Fishery Data Series No. 16-09

Origins of Chinook Salmon in the Yukon River Fisheries, 2013

by

Larry DuBois

February 2016

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 and age composition of Chinook salmon *Oncorhynchus tshawytscha* harvest within the Yukon River drainage was estimated for 2013. Stock composition was estimated by genetic analysis for 3 geographically-based stock groups termed Lower, Middle, and Upper. Stock composition estimates from sampled fish were applied to specific harvests across all age classes. Ages of sampled fish were determined from scales; age composition was estimated from the sample proportions in each age class. Age composition estimates were applied to specific harvests across all stock groups. The total estimated Yukon River harvest in 2013 was 13,345 Chinook salmon; of these 13.4% were estimated to be of Lower, 21.0% Middle, and 65.6% Upper stock group origin. On average over all harvests, age-1.4 fish dominated the harvest at 44.5%, age-1.3 fish were 37.2%, age-1.2 fish were 15.3%, and other age classes combined were 3.0% of the total.

Key words: Chinook salmon, *Oncorhynchus tshawytscha,* stock composition, age composition, harvest, genetic stock identification, age-1.4, age-1.3, age-1.2, stock group, Yukon River.

INTRODUCTION

The Yukon River drains an area of 321,500 square miles, originates in British Columbia, Canada, and flows over 1,980 river miles (rm) to its terminus at the Bering Sea (Estensen et al. 2015; Figures 1 and 2). Chinook salmon *Oncorhynchus tshawytscha* spawn in major tributaries throughout the drainage from the Archuelinguk River (rm 80) to nearly 2,000 rm upstream in the headwaters in Canada. 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. Sport fisheries, a very minor component of harvest overall, primarily occur in lower river tributaries, Tanana River tributaries, and in Canada. The average annual harvest of Chinook salmon within the Yukon River drainage from 2003 through 2012 was 75,285 fish; harvests within Alaska averaged 68,819 fish (JTC 2014).

In 2002, the Yukon River Salmon Agreement was signed as part of the Pacific Salmon Treaty, (hereafter referred to as Treaty), whereby the U.S. and Canada agreed to harvest sharing of Chinook salmon that migrate through Alaska waters and spawn in the Yukon Territory and British Columbia. Since 1985, both nations have been engaged in the cooperative management and conservation of stocks spawning in Canada (JTC 2014). Stock composition estimates of harvests in Alaska provide valuable information for management and conservation of Chinook salmon throughout the Yukon River drainage, and aid in fulfillment of Treaty objectives.

Since 1981, the Alaska Department of Fish and Game (ADF&G) has estimated the stock and age composition of Chinook salmon harvests in the Yukon River. Stock and age compositions of harvests are needed to construct stock specific brood tables, which are used for spawner-recruitment analysis. In particular, accurate estimates of the contribution of the Canadian-origin stock group to Alaska harvests are necessary for spawner-recruitment analysis of this stock group, providing information necessary for its conservation and management in accordance with Treaty objectives.

Scale pattern analysis was used from 1981 to 2003 (e.g., DuBois 2005) to differentiate stock of origin for Chinook salmon harvested in the Yukon River into Lower, Middle, and Upper Yukon River stock groups. Schneiderhan (1997) provides a summary of the analytical methods used historically in the stock identification program. An improved method was developed in 1998 and the historical and subsequent data were processed using the new software program (Lingnau and Bromaghin 1999). The Lower stock group included Chinook salmon originating from Alaska tributary streams from the Andreafsky River to near the confluence with the Tanana River and the lower Koyukuk River drainage. The Middle stock group included Chinook salmon from Alaska tributary streams upstream from the Tanana River confluence, and the upper Koyukuk and Tanana river drainages. The Upper stock group consisted of Canadian-origin fish.

Genetic analysis replaced scale pattern analysis starting in 2004. 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). Subsequently, 2 types of genetic markers, single nucleotide polymorphisms (SNPs) and microsatellites, were investigated to provide a replacement for the allozyme baseline. With the exception of 2005, when microsatellite markers were used, SNPs have been used from 2004 through 2013 for stock composition of Yukon River Chinook salmon. The 3 broad scale reporting groups from genetic analysis are consistent with the 3 groups from scale pattern analysis.

This report presents stock and age class components of Chinook salmon harvest in the Yukon River drainage. To accomplish this, genetic stock and age class compositions were determined from samples representative of specific harvests by district, villages, or other specific location, and fishery. Stock composition estimates were based on genetic analysis of SNPs from fish in harvest and test fishery samples. Ages were determined from scales of individual fish in harvest samples. Estimated stock and age class proportions were applied to location and fishery specific harvest estimates, and then estimates of total harvest by each stock and age class were produced by summing across locations and fisheries. The resulting stock and age composition of the 2013 Chinook salmon harvest is the focus of this report.

Alaska subsistence harvest estimates by species, village, and district were obtained from the Yukon area postseason subsistence survey (e.g., Jallen et al. 2015). Lower Yukon test fishery and Pilot Station test fishery harvest estimates donated to subsistence users were provided by ADF&G staff. Alaska sport fishery and Canadian harvest estimates were obtained from ADF&G reports (Burr 2015; JTC 2014). Stock composition estimates from Pilot Station sonar samples were from the ADF&G Gene Conservation Laboratory[1] (GCL). Stock composition estimates from 3 groupings of subsistence harvest samples were also analyzed in the GCL. Number and percentage of fish by age class were derived from data housed in the AYKDBMS[2] (Arctic-Yukon-Kuskokwim Database Management System).

OBJECTIVES

The objectives of this project are to estimate the total Yukon River Chinook salmon harvest by 1) stock group and 2) age class for the 2013 season.

