2020 Alsek River
Sockeye Salmon Run Reconstruction
Using Genetic Stock Identification

Project NF-2020-I-23
DFO CA #57375

Final Report
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Introduction

The Alsek River originates in the Yukon Territory, Canada, and flows in a southwesterly direction through British Columbia and into the Gulf of Alaska southeast of Yakutat, Alaska (Figure 1). Alsek River sockeye salmon (*Oncorhynchus nerka*) are caught primarily in U.S. commercial and subsistence set gillnet fisheries in the lower Alsek River and in aboriginal and recreational fisheries in Canada. A limited number of Alsek sockeye are harvested in marine commercial gillnet fisheries near Yakutat.

Alsek sockeye populations are managed jointly by Canada and the United States (U.S.) through the Pacific Salmon Commission (PSC) process as part of the Canada/U.S. Pacific Salmon Treaty (PST) adopted in 1985 (PSC 2019). Prior to 2000, other than a mark-recapture study conducted in 1983 by Alaska Department of Fish and Game (ADF&G), the total abundance of Alsek River sockeye salmon was largely unknown because stock assessment projects to determine system-wide escapements had not yet been fully developed. The status of sockeye salmon was historically evaluated by monitoring escapement trends of what were assumed to be the two principal sockeye stocks within the drainage: Klukshu River and Nesktaheen Lake sockeye salmon.

For the Klukshu River stock, abundance has been determined through counts conducted by Fisheries and Oceans Canada (DFO) in co-operation with the Champagne-Aishihik First Nation (CAFN) since 1976. The first escapement goal for Klukshu River was developed in 2000, (Clark and Etherton 2000) but very little else was known about the magnitude of run sizes and system wide production capacity. Also in 2000, a pilot project was initiated to determine the feasibility of assessing the drainage wide escapement for sockeye salmon using mark-recapture. After achieving the objectives of the 2000 study, this program was continued from 2001 through to 2004.

In 2005 and 2006, assessments of the total sockeye return to the Alsek River were made using sockeye salmon counts at Klukshu, sockeye catch and CPUE from the commercial fishery at Dry Bay, plus genetic stock identification (GSI) of tissue samples taken in the Dry Bay commercial fishery (Waugh and Stark 2008a&b). The results were encouraging, and in 2008 a project recommendation was made by the PSC Northern Fund Committee to develop a statistically valid sampling strategy which would include methods of calculations and the precision expected based on various sample sizes and stock contribution levels for the apportionment of Alsek sockeye abundance into the requisite stocks (i.e. Klukshu and others). This sampling strategy, in conjunction with the Klukshu weir counts, provided the foundation for reconstructing sockeye returns to the Alsek River. The project was completed by W. J. Gazey Research with funding from the Northern Fund, "*GSI Sample Size Requirements for In-river Run Reconstruction of Alsek Chinook and Sockeye Stocks, W. J. Gazey, April 2010"*. Gazey's analysis provided a model with which to determine the required genetic tissue sample sizes needed to reconstruct the Alsek sockeye returns to achieve a desired precision at a prescribed confidence level.

The Gazey Model has been used by DFO since 2011 to provide Alsek River system-wide sockeye population estimates. A revised escapement goal for Klukshu River and an Alsek River system-wide escapement goal were recommended by the PSC and adopted by the U.S. and Canada in 2013 (PSC 2015).

The 2019-2028 Transboundary chapter of the PST tasked the Parties and the Transboundary Technical Committee (TTC) to explore methods to determine inriver abundance for Alsek sockeye salmon. Through the "*Pacific Salmon Commission Transboundary Panel Strategic Salmon Plan, March 2019*", the PSC committed to develop and implement abundance based management regimes for Alsek River sockeye which includes estimates of total abundance. This 2020 project was designed to meet the objectives set out in the PST and the Transboundary Panel's strategic salmon plan and funding was secured through the Northern Endowment Fund to analyze tissue samples collected from the U.S. commercial fishery in Dry Bay for the purpose of reconstructing the 2020 Alsek sockeye salmon return.

