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Yukon River Chinook Salmon Subsistence Harvest ASL and Genetic Stock Identification, 2018

by

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and

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May 2020

Alaska Department of Fish and Game **Divisions of Sport Fish and Commercial Fisheries**

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Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
milliliter	mL
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
nautical mile	nmi
ounce	oz
pound	lb
quart	qt
yard	yd

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
degrees kelvin	K
hour	h
minute	min
second	s

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity (negative log of)	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

Alaska Administrative Code	AAC
all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.
all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.
at	@
compass directions:	
east	E
north	N
south	S
west	W
copyright	©
corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
District of Columbia	D.C.
et alii (and others)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.
Federal Information Code	FIC
id est (that is)	i.e.
latitude or longitude	lat or long
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S.C.	United States Code
U.S. state	use two-letter abbreviations (e.g., AK, WA)

Mathematics, statistics

all standard mathematical signs, symbols and abbreviations	
alternate hypothesis	H_A
base of natural logarithm	*e*
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	(F, t, χ^2, etc.)
confidence interval	CI
correlation coefficient (multiple)	R
correlation coefficient (simple)	r
covariance	cov
degree (angular)	°
degrees of freedom	df
expected value	*E*
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	log_2, etc.
minute (angular)	'
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
variance	
population	Var
sample	var

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ABSTRACT

Understanding the age, sex, length, and stock of origin of Chinook salmon *Oncorhynchus tshawytscha*, caught in subsistence fisheries of the Yukon River is important for making well informed management decisions and forecasting salmon runs. The objective of this study was to collect representative genetic mixed stock analysis information, coupled with age, sex, and length data, from the Chinook salmon subsistence harvest in the Coastal District and Districts 1–5. A total of 43 subsistence fishermen from 13 communities sampled 1,573 Chinook salmon that were harvested using gillnets, fish wheels, and dip nets. The age, sex, and length composition of the harvest was 0.3% age-3, 16.9% age-4, 47.1% age-5, 33.9% age-6, 1.8% age-7, 32.5% female, and an average of 725 mm in length. The proportion of the catch that was Canadian-origin ranged from 0.38 in District 2 to 0.72 in District 5. The data generated from this project are essential to estimate total run size of Yukon River Chinook salmon stocks, evaluate boarder passage and harvest share agreements as defined in the Pacific Salmon Treaty, and update spawner-recruit models used to estimate past and future run productivity. Due to the variability in Chinook salmon runs, management actions, and harvest, annual monitoring of the subsistence Chinook salmon harvest is needed.

Key words: Chinook salmon, *Oncorhynchus tshawytscha*, subsistence, stock composition, age composition, sex composition, harvest, genetic mixed stock analysis, Yukon River.

INTRODUCTION

Subsistence salmon fisheries within the Yukon River drainage are among the largest in Alaska. Fishing occurs in the Alaska portion of the Yukon River across distinct fishery management districts and subdistricts (hereafter referred to as districts). Together, the districts span the Yukon River for hundreds of miles; thus, the stock composition of the subsistence harvest varies among these districts because of differences in harvest timing, location, and gear used. Complete information about harvest is critical to create brood year tables of Canadian-origin Chinook salmon, reconstruct runs, and forecast future returns. Run reconstructions form the basis of the spawner-recruit models used to estimate past and future run productivity of Canadian-origin Chinook salmon. These data also help managers understand the effects of management actions and fishing gear on harvest composition. In addition, measuring the total harvest of Canadian-origin Yukon River Chinook salmon is necessary to address harvest sharing objectives outlined in the Pacific Salmon Treaty (PST).

An understanding of the stock composition of subsistence harvests is a critical component to appropriately characterize the return of Chinook salmon to the Yukon River. Alaska subsistence harvests of Yukon River Chinook salmon averaged about 49,000 fish per year (21% of total run) between 2001 and 2011 but only about 14,000 (9% of total run) between 2012 and 2015 (JTC 2018). Because of small run sizes and expectations of limited harvest opportunity, the subsistence harvest sampling programs were essentially eliminated in the lower and middle Yukon River districts from 2013 until 2015. During that time, limited samples were combined with historical estimates and assumptions about harvest stock compositions to update brood tables and estimate the Canadian-origin component of the harvest. These estimates were considered sufficient for making projections because subsistence harvests were so small. However, the Chinook salmon run has improved, and the subsistence harvest increased to about 37,000 fish in 2017. Since 2016, a robust harvest sampling program has been in place to measure the age and stock composition of subsistence caught Chinook salmon, which is critical to understanding the Yukon River Chinook salmon run.

Because of year-to-year changes in stock-specific run size and fishery management actions, it is not always appropriate to use historical harvest composition as a proxy for annual data collection, and for those reasons annual monitoring of the subsistence harvest is valuable. For example, in 2005 under minimal subsistence harvest restrictions, 60% of District 1 subsistence harvest was estimated to be of Canadian origin (DuBois and DeCovich 2008), but under the highly restricted fishery in 2009, the Canadian origin component was down to 36% (DeCovich and Howard 2010). Intensive annual monitoring of the Yukon River Chinook salmon subsistence harvest in Alaska was conducted in 2016 and 2017 through a grant received from the Yukon River Panel (YRP), Restoration and Enhancement (R&E) Fund. In 2016, fishermen were restricted to relatively small mesh gillnets (6-inch stretch mesh) for most of the season, which resulted in a younger and more male fish harvest than what was represented at the test fishery associated with the Pilot Station sonar. The proportion of the subsistence catch that was Canadian-origin ranged from 0.41 in District 2 to 0.64 in Subdistrict 5-B. Across all districts, roughly 0.57 of the Chinook salmon subsistence harvest was Canadian-origin (Larson et al. 2017). Again in 2017, fishermen were restricted to relatively small mesh gillnets for some of the season, which resulted in a younger and more male fish harvest than what was represented at the test fishery associated with the Pilot Station sonar. The proportion of the catch that was Canadian-origin ranged from 0.31 in Subdistrict 4-B to 0.72 in Subdistrict 5-B. Across all districts, roughly 0.56 of the Chinook salmon harvest was Canadian-origin (Larson et al. 2018). R&E funding was again received for monitoring the subsistence harvest composition in 2018.

Like past years, the goal of the 2018 study was to collect representative genetic mixed stock analysis (MSA) information, coupled with age, sex, length (ASL) data, from the Chinook salmon subsistence harvest in Yukon River from the Coastal District to District 5. This work was a continuation of past efforts and built upon a collaboration between ADF&G and Spearfish Research that began in 2016. Spearfish Research was responsible for recruiting and training subsistence fishermen on how to sample their harvest and ADF&G was responsible for analyzing the data. Prior to 2016, Spearfish Research was involved in Chinook salmon subsistence harvest sampling, primarily in the upper Yukon River districts.

The 2018 study provided information needed to understand the dynamics of the Yukon River Chinook salmon subsistence harvest, with emphasis on the proportion of Canadian-origin fish in the harvest. Results from this study contribute to subsequent assessments of stock productivity and long-term trends in the ASL composition for Yukon River Chinook salmon caught in the subsistence fishery. Scientifically-based escapement objectives for Canadian-origin salmon are based on brood tables constructed using accurate stock-specific harvest data. Brood tables are updated annually with the most up-to-date information to improve estimates of brood year returns and future run projections.

This report was submitted to the YRP in partial fulfillment of the R&E grant requirements. This and past project reports can be found on the YRP website[1]. Beginning in 2017, annual R&E reports were also published in the ADF&G RIR series to improve accessibility through the ADF&G publications database.

[1] https://www.yukonriverpanel.com/restoration-enhancement-fund/

OBJECTIVES

The objectives of this study were as follows:

- Sample up to 400 Chinook salmon caught in the subsistence fishery, per district, within the Coastal District and Districts 1–5.
- Estimate the ASL composition of Chinook salmon harvested in the subsistence fishery.
- Estimate the genetic stock composition of Chinook salmon harvested in the subsistence fishery.

STUDY AREA

The Yukon River watershed exceeds 855,000 km^2, is the fourth largest drainage basin in North America, and discharges over 200 km^3 of water per year into the Bering Sea (Brabets et al. 2000). As the longest river in Alaska, the distance between the mouths of the Yukon River to its headwaters in British Columbia, Canada is more than 3,000 km. All 5 species of Pacific salmon, *Oncorhynchus* spp., enter the Yukon River to spawn each year. Within the Alaska portion of the drainage, the Yukon Area is split into 7 fishing districts for management (Coastal District and Districts 1–6; Figure 1). The inriver Districts 1–5 are numbered sequentially progressing from the river mouth to the Canadian border. District 6 represents the Tanana River. Because the stock composition of the harvest changes from downriver to upriver, 2 of the largest districts are further divided into subdistricts. For example, District 4 includes Subdistricts 4-A, 4-B, and 4-C. Similarly, District 5 includes Subdistricts 5-A, 5-B, 5-C, and 5-D. (Figure 1). The 7 districts are generally grouped into broad geographic regions. The Coastal District and Districts 1–3 are often referred to as the Lower Yukon. Districts 4 and 6 are often referred to as the Middle Yukon. District 5 (mainstem of the Yukon River upriver of the Tanana River confluence) is often referred to as the Upper Yukon. These general groupings are similar but not identical to the genetic stock groupings used throughout this report.