STUDY AREA

Within the Alaska portion of the drainage, the Yukon River is split into 6 fishing districts for management, Y-1 through Y-6, numbered sequentially progressing from the river mouth (Y-1) to the Canadian border (Y-5), and Tanana River (Y-6; Figure 1). Commercial fisheries primarily

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[1] Available for download from: www.adfg.alaska.gov/static-f/fishing/PDFs/research/geneconservation/yukonchinookinseasonMSA2013.pdf

[2] AYKDBMS [Arctic-Yukon-Kuskokwim Database Management System] Home Page. Available from: http://www.adfg.alaska.gov/CommFishR3/Website/AYKDBMSWebsite/DataTypes/ASL.aspx

occur in Districts 1 and 2; however, they are occasionally executed in the other districts. Subsistence fishing occurs throughout the river and major tributaries. Test fisheries occur in District 1 near Emmonak, District 2 near Pilot Station, and District 5 near Eagle. Sport fisheries occur in lower river tributaries (e.g., Anvik and Andreafsky rivers) and Tanana River tributaries (e.g., Chena and Salcha rivers).

METHODS

SAMPLING

Chinook salmon were sampled for age (from scales) and stock group (from genetic material) along the mainstem Yukon River from subsistence and test fisheries. Subsistence harvest age and genetic material were collected by fishermen (e.g., Molyneaux and Stockdale 2013). Any Chinook salmon caught incidentally during the directed summer chum salmon (*O. keta*) commercial fishery may be retained for subsistence use and, if available, was sampled. Subsistence and incidental commercial sampling was opportunistic, where every fish available was sampled. Test fisheries operated by ADF&G sampled up to 30 fish each day. Chinook salmon were sampled for age only from non-mainstem locations.

Genetic Collection, Processing, and Analysis

Tissue samples for genetic analyses were typically collected concurrent with scale samples from mainstem Yukon River locations. However, at Rampart Rapids, only genetic samples were collected. An axillary process tissue was collected using clippers or scissors; approximately three-fourths inch was removed and put into an individually numbered 2 ml vial filled with denatured ethanol. At some locations all tissue samples were put into 1 bulk bottle. These vials or bottles were shipped to the GCL for processing.

Stock composition estimates for 3 broad scale stock reporting groups were generated from the harvest samples by location. Genetic processing techniques and analytical methodology similar to DeCovich and Howard (2011) was used. For this report, Lower Yukon, Middle Yukon, and Canada stock reporting groups from the GCL are referred to as Lower, Middle, and Upper stock groups.

Scale Collection, Processing, and Aging

Scales were removed from the preferred area of the fish for age determination and mounted on gum cards (INPFC 1963). Three scales were collected from each Chinook salmon to allow for the incidence of regenerated scales. 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: number of freshwater annuli separated by a decimal from 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.

SAMPLING LOCATIONS

In District 1, Chinook salmon were sampled from subsistence fisheries from the villages of Alakanuk, Emmonak, and Kotlik . Sampling (for age only) was conducted in the Lower Yukon test fishery (LYTF) at the Big Eddy and Middle Mouth sites (Appendix A1 and Table 1). Age samples were also collected near the Big Eddy site from a study that compared Chinook and chum salmon catches from 2 small mesh sizes and 2 net depths. Samples were obtained at Emmonak from Chinook salmon caught incidentally during the directed summer chum salmon fishery.

In District 2, Chinook salmon were sampled from subsistence harvests in Marshall, Mountain Village, Pitkas Point, and St. Marys. Samples were also collected from the Pilot Station sonar test fishery (Appendix A1 and Table 1).

In District 4, Chinook salmon were sampled from subsistence harvests from the villages of Anvik, Galena, and Ruby (Appendix A1 and Table 1). Escapement samples for age were collected from projects on the Gisasa River and Henshaw Creek (Appendix A1), which are tributaries that flow into the Koyukuk River which flows into District 4.

In District 5, Chinook salmon were sampled from the Fort Yukon subsistence harvest (Appendix A1 and Table 1). Subsistence harvests from Rampart Rapids were sampled for genetic tissue only (Table 1). Daily sampling was conducted from the Eagle sonar test fishery for age only (Appendix A1).

Escapement samples for age were collected in the Chena and Salcha rivers (Appendix A1), which are tributaries that flow into District 6.

ESTIMATION METHODS

Stock and age composition of harvests in each district were estimated from 3 components: 1) genetic stock proportions, 2) age class proportions, and 3) estimated harvest (numbers of fish). Stock and age composition of harvests were estimated using samples from harvests representative of those locations and fisheries. Many subsistence harvest sample sizes were small (<100), and in those cases samples from several adjacent locations were combined. The GCL pooled samples from some locations and fisheries in order to achieve sufficient sample sizes (Table 1). Stock composition estimates were obtained representing 4 district/project/fishery groups: subsistence harvests in Districts 1 and 2; test fishery catches at Pilot Station sonar in District 2; subsistence harvests in District 4; and subsistence harvests in District 5. Age composition was likewise estimated from pooled samples representing fisheries and locations over a larger area (Appendix A1 and Table 2). In some areas, subsistence harvest estimates of Chinook salmon comprised mainly fish donated to users from test fishery catches; therefore, the stock and age composition of these harvests were estimated from test fishery samples. Estimates of stock and age proportions were applied to total harvest estimates within 13 “harvest groups” (Appendix A2) to produce the estimated harvest within each group by stock and age class. Estimates of harvest by stock and age class were summed across harvest groups within a district to obtain districtwide harvest by stock and age class; harvests from Districts 1 to 3 were further summed (Table 3). Detailed explanations of which sample age and stock compositions were applied to harvests in each district are provided below.

