Regional Information Report 3A18-03

Yukon River Chinook Salmon Subsistence Harvest Genetic Stock Identification, 2017

by

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and

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June 2018

Alaska Department of Fish and Game **Division of Commercial Fisheries**

Symbols and Abbreviations

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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, and length (ASL), and stock of origin of Chinook salmon (*Oncorhynchus tshawytscha*) caught in the Yukon River subsistence fishery is important for making well informed management decisions and for forecasting salmon runs. The objective of this study was to collect representative genetic mixed stock analysis (MSA) information, coupled with ASL data, from the Chinook salmon subsistence harvest in Districts 1 through 5 in 2017. Forty-one subsistence fishermen from 11 communities sampled 2,051 Chinook salmon that were harvested using gillnets, fish wheels, and dip nets. The ASL composition of the harvest was 0.1% age-3, 11.7% age-4, 56.0% age-5, 31.8% age-6, 0.3% age-7, 36.6% female, and an average of 746 mm in length. The proportion of the catch that was Canadian-origin ranged from 31% in Subdistrict 4-B to 72% in District 5-B. The data generated from this project are essential to form the basis of the spawner-recruit models used to estimate past and future run productivity. Due to the variability of Chinook salmon runs, management actions, and harvest, annual monitoring of the subsistence Chinook salmon harvest is needed.

Key words Chinook salmon, *Oncorhynchus tshawytscha*, subsistence, harvest, age, sex, and length ASL, genetics, 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, 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 Canadian-origin Chinook salmon (*Oncorhynchus tshawytscha*) brood year tables and to perform run reconstructions. Run reconstructions form the basis of the spawner-recruit models used to estimate past and future run productivity for 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 necessary to appropriately characterize the stock and age composition of harvest on the Yukon River. The Alaska subsistence harvest of Yukon River Chinook salmon declined from a long-term average (1961–2015) of about 34,000 fish per year to a recent average (2011–2015) of about 18,000 fish per year (JTC 2017). As a result, the subsistence harvest sampling programs were eliminated in the lower and middle Yukon River districts. Since 2013, historical estimates and assumptions about harvest stock compositions have been used to update brood tables and estimate the Canadian-origin component of the harvest. These estimates were considered sufficient to make projections because subsistence harvests were so small. The subsistence harvest of Chinook salmon increased from about 6,600 fish in 2015 to about 37,000 fish in 2017 due to a relatively strong return of Chinook salmon in 2017. The subsistence harvest of Chinook salmon is expected to increase if run sizes continue to improve in the Yukon River, which makes understanding the age and stock composition of this component of the harvest critical to understanding the Yukon River Chinook salmon run.

Harvest patterns have been variable among years because of changing management actions aimed at limiting the Chinook salmon harvest. Year-to-year changes in the fishery mean that it is not always possible to use historical harvest composition as a proxy for annual data collection in years with large subsistence harvests. 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). Due to this interannual variation, it is essential to have a comprehensive subsistence harvest monitoring program in place to more accurately assess the true stock composition of the harvest in each year.

The goal of this study was to collect representative genetic mixed stock analysis (MSA) information, coupled with age, sex, and length (ASL) data from the Chinook salmon subsistence harvest in Yukon River Districts 1 through 5. This work is a collaboration between ADF&G and Spearfish Research that began in 2016. Spearfish Research was responsible for recruiting and training subsistence fishermen about 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.

This 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. This study also contributes to subsequent assessments of stock productivity and long-term trends in the ASL composition of Yukon River Chinook salmon caught in the subsistence fishery.

OBJECTIVES

The objectives of this study were as follows:

1. Sample up to 400 Chinook salmon caught in the subsistence fishery, per district, within Districts 1 through 5.
2. Estimate the ASL composition of Chinook salmon harvested in the subsistence fishery.
3. 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. The study occurred in villages located along the Yukon River, within Districts 1 through 5 (Figure 1).

METHODS

SAMPLE SIZE CONSIDERATION

We assumed that the age and stock composition of subsistence Chinook salmon harvests were a function of gear selectivity, run timing, and location of fishing, relative to the total Chinook salmon run through the districts. 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 and 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 data set 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 Districts 1 through 5.

For districts where more than one 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, 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 data set that has already been collected by Spearfish Research in Fort Yukon and other neighboring communities, Tanana was the only community sampled in District 5.

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.

Samples were collected immediately after fish were caught. Participants were asked to sample all Chinook salmon harvested during the 2017 season. 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:

1. Sex was determined by cutting the abdomen of the fish and inspecting the gonads, as sex identification from external examination alone has been unreliable (Molyneaux et al. 2010).
2. Length was measured from mid-eye to tail fork (to the nearest mm) using a rigid meter stick.
3. Three scales were collected from the left side of the fish, 2–3 rows of scales above the lateral line, and mounted on pre-printed gum cards.
4. One axillary process was clipped from each fish and placed in an individual vial.