METHODS

SAMPLE SIZE CONSIDERATION

This study's sampling design was developed in the context of both the representativeness of the samples and its effect on the accuracy and precision of the stock composition estimates. Precision and accuracy of stock composition estimates are affected primarily by the representativeness of the genetic baseline and the harvest sampling. The Yukon River Panel's Joint Technical Committee's (JTC) Subcommittee on Stock Identification recommended specific criteria for the precision and accuracy of stock composition estimates used for the management of Yukon River Chinook salmon. The JTC recommended that stock composition estimates of 20 percent or greater have a coefficient of variation of 20% or less. If estimator performance is to be assessed using simulation techniques, it was recommended that the Relative Root Mean Squared Error (RRMSE) be 20% or less (JTC 1997).

We assumed that the age and stock composition of the subsistence Chinook salmon harvests were a function of the gear selectivity, run timing, and location of fishing relative to the total Chinook salmon run. Given these assumptions, a representative sample required that data be collected proportional to the true distribution of the harvest across gear, time, and location. However, the true distribution was unknown and each of these 3 elements varied between fishermen throughout the season, depending on variables such as personal preferences, fish availability (i.e., run timing and abundance), fishing conditions (e.g., turbidity and water level), and regulatory requirements (e.g., gear, time, and area restrictions). Such constraints created practical limits that precluded implementing a true random sampling design. Instead, we used a "grab sample" design (Geiger and Wilbur 1990) and assumed that a well distributed grab sample from volunteer participants resulted in a representative dataset that was "self-weighted" to the actual distribution of harvest across gear, time, and location of harvest. The data collected represented a "grab sample" of the total subsistence harvest of Chinook salmon in the Coastal District and Districts 1–5.

Sample size varied by fishing district. For districts where more than 1 community was sampled, the targeted sample size was 400. This ensured that communities with different fishing methods were adequately represented within the sample. For districts where a single community represented the district, 200 samples were sufficient (Bromaghin 1993). Communities with the largest historical Chinook salmon harvests in the district were chosen for sampling; including, Hooper Bay and Scammon Bay in the Coastal District; Alakanuk, Emmonak and Kotlik in District 1; Mountain Village and St. Mary's in District 2; Russian Mission in District 3; Kaltag, Nulato, Galena, and Ruby in District 4; and Tanana in District 5 (Figure 1). Due to the long-term stock composition dataset that has already been collected by Spearfish Research in Fort Yukon and other neighboring communities, Tanana was the only community sampled in District 5. There was not a sample size goal for number of participants; however, the intent was to collect samples from enough participants so that the resulting collection was representative of the overall subsistence harvest.

SAMPLING PROCEDURES AND ANALYSIS

Community members were recruited and trained on how to take ASL and MSA samples of their subsistence-caught Chinook salmon. Training followed ADF&G's salmon ASL sampling procedures and instructions from the ADF&G Gene Conservation Laboratory. Trainings included verbal, visual, and hands-on activities regarding data collection. Participants were paid $10 for each fish sampled to encourage participation. Community coordinators were hired in each village to help recruit participants and to serve as a local contact for sampling questions. Community coordinators also assisted with the return of samples from participants to Spearfish Research.

Participants were asked to sample all Chinook salmon harvested during the 2018 season. Samples were collected immediately after fish were caught. Data sheets included space to record capture methods, mesh size, location, harvest date, fish number, scale card number, sampler's name, and genetic vial numbers. Participants followed collection methods established by ADF&G:

- Sex was determined by cutting the abdomen of the fish and inspecting the gonads, because sex identification from external examination alone has been unreliable (Molyneaux et al. 2010).
- Length was measured from mideye to tail fork (METF) (to the nearest mm) using a rigid meter stick.
- A total of 3 scales were collected from the left side of the fish, 2–3 rows of scales above the lateral line, between the dorsal and anal fins, and mounted on pre-printed gum cards.
- A single axillary process was clipped from each fish and placed in an individual, ethanol-filled vial.

Biological data were numbered and recorded so that ASL and genetic samples could be matched to each fish sampled. All data and samples were shipped to ADF&G for processing. ADF&G staff determined the age of samples from scale pattern analysis using standard methods (Eaton 2015). Ages were reported using European notation (Koo 1962) and as total age. With European notation, the number of freshwater annuli is followed by a decimal and then the number of marine annuli. Total age from the brood year is the sum of freshwater and marine annuli plus 1 to account for time spent in the gravel before hatching.

Genetic data was collected from the fishery samples as individual multi-locus genotypes for 42 Single Nucleotide Polymorphisms (SNPs; Table 1). Genomic DNA was extracted using a DNeasy® 96 Blood & Tissue Kit by QIAGEN® (Valencia, CA)[2]. Chinook salmon samples were genotyped using Fluidigm 192.24 Dynamic Array Integrated Fluidic Circuits (IFCs), which systematically combine up to 24 assays and 192 samples into 4,806 parallel reactions. Each reaction was conducted in a 8 nL volume consisting of 20X Fast GT Sample Loading Reagent (Fluidigm), TaqMan® GTXpress™ Master Mix (2X; by Applied Biosystems and consisting of AmpliTaq® Fast DNA Polymerase, UP, dNTPs, Tracking Dye, and ROX™ dye), TaqMan® Custom SNP Genotyping Assay (containing 72 µM of each polymerase chain reaction primer and 16 µM of each probe), 2X Assay Loading Reagent (Fluidigm), ROX (50X, Invitrogen), and 60-400ng/µl DNA. Thermal cycling was performed on a Fluidigm FC1™ Cycler. The Dynamic Array IFCs was read on a BioMark™ after amplification and scored using Fluidigm® SNP Genotyping Analysis software. Genotype data were stored in an Oracle database (LOKI) on a network drive maintained by ADF&G computer services. Quality control measures included reanalysis of 8% of each collection for all markers to ensure that genotypes were reproducible and to identify laboratory errors and measure rates of inconsistencies during repeated analyses.

The stock composition of fishery mixtures was estimated using the program BAYES (Pella and Masuda 2001). The Bayesian method of genetic MSA estimated the proportion of stocks caught within each fishery using 4 pieces of information: 1) a baseline of allele frequencies for each population, 2) the grouping of populations into the reporting groups desired for MSA, 3) prior information about the stock proportions of the fishery, and 4) the genotypes of fish sampled from the fishery. For each fishery mixture, we ran 5 independent Markov Chain Monte Carlo chains of 40,000 iterations in BAYES with different starting values, discarding the first 20,000 iterations to remove the influence of the initial start values. To assess the among-chain convergence, we examined the Gelman-Rubin shrink factors computed for all stock groups (Gelman and Rubin 1992). If a shrink factor for any stock group in a mixture was greater than 1.2, we reanalyzed the mixture with 80,000 iterations. We combined the second half of iterations of the 5 chains to form the posterior distribution and tabulate mean estimates, 90% credibility intervals, and standard deviations.

Efforts were made to report estimates to as fine a scale as possible while maintaining a CV below 20%. When sample sizes were large enough, stock composition estimates were reported for groups at 3 hierarchical levels (Table 2): 1) country of origin (*U.S.* and *Canada*), 2) broad scale (*Lower Yukon*, *Middle Yukon*, and *Canada*), and 3) fine scale (*Lower Yukon*, *Middle Yukon, Upper U.S. Yukon, and Canada*). Otherwise, only the first 2 levels of the hierarchy were reported. When sample sizes were insufficient to provide the desired level of stock apportionment for an area stratum, samples were pooled. This strategy allowed all available fish samples to be utilized. This

[2] Product names used in this report are included for scientific completeness, but do not constitute a product endorsement.

method was also used to pool estimates from different communities to create stock composition estimates for a single district.

ASSUMPTIONS

1. The ASL and stock compositions of samples were a function of the harvest gear, time, and location.
2. Recruitment of participants was independent of participant preferences for harvest gear, timing, location, and harvest goals (i.e., number of fish).
3. Taken together, participants employed harvest methods (harvest gear, time, and location) that were proportional to the unknown actual distribution of harvest methods used by the collective Chinook salmon subsistence fleet in the Coastal District and Districts 1–5.
4. Samples that were pooled across gear type, time, and area for each district were representative of the actual total age and stock composition of the season total subsistence harvest of that district.

