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Origins of Chinook Salmon in the Yukon River Fisheries, 2008

by

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and

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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

The stock composition of all harvests and test fishery catches of Chinook salmon *Oncorhynchus tshawytscha* within the Yukon River drainage was estimated in 2008. Stock composition was estimated for 3 geographically-based stock groups termed Lower, Middle, and Upper. Commercial and subsistence harvest age compositions were estimated from aged scales collected. Age compositions from sampled fish, in combination with genetic stock estimates, were used to estimate the stock composition for each age class. The total estimated Yukon River harvest in 2008 was 52,294 Chinook salmon; of these, 17.0% were estimated to be of Lower, 28.0% Middle, and 55.0% Upper Yukon River stock group origin. Age-1.3 fish dominated the harvest totaling 60.9% of the Chinook salmon caught in 2008; age-1.4 fish comprised 30.6% of the harvest.

Key words: Chinook salmon, *Oncorhynchus tshawytscha*, Yukon River, stock composition, age composition, commercial harvest, subsistence harvest, genetic stock identification, age-1.3, age-1.4, Canadian harvest, stock groups.

INTRODUCTION

In 2002, the Yukon River Salmon Agreement was signed as part of the Pacific Salmon Treaty, whereby the U.S. and Canada agreed to harvest sharing of Chinook salmon *Oncorhynchus tshawytscha* that migrate through Alaskan waters and spawn in the Yukon Territory and British Columbia. Since then, the two nations have been engaged in the cooperative management and conservation of stocks spawning in Canada. Stock composition estimates of Alaskan harvests provide valuable information for management and conservation of Chinook salmon throughout the Yukon River drainage, and aid in fulfillment of Treaty obligations.

The Yukon River drains roughly 531,100 square kilometers, originates in northern British Columbia, and flows 3,700 river kilometers (rkm) to the Bering Sea (Vania et al. 2002). Chinook salmon spawn in major tributaries throughout the drainage. Yukon River Chinook salmon are harvested annually in various fisheries in both marine and fresh waters. Within the Yukon River, returning adult salmon are harvested in subsistence and personal use fisheries in Alaska, aboriginal and domestic fisheries in Canada, and commercial, test, and sport fisheries in Alaska and Canada (Figures 1 and 2). In the past, commercially sold Chinook salmon harvests consisted of fish sold in the round and fish harvested by the Alaska Department of Fish and Game (ADF&G) in test fishing projects. However, in recent years fish caught in test fisheries have been donated to local subsistence users and were not sold. Sport fisheries primarily occur in lower river tributaries, i.e., Andreafsky and Anvik rivers, Tanana River tributaries, and in Canada. The average annual harvest of Chinook salmon within the Yukon River drainage from 1999 to 2008 was 92,320 fish. Of these, approximately 90% were harvested in Alaska (JTC 2010).

Within the Alaskan portion of the drainage, the Yukon River is split into 6 fishing districts, Y1-Y6, numbered sequentially progressing from the mouth of the river to the Canadian border. Commercial fisheries primarily occur in Districts 1 and 2; however, they are occasionally executed in District 6, whereas subsistence fishing occurs throughout the river. Samples for this report were collected from commercial fisheries in Districts 1 and 2, test fisheries, escapement projects, and subsistence fisheries in every District. The Lower Yukon Test Fishery, Pilot Station test fishery, and Marshall test fishery occur in Districts 1 and 2. Escapement samples were derived from Anvik and Salcha River escapement projects in Alaska and the mark–recapture fish wheels at White Rock and Sheep Rock in the Yukon Territory, Canada. Sport fishing occurred on the Anvik and Tanana rivers, in Districts 3 and 6, respectively. ADF&G, along with the U.S.

Fish and Wildlife Service, Bering Sea Fisherman's Association, tribal groups and non-profit organizations, collaborated to collect subsistence harvest samples through the drainage, from every District. Villages that contributed samples were thought to be representative of that District or sub-district's harvest and included the following locations: District 1, Holy Cross, Kaltag, Nulato, Bishop Rock, Galena, Ruby, Rampart Rapids, and Eagle.

Although more than 100 spawning streams have been documented (Barton 1984), aerial surveys of Chinook salmon escapements have indicated that the largest concentrations of spawning salmon occur in tributary groupings in 3 distinct geographic regions: 1) Alaskan tributary streams draining the Andreafsky Hills and Kaltag Mountains (rkm 161–805); 2) Alaskan tributary streams in the upper Koyukuk River and Tanana River basins (rkm 1,290–1,770); and 3) Canadian tributary streams draining the Pelly and Big Salmon mountains (rkm 2,090–2,900) (Merritt et al. 1988; Hayes et al. 2008). Initially, McBride and Marshall (1983) termed Chinook salmon stocks within these geographic regions "runs" but Lingnau and Bromaghin (1999) reclassified them as Lower, Middle, and Upper Yukon River stock groups. The Lower stock group includes Alaskan tributary streams from the Andreafsky River to near the confluence with the Tanana River, including the lower Koyukuk River drainage. The Middle stock group includes Alaskan tributary streams upstream from the Tanana River confluence, and the upper Koyukuk and Tanana river drainages. The Upper stock group is Canadian-origin fish.

In 1997, an expert panel convened by the U.S. and Canadian Joint Technical Committee (JTC) determined that scale pattern analysis provided sufficient stock-specific information for management and research pending the development of improved genetic stock identification capabilities (Schneiderhan 1997). Based on surveys of genetic variation among Chinook salmon populations in the Yukon River drainage, a baseline of genetic information was completed and used for genetic stock identification using allozyme loci (Beacham et al. 1989; Wilmot et al. 1992; Templin et al. 2005). Then, in 2003 a survey of single nucleotide polymorphisms (SNPs) in Yukon River Chinook salmon demonstrated that stock identification information could be obtained in an accurate and efficient manner using newly developed genetic methods (Smith et al. 2005). In 2006 the stock composition of Yukon River fishery harvests was estimated using improved mixed stock analysis based on 26 SNPs markers (Templin et al. 2006a); this analysis was again utilized for 2008 (DeCovich et al. 2010).

OBJECTIVES

The goal of this project is to estimate the Yukon River Chinook salmon harvest by stock (i.e., geographic region) and age class during the 2008 season. This report apportions annual harvests within the drainage to Lower, Middle, and Upper stock groups based upon on the 26 SNPs marker baseline and provides estimates by age class, district, and fishery. This information is used to construct brood tables and calculate spawner–recruit relationships.

METHODS

SAMPLING OVERVIEW

Age, sex and length information was collected at each test fishery, commercial fishery, escapement project and a select number of subsistence locations from June through August to coincide with the Chinook salmon run. These projects include Districts 1 and 2 commercial fisheries, Pilot Station test fishery, Marshall test fishery, Anvik and Chena River escapement projects, and White Rock and Sheep Rock (located just upstream of the U.S./Canadian border)

test fish wheels. Subsistence harvest information was collected from Holy Cross, Nulato, Kaltag, Bishop Rock (located just upstream of the boundary of subdistricts 4A and 4B/C), Galena, Ruby, Tanana, and Rampart Rapids and Eagle. Genetic and scale sampling typically occur simultaneously from the same fish, however, the number of fish aged may differ from the total sampled for genetics, as only good quality scales are readable. In most cases, both a genetics sample and scale sample were taken from the same fish, however there were exceptions. Genetics samples were not taken from carcasses sampled from the Salcha and Anvik rivers, nor from the Marshall test fishery, but age, sex and length (ASL) was collected. Axillary process tissue was collected at the Rampart Rapids video wheel by Stan Zuray; however, ASL samples from different fish were collected by ADF&G. Only genetics samples were collected from the Tanana subsistence harvest, and Eagle's harvest was sampled for ASL only. Sample sizes from each of these locations varies and is especially fluid in the case of subsistence harvest sampling due to the smaller harvest and greater difficulty in obtaining samples. The following are typical sample size objectives for Chinook salmon: District 1 subsistence harvest, 400 fish; Districts 3–5 subsistence harvest, 150–250 fish per village; test fisheries, 30 fish per day per gear type; commercial periods, 200 fish per period; Anvik carcass surveys, 250 fish; Salcha carcass surveys, 400–500 fish. The District 2 subsistence harvest was not sampled in 2008.

SCALE COLLECTION, PROCESSING, AND AGING

Scales were removed from the preferred area of the fish for age determination and mounted on gum cards (Clutter and Whitesel 1956). Three scales were collected from each Chinook salmon to allow for the incidence of regenerated scales. Sex and length (mid eye to tail fork) were also recorded from each fish. Field data were recorded in Rite-in-the-Rain[1] books and transferred to Opscan forms (converted into electronic format when run through an Opscan reader) or entered into Microsoft Excel® files. Data collected from Districts 1 and 2 commercial harvests, lower river test fisheries and subsistence harvests, were recorded directly into Juniper data loggers and loaded into a Microsoft Access® database.

