Fishery Data Series No. 18-25

Origins of Chinook Salmon in the Yukon Area Fisheries, 2014

by

Larry DuBois

August 2018

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 Area was estimated for 2014. Limited sampling occurred in 2014 because of anticipated low harvest. Stock composition was estimated by genetic mixed stock analysis for 3 geographically-based stock groups termed Lower, Middle, and Upper. Stock composition estimates from sampled fish were applied to specific harvest groups across all age classes. Stock and age compositions from previous years or from other harvest groups were used to estimate unsampled harvest groups. Ages of sampled fish were determined from scales and age composition was estimated from the sample proportions in each age class. Age composition estimates were applied to specific harvest groups across all stock groups. The total estimated Yukon Area harvest, which included harvest from Coastal District communities and Canada, was 3,390 Chinook salmon, of these 28.9% were estimated to be of Lower, 25.2% Middle, and 45.9% Upper stock origin. Overall, age-1.3 fish dominated the harvest with 2,028 fish, followed by 676 age-1.4 fish, 432 age-1.2 fish, and 254 fish from other age classes combined.

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 Area

INTRODUCTION

The Yukon River drains an area of 321,500 mi^2, 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. Except for a few fish taken in the adjacent coastal waters near the mouth, only salmon of Yukon River origin are harvested in the Yukon Area. 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 both Alaska and Canada. Sport fisheries, a very minor component of harvest overall, primarily occurs in lower river tributaries, Tanana River tributaries, and in Canada. The average annual harvest of Chinook salmon within the Yukon River drainage from 2004 through 2013 was 65,538 fish; harvests within Alaska averaged 60,024 fish (JTC 2015).

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 2015). 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-recruit analysis. In particular, accurate estimates of the contribution of the Canadian-origin stock group to Alaska harvests are necessary for spawner-recruit analysis of this stock group, and provide information necessary for its conservation and management in accordance with Treaty objectives.

Scale pattern analysis was used from 1981 through 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 historically used 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 included Canadian-origin fish.

Genetic analysis replaced scale pattern analysis 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 were used from 2004 through 2014 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 composition of 2014 Chinook salmon harvests in the Yukon Area, in total, and by district. In most cases, samples taken in previous years and other locations were used to apportion harvests in 2014 because few locations were sampled in 2014. This report is differentiated from report years 1981–2013 (e.g., DuBois 2005) by inclusion of the Coastal District harvest. The Coastal District was included to provide a more complete estimate of Yukon River Chinook salmon harvest by stock and to be consistent with information used by ADF&G to determine total run and harvest shares of the Canadian stock component.

OBJECTIVES

The objectives of this project are to estimate the total Yukon Area Chinook salmon harvest by stock group and age class during the 2014 season.

STUDY AREA

Within the Alaska portion of the drainage, the Yukon Area is split into 7 fishing districts for management: Coastal and Y-1–Y-6, numbered sequentially progressing from the river mouth (Y-1) to the Canadian border (Y-5), and Tanana River (Y-6; Figure 1).

METHODS

HARVEST ESTIMATES

Harvest estimates by use type were obtained from various agency management reports. Subsistence fishing occurred throughout the Coastal District, mainstem river and major tributaries; however, limited fishing opportunity was available because of the anticipated low run size. In 2014, there was no commercial or sport fish harvest of Chinook salmon in the drainage. Subsistence Chinook salmon harvest estimates in Alaska were obtained from a Yukon Area postseason subsistence survey, which specified harvest by village and district (Jallen et al. 2017). Estimates from the Coastal District and Districts 1–6 within the Yukon River are included in this report. Canadian harvest estimates were obtained from a report by the Joint Technical Committee to the U.S./Canada Yukon River Panel (JTC 2015).

Test fisheries occurred in District 1 near Emmonak (Lower Yukon test fishery, (LYTF)), District 2 near Pilot Station sonar (PSTF), and District 5 near Eagle (ETF). LYTF and PSTF harvests were donated to subsistence users and total subsistence harvest estimates included fish donated from test fisheries (Jallen et al. 2017). However, test fishery catches may have different stock and age composition compared to the subsistence fishery because of disparity in mesh sizes between test fisheries and legal maximum gear size allowed in the subsistence fishery (Appendix A1). Consequently, test fishery contributions to subsistence harvests were reported by ADF&G staff and treated separately in this analysis.