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).

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).[1] 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 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. In order 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 method was also used to pool estimates from different communities to create stock composition estimates for a single district.

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

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 Districts 1 through 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 88 subsistence fishermen from 11 communities were recruited and trained to sample their subsistence caught Chinook salmon for ASL and genetic tissue in 2017. Of those, 41 people from 11 communities sampled their harvest and submitted their data to Spearfish Research (Table 3). The first Chinook salmon sampled in the subsistence fishery was caught using a 5.875-inch set gillnet in Alakanuk on May 27, 2017. The last Chinook salmon sampled was caught using a 7.5-inch set gillnet in Tanana on July 27, 2017. In total, fishermen sampled 2,051 Chinook salmon using various gear types and gillnet mesh sizes (Table 4). The number of samples obtained per sampler ranged from 1 to 169 with an average of 50 Chinook salmon sampled per person. The highest number of samples collected by an individual were caught in a 7.5-inch drift gillnet in Nulato. Only 175 (8.5%) of the fish sampled were caught using dip nets or fish wheels, but drift and set gillnets accounted for 1,338 (65%) and 538 (26%) of the Chinook salmon sampled, respectively (Table 4). Over half (1,197) of the samples were caught with a 7.5-inch mesh gillnet. Fishermen in Districts 1 and 2 tended to utilize 5.5-inch and 6.0-inch gillnets whereas fishermen in Districts 3 and 4 tended to utilize 7.5-inch mesh gillnet. Nearly half of the fish sampled in District 5-B were caught using a fish wheel (Tables 5 and 6).

ASL were successfully determined for 1,571 (77%) of the Chinook salmon sampled (Table 3). The ASL composition of the subsistence Chinook salmon harvest varied among communities and gear (Tables 7–9). Overall ASL composition of the harvest was 0.1% age-3, 11.7% age-4, 56.0% age-5, 31.8% age-6, 0.3% age-7, 36.6% female, and an average of 746 mm in length (Table 7). Fish caught in gillnets were predominately 5-year-olds and fish length tended to increase with mesh size (Table 8). Chinook salmon sampled in District 1 were, on average, smaller and were a lower proportion female than Chinook salmon sampled in other districts (Table 10).

Tissue samples were collected for most, but not all, fish sampled in 2017. Genetic MSA was successfully performed using 1,589 (78%) of the 2,030 samples collected in 2017. Over 100 genetic samples were collected in each district sampled (Table 11). The proportion of Canadian-origin catch ranged from 31% in District 4-B to 72% in District 5 (Table 9). Across all districts and communities, roughly 56% of the Chinook salmon harvest was Canadian-origin.

DISCUSSION

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 estimate. Precision and accuracy of stock composition estimates are affected primarily by the representativeness of the genetic baseline and 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% or greater have a coefficient of variation of 20% or less and if estimator performance was to be assessed using simulation techniques, it was recommended that the Relative Root Mean Squared Error (RRMSE) be 20% or less (JTC 1997). The baseline used by this study met these criteria for Chinook salmon. The ability of a genetic baseline to discriminate stocks in MSA was critical to the success of this project. Similar criteria are also used for GSI studies on transboundary rivers in southeast Alaska and British Columbia.

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 sampled, which allowed us to determine the Canadian and U.S. components of the harvest in each district. The lower than anticipated sample sizes may have been due to fishing regulations. Quality control screenings occurred throughout the period of data collection and analysis and indicated that high quality tissue samples were collected in 2017; only 8 of the genotyped samples had to be removed due to poor quality. 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 was 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. There was not a 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, including variation between fishermen in their harvest time, gear selection, and harvest location.

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 dip nets. Despite these management actions, 3 fish were sampled from dip nets 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 dip nets were informed postseason of the requirement to release Chinook salmon alive from that gear type in the future.

The ASL and genetic compositions of Chinook salmon caught in the subsistence fishery differed from those of the Chinook salmon run, measured at Pilot Station, during 2017. For example, fish caught in the subsistence fishery had a higher proportion of age-4 and age-5 fish and a slightly lower proportion of age-6 and age-7 fish than those sampled in the test fishery at the Pilot Station sonar. The test fishery at the sonar used a wide range of mesh sizes and was assumed to be representative of the entire Chinook salmon run (JTC 2017). In addition, the proportion of the subsistence harvest that consisted of female fish (37%) was dramatically lower than the proportion in the test fishery at the Pilot Station sonar (51%). The differences in ASL composition of the harvest and the run are undoubtedly a consequence of the management actions taken in 2017. Fishermen were restricted to relatively small mesh gillnets, which tend to catch higher proportion of younger and male fish. For example, 6.0-inch or smaller gillnets were used for most of the season with relatively less opportunity for 7.5-inch gillnets. Despite less opportunity with 7.5-inch gillnets, over half of the fish sampled were caught using this gear type, which indicated that 7.5-inch mesh gillnets were efficient Chinook salmon gear. In addition, the proportion of the subsistence harvest that was of Canadian-origin (56%) was slightly higher than the proportion of the Chinook salmon run that was of Canadian-origin (44%), as indicated by genetic MSA at the Pilot Station sonar. In 2017, subsistence Chinook salmon fishing was liberalized towards the end of the season, when an unusually high proportion of fish entering the Yukon River were bound for Canada, as indicated by the inseason genetic MSA at the Pilot Station sonar. Similarly, most of the U.S. harvest of Chinook salmon occurs in upper river communities, which may not have access to lower or middle Yukon River Chinook salmon stocks. Consequently, 61% of the samples collected in 2017 came from districts upriver of District 3.