Scales were impressed in cellulose acetate using methods described by Clutter and Whitesel (1956); impressions were magnified and examined in a microfiche reader. Age was determined by counting the number of freshwater and marine annuli, the regions of the scale where the circuli, or rings, are tightly spaced, and represent slower growth rates associated with winter conditions (Mosher 1969). Ages were recorded using European notation, in which the number of freshwater annuli is separated by a decimal from 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 COLLECTION, PROCESSING, AND ANALYSIS

Chinook salmon were randomly sampled over the course of the run from test, commercial, and subsistence fisheries. Tissue samples for genetic analyses were collected during each fishing period concurrent with age, sex, and length sample collections (DuBois et al. 2009). Axillary process tissue samples were collected using clippers or scissors; approximately three-fourths of an inch was removed and put into an individually numbered 2 ml vial filled with denatured ethanol. These vials were shipped to the ADF&G Gene Conservation Laboratory for processing. Stock composition estimates for the 3 broad scale stock groups (Lower, Middle and Upper) were

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

generated using the program SPAM, version 3.7 (Debevec et al. 2000). The desired accuracy and precision objectives were a 90% confidence interval with a width of approximately 10% (DeCovich et al. 2010). A baseline of individual genotype data was summarized as allele frequencies at 26 SNP marker loci in each population (Appendix A1). DeCovich et al. (2010) describes laboratory methods used to estimate stock composition for the 2008 harvest samples.

ESCAPEMENT SAMPLING

Select escapement samples were used as a surrogate for harvest samples to characterize age and stock groups, as scale samples were not available from fisheries in all locations. During peak spawning mortality (late July through early August), ADF&G personnel collected scale samples from carcasses at the Anvik River and Bering Sea Fisherman's Association (BSFA) sampled carcasses at the Salcha River. Samples from Anvik were used to characterize sport harvest from the Anvik and Andreafsky rivers; scales from the Salcha River harvest were used to estimate age and stock composition from the Salcha, Chena, and Chatanika rivers. Samples were collected by Canadian Department of Fisheries and Oceans (DFO) from fish captured in fish wheels for a mark–recapture project at White Rock and Sheep Rock in the Yukon Territory, Canada; this project produced estimates of border passage. The Canadian scale samples provided data used to estimate age composition of Canadian harvests.

HARVEST SAMPLING AND STOCK ASSIGNMENT

Harvest sampling for age and genetic data from specific locations and fisheries, as outlined in the previous sections, were used to estimate age and stock composition from these harvests. Age and stock composition of harvests not sampled were estimated from adjacent harvests that were assumed to be similar. All commercial fishing periods were restricted to ≤6 inch mesh nets for targeting smaller chum salmon, and effort was made to collect 200 incidentally caught Chinook salmon samples per commercial period. ADF&G crews sampled Chinook salmon for age and genetic data from 5 of 6 commercial periods in District 1. Samples from District 1, periods 1 and 2 were used to estimate stock composition in those respective harvests. Age and stock composition were combined from periods 3–6 in District 1 to obtain an adequate sample size for analysis and applied to periods 3–6, because period 6 was not sampled.

In District 2 only 1 of 5 commercial periods was sampled and genetic sample size was inadequate to provide Lower/Middle/Upper stock estimates. District 2, period 1 U.S. (Lower/Middle stock combined) and Canadian Upper stock estimates were applied to periods 1 and 2. District 1, period 1 Lower/Middle stock estimates were used to apportion those U.S. stocks in District 2, periods 1 and 2. The stock estimates from District 1, periods 3–5 were applied to District 2, periods 3–5.

Sample size objectives from subsistence fisheries ranged from 250 to 400 from each location, depending on the difficulty in obtaining samples and respective magnitude of local harvests. The age and genetic data collected from the District 1 subsistence samples were used to estimate age and stock composition for that harvest. Age estimates for District 2 subsistence harvests were based on collections from the Pilot Station and Marshall test fisheries; stock composition was from Pilot Station test fishery. The sport fishery harvest from the Anvik River, a tributary flowing into District 4, was assigned to the Lower River as it is a terminal fishery and all fish are assumed to be bound for Lower River spawning grounds. Age composition was estimated using escapement samples from the Anvik River. District 3 subsistence harvest samples from Holy

Cross were used to estimate the age and stock composition from harvests in Russian Mission and Holy Cross in District 3 and Anvik and Grayling in District 4.

Upper Koyukuk River harvests were assigned to the Middle stock group, and age estimates from Bishop Rock were applied to the harvest. Mainstem District 4 stock composition estimates were derived from genetic samples collected in Kaltag, Nulato, Galena, Bishop Rock, and Ruby. Age and stock estimates from the Kaltag/Nulato pooled samples were assigned to those villages' combined harvest. Bishop Rock age and stock composition estimates were applied to the harvest from Koyukuk. Samples from Galena and Ruby were used to estimate stock and age composition from each village's respective harvest.

In District 5, subsistence harvest samples were collected from Tanana, Rampart Rapids, and Eagle. District 5 stock composition estimates were separated by location: harvests from Chandalar and Black rivers, harvests downstream of Fort Yukon to Tanana, harvests upstream of and including Fort Yukon, and harvests from the community of Tanana. The Chandalar and Black rivers subsistence harvest was assigned to the Middle stock group because, as terminal fisheries, these fish are bound for spawning grounds in Alaska. Age estimates from Rampart Rapids were applied to the Chandalar and Black rivers harvest. Stock and age composition estimates from below Fort Yukon were estimated using samples collected from the Rampart Rapids harvest. Harvests upstream of and including Fort Yukon were assigned to the Upper stock group assuming these fish are bound for Canada. Age estimates from the Eagle subsistence harvest were used for these Upper stock fish. Subsistence harvests from Tanana were assigned to the Middle stock, as these fish are assumed to be bound for Tanana River spawning grounds, and age estimates from Rampart Rapids were applied to the harvest.

In District 6, the Tanana River drainage, subsistence and sport harvests were assigned to the Middle stock group based on geographic location. Age composition was estimated from carcass samples collected in the Salcha River.

All harvests occurring in Canada were assigned to the Upper stock group. Canadian border test fish wheel samples were used to estimate age composition of Canadian sport and aboriginal harvests. This was calculated by applying gear-selectivity coefficients to the combined Sheep Rock and White Rock fish wheel age composition to obtain a more accurate estimate of the border passage escapement age composition (Jeff Bromaghin, ADF&G, Commercial Fisheries Biologist, Anchorage, personal communication).

For each harvest the number of fish per stock group and age class was estimated as follows.

Denote,

$N_{d,i,j}$: The number of salmon at *d-th* district or village, *i-th* stock and *j-th* age;

$N_{d,k}$: The number of salmon (e.g., commercial, subsistence harvest) at *d-th* district or village and *k-th* period;

$Ps_{,d,i,k}$: Proportion of *i-th* stock at *d-th* district or village and *k-th* period;

$Pa_{,d,j,k}$: Proportion of *j-th* age at *d-th* district or village and *k-th* period.

The estimated harvest by village, stock, and age-class is then,

$$\hat{N}_{dij} = \sum_{k} (\hat{N}_{d,k} \cdot \hat{P}s_{d,i,k} \cdot \hat{P}a_{d,j,k}) .$$

For example, the community of Ruby harvested 637 Chinook salmon. The proportion of Middle River stock fish was 0.48 and the proportion of age-1.3 fish was 0.69. Using the previous equation we would expect the number of age-1.3 Chinook salmon that were of Middle River origin to be 210 fish. These calculations were used for each harvest group throughout the drainage. Subsistence harvests by village were summed to obtain districtwide estimates by stock and age class.

RESULTS

SAMPLING AND SUMMARY STATISTICS

Chinook salmon age composition was available from 16 commercial, subsistence, and test fishery sampling locations (Table 1). The number of fish sampled for scales from commercial and subsistence fisheries, test fisheries, and escapement projects was varied and ranged from 58 at Rampart Rapids to 736 at the Canadian test fishery (Table 1). Fish sampled were caught using a variety of gear, including drift gill nets, set gill nets, and fish wheels; carcass surveys also supplied samples. Axillary process tissue sample size objectives were met only during commercial fishing period 2 in District 1 (Table 2). Axillary process tissue sample size objectives were met for a number of test fishery and subsistence harvest locations, including Pilot Station (333), District 1 (472), Kaltag/Nulato (380), Galena/Bishop Rock (248), and Rampart Rapids (200; Table 3).

STOCK COMPOSITION BY HARVEST

Commercial

The harvest of 2,530 Chinook salmon in the District 1 commercial fishery was composed of approximately 1,760 Lower, 127 Middle, and 643 Upper stock fish (Table 4). In all District 1 commercial harvest periods, the Lower stock predominated (Table 4; Figure 3). Upper river stock percentages were greatest in District 1, period 1 and lowest in District 1, period 2 (Table 2). Harvest of the Middle stock was consistently lower than the other stock groups among all periods in District 1 (Table 4; Figure 3). The 2,111 Chinook salmon harvested in the District 2 commercial fishery comprised approximately 1,375 Lower, 149 Middle, and 586 Upper stock fish (Table 5; Figure 4). The Lower and Middle stocks comprised 71.8% of the District 2, period 1 harvest (Table 2).

