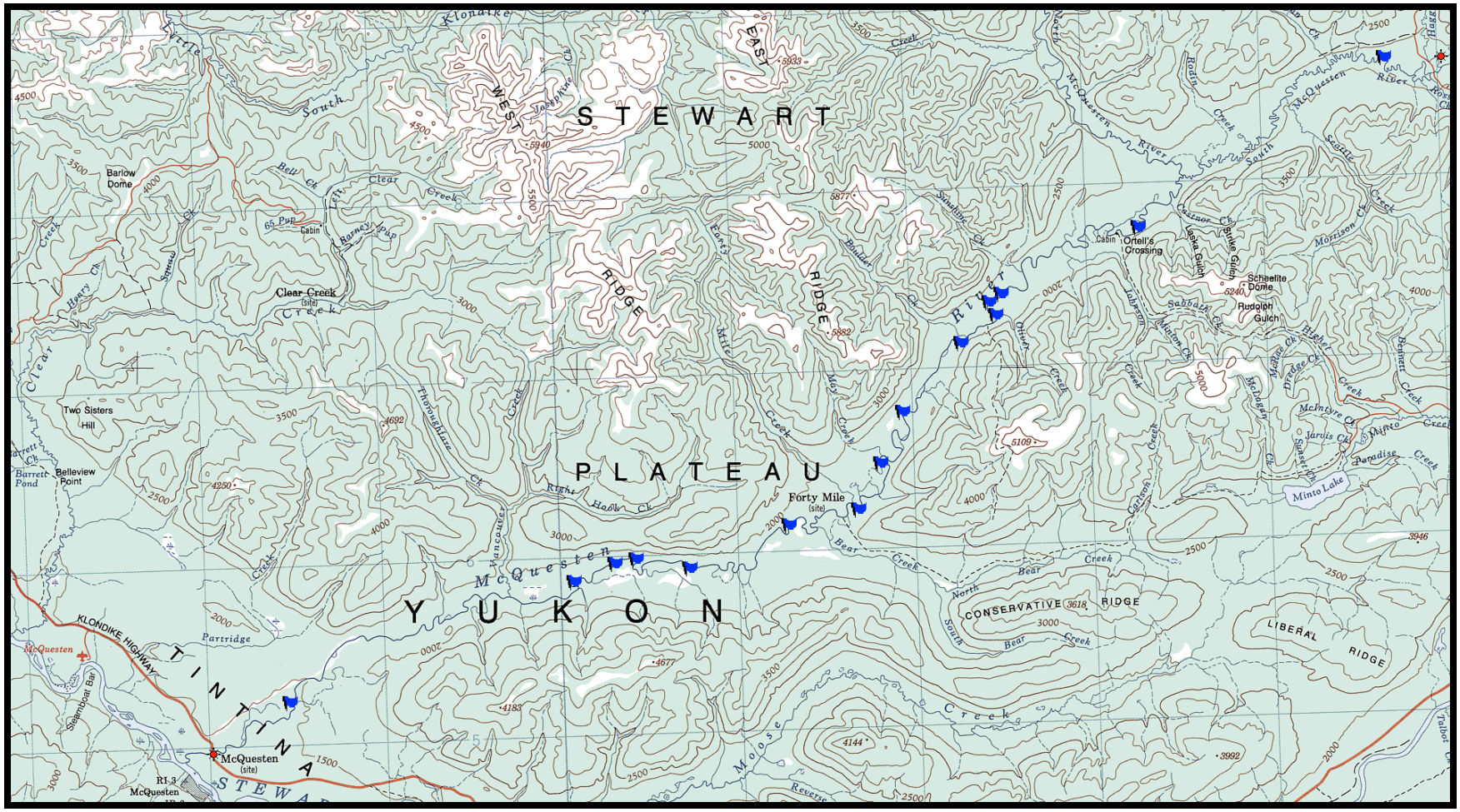


Figure 1 Observed Chinook spawning locations (blue flags) along the McQuesten River during a drift survey in mid-August, 2011. Survey was conducted along the river between navaid waypoint locations (red circles).

Table 1 Summary of various length metrics, sex and condition; capture method and location of genetic sampled Chinook salmon from the McQuesten River, August 2011.