RESULTS

A total of 71 subsistence fishermen from 13 communities were recruited and trained to sample their subsistence caught Chinook salmon for ASL and genetic tissue in 2018. Of those, 43 fishermen sampled their harvest and submitted their data to Spearfish Research (Table 3). The first Chinook salmon sampled in the subsistence fishery were caught on May 31, 2018 in Alakanuk, Mountain Village, and Saint Mary's. The last Chinook salmon sampled was caught using a fish wheel in Tanana on July 23, 2018. In total, fishermen sampled 1,573 Chinook salmon that were caught using various gear types and gillnet mesh sizes (Table 4). The number of samples obtained per sampler ranged from 4–100 with an average of 37 Chinook salmon sampled per person. Only 182 (12%) of the fish sampled were caught using dip nets or fish wheels, whereas drift and set gillnets accounted for 962 (62%) and 429 (27%) of the Chinook salmon sampled, respectively (Table 4). Although a variety of mesh sized gillnets were used, most fish were caught using either 6.0-inch or 7.5-inch mesh gillnets. The use of 5.5-inch gillnets occurred in Districts 1 and 2, but the use of 4.0-inch gillnets occurred only in Districts 2 and 3. Over half of the fish sampled in District 5-B were caught using fish wheel (Tables 5 and 6).

Age, sex, and length were successfully determined for 1,273 (81%) of the Chinook salmon sampled (Table 7). The ASL composition of the subsistence Chinook salmon harvest varied among communities and gear type (Tables 7–9). Fish length ranged from 350 mm to 1,001 mm (Figure 2). Overall ASL composition of the harvest was 0.3% age-1.1, 16.9% age-1.2, 46.9% age-1.3, 0.2% age-2.2, 33.5% age-1.4, 0.4% age-2.3, 1.3% age-1.5, 32.5% female, and an average of 725 mm in length (Table 7). Fish caught in gillnets were predominately age-5 (European ages 1.3 and 2.2) fish, and fish length tended to increase with mesh size (Table 8). Chinook salmon sampled in the Coastal District were, on average, smaller and were a lower percentage female than Chinook salmon sampled in the other districts (Table 10). In total, the Chinook salmon sampled from the 2018 subsistence harvest were slightly older and larger than the 2013–2017 average for salmon sampled in the subsistence fishery. Although annual ASL and MSA results are often compared (Table 11), such comparisons should be done with caution because communities chosen to participate in the subsistence harvest sampling program has varied through time (Table 12).

Genetic MSA was successfully performed using 1,497 (98%) of the 1,520 samples collected and genotyped in 2018 (Table 13). Over 100 tissue samples were used for analysis for each district sampled. The proportion of the catch that was Canadian-origin ranged from 0.38 in District 2 to 0.72 in District 5-B (Table 13 and Figure 3). Across all districts and communities, roughly 0.52 of the Chinook salmon harvest was Canadian-origin. The proportion of the catch that was Canadian-origin was slightly below the 2016–2018 average in Districts 1 and 2 and above the 2016–2018 average in Districts 3–5 (Table 14).

DISCUSSION

We did not achieve the desired sampling goal of 400 fish from each district. However, we were able to process samples from over 100 fish in each district except the Coastal District, which allowed us to determine the Canadian and U.S. components of the harvest in each inriver district. The lower than anticipated sample sizes may have been due to fishing regulations designed to reduce the harvest of Chinook salmon relative to historical harvest levels. In addition, 2018 was the first year that harvest was sampled in the Coastal District and participation could have been low due to unfamiliarity with the project.

Quality control screenings occurred throughout the period of data collection and analysis and indicated that high quality tissue samples were collected in 2018. Only 23 of the genotyped samples had to be removed due to missing data. The collection of regenerated scales attributed to the loss of some age data. Although some loss of samples during ASL and tissue collection in the field is expected, steps will be taken in the future to keep the loss at a minimum. For example, feedback will be given to repeat samplers on their data quality and additional training will be given as needed.

Gillnets were the most commonly used gear among samplers due to their catch efficiency and management actions that required the live release of Chinook salmon from dipnets. Despite these management actions, 13 fish were sampled from dipnets which indicated that some fishermen may have been unaware that Chinook retention was not allowed from this gear type. Individuals who provided samples from fish caught in dipnets were informed postseason of the requirement to release Chinook salmon alive from that gear type in the future.

The ASL composition of Chinook salmon caught in the subsistence fishery differed slightly than Chinook salmon sampled at the Pilot Station sonar test fishery during 2018. Fish caught in the subsistence fishery had a higher percentage of age-4 (European age 1.2) fish (16.9% vs 12.1%), but the percentage of age-5 (European ages 1.3 and 2.2) fish and age-6 (European ages 1.4 and 2.3) fish were each within 3 percentage points from those fish sampled in the Pilot Station sonar test fishery. In addition, the fish caught in the subsistence fishery were smaller (725 mm vs 734 mm) and had a lower percent female (32.5% vs 48.2%) than fish sampled in the Pilot Station test fishery. The Pilot Station test fishery uses a suite of drift gillnets of various sizes (2.75 in, 4.0 in, 5.25 in, 6.5 in, 7.5 in, and 8.5 in stretch mesh) to collect ASL and tissue samples; therefore, samples collected probably reflect the ASL and stock composition of the total run (Schumann et al. 2017). However, the sex ratio of the run observed at Pilot Station sonar test fishery should be interpreted cautiously because the external sex identification methods used at that project are less reliable than internal methods used by subsistence samplers in the lower river, where Chinook salmon are still ocean-bright and secondary sexual characteristics are not well developed.

The differences in ASL composition of the harvest and the run are probably a consequence of the management actions taken in 2018. Fishermen were restricted to relatively small mesh gillnets for parts of the season, which tend to catch higher percentage of younger, smaller, and male fish than the run. For example, 6.0-inch or smaller gillnets were used for much of the season with limited opportunity for 7.5-inch gillnets. This was reflected in the data, where most of the fish sampled were caught using 6.0-inch or smaller gillnets.

The stock composition of Chinook salmon caught in the subsistence fishery was different from the stock composition of the Chinook salmon run in 2018. For example, the proportion of the subsistence harvest that was of Canadian-origin (0.52) was higher than the proportion of the Chinook salmon run that was of Canadian-origin (0.42), as indicated by genetic MSA at the Pilot Station sonar test fishery (JTC 2018). In 2018, fishing was restricted to half of the regulatory schedule during most of the Chinook salmon run. Subsistence periods were cancelled during the first and second pulses of the run in most districts and subsistence fisheries were not relaxed to the full regulatory schedule with 7.5-inch gillnets until most of the run had migrated through each district. Although differences in stock composition between the 2018 harvest and at the Pilot Station sonar test fishery may be in part due to management actions, it was probably driven by harvest locations. For example, almost half of the U.S. harvest of Chinook salmon occurred in District 5 communities (ADF&G unpublished data, on file with Division of Commercial Fisheries, Fairbanks). Upriver communities do not have access to lower or middle Yukon River Chinook salmon stocks, and harvest primarily Canadian-origin Chinook salmon.

Findings from this study apply directly to improving and implementing the US/Canada Yukon River Salmon Agreement management regime to address harvest sharing agreements as outlined in Appendix 2 of Chapter 8 of the Pacific Salmon Treaty. By estimating the total subsistence harvest of Canadian-origin Chinook salmon, managers can assess the effectiveness of actions aimed at achieving border passage objectives, escapement goals, Total Allowable Catch, and harvest shares. The results from this study will be used with those from the postseason subsistence harvest survey project, which provides annual estimates of harvest by community within the Alaska portion of the Yukon. Age and stock composition of the harvest will be applied directly to the harvest estimates by community and district to estimate total harvest of Canadian-origin Chinook salmon. Harvest estimates will be combined with run and escapement data to reconstruct the return of Chinook salmon and update brood tables. This information ultimately allows managers to better forecast the Chinook salmon run and predict potential Canadian-origin harvests, while considering fishing gear and time restrictions to meet harvest objectives. If the Chinook salmon run in the Yukon River continues to improve, and management actions adjust accordingly, it will be important to continue to sample the subsistence harvest and identify shifts in the ASL and stock compositions of the harvest.

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TABLES AND FIGURES

Table 1.–Single nucleotide polymorphism (SNP) markers used for this study.