Subsistence

The District 3 subsistence fishery harvested the most Lower stock fish, 1,835 fish (31.3%; Tables 6 and 7), whereas the District 2 subsistence fishery harvested the most Middle stock fish, totaling 3,473 fish comprising 39.4% of the catch (Tables 6 and 7). The 2008 District 5 subsistence fishery had the highest harvest percentage (79.8%) of Upper river stocks, and the largest total harvest, 11,626 fish (Tables 6 and 7; Figure 5). Within District 5, the villages of Tanana and Rampart Rapids followed this trend, with Upper stock harvests comprising 66.5% and 77.8%, respectively (Table 3). The District 4 subsistence fishery harvested the most Alaskan-origin fish, Lower and Middle stocks combined (56.9%; Table 7).

All Alaskan fisheries combined harvested a total of 25,329 Upper river Chinook salmon and Canadian fisheries harvested 3,426 fish, all of which were Upper stock (Table 8). Upper stock group estimates comprised 55.0% of the total 2008 Chinook salmon harvest, followed by Middle (28.0%) and Lower (17.0%; Table 9).

AGE COMPOSITION

Commercial

For the District 1 commercial fishery, age-1.3 fish comprised the largest proportion of each stock, and 57.8% of the total harvest, with an estimated total of 1,462 fish in all periods combined (Table 4). This trend was also observed in the District 2 commercial fishery harvest, where age-1.3 fish represented 55.9% of the harvest, totaling 1,182 fish (Table 5).

Subsistence

For subsistence fisheries, samples from Rampart Rapids and Eagle contained the highest percentages of age-1.3 fish, 79.3% and 74.8% respectively (Table 1). Only Bishop Rock subsistence samples showed the opposite trend and had a higher proportion of age-1.4 fish (Tables 1 and 3). The age-1.3 percentage was highest from harvests that primarily use fish wheels: Canadian test fishery (75.3%), Rampart Rapids (79.3%), Eagle subsistence (74.8%), and Ruby subsistence (69.2%; Table 1). The adjusted Canadian border passage escapement by major age class was 36.3% age-1.4 and 57.1% age-1.3 fish (Table 1), taking into account the fish wheel gear selectivity coefficients for each age class.

TOTAL HARVEST SUMMARY

The 2008 Chinook salmon total harvest for Alaska and Canada was 52,294 fish, compared with overall (1981–2007) and recent 10-year averages of 152,270 and 96,038 fish (Table 8). Of this, 31,870 (60.9%) were estimated to be age-1.3 fish (Table 6). In Alaska, 11 commercial fisheries in the lower river (Districts 1 and 2) harvested 4,641 Chinook salmon, sport fisheries harvested 409 Chinook salmon, and the subsistence fisheries harvested 43,818 Chinook salmon (Table 6).

DISCUSSION

Overall, the total 2008 harvest of U.S. and Canadian Yukon River Chinook salmon stocks was well below the historical 10-year average. Comparing the 2008 harvest by stock group to the 1981–2007 average, the Lower stock group was below average, the Middle stock above average, and the Upper stock near average (Table 8). Escapement into the Chena and Salcha rivers in 2003 (the parent year for age-5 fish) far exceeded the biological escapement goals established for each of these Tanana River tributaries. Good production from these escapements could partly account for the apparent relative abundance of Middle stock fish that returned in 2008 (JTC 2010). It should be noted, however, that the stock composition of the harvest does not always directly reflect the stock composition of the run: the accuracy of that relationship can vary based on the timing of the harvest relative to stock entrance into the river and movement up the drainage.

The age-1.3 percentage in the total harvest was above average and the age-1.4 component was below average compared to historical data. Age-1.3 fish predominated among all harvest groups except Bishop Rock subsistence. In 2008 there was no Chinook-directed commercial fishery, but some Chinook salmon were incidentally caught in a chum salmon directed commercial fishery, restricted to ≤6 inch gillnets. Small mesh gear selects for smaller fish (Bromaghin 2005), and smaller age-1.3 Chinook salmon dominated this catch, as is typical for this fishery. The age-1.3 percentage was highest from harvests that primarily use fish wheels. Meehan (1961) showed fish wheels tend to harvest smaller, younger fish that migrate near shore and in areas of lower water velocity. Fishery independent data throughout the river also indicated that the 2008 run was

dominated by age-1.3 fish (JTC 2009). This larger than expected contribution of age-1.3 fish may be attributed to the strong parent year of 2003, for which the Canadian-origin border passage estimate was 80,594 Chinook salmon, compared to the 1998–2002 average of 38,694 (JTC 2010).

Harvest trends throughout the river can be explained by the distribution of each stock. In general, the harvest proportion of Canadian-origin fish increases with upriver distance, and the greatest proportion of Upper river stocks are typically harvested from communities in District 5. This pattern is driven mainly by the availability of each stock to local communities. For instance, few Lower river stocks are available to upriver fishermen as these stocks spawn downstream of the district, yet Canadian-origin fish are available along the length of the river and are therefore present in all fisheries. The exception to this pattern is in Districts 4A and B: here, fishermen fish on the South bank of the Yukon River and predominately catch Tanana River stocks, which are bank-oriented in that section of the river.

From 1981 to 2003, scale pattern analysis methods were used to assign the District 5 harvest to the Upper stock group under the assumption that most of the fish harvested in District 5 were bound for Canada. A new genetic baseline was developed in 2004 (Templin et al. 2006b), which provided evidence that the previous assumption was invalid. Thus, from 2004 to present the District 5 harvests downstream from Fort Yukon have been apportioned as a mixed stock (DuBois et al. 2009). In 2008, the District 5 subsistence harvest had a substantial Middle stock component (19.2%; Table 3). Consequently, comparisons of District 5 stock composition since 2004 with historical estimates are tenuous.

Stock and age compositions of harvests are utilized to construct brood tables, which enable run reconstructions necessary for scientifically based escapement goal designation, and Chinook salmon run forecasting. As such, it is imperative that accurate age data be obtained from representative samples, from both subsistence and commercial harvests, in order to estimate the numbers of fish returning from previous brood years. Stock composition estimates of the harvests facilitate analyses of stock-specific harvest patterns. Understanding the relative contribution of Canadian-origin fish to Alaskan harvests is paramount in order to meet Treaty objectives and continue the conservation of these stocks.

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TABLES AND FIGURES

Table 1.–Age composition in samples of Yukon River Chinook salmon by sample location, fishery, gear type, with sample sizes, 2008.

District	Fishery	Gear [a]	Sample Size	Age Class (Percent)									
				1.1	1.2	1.3	2.2	1.4	2.3	1.5	2.4	1.6	2.5
1	Commercial	≤ 6" GN	524	0.4	11.9	57.8	0.3	27.1	0.3	1.8	0.4	0.0	0.0
2	Commercial	≤ 6" GN	105	0.0	11.4	58.1	0.0	28.6	1.0	1.0	0.0	0.0	0.0
1	Subsistence	GN	395	0.0	3.8	59.5	0.0	34.2	0.0	2.3	0.3	0.0	0.0
3	Holy Cross Subsistence	GN	120	0.0	0.8	50.8	0.0	45.0	0.0	3.3	0.0	0.0	0.0
4	Kaltag, Nulato Subsistence	GN	327	0.0	2.4	52.3	0.0	41.6	0.6	3.1	0.0	0.0	0.0
4	Bishop Rock Subsistence	SGN	92	0.0	2.2	41.3	0.0	52.2	0.0	4.3	0.0	0.0	0.0
4	Galena Subsistence	GN, FW	130	0.0	4.6	71.5	0.0	23.8	0.0	0.0	0.0	0.0	0.0
	Ruby Subsistence	SGN, FW	107	0.0	6.5	69.2	0.0	18.7	0.0	5.6	0.0	0.0	0.0
5	Rampart Rapids Subsistence	FW	58	0.0	15.5	79.3	0.0	5.2	0.0	0.0	0.0	0.0	0.0
5	Eagle Subsistence	SGN, FW	230	0.0	7.4	74.8	0.0	16.5	0.4	0.9	0.0	0.0	0.0
4	Anvik River Escapement	Carcass	223	0.0	7.6	69.5	0.0	22.0	0.0	0.9	0.0	0.0	0.0
6	Salcha River Escapement	Carcass	303	0.7	9.9	51.8	0.0	36.0	0.0	1.7	0.0	0.0	0.0
2	Pilot Station Sonar Test Fishery	≥ 6.5" DGN	566	0.4	3.2	63.1	0.0	29.2	0.0	3.5	0.7	0.0	0.0
2	Marshall Test Fishery	8.25" DGN	515	0.0	2.7	48.7	0.0	44.3	0.2	3.7	0.4	0.0	0.0
	Canada Test Fishery	FW	736	0.0	6.9	75.3	0.0	15.8	1.0	1.1	0.0	0.0	0.0
	Canada Test Fishery (adjusted)	FW	736	0.0	0.4	57.1	0.0	36.3	2.2	3.9	0.0	0.0	0.0

[a] Gear type designation: GN= gill net; SGN= set gill net; FW= fish wheel; DGN= drift gill net.

Table 2.–Genetic stock composition estimates from Yukon River Districts 1 and 2 commercial harvest samples, 2008.