Findings from this study apply directly to improving and implementing the U.S./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 harvest of Canadian-origin fish, managers can assess the effectiveness of management actions aimed at achieving total allowable catch. The results from this study will be used in conjunction with the postseason subsistence harvest survey project, which provides annual estimates of harvest by community within the Alaska portion of the Yukon. For example, the age and stock composition of the harvest will be applied directly to harvest estimates by community and district to reconstruct the return of Chinook salmon by stock and age. 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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REFERENCES CITED

Brabets, T. P., B. Wang, and R. H. Meade. 2000. Environmental and hydrologic overview of the Yukon River Basin, Alaska and Canada. U.S. Department of the Interior, U.S. Geological Survey.

Bromaghin, J. F. 1993. Sample size determination for interval estimation of multinomial probabilities. The American Statistician 47:203-206.

DeCovich, N. A., and K. G. Howard. 2010. Genetic stock identification of Chinook salmon harvest on the Yukon River 2009. Alaska Department of Fish and Game, Fishery Data Series No. 10-58, Anchorage.

DuBois, L., and N. A. DeCovich. 2008. Origins of Chinook salmon in the Yukon River, 2005. Alaska Department of Fish and Game, Fishery Data Series No. 08-02, Anchorage.

Eaton, S. M. 2015. Salmon age, sex, and length (ASL) procedures for the Arctic-Yukon-Kuskokwim Region. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 3A15-04, Anchorage.

Geiger, H. J., and R. L. Wilbur. 1990. Proceedings of the 1990 Alaska stock separation workshop. Alaska Department of Fish and Game, Division of Commercial Fisheries, Special Publication No. 2, Juneau.

Gelman, A., and D. B. Rubin. 1992. Inference from iterative simulation using multiple sequences. Statistical Science 7:457–511.

JTC (Joint Technical Committee). 1997. Review of stock identification studies on the Yukon River. The United States and Canada Yukon River Joint Technical Committee, Whitehorse, Yukon Territory.

JTC (Joint Technical Committee of the Yukon River U.S./Canada Panel). 2017. Yukon River salmon 2016 season summary and 2017 season outlook. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 3A17-01, Anchorage.

Molyneaux, D. B., A. R. Brodersen, D. L. Folletti, Z. W. Liller and, G. Roczicka. 2010. Age, sex, and length composition of Chinook salmon in the 2005–2007 Kuskokwim River subsistence fishery. Alaska Department of Fish and Game, Fishery Data Series No. 10-39, Anchorage.

Pella, J., and M. Masuda. 2001. Bayesian methods for analysis of stock mixtures from genetic characters. Fishery Bulletin 99:151-167.

Smith, C. T., W. D. Templin, J. E. Seeb, and L.W. Seeb. 2005a. Single nucleotide polymorphisms (SNPs) provide rapid and accurate estimates of the proportions of U.S. and Canadian Chinook salmon caught in Yukon River fisheries. North American Journal of Fisheries Management 25:944-953.

Smith C. T., J. E. Seeb, P. Schwenke, L.W. Seeb. 2005b. Use of the 5’-nuclease reaction for SNP genotyping in Chinook salmon. Transactions of the American Fisheries Society 134:207- 217.

Smith C. T., A. Antonovich, W. D. Templin, C. M. Elfstom, S. R. Narum, and L. W. Seeb. 2007. Impacts of marker class bias relative to locus-specific variability on population inferences in Chinook salmon; a comparison of SNPs to STRs and allozymes. Transactions of the American Fisheries Society. 136:1647-1687.

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			
			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 (*N*) by community, and the number and percent of those samples that were successfully used for ASL composition estimation, 2017.