Locus	Source
GTH2B-550	GAPs locus
NOD1	GAPs locus
Ots_E2-275	Smith et al. 2005a
Ots_arf-188	Smith et al. 2005a
Ots_AsnRS-60	Smith et al. 2005a
Ots_ETIF1A	GAPs locus
Ots_FARSLA-220	Smith et al. 2007
Ots_FGF6A	Unpublished
Ots_GH2	Smith et al. 2005b
Ots_GPDH-338	Smith et al. 2005a
Ots_GPH-318	Smith et al. 2007
Ots_GST-207	Smith et al. 2007
Ots_hnRNPL-533	Smith et al. 2007
Ots_HSP90B-100	Smith et al. 2007
Ots_IGF-I.1-76	Smith et al. 2005a
Ots_Ikaros-250	Smith et al. 2005a
Ots_il-1racp-166	Smith et al. 2005a
Ots_LEI-292	Smith et al. 2007
Ots_MHC1	Smith et al. 2005b
Ots_MHC2	Smith et al. 2005b
Ots_ZNF330-181	Smith et al. 2005a
Ots_LWSop-638	Smith et al. 2005a
Ots_SWS1op-182	Smith et al. 2005a
Ots_P450	Smith et al. 2005b
Ots_P53	Smith et al. 2005b
Ots_Prl2	Smith et al. 2005b
Ots_ins-115	Smith et al. 2005a
Ots_SClkF2R2-135	Smith et al. 2005a
Ots_SERPC1-209	Smith et al. 2007
Ots_RFC2-558	Smith et al. 2005a
Ots_SL	Smith et al. 2005b
Ots_TAPBP	GAPs locus
Ots_Tnsf	Smith et al. 2005b
Ots_u202-161	Smith et al. 2005a
Ots_u211-85	Smith et al. 2005a
Ots_U212-158	Smith et al. 2005a
Ots_u4-92	Smith et al. 2005a
Ots_u6-75	Smith et al. 2005a
Ots_Zp3b-215	Smith et al. 2005a
RAG3	GAPs locus
S7-1	GAPs locus
unkn526	GAPs locus

Table 2.–Chinook salmon collections from the Yukon River drainage organized hierarchically into reporting groups for genetic mixed stock analysis.

Country	Broad scale	Fine scale	Population	Year(s)	Sample size
U.S.	*Lower Yukon*				
		Lower Yukon			
			Andreafsky River	2003	202
			Anvik River	2007	58
			Nulato River	2012	51
			Kateel River	2002, 2008, 2012	174
			Gisasa River	2001	78
			Tozitna River	2002, 2003	278
	Middle Yukon				
		Middle Yukon			
			S. Fork Koyukuk River	2003	49
			Henshaw Creek	2001, 2007	180
			Kantishna River	2005	187
			Chatanika River	2001, 2007	43
			Chena River	2001	176
			Salcha River	2005	188
			Goodpaster River	2006, 2007, 2011	79
	Upper U.S. Yukon				
		Upper U.S. Yukon	Beaver Creek	1997	91
			Chandalar River	2002, 2003, 2004	162
			Sheenjek River	2002, 2004, 2006, 2011	69
Canada			Colleen River	2011	24
	Canada				
		Canada			
			Kandik River	2007, 2008, 2009, 2010, 2011	56
			Chandindu River	2001	146
			Klondike River	2001, 2003, 2007, 2010, 2011	144
			Porcupine River - Old Crow	2007	127
			Stewart River	1997, 2007	102
			Mayo River	1997, 2003, 2011	72
			Pelly River	1996, 1997	107
			Blind Creek	2003, 2007, 2008	218
			Tin Cup Creek	2003, 2009, 2010, 2011	132
			Mainstem at Minto	2007	97
			Tatchun Creek	1987, 1997, 2002, 2003	160
			Nordenskiold River	2003	55
			Little Salmon	1987, 1997, 2007, 2010	237
			Big Salmon	1987, 1997, 2007	176
			Nisutlin River	1987, 1997	55
			Teslin River	2007, 2009, 2010, 2011	198
			Morley River	1997, 2002, 2003, 2009, 2010	46
			Takhini River	1997, 2003	96
			Whitehorse Hatchery	1985, 1987, 1997, 2010	303
	Total				4,616

Table 3.–Number of subsistence samplers, number of Chinook salmon sampled by community, and the number and percent of those samples that were successfully used for ASL composition estimation, 2018.

				Age		Sex identification		Length	
Location	Capture gear	Number of samplers	Sample size	Number	Percent	Number	Percent	Number	Percent
Hooper Bay	Gillnet	2	9	6	66.7	9	100.0	3	33.3
Scammon Bay	Gillnet	1	37	35	94.6	37	100.0	37	100.0
Kotlik	Gillnet	4	140	121	86.4	140	100.0	140	100.0
Alakanuk	Gillnet	2	72	66	91.7	72	100.0	72	100.0
Emmonak	Gillnet	3	29	25	86.2	29	100.0	29	100.0
Mountain Village	Dipnet/Gillnet	7	130	116	89.2	130	100.0	130	100.0
St. Marys	Dipnet/Gillnet	7	153	131	85.6	150	98.0	153	100.0
Russian Mission	Gillnet	4	170	145	85.3	170	100.0	170	100.0
Kaltag	Gillnet	2	150	122	81.3	149	99.3	150	100.0
Nulato	Gillnet	2	147	112	76.2	147	100.0	147	100.0
Galena	Gillnet	2	120	98	81.7	120	100.0	120	100.0
Ruby	Gillnet	4	139	118	84.9	120	86.3	139	100.0
Tanana	Fish wheel/Gillnet	3	277	200	72.2	267	96.4	277	100.0
Total		43	1,573	1,295	82.3	1,540	97.9	1,567	99.6

Table 4.–Number and percent of total Chinook salmon samples that were sampled from the subsistence fishery for genetics and ASL composition estimation by gear type, 2018.

Gear	Communities	Date range	Number of fishermen	Sample size	Percent of total sampled
Dip net	Mountain Village	6/7–6/26	3	13	0.8
Fish wheel	Tanana	7/4–7/23	2	169	10.7
Drift gillnet	Hooper Bay, Kotlik, Alakanuk, Emmonak, Mountain Village, Saint Marys, Russian Mission, Kaltag, Nulato, Galena, Ruby	6/4–7/12	21	962	61.2
Set gillnet	Scammon Bay, Hooper Bay, Kotlik, Alakanuk, Emmonak, Mountain Village, Russian Mission, Ruby, Tanana	5/31–7/21	17	429	27.3
Total			43	1,573	100.0

Note: Included are the communities that utilized each gear type, the range of dates each gear type was used, and the number of fishermen that utilized each gear type.

Table 5.–Number of Chinook salmon sampled from the subsistence fishery for genetics and ASL composition estimation within each district, by gear type, 2018.

	Gillnet												
District	4.00"	5.00"	5.50"	5.63"	5.75"	5.88"	6.00"	7.00"	7.25"	7.50"	Dipnet	Fish wheel	Total
Coastal	0	0	0	0	0	0	43	3	0	0	0	0	46
1	0	0	59	6	1	50	61	16	0	48	0	0	241
2	2	6	22	0	0	0	142	0	0	98	13	0	283
3	31	0	0	0	0	30	6	0	36	67	0	0	170
4-A Upper	0	0	0	0	0	12	122	0	0	163	0	0	297
4-B	0	0	0	0	0	0	62	0	3	55	0	0	120
4-C	0	0	0	0	0	0	99	0	0	40	0	0	139
5-B	0	0	0	0	0	0	108	0	0	0	0	169	277
Total	33	6	81	6	1	92	643	19	39	471	13	169	1,573

Table 6.–Percent of Chinook salmon sampled from the subsistence fishery for genetics and ASL composition estimation within each district, by gear type, 2018.

	Gillnet												
District	4.00"	5.00"	5.50"	5.63"	5.75"	5.88"	6.00"	7.00"	7.25"	7.50"	Dipnet	Fish wheel	Total
Coastal	0.0	0.0	0.0	0.0	0.0	0.0	93.5	6.5	0.0	0.0	0.0	0.0	100.0
1	0.0	0.0	24.5	2.5	0.4	20.7	25.3	6.6	0.0	19.9	0.0	0.0	100.0
2	0.7	2.1	7.8	0.0	0.0	0.0	50.2	0.0	0.0	34.6	4.6	0.0	100.0
3	18.2	0.0	0.0	0.0	0.0	17.6	3.5	0.0	21.2	39.4	0.0	0.0	100.0
4-A Upper	0.0	0.0	0.0	0.0	0.0	4.0	41.1	0.0	0.0	54.9	0.0	0.0	100.0
4-B	0.0	0.0	0.0	0.0	0.0	0.0	51.7	0.0	2.5	45.8	0.0	0.0	100.0
4-C	0.0	0.0	0.0	0.0	0.0	0.0	71.2	0.0	0.0	28.8	0.0	0.0	100.0
5-B	0.0	0.0	0.0	0.0	0.0	0.0	39.0	0.0	0.0	0.0	0.0	61.0	100.0

Table 7.–Age and sex composition, by sample size (n) and percentage (%), and mean length (mm) of Chinook salmon caught during subsistence fishery in the Yukon Area in 2018.