District	Period Date	Stock Group	Sample Size	Estimated percent	90% CI
1	Period 1	Lower	175	51.1	43.8- 58.6
	2 July	Middle		7.8	3.0- 13.7
		Upper		41.1	33.7- 48.5
1	Period 2	Lower	200	81.9	76.6- 86.9
	5 July	Middle		4.6	1.8- 8.1
		Upper		13.6	8.9- 18.5
1	Periods 3-5	Lower	161	68.5	61.8- 75.0
	7-8, 10, 12	Middle		4.3	1.3- 8.0
	July	Upper		27.3	21.1- 33.8
2	Period 1	Lower/Middle	100	71.8	62.6- 80.3
	4 July	Upper		28.2	19.7- 37.4

Table 3.–Genetic stock composition estimates from Yukon River test fishery and subsistence harvest samples, 2008.

District	Location Fishery	Stock Group	Sample Size	Estimated percent	90% CI
1	Pilot Station	Lower	333	13.4	9.6- 17.6
	Sonar Test Fishery	Middle		39.4	32.9- 46.1
		Upper		47.3	40.8- 53.5
1	District 1	Lower	472	7.7	4.9- 10.9
	Subsistence	Middle		38.9	32.2- 45.6
		Upper		53.5	47.1- 59.9
3	Holy Cross	Lower	133	31.3	24.0- 39.0
	Subsistence	Middle		19.3	12.3- 27.1
		Upper		49.3	40.9- 57.8
4	Kaltag, Nulato	Lower	380	12.9	9.0- 17.1
	Subsistence	Middle		40.8	34.8- 47.0
		Upper		46.3	40.5- 52.1
4	Bishop Rock	Lower	103	6.8	2.3- 12.6
	Subsistence	Middle		34.4	22.4- 46.9
		Upper		58.8	46.5- 71.0
	Galena,	Lower	248	11.8	6.7- 18.0
	Bishop Rock	Middle		42.8	33.8- 52.3
	Subsistence	Upper		45.4	37.5- 53.1
4	Ruby	Lower	128	8.3	3.0- 15.3
	Subsistence	Middle		47.9	36.5- 59.1
		Upper		43.8	33.3- 54.2
5	Tanana	Lower	199	5.3	1.5- 10.2
	Subsistence	Middle		28.2	19.6- 37.2
		Upper		66.5	57.9- 75.0
5	Rampart Rapids	Lower	200	0.3	0- 1.6
	Subsistence	Middle		21.9	12.5- 32.5
		Upper		77.8	67.1- 87.1

Table 4.–Yukon River Chinook salmon District 1 estimated commercial harvest by age, stock group, and period, 2008.

Period	Stock	Age Class										
Date	Group	1.1	1.2	1.3	2.2	1.4	2.3	1.5	2.4	1.6	2.5	Total
Period 1	Lower	0	28	131	0	76	0	6	0	0	0	241
2 July	Middle	0	4	20	0	12	0	1	0	0	0	37
	Alaska	0	32	151	0	88	0	6	0	0	0	278
	Upper	0	23	106	0	61	0	5	0	0	0	194
	Total	0	55	257	0	149	0	11	0	0	0	472
Period 2	Lower	7	124	444	0	93	0	3	0	0	0	671
5 July	Middle	0	7	25	0	5	0	0	0	0	0	37
	Alaska	7	131	469	0	98	0	3	0	0	0	708
	Upper	1	20	74	0	15	0	1	0	0	0	111
	Total	8	151	543	0	113	0	4	0	0	0	819
Periods 3-6	Lower	0	59	454	6	295	6	21	7	0	0	848
8 –14 July	Middle	0	4	28	0	18	0	1	0	0	0	53
& fall season[a]	Alaska	0	63	482	6	314	6	22	7	0	0	901
	Upper	0	24	181	2	118	2	8	3	0	0	338
	Total	0	87	663	9	432	9	31	10	0	0	1,239
All Periods	Lower	7	211	1,030	6	464	6	30	7	0	0	1,760
Combined [a]	Middle	0	15	73	0	35	0	2	0	0	0	127
	Alaska	7	226	1,103	6	499	6	32	7	0	0	1,887
	Upper	1	67	360	2	194	2	13	3	0	0	643
	Total	8	293	1,462	9	694	9	46	10	0	0	2,530

[a] Includes 149 fish from fall season sales.

Table 5.–Yukon River Chinook salmon District 2 estimated commercial harvest by age, stock group, and period, 2008.

Period Date	Stock Group	Age Class 1.1	1.2	1.3	2.2	1.4	2.3	1.5	2.4	1.6	2.5	Total
Period 1	Lower	0	37	188	0	92	3	3	0	0	0	323
4 July	Middle	0	6	29	0	14	0	0	0	0	0	49
	Alaska	0	42	217	0	106	4	4	0	0	0	373
	Upper	0	17	85	0	42	1	1	0	0	0	146
	Total	0	59	302	0	148	5	5	0	0	0	519
Period 2	Lower	0	43	221	0	108	4	4	0	0	0	380
6 July	Middle	0	7	34	0	17	1	1	0	0	0	58
	Alaska	0	50	255	0	125	4	4	0	0	0	438
	Upper	0	20	100	0	49	2	2	0	0	0	172
	Total	0	69	355	0	174	6	6	0	0	0	610
Periods 3-5	Lower	0	47	360	5	234	5	17	5	0	0	672
10, 13, 16 July	Middle	0	3	22	0	15	0	1	0	0	0	42
	Alaska	0	50	382	0	249	5	18	6	0	0	714
	Upper	0	19	143	2	93	2	7	2	0	0	268
	Total	0	69	525	0	342	7	25	8	0	0	982
All Periods	Lower	0	127	769	5	435	11	24	5	0	0	1,375
Combined	Middle	0	15	85	0	45	1	2	0	0	0	149
	Alaska	0	142	854	5	480	13	26	6	0	0	1,525
	Upper	0	55	329	2	184	5	10	2	0	0	586
	Total	0	197	1,182	7	664	18	35	8	0	0	2,111

Table 6.–Yukon River Chinook salmon total harvest by age, stock group, and fishery, 2008.

District	Fishery	Stock Group	Age Class 1.1	1.2	1.3	2.2	1.4	2.3	1.5	2.4	1.6	2.5	Total
1	Commercial	Lower	7	211	1,030	6	464	6	30	7	0	0	1,760
		Middle	0	15	73	0	35	0	2	0	0	0	127
		Alaska	7	226	1,103	6	499	6	32	7	0	0	1,887
		Upper	1	67	360	2	194	2	13	3	0	0	643
		Total	8	293	1,462	9	694	9	46	10	0	0	2,530
	Subsistence	Lower	0	18	281	0	162	0	11	1	0	0	473
		Middle	0	91	1,424	0	818	0	55	6	0	0	2,394
		Alaska	0	109	1,706	0	980	0	65	7	0	0	2,867
		Upper	0	125	1,961	0	1,126	0	75	8	0	0	3,296
		Total	0	234	3,667	0	2,106	0	140	16	0	0	6,163
2	Commercial	Lower	0	127	769	5	435	11	24	5	0	0	1,375
		Middle	0	15	85	0	45	1	2	0	0	0	149
		Alaska	0	142	854	5	480	13	26	6	0	0	1,525
		Upper	0	55	329	2	184	5	10	2	0	0	586
		Total	0	197	1,182	7	664	18	35	8	0	0	2,111
	Subsistence	Lower	2	35	665	0	430	1	43	7	0	0	1,183
		Middle	6	103	1953	0	1263	3	125	19	0	0	3,473
		Alaska	9	138	2619	0	1693	4	168	26	0	0	4,656
		Upper	8	123	2346	0	1516	4	150	23	0	0	4,170
		Total	16	261	4,964	0	3,209	8	318	49	0	0	8,826
	Sport	Lower	0	12	108	0	34	0	1	0	0	0	155
3	Subsistence	Lower	0	15	933	0	826	0	61	0	0	0	1,835
		Middle	0	9	576	0	510	0	38	0	0	0	1,133
		Alaska	0	25	1508	0	1335	0	99	0	0	0	2,968
		Upper	0	24	1468	0	1299	0	96	0	0	0	2,887
		Total	0	49	2,976	0	2635	0	195	0	0	0	5,855
4	Subsistence	Lower	0	40	1,049	0	756	3	52	0	0	0	1,900
		Middle	0	129	2,416	0	1,487	11	103	0	0	0	4,147
		Alaska	0	169	3,466	0	2,243	14	155	0	0	0	6,047
		Upper	0	113	2,521	0	1,795	10	133	0	0	0	4,572
		Total	0	281	5,987	0	4,038	25	288	0	0	0	10,619

Table 6.–Page 2 of 2.

District	Fishery	Stock Group	Age Class 1.1	1.2	1.3	2.2	1.4	2.3	1.5	2.4	1.6	2.5	Total
5	Subsistence	Lower	0	34	176	0	11	0	0	0	0	0	222
		Middle	0	346	1,769	0	115	0	0	0	0	0	2,230
		Alaska	0	380	1,945	0	127	0	0	0	0	0	2,452
		Upper	0	1,129	7,112	0	886	16	32	0	0	0	9,174
		Total	0	1,509	9,056	0	1,013	16	32	0	0	0	11,626
6	Subsistence	Middle	5	72	378	0	262	0	12	0	0	0	729
	Sport	Middle	2	25	132	0	91	0	4	0	0	0	254
		Total	6	97	509	0	354	0	16	0	0	0	983
Canada	Aboriginal	Upper	0	11	1,664	0	1,058	64	115	0	0	0	2,912
	Test	Upper	0	2	294	0	187	11	20	0	0	0	514
		Total	0	13	1,958	0	1,245	75	135	0	0	0	3,426
Total Harvest		Lower	9	492	5,011	11	3,117	21	222	20	0	0	8,903
		Middle	13	805	8,806	1	4,627	16	341	26	0	0	14,636
		Alaska	22	1,298	13,817	11	7,745	38	563	46	0	0	23,539
		Upper	9	1,649	18,054	4	8,246	112	644	36	0	0	28,755
		Total	31	2,947	31,870	16	15,991	150	1,207	82	0	0	52,294

Note: Commercial fishery data are included in this table for comparison with other fishery data.