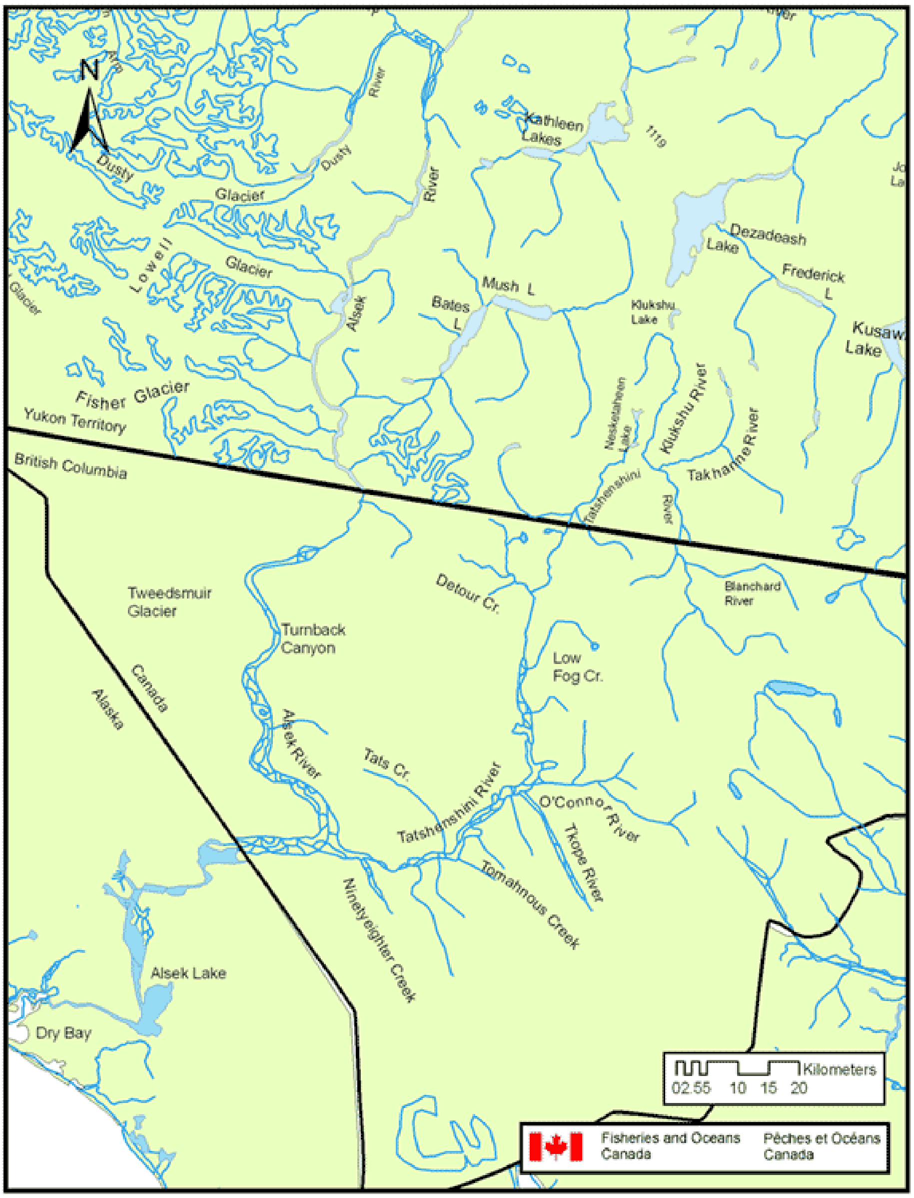

Figure 1. Map of salmon bearing portion of Alsek River drainage.

Objectives

The following objectives were set for this project in 2020:

- Collection of fishery performance data and tissue samples (up to 750) from the Alsek sockeye salmon commercial fishery (Dry Bay, Alaska);
- GSI analysis of tissue samples collected in the Dry Bay commercial fishery;
- Run reconstruction of the 2020 Alsek sockeye run at the desired precision, <25% within a 95% confidence level;
- Assessment of the Klukshu River sockeye salmon contribution to the drainage wide escapement within the Alsek River.