Sample dates	Sample	Brood year	2015	2014	2013	2013	2012	2012	2011	2011	
(Community)	size	Age	1.1	1.2	1.3	2.2	1.4	2.3	1.5	2.4	Total
6/6, 6/11, 6/21, 6/25, 6/20	3	Male n	0	0	2	0	0	1	0	0	3
Hooper Bay		Female n	0	0	0	0	0	0	0	0	0
		Total n	0	0	2	0	0	1	0	0	3
		Male %	0.0	0.0	66.7	0.0	0.0	33.3	0.0	0.0	100.0
		Female %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Total %	0.0	0.0	66.7	0.0	0.0	33.3	0.0	0.0	100.0
		Male mean length			656			652			
		SD			23			0			
		Range			640–673			652–652			
		n	0	0	2	0	0	1	0	0	
		Female mean length									
		SD									
		Range									
		n	0	0	0	0	0	0	0	0	
6/2, 6/5, 6/6, 6/26,	34	Male n	0	8	17	0	3	0	1	0	29
7/9, 7/10		Female n	0	0	2	0	2	0	0	1	5
Scammon Bay		Total n	0	8	19	0	5	0	1	1	34
		Male %	0.0	23.5	50.0	0.0	8.8	0.0	2.9	0.0	85.3
		Female %	0.0	0.0	5.9	0.0	5.9	0.0	0.0	2.9	14.7
		Total %	0.0	23.5	55.9	0.0	14.7	0.0	2.9	2.9	100.0
		Male mean length		583	710		781		889		
		SD		64	41		117		0		
		Range		500–676	663–776		653–882		889–889		
		n	0	8	17	0	3	0	1	0	
		Female mean length			728		894			788	
		SD			38		10			0	
		Range			701–755		887–901			788–788	
		n	0	0	2	0	2	0	0	1	

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Sample dates (Community)	Sample size	Brood year	2015	2014	2013	2013	2012	2012	2011	2011	
		Age	1.1	1.2	1.3	2.2	1.4	2.3	1.5	2.4	Total
6/5, 6/8, 6/9, 6/12, 6/13, 6/16, 6/22, 7/3, 7/5, 7/6, 7/8, 7/9 Kotlik	122	Male n	1	16	40	0	17	0	1	0	75
		Female n	0	0	9	0	37	0	1	0	47
		Total n	1	16	49	0	54	0	2	0	122
		Male %	0.8	13.1	32.8	0.0	13.9	0.0	0.8	0.0	61.5
		Female %	0.0	0.0	7.4	0.0	30.3	0.0	0.8	0.0	38.5
		Total %	0.8	13.1	40.2	0.0	44.3	0.0	1.6	0.0	100.0
		Male mean length	360	566	699		827		860		
		SD	0	50	48		61		0		
		Range	360–360	467–650	600–789		710–940		860–860		
		n	1	16	40	0	17	0	1	0	
		Female mean length			726		857		942		
		SD			76		56		0		
		Range			600–810		764–990		942–942		
		n	0	0	9	0	37	0	1	0	
5/31, 6/4, 6/6–6/8, 6/13, 6/22, 7/7, 7/10 Alakanuk	66	Male n	0	12	22	0	13	0	0	0	47
		Female n	0	0	5	0	14	0	0	0	19
		Total n	0	12	27	0	27	0	0	0	66
		Male %	0.0	18.2	33.3	0.0	19.7	0.0	0.0	0.0	71.2
		Female %	0.0	0.0	7.6	0.0	21.2	0.0	0.0	0.0	28.8
		Total %	0.0	18.2	40.9	0.0	40.9	0.0	0.0	0.0	100.0
		Male mean length		585	675		801				
		SD		30	54		68				
		Range		533–644	594–780		680–925				
		n	0	12	22	0	13	0	0	0	
		Female mean length			747		791				
		SD			34		58				
		Range			692–781		678–920				
		n	0	0	5	0	14	0	0	0	

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Sample dates (Community)	Sample size	Brood year Age	2015 1.1	2014 1.2	2013 1.3	2013 2.2	2012 1.4	2012 2.3	2011 1.5	2011 2.4	Total
6/7–6/9, 6/28	25	Male n	0	2	14	0	3	0	0	0	19
Emmonak		Female n	0	0	3	0	3	0	0	0	6
		Total n	0	2	17	0	6	0	0	0	25
		Male %	0.0	8.0	56.0	0.0	12.0	0.0	0.0	0.0	76.0
		Female %	0.0	0.0	12.0	0.0	12.0	0.0	0.0	0.0	24.0
		Total %	0.0	8.0	68.0	0.0	24.0	0.0	0.0	0.0	100.0
		Male mean length		605	716		807				
		SD		64	40		76				
		Range		560–650	622–780		740–890				
		n	0	2	14	0	3	0	0	0	
		Female mean length			754		838				
		SD			14		13				
		Range			743–770		825–850				
		n	0	0	3	0	3	0	0	0	
5/31, 6/1, 6/4, 6/6–6/12, 6/14,	116	Male n	0	18	55	0	15	1	0	0	89
6/22, 6/26, 7/2, 7/12		Female n	0	1	9	0	16	0	1	0	27
Mountain Village		Total n	0	19	64	0	31	1	1	0	116
		Male %	0.0	15.5	47.4	0.0	12.9	0.9	0.0	0.0	76.7
		Female %	0.0	0.9	7.8	0.0	13.8	0.0	0.9	0.0	23.3
		Total %	0.0	16.4	55.2	0.0	26.7	0.9	0.9	0.0	100.0
		Male mean length		592	686		781	621			
		SD		48	75		109	0			
		Range		511–658	410–889		522–945	621–621			
		n	0	18	55	0	15	1	0	0	
		Female mean length		710	754		812		930		
		SD		0	50		55		0		
		Range		710–710	655–822		743–926		930–930		
		n	0	1	9	0	16	0	1	0	

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Sample dates (Community)	Sample size	Brood year / Age	2015 / 1.1	2014 / 1.2	2013 / 1.3	2013 / 2.2	2012 / 1.4	2012 / 2.3	2011 / 1.5	2011 / 2.4	Total
5/31, 6/5–6/10, 6/14–6/17, 6/19, 6/21, 6/25, 7/2, 7/5 7/11, 7/12 Saint Marys	128	Male n	0	16	41	0	12	0	1	1	71
		Female n	0	2	20	0	31	0	4	0	57
		Total n	0	18	61	0	43	0	5	1	128
		Male %	0.0	12.5	32.0	0.0	9.4	0.0	0.8	0.8	55.5
		Female %	0.0	1.6	15.6	0.0	24.2	0.0	3.1	0.0	44.5
		Total %	0.0	14.1	47.7	0.0	33.6	0.0	3.9	0.8	100.0
		Male mean length		587	694		795		960	776	
		SD		59	82		64		0	0	
		Range		442–665	350–820		688–897		960–960	776–776	
		n	0	16	41	0	12	0	1	1	
		Female mean length		552	729		810		886		
		SD		47	65		57		58		
		Range		519–585	594–836		670–930		824–942		
		n	0	2	20	0	31	0	4	0	
6/5, 6/6, 6/8–6/11, 6/13, 6/14–6/16, 6/21, 6/22, 6/24 6/26, 6/27, 7/2, 7/5 Russian Mission	148	Male n	2	33	46	0	20	0	1	0	102
		Female n	1	1	15	0	26	0	1	2	46
		Total n	3	34	61	0	46	0	2	2	148
		Male %	1.4	22.3	31.1	0.0	13.5	0.0	0.7	0.0	68.9
		Female %	0.7	0.7	10.1	0.0	17.6	0.0	0.7	1.4	31.1
		Total %	2.0	23.0	41.2	0.0	31.1	0.0	1.4	1.4	100.0
		Male mean length	416	553	702		814		810		
		SD	58	61	41		54		0		
		Range	375–457	418–668	601–780		735–915		810–810		
		n	2	33	46	0	20	0	1	0	
		Female mean length	396	630	721		798		877	775	
		SD	0	0	35		46		0	7	
		Range	396–396	630–630	670–790		708–895		877–877	770–780	
		n	1	1	15	0	26	0	1	2	

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Sample dates (Community)	Sample size	Brood year	2015	2014	2013	2013	2012	2012	2011	2011	
		Age	1.1	1.2	1.3	2.2	1.4	2.3	1.5	2.4	Total
6/18, 6/25, 6/26, 7/1, 7/2, 7/4, 7/5, 7/8 Kaltag	121	Male n	0	16	49	1	21	0	0	0	87
		Female n	0	0	5	0	27	0	1	1	34
		Total n	0	16	54	1	48	0	1	1	121
		Male %	0.0	13.2	40.5	0.8	17.4	0.0	0.0	0.0	71.9
		Female %	0.0	0.0	4.1	0.0	22.3	0.0	0.8	0.8	28.1
		Total %	0.0	13.2	44.6	0.8	39.7	0.0	0.8	0.8	100.0
		Male mean length		583	698	590	777				
		SD		58	46	0	70				
		Range		465–700	620–825	590–590	650–940				
		n	0	16	49	1	21	0	0	0	
		Female mean length			712		831		870	765	
		SD			26		44		0	0	
		Range			690–740		710–930		870–870	765–765	
		n	0	0	5	0	27	0	1	1	
6/24, 7/2, 7/5, 7/12 Nulato	112	Male n	0	14	34	0	18	0	0	0	66
		Female n	0	0	8	0	36	0	1	1	46
		Total n	0	14	42	0	54	0	1	1	112
		Male %	0.0	12.5	30.4	0.0	16.1	0.0	0.0	0.0	58.9
		Female %	0.0	0.0	7.1	0.0	32.1	0.0	0.9	0.9	41.1
		Total %	0.0	12.5	37.5	0.0	48.2	0.0	0.9	0.9	100.0
		Male mean length		605	730		804				
		SD		48	49		65				
		Range		500–670	650–860		690–900				
		n	0	14	34	0	18	0	0	0	
		Female mean length			731		817		890	765	
		SD			36		40		0	0	
		Range			670–780		715–910		890–890	765–765	
		n	0	0	8	0	36	0	1	1	