Table 7.–Yukon River Chinook salmon estimated percentages by age, stock group, and fishery, 2008.

District	Fishery	Stock Group	Age Class 1.1	1.2	1.3	2.2	1.4	2.3	1.5	2.4	1.6	2.5	Total
1	Commercial	Lower	0.3	8.3	40.7	0.2	18.4	0.2	1.2	0.3	0.0	0.0	69.6
		Middle	0.0	0.6	2.9	0.0	1.4	0.0	0.1	0.0	0.0	0.0	5.0
		Alaska	0.3	8.9	43.6	0.2	19.7	0.2	1.3	0.3	0.0	0.0	74.6
		Upper	0.0	2.6	14.2	0.1	7.7	0.1	0.5	0.1	0.0	0.0	25.4
		Total	0.3	11.6	57.8	0.3	27.4	0.3	1.8	0.4	0.0	0.0	100.0
	Subsistence	Lower	0.0	0.3	4.6	0.0	2.6	0.0	0.2	0.0	0.0	0.0	7.7
		Middle	0.0	1.5	23.1	0.0	13.3	0.0	0.9	0.1	0.0	0.0	38.9
		Alaska	0.0	1.8	27.7	0.0	15.9	0.0	1.1	0.1	0.0	0.0	46.5
		Upper	0.0	2.0	31.8	0.0	18.3	0.0	1.2	0.1	0.0	0.0	53.5
		Total	0.0	3.8	59.5	0.0	34.2	0.0	2.3	0.3	0.0	0.0	100.0
2	Commercial	Lower	0.0	6.0	36.4	0.2	20.6	0.5	1.1	0.3	0.0	0.0	65.2
		Middle	0.0	0.7	4.0	0.0	2.1	0.1	0.1	0.0	0.0	0.0	7.1
		Alaska	0.0	6.7	40.4	0.2	22.7	0.6	1.2	0.3	0.0	0.0	72.2
		Upper	0.0	2.6	15.6	0.1	8.7	0.2	0.5	0.1	0.0	0.0	27.8
		Total	0.0	9.3	56.0	0.3	31.5	0.8	1.7	0.4	0.0	0.0	100.0
	Subsistence	Lower	0.0	0.4	7.5	0.0	4.9	0.0	0.5	0.1	0.0	0.0	13.4
		Middle	0.1	1.2	22.1	0.0	14.3	0.0	1.4	0.2	0.0	0.0	39.4
		Alaska	0.1	1.6	29.7	0.0	19.2	0.0	1.9	0.3	0.0	0.0	52.8
		Upper	0.1	1.4	26.6	0.0	17.2	0.0	1.7	0.3	0.0	0.0	47.3
		Total	0.2	3.0	56.2	0.0	36.4	0.1	3.6	0.6	0.0	0.0	100.0
	Sport	Lower	0.0	7.6	69.5	0.0	22.0	0.0	0.9	0.0	0.0	0.0	100.0
3	Subsistence	Lower	0.0	0.3	15.9	0.0	14.1	0.0	1.0	0.0	0.0	0.0	31.3
		Middle	0.0	0.2	9.8	0.0	8.7	0.0	0.6	0.0	0.0	0.0	19.3
		Alaska	0.0	0.4	25.8	0.0	22.8	0.0	1.7	0.0	0.0	0.0	50.7
		Upper	0.0	0.4	25.1	0.0	22.2	0.0	1.6	0.0	0.0	0.0	49.3
		Total	0.0	0.8	50.8	0.0	45.0	0.0	3.3	0.0	0.0	0.0	100.0
4	Subsistence	Lower	0.0	0.4	9.9	0.0	7.1	0.0	0.5	0.0	0.0	0.0	17.9
		Middle	0.0	1.2	22.8	0.0	14.0	0.1	1.0	0.0	0.0	0.0	39.1
		Alaska	0.0	1.6	32.6	0.0	21.1	0.1	1.5	0.0	0.0	0.0	56.9
		Upper	0.0	1.1	23.7	0.0	16.9	0.1	1.3	0.0	0.0	0.0	43.1
		Total	0.0	2.6	56.4	0.0	38.0	0.2	2.7	0.0	0.0	0.0	100.0

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Table 7.–Page 2 of 2.

District	Fishery	Stock Group	Age Class 1.1	1.2	1.3	2.2	1.4	2.3	1.5	2.4	1.6	2.5	Total
5	Subsistence	Lower	0.0	0.3	1.5	0.0	0.1	0.0	0.0	0.0	0.0	0.0	1.9
		Middle	0.0	3.0	15.2	0.0	1.0	0.0	0.0	0.0	0.0	0.0	19.2
		Alaska	0.0	3.3	16.7	0.0	1.1	0.0	0.0	0.0	0.0	0.0	21.1
		Upper	0.0	9.7	61.2	0.0	7.6	0.1	0.3	0.0	0.0	0.0	78.9
		Total	0.0	13.0	77.9	0.0	8.7	0.1	0.3	0.0	0.0	0.0	100.0
6[f]	Subsistence	Middle	0.5	7.3	38.4	0.0	26.7	0.0	1.2	0.0	0.0	0.0	74.2
	Sport	Middle	0.2	2.6	13.4	0.0	9.3	0.0	0.4	0.0	0.0	0.0	25.8
		Total	0.7	9.9	51.8	0.0	36.0	0.0	1.7	0.0	0.0	0.0	100.0
Canada[g]	Aboriginal	Upper	0.0	0.3	48.6	0.0	30.9	1.9	3.3	0.0	0.0	0.0	85.0
	Test	Upper	0.0	0.1	8.6	0.0	5.5	0.3	0.6	0.0	0.0	0.0	15.0
		Total	0.0	0.4	57.1	0.0	36.3	2.2	3.9	0.0	0.0	0.0	100.0
Total Harvest		Lower	0.0	0.9	9.6	0.0	6.0	0.0	0.4	0.0	0.0	0.0	17.0
		Middle	0.0	1.5	16.8	0.0	8.8	0.0	0.7	0.0	0.0	0.0	28.0
		Alaska	0.0	2.5	26.4	0.0	14.8	0.1	1.1	0.1	0.0	0.0	45.0
		Upper	0.0	3.2	34.5	0.0	15.8	0.2	1.2	0.1	0.0	0.0	55.0
		Total	0.1	5.6	60.9	0.0	30.6	0.3	2.3	0.2	0.0	0.0	100.0

Note: Commercial fishery data are included in this table for comparison with other fishery data.

Table 8.–Yukon River Chinook salmon historical harvest by stock group for the United States and Canada, 1981–2008.

Year	Lower	Middle	Upper			Total
			U.S.	Canada	Total	
1981	11,164	112,669	64,644	18,109	82,753	206,586
1982	23,601	41,967	87,241	17,208	104,449	170,017
1983	28,081	73,361	96,994	18,952	115,946	217,388
1984	45,210	71,656	44,735	16,795	61,530	178,396
1985	57,770	46,753	85,773	19,301	105,074	209,597
1986	32,517	15,894	97,593	20,364	117,957	166,368
1987	32,847	40,281	115,258	17,614	132,872	206,000
1988	36,967	26,805	84,649	21,427	106,076	169,848
1989	42,872	27,936	86,798	17,944	104,742	175,550
1990	34,007	42,430	72,996	19,227	92,223	168,660
1991	49,113	44,328	61,210	20,607	81,817	175,258
1992	30,330	40,600	97,261	17,903	115,164	186,094
1993	38,592	45,671	78,815	16,611	95,426	179,689
1994	35,161	41,488	95,666	21,218	116,884	193,533
1995	35,518	44,404	97,741	20,887	118,628	198,550
1996	33,278	16,386	88,958	19,612	108,570	158,234
1997	50,420	32,043	92,162	16,528	108,690	191,153
1998	34,759	18,509	46,947	5,937	52,884	106,152
1999	54,788	8,619	60,908	12,468	73,376	136,783
2000	16,989	6,176	22,143	4,879	27,022	50,187
2001	20,115	10,190	23,325	10,139	33,421	63,726
2002	14,895	22,395	30,058	9,257	39,387	76,677
2003	7,394	31,232	59,940	9,619	69,559	108,185
2004	18,965	35,553	57,831	11,238	69,069	123,587
2005	19,893	20,607	44,650	11,074	55,724	96,223
2006	18,301	28,756	48,097	9,072	57,169	104,225
2007	12,311	28,924	48,320	5,094	53,414	94,649
2008	8,903	14,636	25,329	3,426	28,755	52,294
Average (1981-2007)	30,958	36,135	70,026	15,151	85,179	152,271
10-Year Average (1998-2007)	21,841	21,096	44,222	8,878	53,102	96,039

Table 9.–Yukon River Chinook salmon historical harvest percentage by stock group for the United States and Canada, 1981–2008.