				Age		Sex ID		Length	
Location	Capture Gear	Number of Samplers	Number Sampled	Number	Percent	Number	Percent	Number	Percent
Kotlik	Gillnet	2	56	48	85.7	56	100.0	56	100.0
Alakanuk	Gillnet	4	122	94	77.0	120	98.4	121	99.2
Emmonak	Gillnet	2	25	24	96.0	25	100.0	25	100.0
Mountain Village	Gillnet	4	109	81	74.3	97	89.0	97	89.0
Saint Mary's	Dip net/Gillnet	5	190	155	81.6	190	100.0	190	100.0
Russian Mission	Gillnet	6	259	235	90.7	259	100.0	259	100.0
Kaltag	Gillnet	2	66	57	86.4	66	100.0	66	100.0
Nulato	Gillnet	2	223	45	20.2	50	22.4	200	89.7
Galena	Gillnet	5	399	347	87.0	398	99.7	398	99.7
Ruby	Gillnet	5	255	201	78.8	236	92.5	236	92.5
Tanana	Fish wheel/Gillnet	4	347	284	81.8	347	100.0	347	100.0
Total		41	2,051	1,571	76.6	1,844	89.9	1,995	97.3

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, 2017.

Gear	Communities	Date Range	Number of Fishermen	Number Sampled	Percent of total Sampled
Dip Net	Saint Marys	6/8	1	3	0.1
Fish wheel	Ruby, Tanana	6/26–7/23	4	172	8.4
Drift Gillnet	Kotlik, Alakanuk, Emmonak, Mountain Village, Saint Marys, Russian Mission, Kaltag, Nulato, Galena, Ruby	5/31–7/23	34	1,338	65.2
Set Gillnet	Kotlik, Alakanuk, Emmonak, Saint Marys, Russian Mission, Galena, Ruby, Tanana	6/1–7/27	15	538	26.2
Total			54	2,051	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, 2017.

	Gillnet										
District	4.00"	5.50"	5.75"	5.88"	6.00"	6.50"	7.00"	7.50"	Fish wheel	Dip net	Total
1	0	77	1	36	12	0	0	21	0	0	147
2	0	41	0	0	104	0	0	140	0	3	288
3	2	0	0	6	33	0	0	218	0	0	259
4-A Upper	0	0	0	0	30	6	0	309	0	0	345
4-B	0	20	0	0	0	0	0	240	5	0	265
4-C	0	0	0	0	122	0	31	100	2	0	255
5B	0	0	0	0	13	0	0	169	165	0	347
Total	2	138	1	42	314	6	31	1,197	172	3	1,906

Table 6.–Percent of Chinook salmon sampled from the subsistence fishery for genetics and ASL composition estimation within each district, by gear type, 2017.

	Gillnet										
District	4.00"	5.50"	5.75"	5.88"	6.00"	6.50"	7.00"	7.50"	Fish wheel	Dip net	Total
1	0	52	1	24	8	0	0	14	0	0	100
2	0	14	0	0	36	0	0	49	0	1	100
3	1	0	0	2	13	0	0	84	0	0	100
4-A Upper	0	0	0	0	9	2	0	90	0	0	100
4-B	0	8	0	0	0	0	0	91	2	0	100
4-C	0	0	0	0	48	0	12	39	1	0	100
5B	0	0	0	0	4	0	0	49	48	0	100

Table 7.–Age, sex, and length (mm) composition of Yukon River Chinook salmon sampled in the subsistence fishery by community, 2017.

Sample Dates	Sample	Brood Year	2014	2013	2012	2011	2011	2010	2010	
(Village/City)	Size	Age	1.1	1.2	1.3	1.4	2.3	1.5	2.4	Total
6/9, 6/13, 6/16, 6/18	48	Male *n*	0	5	21	7	0	0	0	33
(Kotlik)		Female *n*	0	0	8	7	0	0	0	15
		Total *n*	0	5	29	14	0	0	0	48
		Male %	0.0	10.4	43.8	14.6	0.0	0.0	0.0	68.8
		Female %	0.0	0.0	16.7	14.6	0.0	0.0	0.0	31.3
		Total %	0.0	10.4	60.5	29.2	0.0	0.0	0.0	100.1
		Male Mean Length		551	707	796				
		SD		57	34	53				
		Range		470-630	650-800	720-875				
		n	0	5	21	7	0	0	0	
		Female Mean Length			782	835				
		SD			26	51				
		Range			740-820	780-900				
		n	0	0	8	7	0	0	0	
Sample Dates	Sample	Brood Year	2014	2013	2012	2011	2011	2010	2010	
(Village/City)	Size	Age	1.1	1.2	1.3	1.4	2.3	1.5	2.4	Total
5/27-5/29, 5/31-6/3, 6/5-6/7,	94	Male *n*	0	27	35	12	0	0	0	74
6/18, 6/25, 6/27-6/28,		Female *n*	0	1	9	7	2	0	1	20
6/30-7/2, 7/5-7/6, 7/11, 7/20		Total *n*	0	28	44	19	2	0	1	94
(Alakanuk)		Male %	0.0	28.7	37.2	12.8	0.0	0.0	0.0	78.7
		Female %	0.0	1.1	9.6	7.4	2.1	0.0	1.1	21.3
		Total %	0.0	29.8	46.8	20.2	2.1	0.0	1.1	100.0
		Male Mean Length		569	709	823				
		SD		49	61	72				
		Range		455-655	549-835	734-958				
		n	0	27	35	12	0	0	0	
		Female Mean Length		634	780	836	730		833	
		SD		0	58	43	13		0	
		Range		634-634	674-860	780-901	721-739		833-833	
		n	0	1	9	7	2	0	1	