Assumptions

The GSI ratio-based expansion approach requires several fundamental assumptions:

1) all Alsek River sockeye salmon stocks are equally vulnerable to capture by the commercial fishery when it is operating (Event I),
2) the commercial fishery (Event I) samples in proportion to the entire Alsek River sockeye salmon run,
3) the stock(s) being expanded are of a large enough proportion to yield statistically valid results,
4) the entire escapement of the expanded stock will be accurately enumerated (Event II),
5) the assignment of genetic samples to stock reporting groups is accurate.

The following discussion related to these assumptions is germane to the years 2005, 2006, and 2011 – 2019; years for which we have Alsek River sockeye salmon GSI data.

Assumption 1:

We assume that the Dry Bay commercial drift gillnet fishery is unbiased in relation to stock groupings, and captures all stock groups equally when operating.

Assumption 2:

The Dry Bay, Alaska commercial sockeye fishery begins about 50% of the time in statistical week (SW) 23 (usually the second week in June), about 40% of the time in SW 24, and about 10% of the time in SW 25 (years with Chinook salmon conservation concerns). Run timing profiles vary among Alsek River sockeye stock groupings, with Blanchard and Takhanne river stocks being the earliest to enter the river (Smith et al 2009). Mark-recapture studies conducted from 2000 – 2004 showed that the mean date of passage for the Takhanne stock was 20 May – 07 June, and the mean date of passage for Blanchard stock was from 07 – 14 June. Based on radio tag recoveries, these early stocks were relatively minor contributors to the overall Alsek River return, with the Takhanne contribution less than 1% and the Blanchard contribution ranging from 8-14% (Smith et al, 2009). These studies also showed that the beginning of the run for the Klukshu River stock through Dry Bay averaged 01 June. As of 07 June (the typically start of SW 23 and the commercial fishery) the cumulative Klukshu stock run timing through Dry Bay averaged 14%, and as of 14 June (typical start of SW 24) averaged 23%. GSI results from samples gathered in the commercial fishery indicate a smaller proportion of the Klukshu stock is seen in early weeks. Raw GSI data (full analysis pending) indicate that the Klukshu stock represents an average of <2% in SW 23 (n=5), <2% in SW 24 (n=7), and ~6% in SW 25 (n=9).

These data indicate that on average a small and variable portion of the total Alsek River sockeye run is past Dry Bay by the time the commercial fishery begins, and this can be exacerbated in years when the fishery start is delayed due to conservation concerns. However, the Klukshu stock tends to run a bit later in the overall run and has been generally captured by the commercial fishery. Expansion analyses need to take into account early run timing considerations, particularly in years where the fishery start is delayed.

A group of statisticians are currently working on development of analysis tools to apply to these types of GSI data (Dr. Carl Schwarz, pers. comm. 2019), and we hope to leverage that expertise in coming years.

Assumption 3:

The Klukshu River sockeye stock comprises a substantial but variable portion of the total Alsek River sockeye run. Radio telemetry studies from 2001 – 2003 found the Klukshu stock represented an average contribution of 27%, while concurrent mark-recapture studies from 2000 – 2004 found an average contribution of 24% (15 – 32%) (Smith et al, 2009). Analyses using the GSI Gazey approach for the years 2005, 2006, and 2011 – 2018 found an average contribution of 17% (4 – 36%). In most cases these values exceed recommendations for utility in expansion, where in general, values >20% are desirable.

Assumption 4:

The annual Klukshu River sockeye salmon run has been determined by absolute count since 1976, and complete enumeration has occurred in all years. The enumeration facility is in place well before the sockeye run begins (it enumerates early returning Chinook salmon also), and operation extends beyond the end of the sockeye run (it enumerates ate returning coho salmon as well). Past operations utilized a manually operated fence with physical counts of all passing sockeye, but video enumeration techniques have been employed since 2016.

Assumption 5:

Alsek River sockeye salmon genetic baselines and analysis tools have been established, monitored, and maintained bilaterally through the Transboundary Technical Committee (TTC). Details can be found in the Alsek River salmon management plan (PSC, 2020).