Year	Lower	Middle	Upper		Total
			U.S.	Canada	
1981	5.4	54.5	31.3	8.8	40.1
1982	13.9	24.7	51.3	10.1	61.4
1983	12.9	33.7	44.6	8.7	53.3
1984	25.3	40.2	25.1	9.4	34.5
1985	27.6	22.3	40.9	9.2	50.1
1986	19.5	9.6	58.7	12.2	70.9
1987	15.9	19.6	56.0	8.6	64.5
1988	21.8	15.8	49.8	12.6	62.5
1989	24.4	15.9	49.4	10.2	59.7
1990	20.2	25.2	43.3	11.4	54.7
1991	28.0	25.3	34.9	11.8	46.7
1992	16.3	21.8	52.3	9.6	61.9
1993	21.5	25.4	43.9	9.2	53.1
1994	18.2	21.4	49.4	11.0	60.4
1995	17.9	22.4	49.2	10.5	59.7
1996	21.0	10.4	56.2	12.4	68.6
1997	26.4	16.8	48.2	8.6	56.9
1998	32.7	17.4	44.2	5.6	49.8
1999	40.1	6.3	44.5	9.1	53.6
2000	33.9	12.3	44.1	9.7	53.8
2001	31.6	16.0	36.5	15.9	52.4
2002	19.4	29.2	39.3	12.1	51.4
2003	6.8	28.9	55.4	8.9	64.3
2004	15.3	28.8	46.8	9.1	55.9
2005	20.7	21.4	46.4	11.5	57.9
2006	17.6	27.6	46.1	8.7	54.9
2007	12.4	31.3	50.9	5.4	56.3
2008	17.0	28.0	48.4	6.6	55.0
Average (1981-2007)	20.3	23.7	46.0	10.0	55.9
10-Year Average (1998-2007)	22.7	22.0	46.0	9.2	55.3

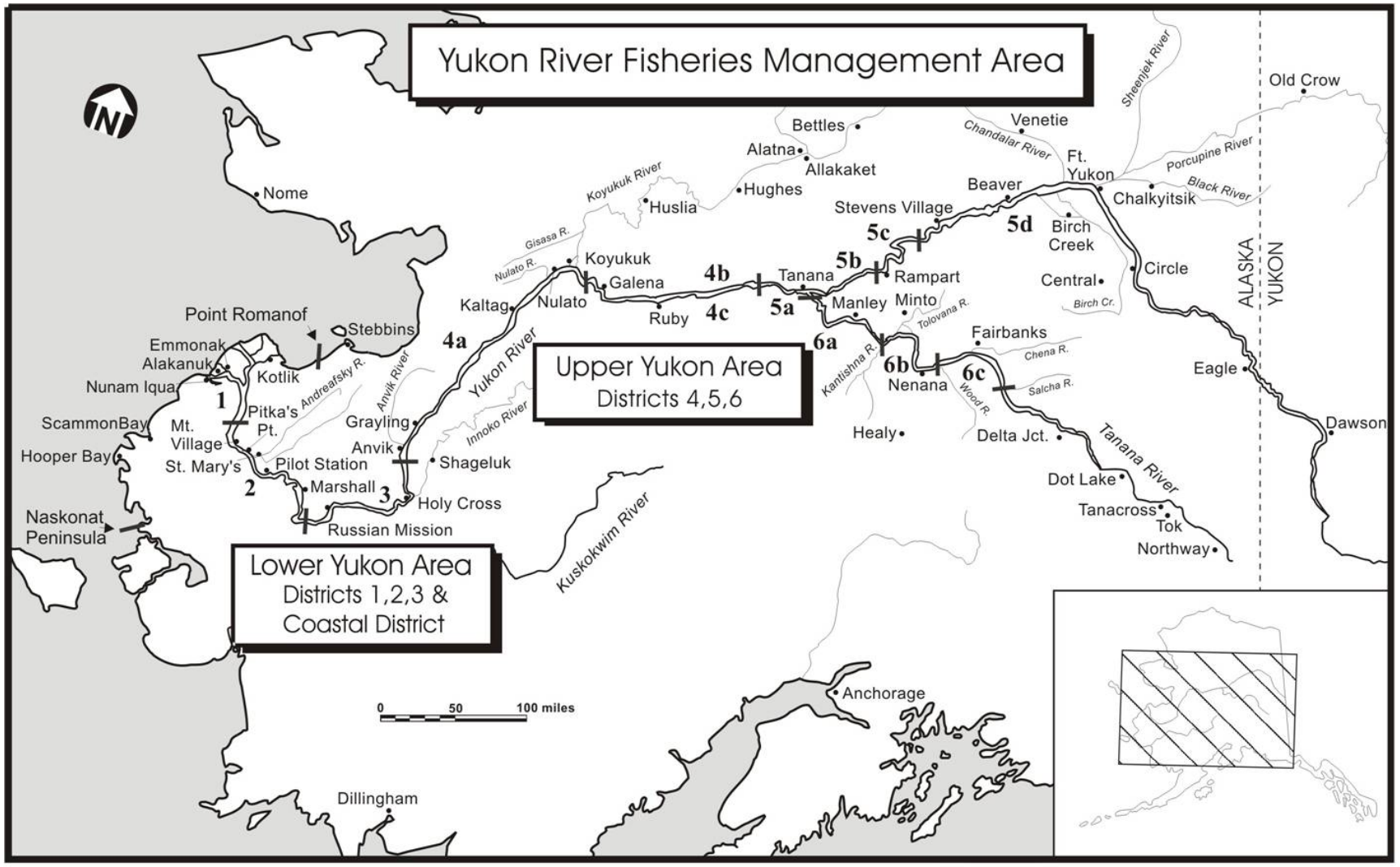


Figure 1.–Alaska portion of the Yukon River drainage with district boundaries and major spawning tributaries.