The age and stock composition of subsistence harvests in Districts 1 and 2 were estimated from pooled samples from subsistence and incidental commercial harvests in these 2 districts, and from the small mesh size and net depth study (harvest groups 1 and 3). In District 1, age samples from LYTF catches and genetic samples from Pilot Station test fishery catches were used to represent the LYTF harvest, which was subsequently donated to subsistence users (harvest group 2). In District 2, age and genetic samples were collected from Pilot Station test fishery catches donated to subsistence users so that portion of the harvest was estimated directly from these samples (harvest group 4).

Samples were not collected in District 3, so samples from subsistence harvests in Districts 1 and 2 were used to represent age and stock composition of the District 3 subsistence harvest (harvest group 5).

In District 4, genetic and age samples from Anvik, Galena, and Ruby were used to represent the subsistence harvest from villages on the mainstem Yukon River (harvest group 6). Age samples from these villages were also used to represent age composition of the Anvik River sport fish harvest. This sport fish harvest was assigned to the Lower stock group based on location (harvest group 8). Age samples from Gisasa River and Henshaw Creek escapements were used to represent the harvest from villages along the Koyukuk River, which were assigned to the Middle stock group based upon geographic location (harvest group 7).

In District 5, age composition estimates were based on samples collected in Fort Yukon (harvest groups 9–11). Stock composition estimates, based on genetic samples from Rampart Rapids and Fort Yukon, were used to represent subsistence harvests from Tanana upstream to Fort Yukon (harvest group 9). Harvests above Fort Yukon to the Canadian border were assigned to the Upper stock group based on location (harvest group 10). Harvests from Chandalar and Black rivers were assigned to the Middle stock group based on location (harvest group 11).

In District 6 (Tanana River), age composition from the pooled escapement samples collected from the Chena and Salcha rivers was used to represent all subsistence and sport fish harvest in the district (harvest group 12). The Tanana River harvest was assigned to the Middle stock group based on location.

The age composition from the Eagle sonar test fishery was used to represent all harvests occurring in Canada. Harvest age samples are not routinely or consistently collected in Canada. These harvests were assigned to the Upper stock group based on location (harvest group 13).

Regardless of sampling location, age composition of the harvest was assumed to be similar in all stock groups present in that location. Therefore age composition estimates from each sample were applied equally to all stock groups represented by that sample.

STOCK AND AGE ASSIGNMENT

Samples from all mesh sizes, gear types, and locations were pooled within project, harvest group, or fishery (Appendix A1). For the harvest in each harvest group the number of fish by stock and age class was estimated as follows.

Denote that

$n_{k,h}$ is the number of age samples from fishery or project k, representing harvest group h; and

$n_{j,k,h}$ is the number of samples at age j from fishery or project k, representing harvest group h.

Summing across projects or fisheries within harvest group h, the proportion $Pa_{j,h}$ of fish at age j representing harvest group h was estimated as

$$\hat{P}a_{j,h} = \frac{\sum_k n_{j,k,h}}{\sum_k n_{k,h}}. \tag{1}$$

Let $Ps_{,i,h}$ be the proportion of stock *i*, representing harvest group *h* and N_h be the number of fish harvested in harvest group *h*. Then the number of fish of stock *i* and age *j* in harvest group *h* was estimated as

$$\hat{N}_{h,i,j} = N_h \cdot \hat{P}s_{i,h} \cdot \hat{P}a_{j,h}. \tag{2}$$

The number of fish of stock *i* and age *j* harvested in each district *d* was then estimated as the sum of harvests of that stock and age from all harvest groups within that district.

The total number of fish of stock *i* harvested within the Yukon drainage N_i was estimated as

$$\hat{N}_{d,i} = \sum_h \sum_j \hat{N}_{d,i,j,h}. \tag{3}$$

RESULTS

The total harvest of Chinook salmon from U.S. and Canada in 2013 was 13,345 fish (Table 3). Of this harvest, the Lower stock group comprised 1,793 fish (13.4%), Middle stock group 2,802 fish (21.0%), and Upper stock group 8,750 fish (65.6%, Tables 3 and 4). The Canadian harvest was 2,146 fish, or 16.1% of the total harvest (Tables 5 and 6). Age-1.4 fish comprised 44.5% (5,938 fish) of the total harvest, followed by age-1.3 fish (37.2%), and age-1.2 fish (15.3%, Tables 3 and 4).

STOCK COMPOSITION

In Districts 1 and 2, 220 genetic samples were analyzed from the subsistence harvest; the Lower stock group dominated in these samples (Table 1). In District 2, 278 genetic samples were analyzed from the Pilot Station sonar test fishery. In District 4, 124 genetic samples were analyzed from the subsistence harvest. In District 5, 374 genetic samples were analyzed from the combined Rampart Rapids and Fort Yukon subsistence harvests. The Upper stock group dominated in all samples except for Districts 1 and 2. Stock composition estimates resulting from applying sample proportions to harvests are provided below.

The subsistence harvest in Districts 1–3 was 1,427 fish from the Upper stock group, followed by 1,361 fish from the Lower and 394 fish from the Middle stock group (Table 3). The Upper stock group dominated the District 4 subsistence harvest (1,697 fish), followed by 939 fish from the Middle, and 265 fish from the Lower stock group. The sport fishery estimated harvest from the Anvik River (tributary flowing into District 4) was 155 fish from the Lower stock group. By District 5, most of the harvest was from the Upper stock group (3,479 fish), followed by 1,049 fish from the Middle, and only 13 fish from the Lower stock group. In District 6, 420 fish were assigned to the Middle stock group from the subsistence and sport fishery harvest.