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Sample Dates	Sample	Brood Year	2014	2013	2012	2011	2011	2010	2010	
(Village/City)	Size	Age	1.1	1.2	1.3	1.4	2.3	1.5	2.4	Total
6/6, 6/26, 6/28, 6/30	24	Male *n*	0	6	8	0	0	0	0	14
(Emmonak)		Female *n*	0	0	4	6	0	0	0	10
		Total *n*	0	6	12	6	0	0	0	24
		Male %	0.0	25.0	33.3	0.0	0.0	0.0	0.0	58.3
		Female %	0.0	0.0	16.7	25.0	0.0	0.0	0.0	41.7
		Total %	0.0	25.0	50.0	25.0	0.0	0.0	0.0	100.0
		Male Mean Length		555	634					
		SD		40	103					
		Range		505-600	465-750					
		n	0	6	8	0	0	0	0	
		Female Mean Length			713	805				
		SD			61	70				
		Range			625-764	705-904				
		n	0	0	4	6	0	0	0	
Sample Dates	Sample	Brood Year	2014	2013	2012	2011	2011	2010	2010	
(Village/City)	Size	Age	1.1	1.2	1.3	1.4	2.3	1.5	2.4	Total
6/2, 6/5, 6/8, 6/18, 6/22-6/23,	81	Male *n*	0	7	27	10	0	0	0	44
6/25, 6/27, 7/1-7/3, 7/13, 7/23		Female *n*	0	9	13	15	0	0	0	37
(Mountain Village)		Total *n*	0	16	40	25	0	0	0	81
		Male %	0.0	8.6	33.3	12.3	0.0	0.0	0.0	54.2
		Female %	0.0	11.1	16.0	18.5	0.0	0.0	0.0	45.6
		Total %	0.0	19.7	49.3	30.8	0.0	0.0	0.0	99.8
		Male Mean Length		583	728	844				
		SD		55	75	71				
		Range		510-668	561-890	711-991				
		n	0	7	27	10	0	0	0	
		Female Mean Length		569	755	831				
		SD		46	64	46				
		Range		495-620	640-870	750-902				
		n	0	9	13	15	0	0	0	

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Sample Dates (Village/City)	Sample Size	Brood Year / Age	2014 / 1.1	2013 / 1.2	2012 / 1.3	2011 / 1.4	2011 / 2.3	2010 / 1.5	2010 / 2.4	Total
6/1, 6/4-6/5, 6/7-6/9, 7/2, 7/4, 6/18-6/19, 6/21-6/22, 6/24, 6/26-7/18 (Saint Mary's)	155	Male *n*	0	28	47	16	1	0	0	92
		Female *n*	0	1	34	26	1	1	0	63
		Total *n*	0	29	81	42	2	1	0	155
		Male %	0.0	18.1	30.3	10.3	0.6	0.0	0.0	59.3
		Female %	0.0	0.6	21.9	16.8	0.6	0.6	0.0	40.5
		Total %	0.0	18.7	52.2	27.1	1.2	0.6	0.0	99.8
		Male Mean Length		576	719	793	730			
		SD		45	64	75	0			
		Range		509-672	490-840	700-1000	730-730			
		n	0	28	47	16	1	0	0	
		Female Mean Length		547	762	817	760	930		
		SD		0	57	61	0	0		
		Range		547-547	680-900	667-915	760-760	930-930		
		n	0	1	34	26	1	1	0	
Sample Dates (Village/City)	**Sample Size**	**Brood Year / Age**	**2014 / 1.1**	**2013 / 1.2**	**2012 / 1.3**	**2011 / 1.4**	**2011 / 2.3**	**2010 / 1.5**	**2010 / 2.4**	**Total**
6/5-6/9, 6/14, 6/18-6/21, 6/23, 6/25-6/29, 7/3, 7/6 (Russian Mission)	235	Male *n*	0	19	81	22	1	0	1	124
		Female *n*	0	7	59	45	0	0	0	111
		Total *n*	0	26	140	67	1	0	1	235
		Male %	0.0	8.1	34.5	9.4	0.4	0.0	0.4	52.8
		Female %	0.0	3.0	25.1	19.1	0.0	0.0	0.0	47.2
		Total %	0.0	11.1	59.6	28.5	0.4	0.0	0.4	100.0
		Male Mean Length		543	735	777	690		840	
		SD		44	43	49	0		0	
		Range		470-650	632-846	706-939	690-690		840-840	
		n	0	19	81	22	1	0	1	
		Female Mean Length		575	749	808				
		SD		32	53	39				
		Range		517-615	580-876	725-890				
		n	0	7	59	45	0	0	0	