Methodology

DNA Collection and Analysis

A target of 750 Alsek River sockeye salmon tissue samples (severed axillary appendages) were targeted to be collected in proportion to the run from the 2020 U.S. commercial fishery catch in Dry Bay, Alaska from the beginning of June to the middle of August. Samples were composited by statistical week and analyzed at the DFO Molecular Genetics Laboratory (MGL) in Nanaimo, British Columbia. Genetic stock identification (GSI) was conducted as per Withler et al (2000) to determine the weekly genetic stock composition of the commercial sockeye salmon catch, including the weekly proportion of Klukshu stock.

The genetic stock identification methods used by Canada are bilaterally reviewed by the Transboundary Technical Committee (TTC) of Pacific Salmon Commission and detailed in the annual management plan for the Transboundary Rivers (PSC In Prep.). The management plan also details the baseline populations for Alsek River sockeye salmon. More detailed descriptions of methods used in mixed-stock analysis by the MGL can be found in Beacham et. al. (2005 and 2006), Neaves et. al. (2004-2008), and Pella and Matsuda (2001).

The CBAYES computer program for mixed-stock analysis uses Bayesian statistical methods to establish a genetic profiles for all samples and estimates weekly and seasonal stock composition and associated error in the Taku River commercial sockeye salmon fishery. Results are reported based on two stock groupings that have been bilaterally agreed to as the transboundary fisheries management reporting groups identified from the TTC Genetics workshop in April 2013.

Run Reconstruction

Run reconstruction methodology followed the model detailed in "*GSI Sample Size Requirements for In-river Run Reconstruction of Alsek Chinook and Sockeye Stocks, W.J. Gazey, April 2010*". Sockeye salmon counts from the Klukshu River, sockeye catch and CPUE data from the commercial fishery at Dry Bay, and GSI results from tissue samples taken in the Dry Bay commercial fishery, were used to estimate the 2020 run of Alsek River sockeye salmon.

Results

DNA Collection and Analysis

There were significant restrictions placed on the U.S. Alsek River Dry Bay commercial sockeye fishery in 2020 due to salmon conservation concerns. The initial opening of only 12 hours was delayed to SW 24 due to Chinook salmon concerns, and subsequent weekly openings were reduced inseason to only one day per week due to low sockeye abundance. The directed sockeye fishery was open for a total of 7.5 days in 2020, and the total harvest of 2,518 sockeye was 32% of average. In spite of the reduced fishery, ADF&G samplers were able to collect a total of 486 sockeye tissue samples (axillary appendages) from the fishery (Table 1). Samples were collected beginning in statistical week 24 (starting 07 June) and completed in week 31 (ending 01 August), apportioned based on catch. The sockeye fishery is mostly over at that point as a majority of the run has passed through the lower river, but no fish were sampled in the remaining weeks of the commercial fishery as no further fishing activity occurred. Samples were shipped to the DFO MGL in Nanaimo, British Columbia for analysis in the winter of 2020/21. All 486 samples are currently being analyzed at time of writing.

Table 1 Alsek River sockeye salmon commercial catch and GSI samples by statistical week, Dry Bay, Alaska, 2020.

Stat Week	Sockeye Catch	Sockeye Samples Obtained	Sockeye Samples Analyzed
23			
24	163	40	n/a

25	306	55	
26	406	80	
27	686	120	
28	567	120	
29	247	37	
30	109	34	
31	34	0	
32-41	0	0	
Total	**2,518**	**486**	**0**

Run Reconstruction

The Alsek River terminal sockeye salmon run reconstruction for 2020 is not yet available as the analysis of genetic samples is incomplete at the time of writing.

Discussion

The 2020 Alsek River inriver sockeye salmon run estimate is not yet available as the analysis of genetic samples is incomplete at the time of writing. Alsek River sockeye salmon runs over time are presented in Table 2.

Table 2 Alsek River sockeye salmon, 2000–2006, 2012–2019 (PSC, In Prep)

The 2000-2004 estimates are based on a mark-recapture study and the 2005-2006 estimates was based on GSI analysis and the expansion of the Klukshu River weir count.