AGE COMPOSITION

In Districts 1 and 2, 265 age samples were collected from the subsistence and incidental commercial harvests and the small mesh size and net depth study, which comprised 35.5% age-1.4, 34.0% age-1.3, and 28.7% age-1.2 fish (Appendix A1 and Table 2). In the LYTF (District

1), 677 age samples were collected and age-1.4 fish dominated at 71.2%. In the Pilot Station test fishery (District 2), 272 age samples were collected and age-1.4 fish dominated at 55.1%. In the District 4 subsistence harvest, 116 age samples were collected and age-1.3 fish were most frequent at 45.7%. In the Gisasa River and Henshaw Creek escapement samples (tributaries that flow into District 4), 685 age samples were collected and age-1.4 fish were most frequent at 38.8%. In the Fort Yukon subsistence harvest (District 5), 222 age samples were collected; both age-1.3 fish (42.3%) and age-1.4 fish (44.6%) were frequent. In the Eagle sonar test fishery (District 5), 265 age samples were collected and age-1.4 fish dominated at 62.6%. In the Chena and Salcha rivers escapement samples (tributaries that flow into District 6), 358 age samples were collected and age-1.4 fish dominated at 62.6%. Age composition estimates resulting from applying sample proportions to harvests are provided below.

The subsistence harvest in Districts 1–3 was 1,425 age-1.4 fish, followed by 989 age-1.3 and 682 age-1.2 fish (Table 3). The subsistence harvest in District 4 was 1,315 age-1.3 fish, followed by 857 age-1.4 and 679 age-1.2 fish. The subsistence harvest in District 5 was 2,025 age-1.4 fish, followed by 1,923 age-1.3 and 470 age-1.2 fish. The subsistence harvest in District 6 was 234 age-1.4 fish, followed by 83 age-1.2 and 78 age-1.3 fish. The Canadian harvest was 1,344 age-1.4 fish, followed by 591 age-1.3 and 89 age-1.2 fish. Minor age classes (age-1.1, age-2.3, age-1.5, and age-2.4) comprised 397 fish, or 3.0% of the total harvest (Tables 3 and 4).

DISCUSSION

Overall, the 2013 Yukon River harvest was a record low because of a small run size and management actions to conserve Chinook salmon. In Alaska, subsistence fishing was closed during Chinook salmon pulses, gillnet mesh size was restricted to 6.0 in or less, and fish wheels were manned to allow release of Chinook salmon. Summer chum salmon commercial harvest gear was dipnets (with live Chinook salmon release), or gillnet mesh size was 5.5 in or 6.0 in or less. In Canada, fisheries were either reduced (aboriginal) or closed (commercial and sport; JTC 2014) The high percentage of age-1.4 fish from mainstem test fishery projects (LYTF, Pilot Station, and Eagle) suggests this age class predominated in the run. Younger fish (age-1.2 and -1.3) were represented more in the harvest undoubtedly because of management actions in Alaska that only allowed Chinook salmon harvest with small mesh gear.

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TABLES AND FIGURES

Table 1.–Genetic stock composition of Chinook salmon sampled in the Yukon area by district and project, in 2013.

District	Project	Stock group	Sample size	Estimate	90% CI
1, 2	Subsistence	Lower	220	0.465	0.393-0.540
		Middle		0.121	0.061-0.197
		Upper		0.414	0.331-0.498
2	Pilot Station sonar test fishery	Lower	278	0.329	0.276-0.384
		Middle		0.132	0.080-0.193
		Upper		0.539	0.475-0.600
4	Subsistence Anvik/Galena/Ruby	Lower	124	0.094	0.007-0.248
		Middle		0.306	0.118-0.582
		Upper		0.600	0.336-0.813
5	Subsistence Rampart Rapids/ Fort Yukon	Lower	374	0.003	0.000-0.013
		Middle		0.190	0.134-0.253
		Upper		0.806	0.744-0.863

Table 2.–Age class composition of Chinook salmon sampled in the Yukon River by district and project, in 2013.

		Percentage by age class [a]							
District	Project	1.1	1.2	1.3	2.2	1.4	2.3	1.5	2.4
1, 2	Incidental commercial, mesh size/depth study, subsistence	0.0	28.7	34.0	0.0	35.5	1.1	0.4	0.4
1	Lower Yukon test fishery	0.1	1.8	21.9	0.0	71.2	1.2	1.3	2.5
2	Pilot Station sonar test fishery	0.0	6.6	35.7	0.0	55.1	0.4	1.8	0.4
4	Subsistence	0.0	23.3	45.7	0.0	29.3	0.0	0.9	0.9
4	Gisasa River / Henshaw Creek escapement	0.4	27.7	31.4	0.0	38.8	0.7	0.9	0.0
5	Subsistence	0.0	10.4	42.3	0.0	44.6	2.3	0.0	0.5
6	Chena / Salcha rivers escapement	1.1	20.4	19.0	0.0	57.3	0.3	2.0	0.0
5	Eagle sonar test fishery	0.0	4.2	27.5	0.0	62.6	0.8	3.4	1.5

[a] Derived from data housed in the ADF&G AYKDBMS:
http://www.adfg.alaska.gov/CommFishR3/Website/AYKDBMSWebsite/DataTypes/ASL.aspx

Table 3.–Estimated harvest of Chinook salmon in the Yukon River apportioned by age class and stock group, in 2013.