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Sample Dates	Sample	Brood Year	2014	2013	2012	2011	2011	2010	2010	
(Village/City)	Size	Age	1.1	1.2	1.3	1.4	2.3	1.5	2.4	Total
6/27, 6/29	57	Male *n*	1	4	27	7	0	0	0	39
(Kaltag)		Female *n*	0	1	11	6	0	0	0	18
		Total *n*	1	5	38	13	0	0	0	57
		Male %	1.8	7.0	47.4	12.3	0.0	0.0	0.0	68.5
		Female %	0.0	1.8	19.3	10.5	0.0	0.0	0.0	31.6
		Total %	1.8	8.8	66.7	22.8	0.0	0.0	0.0	100.1
		Male Mean Length	407	636	737	829				
		SD	0	52	49	25				
		Range	407-407	608-714	650-843	790-861				
		n	1	4	27	7	0	0	0	
		Female Mean Length		600	732	822				
		SD		0	32	66				
		Range		600-600	690-800	760-942				
		n	0	1	11	6	0	0	0	
Sample Dates	Sample	Brood Year	2014	2013	2012	2011	2011	2010	2010	
(Village/City)	Size	Age	1.1	1.2	1.3	1.4	2.3	1.5	2.4	
6/26-6/30, 7/4	45	Male *n*	0	1	17	10	0	0	0	28
(Nulato)		Female *n*	0	0	6	11	0	0	0	17
		Total *n*	0	1	23	21	0	0	0	45
		Male %	0	2.2	37.8	22.2	0.0	0.0	0.0	62.2
		Female %	0	0	13.3	24.4	0.0	0.0	0.0	37.7
		Total %	0	2.2	51.1	46.6	0.0	0.0	0.0	99.9
		Male Mean Length		520	730	802				
		SD		0	47	43				
		Range		520-520	670-850	740-850				
		n	0	1	17	10	0	0	0	
		Female Mean Length			781	839				
		SD			39	46				
		Range			720-820	760-890				
		n	0	0	6	11	0	0	0	

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Sample Dates (Village/City)	Sample Size	Brood Year	2014	2013	2012	2011	2011	2010	2010	
		Age	1.1	1.2	1.3	1.4	2.3	1.5	2.4	Total
6/20, 6/25-6/30, 7/2-7/3, 7/5, 7/7, 7/10-7/11 (Galena)	347	Male *n*	0	36	142	38	2	0	0	218
		Female *n*	0	5	64	60	0	0	0	129
		Total *n*	0	41	206	98	2	0	0	347
		Male %	0.0	10.4	40.9	11.0	0.6	0.0	0.0	62.9
		Female %	0.0	1.4	18.4	17.3	0.0	0.0	0.0	37.1
		Total %	0.0	11.8	59.3	28.3	0.6	0.0	0.0	100.0
		Male Mean Length		582	724	804	660			
		SD		54	49	56	57			
		Range		500-790	600-855	710-910	620-700			
		n	0	36	142	38	2	0	0	
		Female Mean Length		568	766	825				
		SD		35	58	51				
		Range		520-610	580-880	710-930				
		n	0	5	64	60	0	0	0	
Sample Dates (Village/City)	Sample Size	Brood Year	2014	2013	2012	2011	2011	2010	2010	
		Age	1.1	1.2	1.3	1.4	2.3	1.5	2.4	Total
6/18, 6/22-6/23, 6/26-6/30, 7/3-7/7, 7/10-7/11 (Ruby)	201	Male *n*	0	13	101	28	0	0	1	143
		Female *n*	0	0	16	40	1	0	1	58
		Total *n*	0	13	117	68	1	0	2	201
		Male %	0.0	6.5	50.2	13.9	0.0	0.0	0.5	71.1
		Female %	0.0	0.0	8.0	19.9	0.5	0.0	0.5	28.9
		Total %	0.0	6.5	58.2	33.8	0.5	0.0	1.0	100.0
		Male Mean Length		600	723	824			850	
		SD		76	58	57			0	
		Range		525-820	565-904	690-960			850-850	
		n	0	13	101	28	0	0	1	
		Female Mean Length			765	843	780		860	
		SD			64	38	0		0	
		Range			555-830	740-902	780-780		860-860	
		n	0	0	16	40	1	0	1	

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Table 7.–Page 6 of 6.