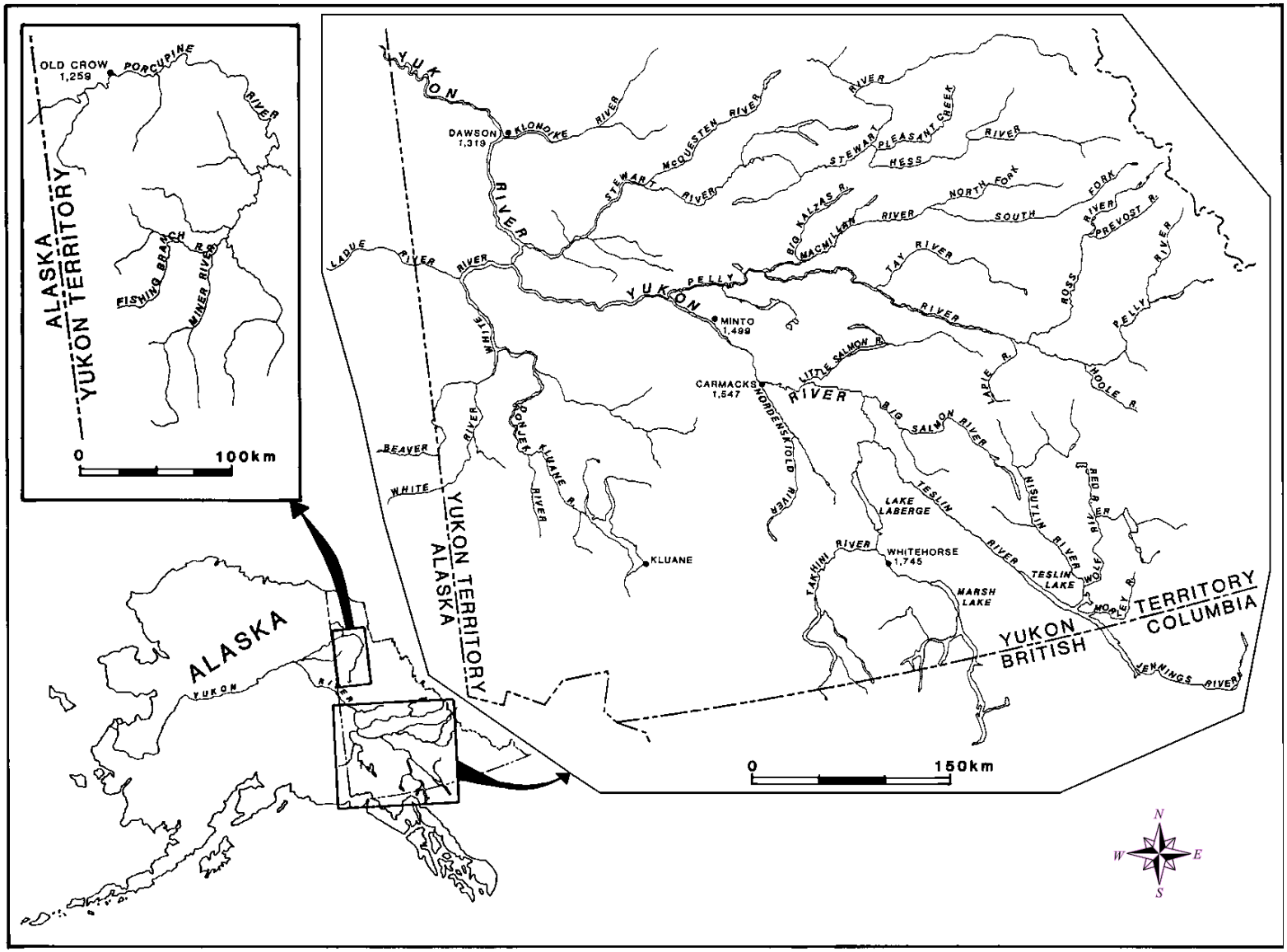
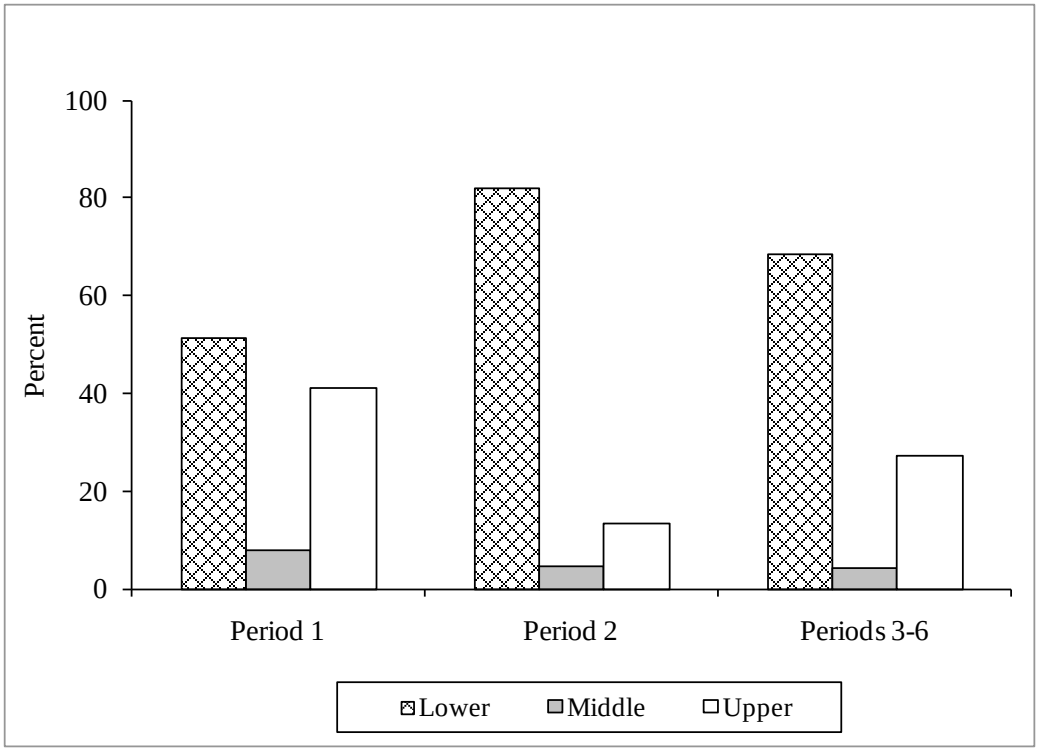


Figure 2.–Canadian portion of the Yukon River drainage and major spawning tributaries.



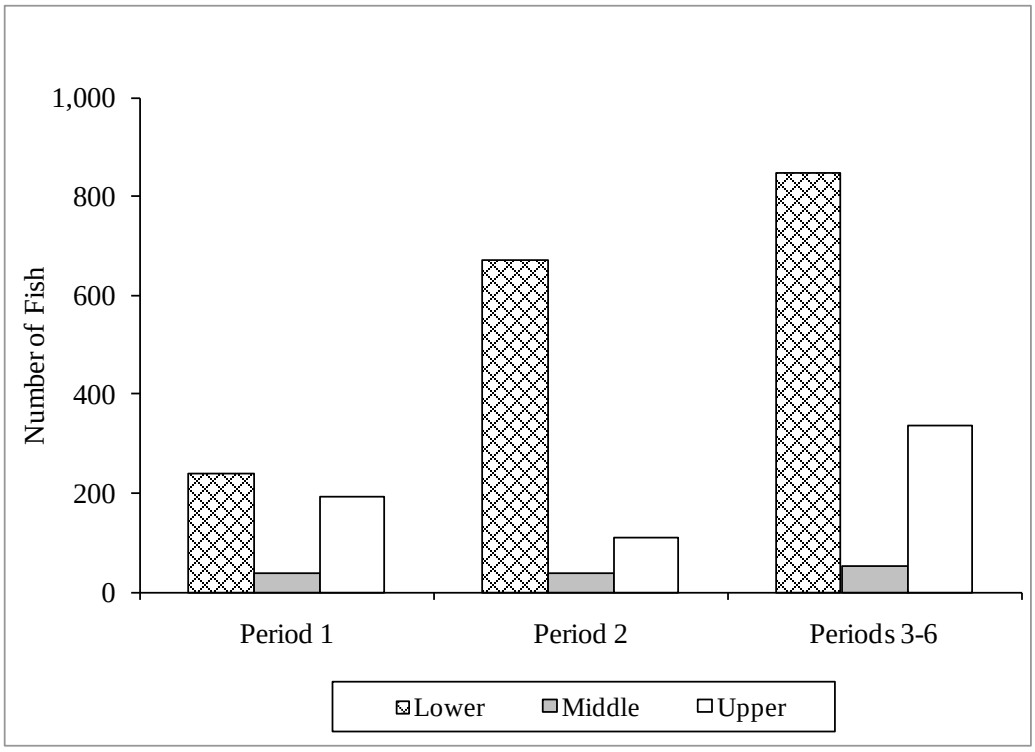


Figure 3.–Estimated percentages and numbers of Chinook salmon harvested in the commercial fishery, by fishing period and stock group, Yukon River District 1, 2008.

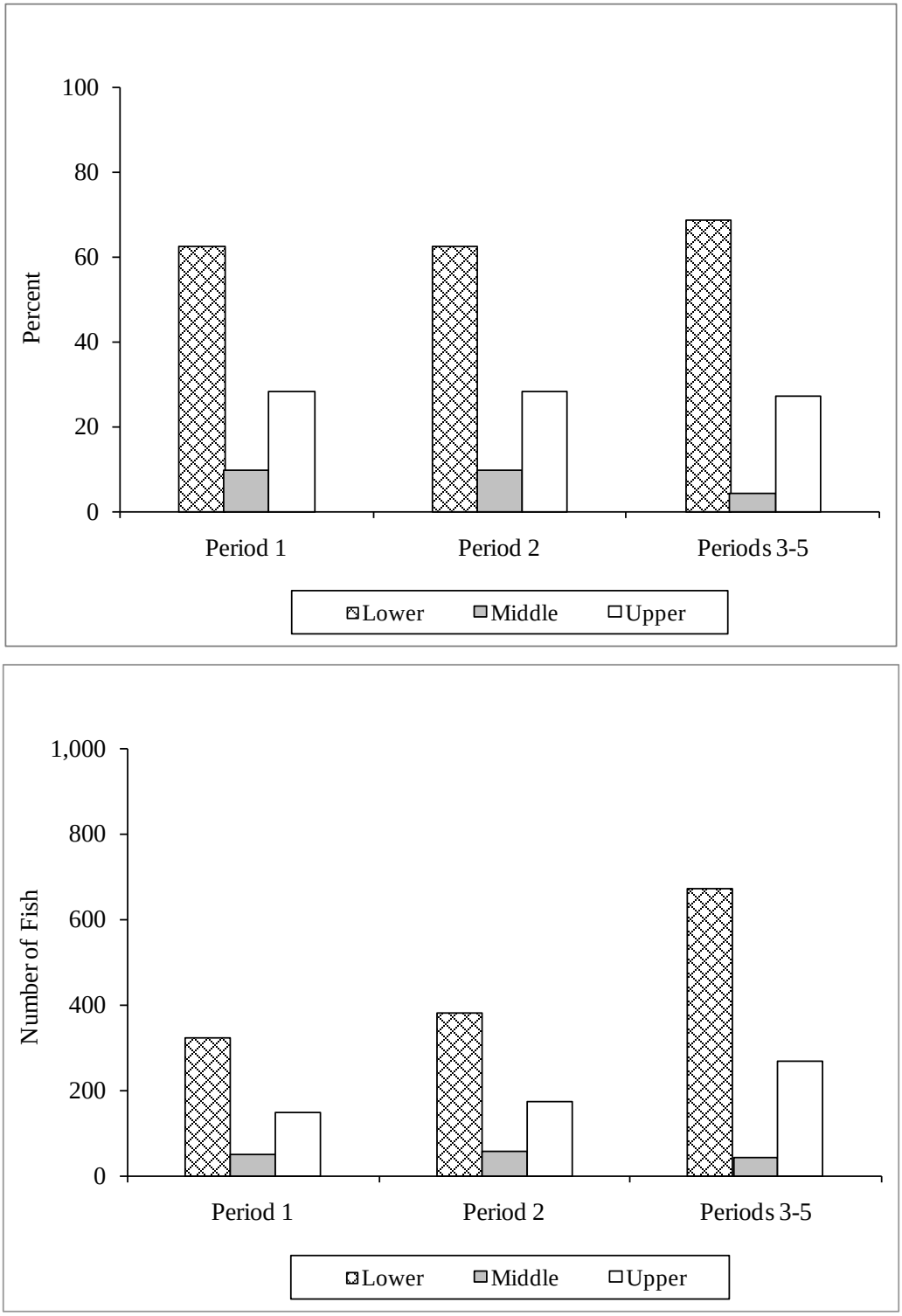
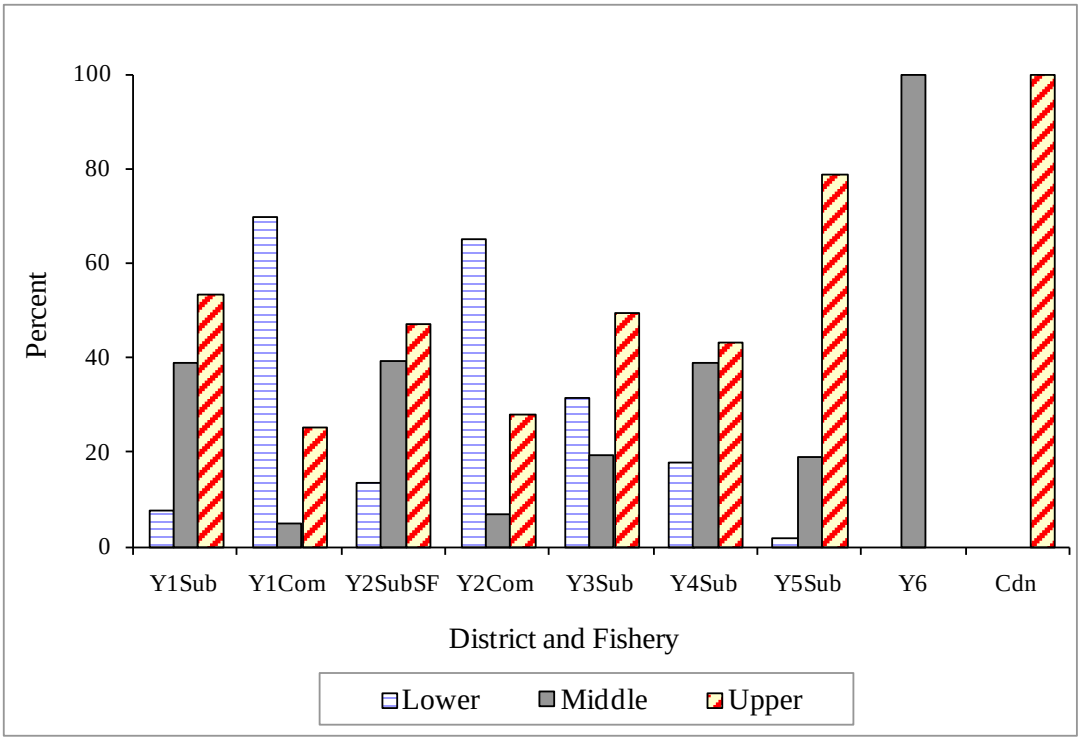