District	Fishery	Stock group	Age class 1.1	1.2	1.3	2.2	1.4	2.3	1.5	2.4	Total
1-3	Subsistence	Lower	0	314	432	0	580	15	8	11	1,361
		Middle	0	83	122	0	179	4	3	4	394
		Alaska	1	397	553	0	759	20	11	14	1,755
		Upper	1	285	435	0	666	16	10	14	1,427
		Total	1	682	989	0	1,425	36	21	29	3,182
4	Subsistence	Lower	0	62	121	0	78	0	2	2	265
		Middle	0	222	418	0	282	1	8	7	939
		Alaska	0	283	539	0	360	1	10	10	1,204
		Upper	0	395	775	0	497	0	15	15	1,697
		Total	0	679	1,315	0	857	1	25	24	2,901
	Sport	Lower	0	36	71	0	45	0	1	1	155
5	Subsistence	Lower	0	1	5	0	6	0	0	0	13
		Middle	0	109	444	0	468	24	0	5	1,049
		Alaska	0	110	450	0	473	24	0	5	1,062
		Upper	0	360	1,473	0	1,552	78	0	16	3,479
		Total	0	470	1,923	0	2,025	102	0	20	4,541
6	Subsistence	Middle	5	83	78	0	234	1	8	0	409
	Sport	Middle	0	2	2	0	6	0	0	0	11
Canada		Upper	0	89	591	0	1,344	16	73	32	2,146
Total harvest		Lower	0	413	629	0	709	16	12	14	1,793
		Middle	5	499	1,064	0	1,169	30	19	16	2,802
		Alaska	6	912	1,693	0	1,878	45	31	30	4,595
		Upper	1	1,130	3,275	0	4,059	111	98	77	8,750
		Total	6	2,042	4,968	0	5,938	156	128	107	13,345

Table 4.– Estimated harvest (percentage) of Chinook salmon in the Yukon River apportioned by age class and stock group, in 2013.

District	Fishery	Stock group	Age class 1.1	1.2	1.3	2.2	1.4	2.3	1.5	2.4	Total
1-3	Subsistence	Lower	0.0	9.9	13.6	0.0	18.2	0.5	0.3	0.3	42.8
		Middle	0.0	2.6	3.8	0.0	5.6	0.1	0.1	0.1	12.4
		Alaska	0.0	12.5	17.4	0.0	23.9	0.6	0.3	0.4	55.1
		Upper	0.0	9.0	13.7	0.0	20.9	0.5	0.3	0.4	44.9
		Total	0.0	21.4	31.1	0.0	44.8	1.1	0.7	0.9	100.0
4	Subsistence	Lower	0.0	2.1	4.2	0.0	2.7	0.0	0.1	0.1	9.1
		Middle	0.0	7.6	14.4	0.0	9.7	0.0	0.3	0.3	32.4
		Alaska	0.0	9.8	18.6	0.0	12.4	0.0	0.4	0.3	41.5
		Upper	0.0	13.6	26.7	0.0	17.1	0.0	0.5	0.5	58.5
		Total	0.0	23.4	45.3	0.0	29.6	0.0	0.9	0.8	100.0
	Sport	Lower	0.0	23.4	45.3	0.0	29.6	0.0	0.9	0.8	100.0
5	Subsistence	Lower	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.3
		Middle	0.0	2.4	9.8	0.0	10.3	0.5	0.0	0.1	23.1
		Alaska	0.0	2.4	9.9	0.0	10.4	0.5	0.0	0.1	23.4
		Upper	0.0	7.9	32.4	0.0	34.2	1.7	0.0	0.3	76.6
		Total	0.0	10.4	42.3	0.0	44.6	2.3	0.0	0.5	100.0
6	Subsistence	Middle	1.1	20.4	19.0	0.0	57.3	0.3	2.0	0.0	100.0
	Sport	Middle	1.1	20.4	19.0	0.0	57.3	0.3	2.0	0.0	100.0
Canada		Upper	0.0	4.2	27.5	0.0	62.6	0.8	3.4	1.5	100.0
Total harvest		Lower	0.0	3.1	4.7	0.0	5.3	0.1	0.1	0.1	13.4
		Middle	0.0	3.7	8.0	0.0	8.8	0.2	0.1	0.1	21.0
		Alaska	0.0	6.8	12.7	0.0	14.1	0.3	0.2	0.2	34.4
		Upper	0.0	8.5	24.5	0.0	30.4	0.8	0.7	0.6	65.6
		Total	0.0	15.3	37.2	0.0	44.5	1.2	1.0	0.8	100.0

Table 5.–Estimated harvest of Chinook salmon in the Yukon River by stock group for U.S. and Canada, 1981–2013.

			Upper			
Year	Lower	Middle	U.S.	Canada	Total	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
2009	4,332	12,229	17,646	4,758	22,404	38,964
2010	10,046	18,465	25,271	2,647	27,918	56,429
2011	6,356	13,591	20,824	4,884	25,708	45,656
2012	4,123	10,763	13,842	2,200	16,042	30,927
2013	1,793	2,802	6,604	2,146	8,750	13,345
Average						
1981-2012	27,176	32,666	62,301	13,344	75,645	135,487
2008-2012	6,752	13,937	20,582	3,583	24,165	44,854

Table 6.–Estimated harvest (percentage) of Chinook salmon in the Yukon River by stock group for U.S. and Canada, 1981–2013.

			Upper		
Year	Lower	Middle	U.S.	Canada	Total
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	13.0	30.6	51.1	5.4	56.4
2008	17.0	28.0	48.4	6.6	55.0
2009	11.1	31.4	45.3	12.2	57.5
2010	17.8	32.7	44.8	4.7	49.5
2011	13.9	29.8	45.6	10.7	56.3
2012	13.3	34.8	44.8	7.1	51.9
2013	13.4	21.0	49.5	16.1	65.6
Average					
1981-2012	20.0	24.4	45.9	9.7	55.6
2008-2012	14.6	31.3	45.8	8.3	54.0