The 2000-2004 estimates are based on a mark-recapture study; starting in 2005 estimates based on GSI analysis and the expansion of the Klukshu River weir count.

Year	Above border Run Estimate	CI Lower	CI Upper	Canadian Harvest	Spawning Escapement	U.S. Harvest	Total Inriver Run	Spawning Escapement Percent Klukshu
2000	37,887	23,410	52,365	745	37,142	9,668	47,555	14.6%
2001	31,164	23,143	39,185	1,177	29,987	14,067	45,231	31.1%
2002	95,427	55,893	134,961	2,255	93,172	17,150	112,577	25.3%
2003	103,507	74,350	132,664	2,795	100,712	39,874	143,381	31.9%
2004	83,703	39,566	127,841	2,122	81,581	18,254	101,957	16.8%
2005	57,817	21,907	93,727	594	57,223	7,857	65,674	5.5%
2006	48,901	41,234	56,569	1,327	47,574	10,338	59,239	27.1%
2011	86,009	72,970	99,049	2,110	83,899	24,556	110,565	24.8%
2012	78,384	64,311	92,456	1,786	76,598	18,582	96,966	22.4%
2013	84,279	16,466	152,091	508	83,771	7,664	91,943	4.5%
2014	88,233	69,508	106,958	1,140	87,093	33,847	122,080	13.9%
2015	64,793	47,474	82,111	1,084	63,709	16,267	81,060	17.8%
2016	59,651	43,558	75,743	815	58,836	6,890	66,541	12.6%
2017	102,186	57,832	146,540	622	101,564	5,008	107,194	3.7%
2018	19,928	17,086	22,770	0	19,928	1,505	21,433	35.8%
2019	82,536	69,077	95,995	653	81,883	10,016	92,552	22.9%
2020								
Averages								
11-19	74,000			969	73,031	13,815	87,815	17.6%

In 2020 we were unable to fully meet all of the project objectives, but still conducted a successful project. We fell short of the targeted 750 sockeye tissue samples (n=486) for genetic analysis due to the restrictive Dry Bay commercial fisheries, but we have been able to begin analysis of all samples. It remains to be seen if the 2020 Alsek River sockeye salmon run estimate achieves the desired <25% precision at the 95% confidence level, but success is anticipated.

Budget Summary

The Northern Endowment Fund allocation to DFO of $15,750.00 was not fully expended. Total expenditures of NEF funds amounted to $10,206.00 which is $5,544.00 under budget. This is due to not obtaining the target number of genetic samples. The 10% holdback of $1,575.00 is not required from the PSC, and once the final project report is accepted by the PSC, DFO will issue a refund of $3,969.00 of unspent advance monies. A budget summary of expenditures can be referenced in Appendix 2.

Acknowledgements

Rick Hoffman of ADF&G was instrumental in this project by coordinating and collecting the samples in Dry Bay, Alaska, thank you to him as well as Chase Jalbert, Kyle Shedd and staff at the ADF&G Genetics Lab for forwarding the samples on to the DFO Molecular Genetics Lab (MGL) in Nanaimo, B.C.. Much appreciation to Ben Sutherland and crew at the MGL for coordinating and beginning to process the samples in a timely manner. Thanks to Yvonne Muirhead-Vert and Colleen Claggett for financial administrative support.

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Appendices

Appendix 1. Financial Summary

Alsek River - Sockeye Salmon GSI Run Reconstruction 2020 (PSC NF-2020-I-24)

EXPENDITURES

Labour

DFO Employee Salaries and Benefits

Position		Expenditures (DFO Inkind + PSC)	DFO-Inkind	PSC funding (expenses)	Approved Budget (PSC Funding)	Total PSC Funded Expenditure	Variance
Manager	Salary	$ -					
	Benefits	$ -			$ -		
Biologist	Salary	$ 1,215.00	$ 1,215.00				
	Benefits	$ 328.05	$ 328.05		$ -		
Technician	Salary	$ 615.00	$ 615.00				
	Benefits	$ 166.05	$ 166.05		$ -		
	Total Expended	**$ 2,324.10**	**$ 2,324.10**	**$ -**	**$ -**	**$ -**	**$ -**