Sample Dates (Village/City)	Sample Size	Brood Year	2014	2013	2012	2011	2011	2010	2010	
		Age	1.1	1.2	1.3	1.4	2.3	1.5	2.4	
6/19, 6/21-6/23, 6/28-6/29, 7/2, 7/5-7/6, 7/8-7/9, 7/12-7/13, 7/15-7/17,7/20, 7/22-7/23, 7/26-7/27 (Tanana)	284	Male *n*	0	15	112	58	2	0	0	187
		Female *n*	0	0	38	57	2	0	0	97
		Total *n*	0	15	150	115	4	0	0	284
		Male %	0	5.3	39.4	20.4	0.7	0	0	65.8
		Female %	0	0	13.4	20.1	0.7	0	0	34.2
		Total %	0	5.3	52.8	40.5	1.4	0	0	100.0
		Male Mean Length		603	757	849	735			
		SD		55	53	61	78			
		Range		546-770	620-913	723-970	680-790			
		n	0	15	112	58	2	0	0	
		Female Mean Length			789	851	752			
		SD			54	45	59			
		Range			623-855	770-985	710-794			
		n	0	0	38	57	2	0	0	
Total All Villages/Cities	Sample Size	Brood Year	2014	2013	2012	2011	2011	2010	2010	
		Age	1.1	1.2	1.3	1.4	2.3	1.5	2.4	
	1,571	Male *n*	1	161	618	208	6	0	2	996
		Female *n*	0	24	262	280	6	1	2	575
		Total *n*	1	185	880	488	12	1	4	1,571
		Male %	0.1	10.2	39.3	13.2	0.4	0	0.1	63.3
		Female %	0	1.5	16.7	17.8	0.4	0.1	0.1	36.6
		Total %	0.1	11.7	56.0	31.0	0.8	0.1	0.2	100.0
		Male Mean Length	407	577	729	819	702		845	
		SD		55	57	63	56		7	
		Range	407-407	455-820	465-913	690-1000	620-790		840-850	
		n	1	161	618	208	6	0	2	
		Female Mean Length		574	763	830	751	930	846	
		SD		38	56	49	33	0	19	
		Range		495-634	555-900	667-985	710-794	930-930	833-860	
		n	0	24	262	280	6	1	2	

Table 8.–Total number of samples (*N*), mean total age and length (mm), with standard deviation (SD), mean total age, and percent female (%) for Chinook salmon caught in drift and set gillnets, broken out by mesh size, 2017.

		Percent	Age		Length		Percent
Mesh Size	*N*	of Total	Mean	SD	Mean	SD	Female
4.00	2	0.1	5	1	653	209	0.0
5.50	138	8.0	5	1	681	118	34.6
5.75	1	0.1	–	–	–	–	100.0
5.88	42	2.4	5	1	708	97	2.4
6.00	314	18.1	5	1	717	106	28.7
6.50	6	0.3	5	1	682	131	16.7
7.00	31	1.8	6	1	808	74	47.8
7.50	1,197	69.2	5	1	760	80	42.1

Table 9.–Average Chinook salmon age, sex, and length composition, with standard deviation (SD), at each sampling location, 2017.

		Percent	Age		Length		Percent
Village	*N*	of Samples	Mean	SD	Mean	SD	Female
Kotlik	56	2.7	5	1	733	92	29
Alakanuk	122	5.9	5	1	698	109	24
Emmonak	25	1.2	5	1	667	117	40
Mountain Village	109	5.3	5	1	734	108	51
St Marys	190	9.3	5	1	732	97	44
Russian Mission	259	12.6	5	1	736	85	47
Kaltag	66	3.2	5	1	743	79	32
Nulato	223	10.9	5	1	737	90	42
Galena	399	19.5	5	1	741	88	37
Ruby	255	12.4	5	1	755	86	28
Tanana	347	16.9	5	1	793	82	37

Table 10.–Average Chinook salmon age, sex, and length composition, with standard deviation (SD), within each district, 2017.

		Percent	Age		Length		Percent
District	*N*	of Samples	Mean	SD	Mean	SD	Female
1	147	7.2	5	1	693	111	27
2	299	14.6	5	1	733	101	46
3	259	12.6	5	1	736	85	47
4-A Upper	345	16.8	5	1	738	88	34
4-B	399	19.5	5	1	741	88	37
4-C	255	12.4	5	1	755	86	28
5B	347	16.9	5	1	793	82	37

Table 11.–Estimates of stock composition of subsistence harvests in districts and communities of the Yukon River Management Area.