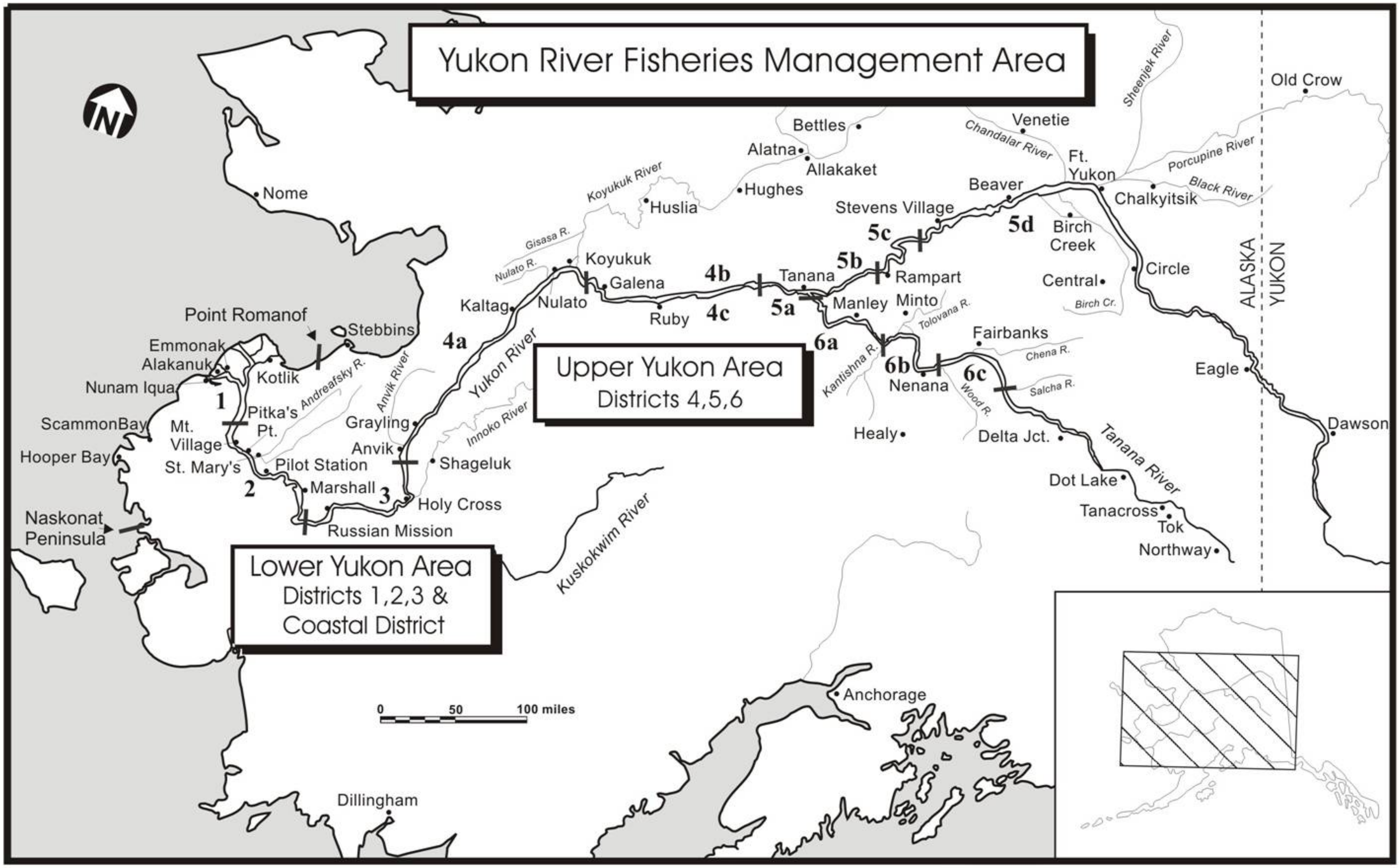

Figure 1.–Alaska portion of the Yukon River drainage with district boundaries and major spawning tributaries.