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Sample dates (Community)	Sample size	Brood year	2015	2014	2013	2013	2012	2012	2011	2011	
		Age	1.1	1.2	1.3	2.2	1.4	2.3	1.5	2.4	Total
6/25, 7/2, 7/5, 7/8, 7/9, 7/11	98	Male n	0	10	38	1	14	1	0	0	64
Galena		Female n	0	2	11	0	20	1	0	0	34
		Total n	0	12	49	1	34	2	0	0	98
		Male %	0.0	10.2	38.8	1.0	14.3	1.0	0.0	0.0	65.3
		Female %	0.0	2.0	11.2	0.0	20.4	1.0	0.0	0.0	34.7
		Total %	0.0	12.2	50.0	1.0	34.7	2.0	0.0	0.0	100.0
		Male mean length		599	699	603	805	664			
		SD		43	61	0	58	0			
		Range		551–665	560–865	603–603	703–920	664–664			
		n	0	10	38	1	14	1	0	0	
		Female mean length		623	750		838	800			
		SD		82	47		43	0			
		Range		565–681	665–813		742–897	800–800			
		n	0	2	11	0	20	1	0	0	
6/25, 7/1, 7/2, 7/5, 7/8, 7/9, 7/12	101	Male n	0	15	43	0	11	1	0	0	70
Ruby		Female n	0	0	12	0	16	0	3	0	31
		Total n	0	15	55	0	27	1	3	0	101
		Male %	0.0	14.9	42.6	0.0	10.9	1.0	0.0	0.0	69.3
		Female %	0.0	0.0	11.9	0.0	15.8	0.0	3.0	0.0	30.7
		Total %	0.0	14.9	54.5	0.0	26.7	1.0	3.0	0.0	100.0
		Male mean length		603	717		795	695			
		SD		33	50		55	0			
		Range		510–655	614–840		704–890	695–695			
		n	0	15	43	0	11	1	0	0	
		Female mean length			744		808		873		
		SD			52		71		40		
		Range			660–810		600–921		830–910		
		n	0	0	12	0	16	0	3	0	

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Sample dates (Community)	Sample Size	Brood year	2015	2014	2013	2013	2012	2012	2011	2011	
		Age	1.1	1.2	1.3	2.2	1.4	2.3	1.5	2.4	Total
6/30, 7/4, 7/7, 7/11, 7/12, 7/14, 7/15, 7/17, 7/18, 7/21, 7/23	199	Male n	0	45	70	0	21	0	0	1	137
Tanana		Female n	0	4	27	0	31	0	0	0	62
		Total n	0	49	97	0	52	0	0	1	199
		Male %	0.0	22.6	35.2	0.0	10.6	0.0	0.0	0.5	68.8
		Female %	0.0	2.0	13.6	0.0	15.6	0.0	0.0	0.0	31.2
		Total %	0.0	24.6	48.7	0.0	26.1	0.0	0.0	0.5	100.0
		Male mean length		591	696		847			770	
		SD		72	58		108			0	
		Range		431–870	570–824		530–1001			770–770	
		n	0	45	70	0	21	0	0	1	
		Female mean length		651	761		832				
		SD		73	70		61				
		Range		602–760	590–904		705–997				
		n	0	4	27	0	31	0	0	0	
Total All communities	1,273	Male n	3	205	471	2	168	4	4	2	859
		Female n	1	10	126	0	259	1	12	5	414
		Total n	4	215	597	2	427	5	16	7	1,273
		Male %	0.2	16.1	37.0	0.2	13.2	0.3	0.3	0.2	67.5
		Female %	0.1	0.8	9.9	0.0	20.3	0.1	0.9	0.4	32.5
		Total %	0.3	16.9	46.9	0.2	33.5	0.4	1.3	0.5	100.0
		Male mean length	397	584	700	596	806	658	880	773	
		SD	52	58	58	9	77	31	63	4	
		Range	360–457	418–870	350–889	590–603	522–1001	621–695	810–960	770–776	
		n	3	205	471	2	168	4	4	2	
		Female mean length	396	629	740		823	800	890	774	
		SD		71	56		55		42	10	
		Range	396–396	519–760	590–904		600–997	800–800	824–942	765–788	
		n	1	10	126	0	259	1	12	5	

Table 8.–Sample size, mean total age and length (mm), with standard deviation (SD), and percent female for Chinook salmon caught in drift and set gillnets, broken out by mesh size, 2018.

		Percent	Age		Length		Percent
Mesh size	Sample size	of total	Mean	SD	Mean	SD	female
4.00	33	2.4	4	0.5	542	92	6.1
5.00	6	0.4	5	0.0	619	59	0.0
5.50	81	5.8	5	0.5	700	126	23.5
5.63	6	0.4	6	0.7	617	101	16.7
5.75	1	0.1	6	–	864	–	0.0
5.88	92	6.6	5	0.8	686	94	19.6
6.00	643	46.2	5	0.7	729	95	35.7
7.00	19	1.4	5	0.5	739	58	26.3
7.25	39	2.8	6	0.7	770	68	53.8
7.50	471	33.9	5	0.7	745	86	33.9
Total	1,391	100.0					

Note: En dash indicates no data available.

Table 9.–Sample size, mean total age and length (mm), with standard deviation (SD), and percent female for Chinook salmon sampled in each community, 2018.

		Percent	Age		Length		Percent
Community	Sample size	of samples	Mean	SD	Mean	SD	female
Hooper Bay	9	0.6	6	0.5	655	17	22.2
Scammon Bay	37	2.4	5	0.8	703	100	13.5
Kotlik	140	8.9	5	0.7	746	119	37.9
Alakanuk	72	4.6	5	0.7	709	96	29.2
Emmonak	29	1.8	5	0.6	728	77	24.1
Mountain Village	130	8.3	5	0.7	707	101	22.3
St Marys	153	9.7	5	0.8	729	105	42.7
Russian Mission	170	10.8	5	0.8	704	110	32.4
Kaltag	150	9.5	5	0.7	725	90	28.9
Nulato	147	9.3	5	0.7	753	83	40.8
Galena	120	7.6	5	0.7	728	92	33.3
Ruby	139	8.8	5	0.7	731	85	33.3
Tanana	277	17.6	5	0.7	720	112	33.3

Table 10.–Sample size, mean total age and length (mm), with standard deviation (SD), and percent female for Chinook salmon sampled in each district, 2018.

District	Sample size	Percent of samples	Age Mean	Age SD	Length Mean	Length SD	Percent Female
Coastal	41	3.2	5	0.8	699	97	15.2
1	212	16.4	5	0.7	733	109	33.6
2	247	19.1	5	0.7	719	104	33.2
3	145	11.2	5	0.8	704	110	32.4
4-A Upper	234	18.1	5	0.7	739	87	34.8
4-B	98	7.6	5	0.7	728	92	33.3
4-C	118	9.1	5	0.7	731	85	33.3
5-B	200	15.4	5	0.7	720	112	33.3

Table 11.–Total age, percent female, and mean length (mm) of Chinook salmon sampled from the subsistence harvest, 2001–2018.

		Percent by age class							
Year	Sample size	Age-3	Age-4	Age-5	Age-6	Age-7	Age-8	Percent female	Mean length
2001	1,184	0.1	9.0	27.4	57.5	6.1	0.0	35.4	780
2002	790	0.0	18.5	34.7	38.0	8.9	0.0	40.0	744
2003	1,075	0.0	3.8	36.9	53.2	6.0	0.0	43.2	820
2004	1474	0.1	11.6	26.8	57.8	3.7	0.0	33.5	765
2005	1,228	0.0	6.4	42.1	48.2	3.3	0.1	36.0	766
2006	771	0.0	6.6	50.8	39.8	2.7	0.0	33.1	750
2007	1,357	0.0	14.5	30.8	54.1	0.6	0.0	38.3	751
2008	1,545	0.1	5.2	61.4	31.0	2.2	0.1	28.4	742
2009	1,933	0.1	16.1	16.8	65.8	1.3	0.0	39.8	787
2010	2,320	0.0	11.5	52.3	31.9	4.2	0.0	33.5	750
2011	2,185	0.0	5.9	54.0	37.5	2.6	0.0	26.2	751
2012	871	0.1	6.4	57.1	35.0	1.4	0.0	27.4	740
2013	514	0.0	17.3	41.4	40.3	1.0	0.0	33.0	733
2014	108	10.2	24.1	46.3	19.4	0.0	0.0	37.3	683
2015	422	0.2	54.7	24.4	20.1	0.5	0.0	25.8	665
2016	1,050	3.0	29.6	53.5	13.3	0.6	0.0	26.9	688
2017	1,761	0.1	12.4	56.5	30.7	0.3	0.0	37.6	746
2018	1,273	0.3	16.9	47.1	33.9	1.7	0.0	32.5	725
Average (2001-2017)	1,211	0.8	14.9	42.0	39.6	2.7	0.0	33.9	745
5-yr Average (2013-2017)	771	2.7	27.6	44.4	24.8	0.5	0.0	32.1	703

Note: Sample size is the number of fish that were successfully aged.