District	Communities Sampled	*N*	Reporting Group	Estimate	90% Confidence Interval Lower	Upper	SD
1	Kotlik	178	Lower Yukon	23.6	17.4	30.2	3.9
	Alakanuk		Middle Yukon	30.5	20.3	40.4	6.1
	Emmonak		Canada	45.9	36.4	56.4	6.1
2	Mountain Village	197	Lower Yukon	22.0	16.8	27.8	3.4
	St. Mary's		Middle Yukon	36.8	29.7	44.4	4.5
			Canada	41.0	33.6	48.4	4.5
3	Russian Mission	254	Lower Yukon	10.3	6.2	15.2	2.7
			Middle Yukon	46.5	39.1	53.9	4.5
			Canada	43.2	36.4	50.0	4.1
4-A Upper	Kaltag	269	Lower Yukon	5.6	1.6	10.2	2.6
	Nulato		Middle Yukon	49.6	42.7	56.6	4.2
			Canada	44.8	38.5	51.2	3.9
4-B	Galena	200	Lower Yukon	10.5	4.7	18.4	4.2
			Middle Yukon	58.0	48.9	66.6	5.4
			Canada	31.5	24.5	38.8	4.3
4-C	Ruby	198	Lower Yukon	3.6	0.0	9.0	2.9
			Middle Yukon	42.3	34.2	50.6	5.0
			Canada	54.0	46.3	61.4	4.6
5	Tanana	293	Lower Yukon	5.4	2.6	8.9	1.9
			Middle Yukon	22.7	14.9	31.4	5.0
			Canada	71.9	63.3	79.6	5.0

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

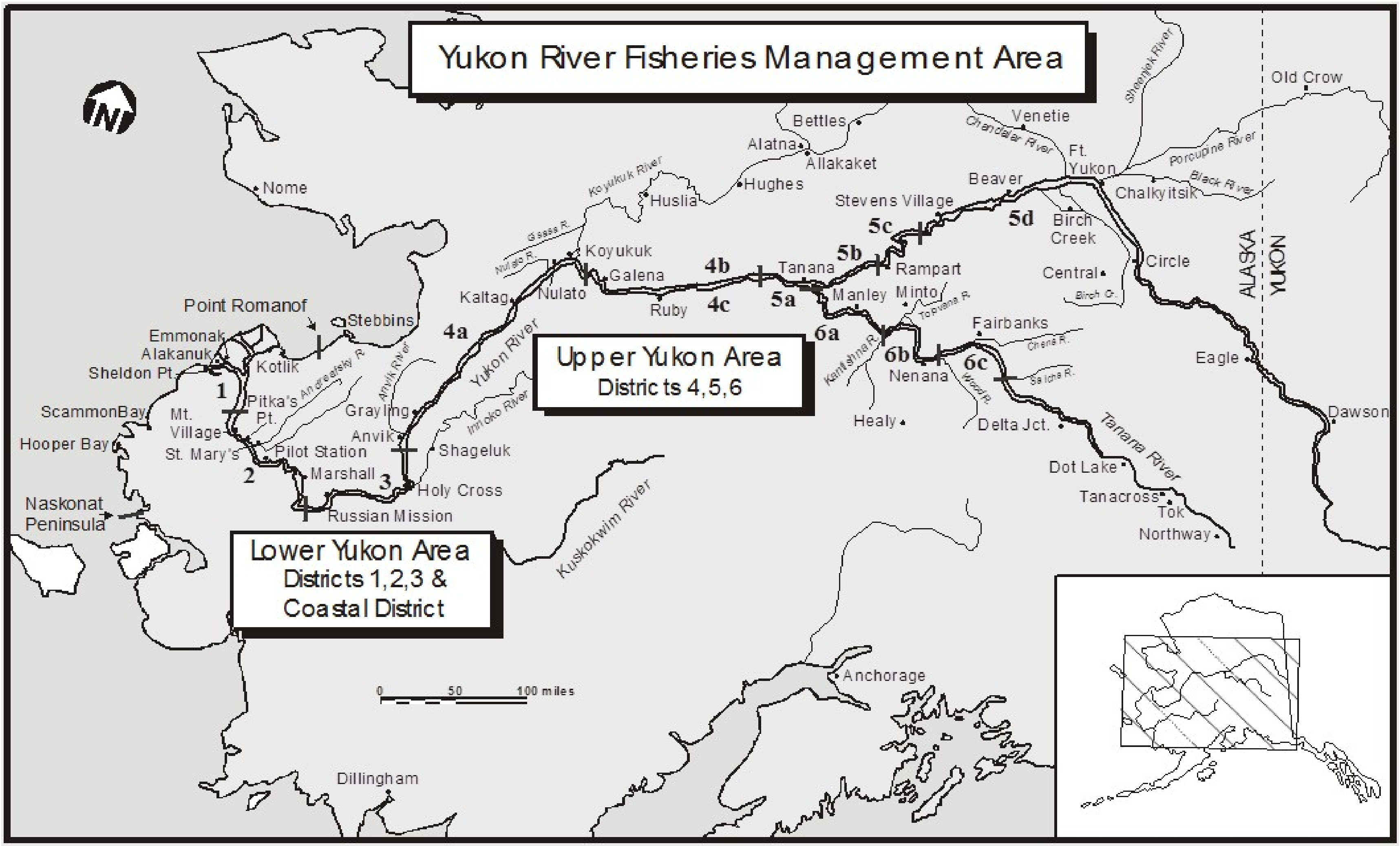

Figure 1.–The Alaska portion of Yukon River with location of communities and fisheries management districts.