Figure 4.–Estimated percentages and numbers of Chinook salmon harvested in the commercial fishery, by fishing period and stock group, Yukon River District 2, 2008.



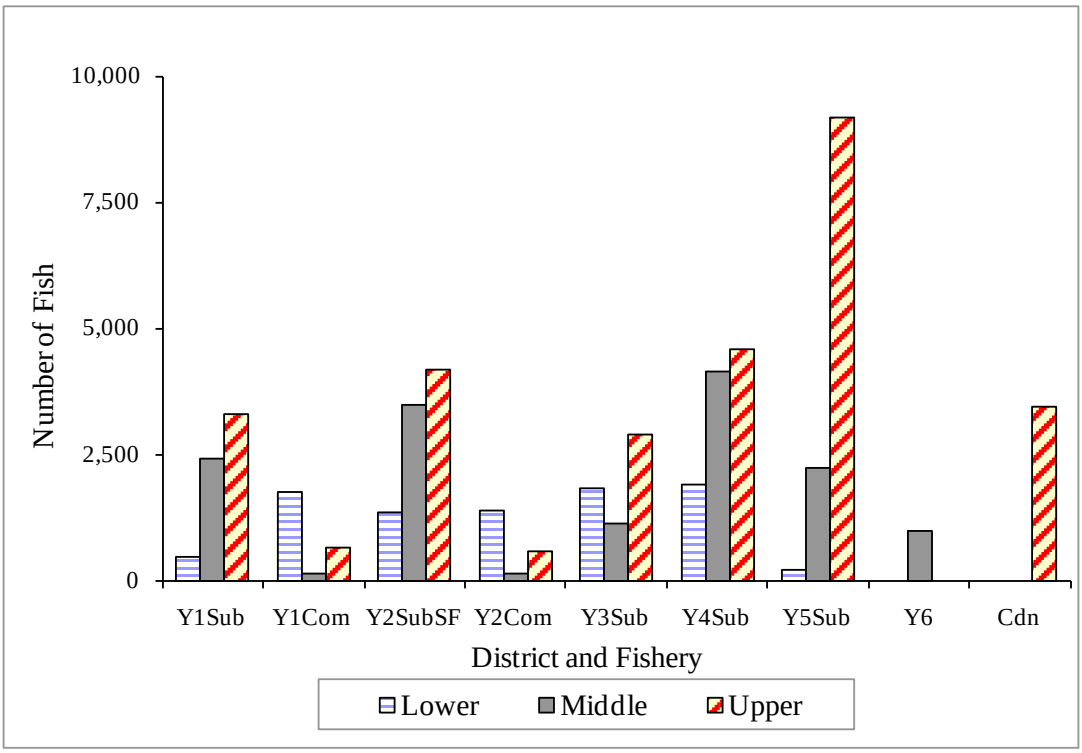


Figure 5.–Genetic stock composition estimates, by percentage and number of fish, from the total Yukon River harvest, by fishing district and fishery, 2008.

APPENDIX A

Appendix A1.–Chinook salmon baseline collections from the Yukon River drainage organized hierarchically into reporting groups for mixed stock analysis.

Reporting Group				
Country	Stock	Fine scale	Location	Sample
United States				
	Lower			
		Lower Yukon		
			Anvik River	94
			Andreafsky River	208
			Tozitna River	190
			Gisasa River	188
	Middle			
		Upper U.S. Yukon		
			Beaver Creek	100
			Chandalar River	113
			Henshaw Creek	147
		Tanana River		
			Chena River	189
			Salcha River	133
Canada				
	Upper			
		Border		
			Chandindu River	567
		Stewart		
			Mayo River	194
			Stewart River	112
		Pelly		
			Blind Creek	161
			Pelly River	130
		Carmacks		
			Little Salmon River	100
			Big Salmon River	117
			Tatchun Creek	366
		Takhini		
			Takhini River	167
			Whitehorse Hatchery	241

Appendix A2.–Genetic samples collected in commercial and subsistence fisheries by location, 2008.

District	Period	Dates	Gear Type	Location	Sample size	# Assayed
Commercial						
Y-1	1	7/2	≤6 Restricted	Emmonak	175	175
	2	7/5	≤6 Restricted		200	200
	3	7/8	≤6 Restricted		65	65
	4	7/10	≤6 Restricted		72	72
	5	7/12	≤6 Restricted		19	19
	6	7/14	≤6 Restricted		4	4
				Total Y-1 commercial	535	535
Y-2	1	7/4	≤6 Restricted	Saint Marys	108	100
				Total Commercial	643	100
Subsistence						
Y-1		6/24 - 7/7	SGN	Emmonak	472	472
Y-3		6/17 - 7/14	SGN	Holy Cross	133	133
Y-4A		6/25 - 7/9	DGN	Kaltag	250	250
Y-4A		6/26 - 7/15	SGN	Nulato	130	130
Y-4B		7/7 - 7/22	SGN	Bishop Rock	103	103
Y-4B		6/20 - 7/17	SGN/ DGN	Galena	145	145
Y-4C		6/26 - 7/17	SGN/ FW	Ruby	128	128
				Total Y-4 Subsistence	756	756
Y-5B		6/25 - 7/6	FW	Tanana	213	200
Y-5C		6/17 - 7/24	FW	Rapids	1071	400
				Total Subsistence	2645	1961

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District	Period	Dates	Gear Type	Location	Sample size	# Assayed
Test Fishery						
Y-1	A	6/3 - 6/17	SGN	LYTF-Big Eddy	183	183
	B	6/18 - 6/25			105	105
	C	6/26 - 6/29			112	112
Y-1	A	6/5 - 6/17	SGN	LYTF-Middle Mouth	175	175
	B	6/18 - 6/25			222	222
	C	6/26 - 6/29			103	103
				Total LYTF	900	900
Y-2	A	6/7 - 6/23	DGN	Pilot Station	333	333
	B	6/24 - 6/29			155	155
	C	6/30 - 8/2			223	223
				Total Pilot Station	711	711
				Total Test Fishery	1611	1611
				Grand Total	4,899	3,672

Source: Included with permission from DeCovich et al. 2010.