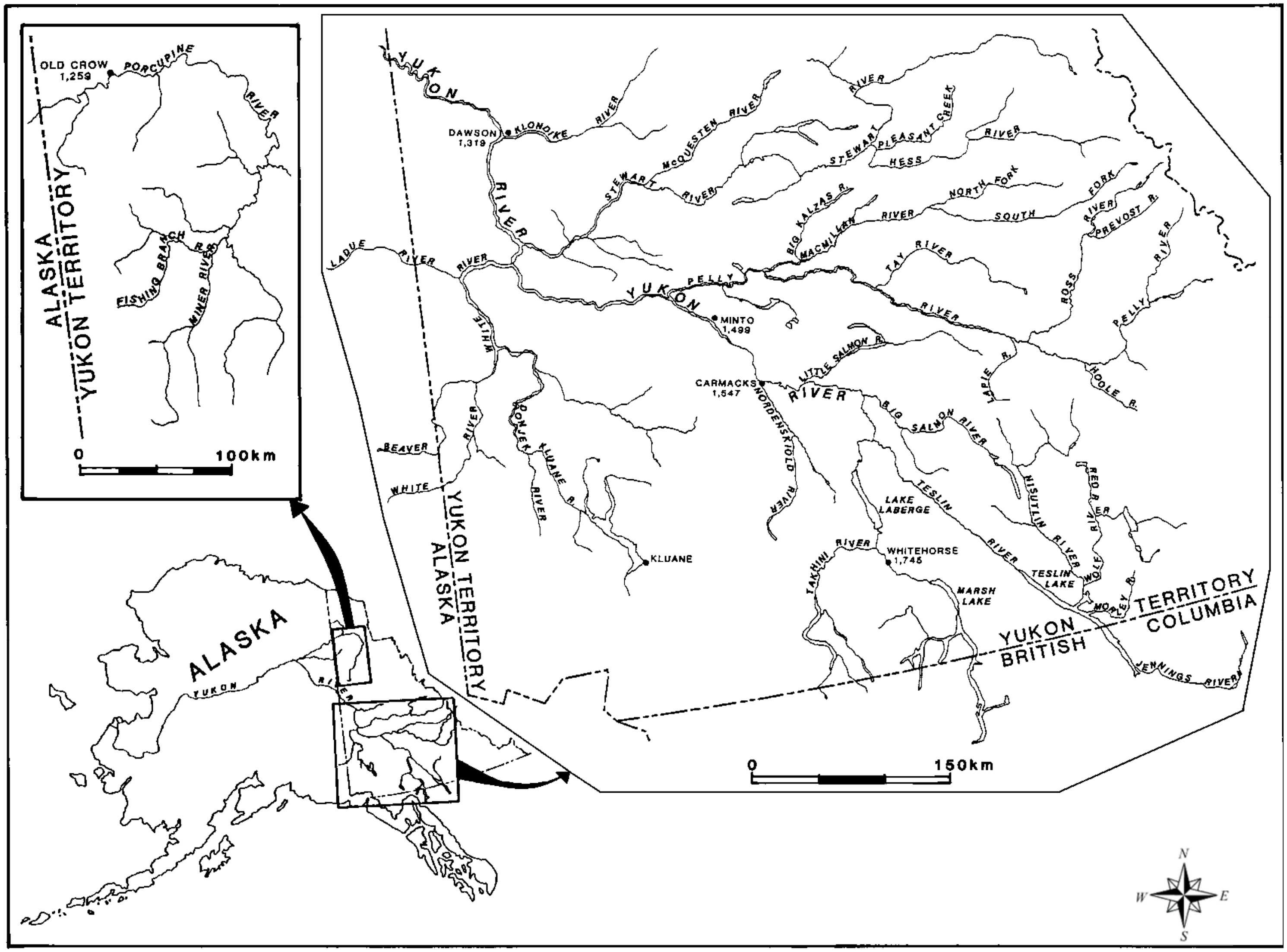

Figure 2.–Canadian portion of the Yukon River drainage and major spawning tributaries.

APPENDIX A

Appendix A1.–Age class composition, in numbers of fish, of Chinook salmon sampled in the Yukon River by district, fishery, harvest group, project, location, gear, and mesh size, in 2013.

District	Fishery	Harvest group	Project	Location	Gear	Mesh	Age class 1.1	1.2	1.3	2.2	1.4	2.3	1.5	2.4	Total
1	Subsistence	1, 3, 5	Incidental commercial												
				Emmonak	Dip net	4.5	0	7	1	0	5	0	0	0	13
					Drift gillnet	5.5	0	3	5	0	7	0	0	0	15
					Drift gillnet	6	0	0	1	0	0	0	0	0	1
			Mesh size/depth study												
				Big Eddy	Drift gillnet	5.5	0	15	7	0	6	0	0	0	28
					Drift gillnet	6	0	12	10	0	10	0	0	0	32
			Subsistence												
				Alakanuk	Dip net	4.5	0	4	0	0	1	0	0	0	5
					Drift gillnet	5.5	0	0	0	0	1	0	0	0	1
					Set gillnet	5.5	0	0	1	0	0	0	0	0	1
					Set gillnet	5.88	0	1	0	0	0	0	0	0	1
					Drift gillnet	6	0	4	7	0	1	0	0	0	12
					Set gillnet	6	0	2	3	0	3	0	0	0	8
				Emmonak	Drift gillnet	5.5	0	2	6	0	3	0	1	0	12
					Set gillnet	5.5	0	0	0	0	1	0	0	0	1
					Set gillnet	5.875	0	0	0	0	1	0	0	0	1
					Drift gillnet	5.875	0	0	1	0	2	0	0	0	3
					Drift gillnet	6	0	0	1	0	0	1	0	0	2
					Set gillnet	6	0	4	7	0	1	0	0	0	12
				Kotlik	Drift gillnet	5.5	0	1	2	0	2	0	0	0	5
					Drift gillnet	5.88	0	0	0	0	1	0	0	0	1
					Drift gillnet	6	0	9	7	0	8	1	0	1	26
					Set gillnet	6	0	9	23	0	32	0	0	0	64
2	Subsistence	1, 3, 5	Subsistence												
				Marshall	Drift gillnet	6	0	0	0	0	0	0	0	0	0
					Set gillnet	7.5	0	0	3	0	2	1	0	0	6
				Mountain Village	Drift gillnet	5.875	0	2	0	0	0	0	0	0	2
					Drift gillnet	6	0	0	1	0	3	0	0	0	4
				Pitkas Point	Drift gillnet	5.875	0	0	0	0	2	0	0	0	2
				St Marys	Drift gillnet	5.75	0	1	1	0	0	0	0	0	2
					Drift gillnet	6	0	0	3	0	2	0	0	0	5
			Incidental commercial, mesh size/depth study, subsistence												