Table 12.–Number of ASL samples collected through subsistence harvest sampling programs on the Yukon River by sampling location, 2001-2018.

	Year																	
Location	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Alakanuk										49	64	88	31				122	72
Anvik										396	501	79	20					
Bishop Rock					190	200	200	103	191	115								
Eagle								246	201	200	216							
Emmonak	739	561	756		343	145	259	472		30	56	64	34			44	25	29
Fort Yukon									128	184	53	253	267	114	479			
Galena	40			179	69		145	145	353	467	571	30	62	4	24	84	399	116
Grayling				200														
Haul Road Bridge										250	224							
Hess Creek									190									
Holy Cross			64	141			232	133	239	369								
Hooper Bay																		9
Huslia											100							
Kaltag	248	221	243	246	249	241	224	250	205	240	250	68				330	66	150
Kotlik												36	108			67	56	140
Koyukuk		10				49												
Marshal												143	8			8		
Minto			4															
Mountain Village												82	6			38	108	130
Nenana	58	17					2	20	5									
Nulato			63		200	130	99	130	387	290	71					85	223	147
Nulato River				232														
Pitkas Point													2					
Rampart Rapids	130	39						64	87	38								
Rapids Research Center				1,007	702	756	881	1,259	808		1,215							
Ruby	100	38	66	50	304	90	214	148		266	95	46	49		31	128	255	139
Russian Mission																135	259	170
Scammon Bay																		37
Saint Marys											209	246	9			88	190	151
Tanana	43			132			92			689	252					201	347	280
Y1 District				539														
Y6 District			4															
Yukon District									174									
Total	1,358	886	1,200	2,726	2,057	1,611	2,348	2,970	2,968	3,583	3,877	1,135	596	118	534	1,208	2,050	1,570

Table 13.–Estimates of stock composition of subsistence harvests in districts and communities of the Yukon River Management Area, 2018.

District	Communities sampled	Sample size	Reporting group	Estimate	95% confidence interval		SD
					Lower	Upper	
1	Kotlik	236	Lower Yukon	0.23	0.18	0.29	0.03
	Alakanuk		Middle Yukon	0.33	0.24	0.42	0.05
	Emmonak		Canada	0.44	0.35	0.53	0.05
2	Mountain Village	277	Lower Yukon	0.22	0.17	0.27	0.03
	St. Marys		Middle Yukon	0.40	0.32	0.48	0.05
			Canada	0.38	0.31	0.46	0.05
3	Russian Mission	166	Lower Yukon	0.15	0.09	0.21	0.04
			Middle Yukon	0.30	0.19	0.41	0.07
			Canada	0.55	0.44	0.66	0.07
4-A Upper	Kaltag	295	Lower Yukon	0.11	0.07	0.16	0.03
	Nulato		Middle Yukon	0.43	0.35	0.51	0.05
			Canada	0.46	0.39	0.53	0.04
4-B	Galena	114	Lower Yukon	0.05	0.01	0.11	0.03
			Middle Yukon	0.51	0.39	0.62	0.07
			Canada	0.44	0.34	0.54	0.06
4-C	Ruby	136	Lower Yukon	0.03	0.00	0.09	0.03
			Middle Yukon	0.29	0.19	0.39	0.06
			Canada	0.69	0.59	0.78	0.06
5-B	Tanana	273	Lower Yukon	0.01	0.00	0.03	0.01
			Middle Yukon	0.27	0.19	0.36	0.05
			Canada	0.72	0.64	0.80	0.05

Note: Estimates include the estimated proportion assigned to each reporting group, 90% credibility interval, and standard deviation (SD).

Table 14.–Historical stock composition for Chinook salmon caught in the subsistence fishery, 2016–2018.

District	Reporting group	2016 Sample size	2016 MSA estimate	2017 Sample size	2017 MSA estimate	2018 Sample size	2018 MSA estimate	2016–2017 Average MSA estimate	2016–2018 Average MSA estimate
1	Lower	264	0.27	178	0.24	236	0.23	0.25	0.25
	Middle		0.21		0.31		0.33	0.26	0.28
	Canada		0.52		0.46		0.44	0.49	0.47
2	Lower	106	0.24	197	0.22	277	0.22	0.23	0.23
	Middle		0.35		0.37		0.40	0.36	0.37
	Canada		0.41		0.41		0.38	0.41	0.40
3	Lower	109	0.18	254	0.10	166	0.15	0.14	0.14
	Middle		0.40		0.47		0.30	0.43	0.39
	Canada		0.42		0.43		0.55	0.43	0.47
4-A Upper	Lower	359	0.19	269	0.06	295	0.11	0.12	0.12
	Middle		0.40		0.50		0.43	0.45	0.44
	Canada		0.42		0.45		0.46	0.43	0.44
4-B	Lower	–	–	200	0.11	114	0.05	0.11	0.08
	Middle	–	–		0.58		0.51	0.58	0.54
	Canada	–	–		0.31		0.44	0.31	0.38
4-C	Lower	126	0.18	198	0.04	136	0.03	0.11	0.08
	Middle		0.29		0.42		0.29	0.36	0.33
	Canada		0.53		0.54		0.69	0.54	0.59
5-B	Lower	186	0.11	293	0.05	273	0.01	0.08	0.06
	Middle		0.25		0.23		0.27	0.24	0.25
	Canada		0.64		0.72		0.72	0.68	0.69

Note: MSA is mixed stock analysis. En dash indicates no data available.

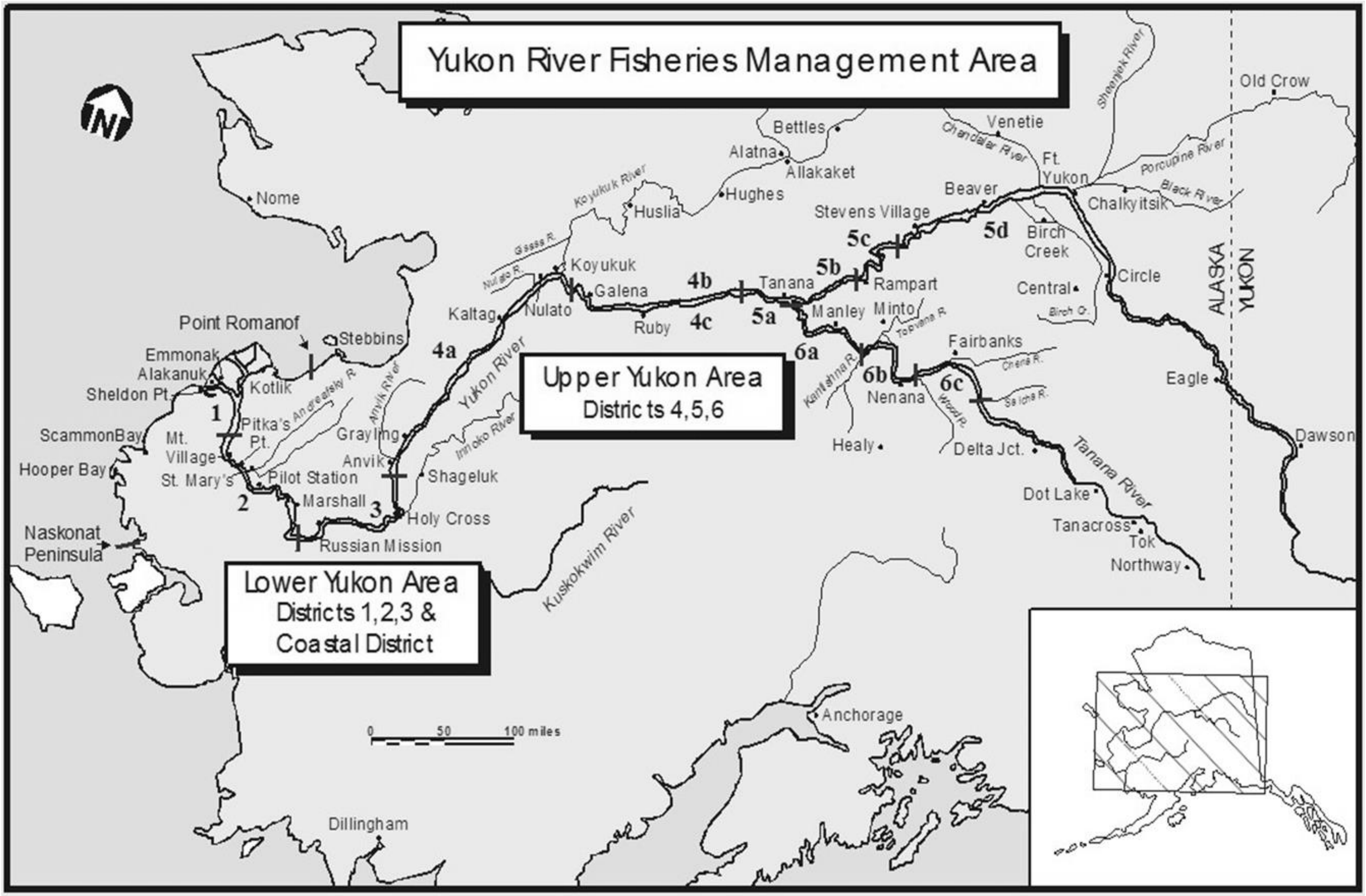

Figure 1.–The Alaska portion of the Yukon River with location of communities and fisheries management districts.