Fish No.	Date	Book #	Scale #	FL (cm)	MEF (cm)	POH (cm)	Girth (cm)	Sex	Condition	Method of Capture	Spawning Site
1	12-Aug-11	95490	10 - 50	84.0	77.0	67.0	33.0	F	100% Spent	Angling	002
2	13-Aug-11	95490	9 – 49	96.0	89.5	81.0	37.0	F	100% Spent	Carcass	003
3	13-Aug-11	95490	8 – 48	102.0	92.0	87.0	41.0	-	100% Spent	Angling	003
4	13-Aug-11	95490	7 – 47	94.0	85.5	77.0	36.0	F	100% Spent	Angling	003
5	13-Aug-11	95490	6 – 46	92.0	82.5	77.5	40.0	M	100% Spent	Carcass	003
6	13-Aug-11	95490	5 – 45	94.0	86.0	76.0	38.0	F	100% Spent	Angling	006
7	13-Aug-11	95490	4 – 44	101.0	92.0	83.0	42.0	F	100% Spent	Angling	006
8	13-Aug-11	95490	3 – 43	94.0	87.0	79.0	38.0	F	100% Spent	Carcass	008
9	13-Aug-11	95490	2 – 42	97.0	89.0	79.5	40.0	F	100% Spent	Carcass	008
10	14-Aug-11	95490	1 - 41	83.0	74.0	68.0	38.0	M	100% Spent	Carcass	010
11	14-Aug-11	95500	10 - 50	80.0	70.0	60.0	35.0	M	100% Spent	Angling	010
12	14-Aug-11	95500	9 – 49	93.0	84.0	76.5	40.5	F	100% Spent	Carcass	010
13	14-Aug-11	95500	8 – 48	100.0	91.0	83.5	38.5	F	100% Spent	Carcass	011
14	14-Aug-11	95500	7 – 47	108.0	95.0	83.0	49.5	M	95% Spent	Angling	-
15	14-Aug-11	95500	6 – 46	94.0	85.0	77.0	38.0	F	100% Spent	Carcass	012
16	14-Aug-11	95500	5 – 45	99.0	89.0	79.0	38.0	F	100% Spent	Angling	012
17	14-Aug-11	95500	4 – 44	93.0	86.0	77.0	36.0	F	100% Spent	Carcass	012
18	14-Aug-11	95500	3 – 43	100.0	90.0	83.0	39.5	F	100% Spent	Carcass	012
19	14-Aug-11	95500	2 – 42	86.0	77.0	68.0	35.5	M	100% Spent	Carcass	012
20	14-Aug-11	95500	1 - 41	96.0	88.0	78.5	40.0	F	100% Spent	Angling	012
21	14-Aug-11	95499	10 - 50	102.0	92.0	88.0	40.0	F	100% Spent	Carcass	013
22	14-Aug-11	95499	9 – 49	96.0	86.0	78.0	37.0	F	100% Spent	Angling	014
23	14-Aug-11	95499	8 – 48	93.0	85.0	76.0	38.0	F	100% Spent	Angling	014
24	15-Aug-11	95499	7 – 47	101.0	91.0	81.5	43.0	F	100% Spent	Carcass	-
25	15-Aug-11	95499	6 – 46	88.0	80.0	73.5	33.0	F	100% Spent	Carcass	-

Fish No.	Date	Book #	Scale #	FL (cm)	MEF (cm)	POH (cm)	Girth (cm)	Sex	Condition	Method of Capture	Spawning Site
26	15-Aug-11	95499	5 – 45	82.0	74.0	66.0	33.5	M	100% Spent	Carcass	-
27	15-Aug-11	95499	4 – 44	89.0	83.0	75.0	37.5	F	100% Spent	Carcass	-
28	15-Aug-11	95499	3 – 43	92.0	83.0	74.5	35.0	F	100% Spent	Carcass	-
29	15-Aug-11	95499	2 – 42	101.0	92.0	82.5	42.0	F	100% Spent	Carcass	-
30	15-Aug-11	95499	1 - 41	98.0	88.0	80.0	38.5	F	100% Spent	Carcass	-
31	15-Aug-11	95498	10 - 50	67.0	61.0	56.0	31.0	M	100% Spent	Carcass	-
32	15-Aug-11	95498	9 – 49	97.0	85.0	75.5	39.5	M	100% Spent	Carcass	-
33	15-Aug-11	95498	8 – 48	94.0	86.0	79.0	38.5	F	100% Spent	Carcass	-
34	15-Aug-11	95498	7 – 47	99.0	89.0	82.0	41.0	F	100% Spent	Carcass	-
35	15-Aug-11	95498	6 – 46	106.0	97.0	87.0	43.5	F	100% Spent	Carcass	-
36	15-Aug-11	95498	5 – 45	87.0	77.0	68.5	36.0	M	100% Spent	Carcass	-
37	15-Aug-11	95498	4 – 44	79.0	71.0	63.5	32.0	M	100% Spent	Carcass	-
38	15-Aug-11	95498	3 – 43	104.0	91.0	80.0	45.0	M	100% Spent	Carcass	-
39	15-Aug-11	95498	2 – 42	85.0	76.0	67.0	-	M	100% Spent	Carcass	-
40	15-Aug-11	95498	1 - 41	79.0	71.0	63.0	32.0	M	100% Spent	Carcass	-
41	15-Aug-11	95496	10 - 50	109.0	94.0	83.5	-	M	100% Spent	Carcass	-
42	15-Aug-11	95496	9 – 49	77.0	69.0	62.0	32.0	M	100% Spent	Carcass	-
43	15-Aug-11	95496	8 – 48	91.0	82.0	74.0	36.0	F	100% Spent	Carcass	-
44	15-Aug-11	95496	7 – 47	104.0	94.0	87.0	44.0	F	100% Spent	Carcass	016
45	15-Aug-11	95496	6 – 46	95.0	86.0	77.0	39.5	F	100% Spent	Carcass	016
46	15-Aug-11	95496	5 – 45	97.0	88.0	78.0	-	F	100% Spent	Carcass	016
47	15-Aug-11	95496	4 – 44	81.0	74.0	67.0	30.0	M	100% Spent	Carcass	016
48	15-Aug-11	95496	3 – 43	99.0	89.0	80.0	40.5	F	100% Spent	Carcass	016
49	15-Aug-11	95496	2 – 42	104.0	94.0	85.0	41.0	F	100% Spent	Carcass	016
50	15-Aug-11	95496	1 - 41	87.0	80.0	71.0	34.0	F	100% Spent	Carcass	-
51	15-Aug-11	95497	10 - 50	72.0	63.0	56.0	29.0	M	100% Spent	Carcass	-