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District	Fishery	Harvest group	Project	Location	Gear	Mesh	Age Class 1.1	1.2	1.3	2.2	1.4	2.3	1.5	2.4	Total
1, 2					All gear	All mesh	0	76	90	0	94	3	1	1	265
1	Subsistence	2	Test fishery	Big Eddy	Drift gillnet	8.25	0	2	30	0	75	2	4	5	118
					Set gillnet	8.5	1	7	52	0	107	2	2	7	178
				Middle Mouth	Set gillnet	8.5	0	3	66	0	300	4	3	5	381
			Lower Yukon test fishery		All gear	All mesh	1	12	148	0	482	8	9	17	677
2	Subsistence	4	Test fishery	Pilot Station sonar	Drift gillnet	4	0	2	5	0	2	0	0	0	9
						5.25	0	5	4	0	7	0	0	0	16
						6.5	0	4	28	0	22	1	1	0	56
						7.5	0	4	35	0	54	0	1	0	94
						8.5	0	3	25	0	65	0	3	1	97
						All mesh	0	18	97	0	150	1	5	1	272
4	Subsistence	6, 8	Subsistence	Anvik	Drift gillnet	6	0	5	9	0	2	0	0	0	16
				Galena	Drift gillnet	6	0	7	27	0	21	0	0	1	56
				Ruby	Set gillnet	Unknown	0	0	1	0	0	0	0	0	1
				Ruby	Set gillnet	6	0	15	16	0	11	0	1	0	43
				District 4	All gear	All mesh	0	27	53	0	34	0	1	1	116
4	n/a	7	Escapement	Gisasa River	Weir		1	128	144	0	179	2	5	0	459
				Henshaw Creek			2	62	71	0	87	3	1	0	226
				Koyukuk River tributaries		Total	3	190	215	0	266	5	6	0	685
5	Subsistence	9-11	Subsistence	Fort Yukon	Fish wheel		0	19	70	0	79	3	0	0	171
					Set gillnet	3.5	0	0	3	0	5	0	0	1	9
					Set gillnet	6	0	4	21	0	15	2	0	0	42
					All gear	All mesh	0	23	94	0	99	5	0	1	222

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District	Fishery	Harvest Group	Project	Location	Gear	Mesh	Age class 1.1	1.2	1.3	2.2	1.4	2.3	1.5	2.4	Total
1, 2					All gear	All mesh	0	76	90	0	94	3	1	1	265
5	Subsistence	13	Test fishery	Eagle sonar	Drift gillnet	5.25	0	5	25	0	32	0	1	0	63
						6.5	0	0	17	0	35	2	2	0	56
						7.5	0	5	21	0	66	0	2	3	97
						8.5	0	1	10	0	33	0	4	1	49
						All mesh	0	11	73	0	166	2	9	4	265
6	n/a	12	Escapement	Chena River	Handpicked		2	53	40	0	81	1	2	0	179
				Salcha River			2	20	28	0	124	0	5	0	179
				Tanana River tributaries		Total	4	73	68	0	205	1	7	0	358

Appendix A2.–Estimated harvest of Chinook salmon in the Yukon River apportioned within districts, by stock group and age class proportion, in 2013.

						Age class proportion								Source data for	
District	Fishery	Harvest group	Harvest	Stock group	Stock prop.	1.1	1.2	1.3	2.2	1.4	2.3	1.5	2.4	Stock composition	Age composition
1	Subsistence	1	860	Lower	0.465	0.000	0.287	0.340	0.000	0.355	0.011	0.004	0.004	Districts 1 and 2	District 1 incidental com.
				Middle	0.121									Subsistence	Mesh size/depth study
				Upper	0.414										Districts 1 and 2 Subsistence
1	Subsistence	2	774	Lower	0.329	0.001	0.018	0.219	0.000	0.712	0.012	0.013	0.025	Pilot Station Sonar	Lower Yukon
				Middle	0.132									Test Fishery	Test fishery
				Upper	0.539										
2	Subsistence	3	1,003	Lower	0.465	0.000	0.287	0.340	0.000	0.355	0.011	0.004	0.004	Districts 1 and 2	District 1 incidental com.
				Middle	0.121									Subsistence	Mesh size/depth study
				Upper	0.414										Districts 1 and 2 Subsistence
2	Subsistence	4	101	Lower	0.329	0.000	0.066	0.357	0.000	0.551	0.004	0.018	0.004	Pilot Station Sonar	Pilot Station sonar
				Middle	0.132									Test Fishery	Test fishery
				Upper	0.539										
3	Subsistence	5	444	Lower	0.465	0.000	0.287	0.340	0.000	0.355	0.011	0.004	0.004	Districts 1 and 2	District 1 incidental com.
				Middle	0.121									Subsistence	Mesh size/depth study
				Upper	0.414										Districts 1 and 2 Subsistence
4	Subsistence	6	2,827	Lower	0.094	0.000	0.233	0.457	0.000	0.293	0.000	0.009	0.009	District 4	District 4
Mainstem villages				Middle	0.306									Subsistence	Subsistence
				Upper	0.600										

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						Age class proportion								Source data for	
District	Fishery	Harvest group	Harvest	Stock group	Stock prop.	1.1	1.2	1.3	2.2	1.4	2.3	1.5	2.4	Stock composition	Age composition
4	Subsistence	7	74	Middle	1.000	0.004	0.277	0.314	0.000	0.388	0.007	0.009	0.000	Assigned	Gisasa River
	Koyukuk River villages														Henshaw Creek
4	Sport	8	155	Lower	1.000	0.000	0.233	0.457	0.000	0.293	0.000	0.009	0.009	Assigned	District 4 Subsistence
5	Subsistence	9	3,877	Lower	0.003	0.000	0.104	0.423	0.000	0.446	0.023	0.000	0.005	Fort Yukon,	Fort Yukon
	Tanana to Fort Yukon			Middle	0.190									Rampart Rapids	Subsistence
				Upper	0.806									Subsistence	
5	Subsistence	10	353	Upper	1.000	0.000	0.104	0.423	0.000	0.446	0.023	0.000	0.005	Assigned	Fort Yukon
	Villages above Fort Yukon														Subsistence
5	Subsistence	11	311	Middle	1.000	0.000	0.104	0.423	0.000	0.446	0.023	0.000	0.005	Assigned	Fort Yukon
	Chandalar and Black river villages														Subsistence
6	Subsistence,	12	409	Middle	1.000	0.011	0.204	0.190	0.000	0.573	0.003	0.020	0.000		Chena and Salcha rivers
	Sport		11												
Canada	All	13	2,146	Upper	1.000	0.000	0.042	0.275	0.000	0.626	0.008	0.034	0.015	Assigned	Eagle sonar Test fishery