Subcontractors & Consultants

Contract		Contract Amount Expended	Inkind	PSC funding (expenses)	Approved Budget	Total PSC Funded Expenditure	Variance
Contract A		$ -					
Contract B		$ -					
Contract C		$ -					
		$ -					
		$ -					
	Total Expended	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
			$ 2,324.10	**Total**	**$ -**	**$ -**	**$ -**

Site / Project Costs

Item		Amount Expended	Inkind	PSC funding (expenses)	Approved Budget	Total PSC Funded Expenditure	Variance
Travel		$ -					
Small Tools & Equipment		$ -					
Site Supplies & Materials - Lab Supp. for GSI		$ 10,206.00		$ 10,206.00	$ 15,750.00		
Equipment Rental		$ -					
Work & Safety Gear		$ -					
Repairs & Maintenance		$ -					
Permits		$ -					
Other costs		$ -					
	Total Expended	**$ 10,206.00**	**$ -**	**$ 10,206.00**	**$ 15,750.00**	**$ 10,206.00**	**$ 5,544.00**
			$ -		**$ 15,750.00**	**$ 10,206.00**	**$ 5,544.00**

Training Costs

Item		Amount Expended	Inkind	PSC funding (expenses)	Approved Budget	Total PSC Funded Expenditure	Variance
Name of course		$ -					
		$ -					
	Total Expended	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
			$ -		**$ -**	**$ -**	**$ -**

Overhead / Indirect Costs							
Item	Amount Expended	Inkind	PSC funding (expenses)		Approved Budget	Total PSC Funded Expenditure	Variance
Office space; including utilities, etc.	$ -						
Insurance	$ -						
Office supplies	$ -						
Telephone & long Distance	$ -						
Photocopies & printing	$ -						
Indirect/overhead costs	$ -						
Administration and financial management	$ -						
(If the PSC contribution to Indirect costs exceeds 20% of the total PSC grant submission of back-up documentation justifying the expense is required).							
Total Expended	$ -	$ -	$ -		$ -	$ -	$ -
		$ -			**$ -**	**$ -**	**$ -**

Capital Costs / Assets (Value > $250.00)							
Item	Amount Expended		PSC funding (expenses)		Approved Budget	Total PSC Funded Expenditure	Variance
	$ -						
	$ -						
	$ -						
	$ -						
Total Expended	$ -	$ -	$ -		$ -	$ -	$ -
		$ -			**$ -**	**$ -**	**$ -**

Financial Report

Categories	DFO InKind		**Approved Budget (PSC Grant)**	**Project Expenditures (PSC$)**	**Variance**
Labour	$ 2,324.10		$ -	$ -	$ -
Site / Project Costs	$ -		$ 15,750.00	$ 10,206.00	$ 5,544.00
Training	$ -		$ -	$ -	$ -
Overhead / Indirect Costs	$ -		$ -	$ -	$ -
Capital Costs / Assets	$ -		$ -	$ -	$ -
TOTAL			**$ 15,750.00**	**$ 10,206.00**	**$ 5,544.00**

PSC Project Funding Grant Advance Amount Received	**$ (14,175.00)**	(funds rec enter as negative)
PSC Project Funding Grant Amount Remaining to be Paid	**$ 3,969.00**	(positive refundable to PSC)
Difference Between Grant Amount and Project Expenditures	**$ -**	

Justification if Variance

Not all funds granted were expended. DFO will be issuing a refund to the PSC in the amount of $3,969.00.

Project Manager Name Aaron Foos

Project Manager Signature Foos, Aaron Digitally signed by Foos, Aaron Date: 2021.02.08 09:04:31 -07'00'

Date

DFO Responsibility Center Manager Name William Waugh

DFO Responsibility Center Manager Signature Waugh, William Digitally signed by Waugh, William Date: 2021.02.08 09:33:39 -07'00'

Date