REFERENCES

DFO 2011. Memorandum: Yukon River Salmon Update, August 18, 2011. Department of Fisheries and Oceans Canada, 100-419 Range Road, Whitehorse, Yukon Y1A 3V1.

EDI 2010. McQuesten River Sonar Pilot Program. Prepared for the Yukon River Panel. Project RE-142N-10.

Gormican, S.P. Vonk, R. Firth, W. Duval and S. Skey, Yukon Placer Mining Study, Volume II, Reports of Principle Investigators. Prepared for the Yukon Placer Implementation Review Committee, Whitehorse, Yukon by Seakem Group in association with Northwest Hydraulic Consultants Ltd., Aquatic Environments Ltd. And ARA Consulting Group. July, 1982.

Osborne, C.T., B.J. Mercer and J.H. Eiler. 2003. Radio telemetry tracking of Chinook salmon in the Canadian portion of the Yukon River watershed - 2002. Prepared for the Yukon River Panel. Project RE-78-02.

Smith, P. 1998. Chinook Salmon (*Oncorhynchus tshawytscha*) stock and habitat assessment in the McQuesten River Drainage Basin and recommendations for a stock restoration plan.

ACKNOWLEDGEMENTS

Can-nic-a-nick Environmental Sciences gratefully acknowledges the efforts and encouragement of Dennis Buyck, Steven Buyck of the First Nation of Na-Cho Nyäk Dun for support and encouragement of this project. The venerable efforts of Trix Tanner are also acknowledged for her technical knowledge on behalf of Fisheries and Oceans Canada. I would especially like to thank Adam Wrench, a fisheries biologist with the First Nation of Na-Cho Nyäk Dun, who provided excellent field assistance during this project. Thanks to all.

APPENDIX I

WAYPOINTS OF CONFIRMED SPAWNING SITES IN THE McQUESTEN RIVER AUGUST 2011

Map Reference*	Site	Description
N 63° 54' 11.005" W 136° 04' 41.055"	002	2 female Chinook on redds
N 63° 49' 08.414" W 136° 21' 36.857"	003	11 Chinook and redds
N 63° 47' 10.419" W 136° 31' 02.803"	004	2 female Chinook on redds
N 63° 46' 56.704" W 136° 31' 53.670"	005	1 female Chinook on redd
N 63° 46' 32.980" W 136° 31' 25.342"	006	4 Chinook and redds
N 63° 45' 42.584" W 136° 33' 48.729"	007	1 female Chinook on redd
N 63° 43' 38.283" W 136° 37' 50.003"	008	3 Chinook and redds
N 63° 42' 06.163" W 136° 39' 20.872"	009	3 Chinook and redds
N 63° 40' 41.963" W 136° 40' 50.300"	010	10 Chinook and redds
N 63° 40' 14.284" W 136° 45' 36.708"	011	6 Chinook and redds
N 63° 38' 57.541" W 136° 52' 20.152"	012	5 Chinook and redds
N 63° 39' 14.357" W 136° 55' 59.239"	013	1 Chinook and redd
N 63° 39' 05.286" W 136° 57' 25.853"	014	8 Chinook and redds
N 63° 38' 32.314" W 137° 00' 12.422"	015	4 Chinook and redds
N 63° 34' 53.496" W 137° 19' 30.160"	016	3 Chinook and redds

*Position Format: dddº mm' ss.sss" (NAD 27)