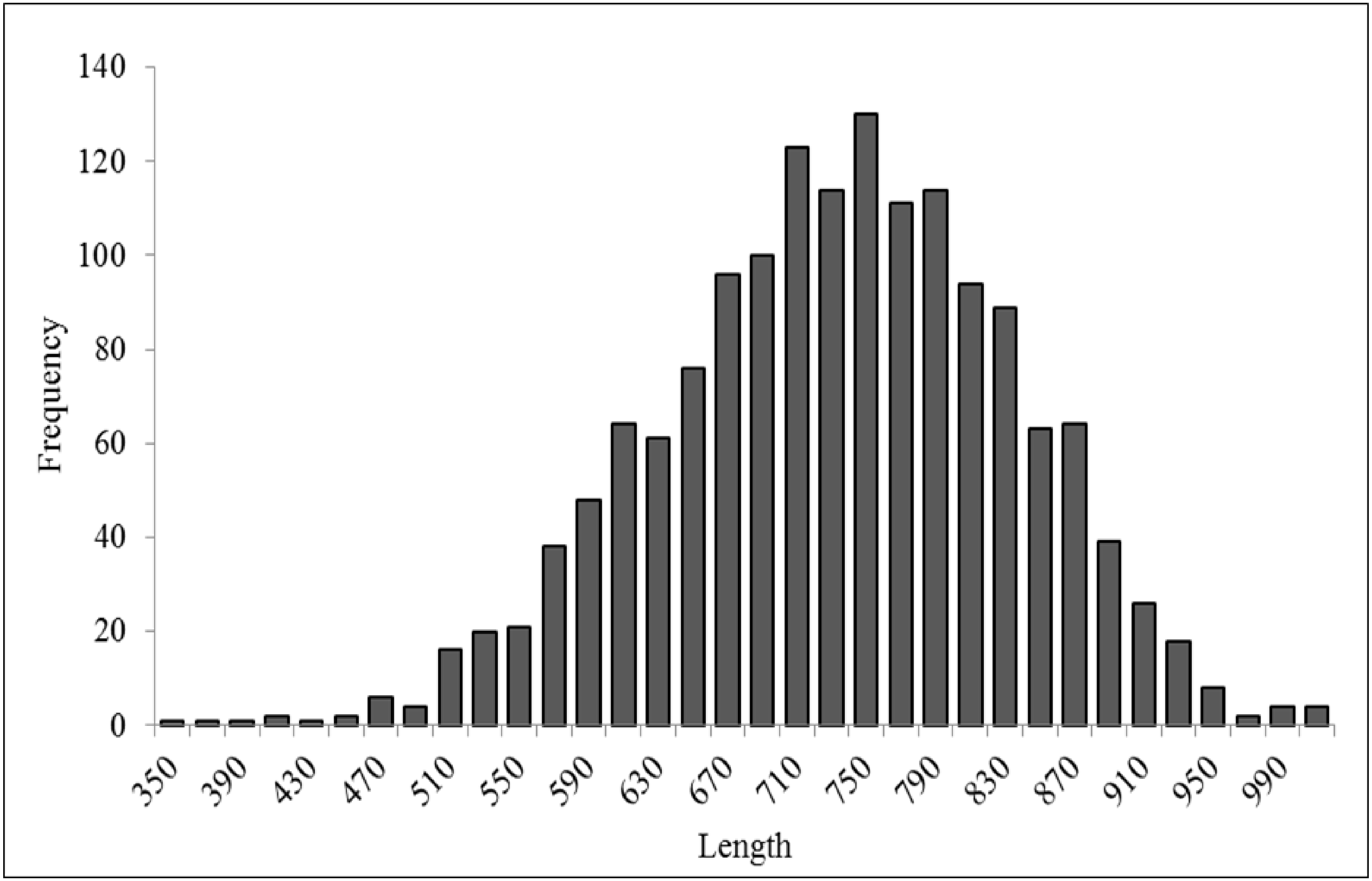

Figure 2.–Length frequency (mm) of Chinook salmon sampled from the Yukon River subsistence fishery, 2018.

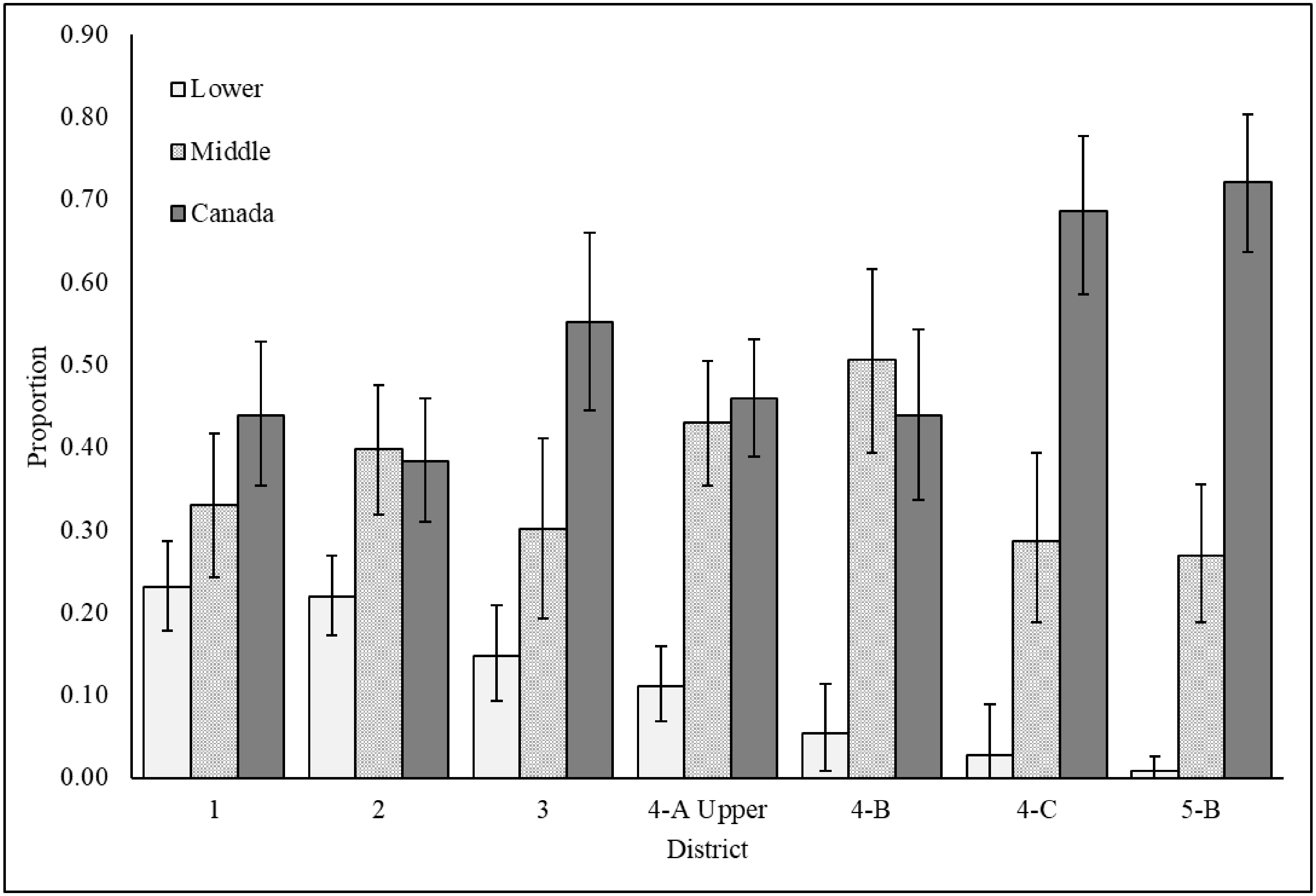

Figure 3.–Estimates of stock composition of subsistence harvests for each district sampled in 2018.

Note: Estimates for the lower (light gray), middle (dotted), and Canadian (dark gray) stock groups include the estimated upper and lower bounds of the 90% credibility interval.