SAMPLING

Chinook salmon were sampled for age (from scales) and stock group (from genetic material) from subsistence and test fisheries (Eaton 2015). Subsistence harvest scales and genetic material were collected by fishermen. To ensure that sampling effort was proportional to harvest through time, subsistence fishermen were not limited to a sample size. Instead, they were asked to sample every Chinook salmon caught (Drobny 2015). Test fisheries operated by ADF&G sampled up to 30 fish each day. Chinook salmon were sampled for age only from tributaries of the mainstem Yukon River and Tanana River.

Genetic Collection, Processing, and Analysis

Tissue samples for genetic analyses were typically collected concurrent with scale samples from mainstem Yukon River locations. 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. These vials were shipped to the ADF&G Gene Conservation Lab (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 (Eaton 2015). 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 (MacLellan and Gillespie 2015). 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. The number of fish by age class and the subsequent age compositions were derived from data housed in the ADF&G Arctic-Yukon-Kuskokwim Database Management System (AYKDBMS).

Locations

Genetic samples were collected from 2 locations and age samples were collected from 6 locations in 2014 (Appendices A2 and A3). In District 1, sampling (for age only) was conducted in the LYTF at the Big Eddy and Middle Mouth sites. In District 2, genetic and age samples were collected from the PSTF. Scale samples were collected from an escapement weir project on the Gisasa River, which is a tributary of the Koyukuk River which flows into the mainstem in District 4. In District 5, genetic and age samples were collected from the Fort Yukon subsistence harvest. Daily genetic and age sampling was conducted from the ETF of Chinook salmon entering Canada; however, the genetic samples were not used in this analysis because all fish that pass this location are presumed Canadian-origin. Age samples were collected in the Chena River and Salcha River escapement projects, which are tributaries of the Tanana River in District 6.

Because most subsistence harvests in 2014 were not sampled, genetic samples from previous years were used as substitutes to estimate the stock of origin for harvest groups not sampled. The 2010 and 2011 genetic composition of LYTF catches in District 1 was averaged. The annual genetic composition of subsistence harvest in District 5 (Tanana) for years 2010–2012 were averaged. Genetic samples from 10 villages in 2013 were pooled into 2 separate estimates of harvest composition. Samples collected in 2013 from District 1 (Alakanuk, Emmonak, and Kotlik) and District 2 (Marshall, Mountain Village, Pitkas Point, and St. Mary's) were pooled. Samples collected in 2013 from Anvik, Galena, and Ruby in District 4 were pooled (Appendix A2).

APPORTIONMENT ASSUMPTIONS

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 in numbers of fish. Estimates of stock and age proportions were applied to harvest estimates for 14 harvest groups to produce the estimated harvest within each group by stock and age class (Tables 1 and 2). Each harvest group was assumed to have a similar stock composition across all age groups and a similar age composition across all stock groups. 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.

In 2014, other than test fishery catches donated to subsistence, the subsistence harvest was only sampled from 1 village in District 5 (Fort Yukon); therefore, substitutes (other samples) were chosen to represent the stock and age composition of other subsistence harvests. Substitute stock and age compositions were selected based on knowledge of harvest demographics spatially, temporally, and through gear selectivity from past assessment of subsistence harvests. Similar stock composition of harvest from a sample location has been observed across years. Run timing in the Yukon River has indicated that the Upper stock arrives earlier in the run, and Middle and Lower stocks arrive later in the run (DeCovich and Howard 2011). Gear type has been shown to influence stock and age composition of the catch (Howard and Evenson 2010). Consequently, decisions were made to select substitute data from similar locations, of similar run timing, and using similar harvest gear to those harvest groups being estimated. Additionally, terminal tributary harvests were assumed to include only those fish of that terminal stock group and no other stocks. Lower and Middle Yukon stocks were presumed to be unavailable to mainstem harvesters upstream of their spawning locations.

The stock composition of harvest groups 1, 2, 4, and 6 (non-test fishery harvests in the Coastal District and Districts, 1–3) were estimated from subsistence and incidental commercial harvests (retained for subsistence use) that were sampled from Districts 1 and 2 in 2013 (Tables 1 and 2). The stock composition of subsistence harvests were probably influenced by management actions and limitations placed on allowable gear. In 2013 and 2014, subsistence gillnets were restricted to 6.0-inch or smaller mesh for most of the season, and fish wheels and dip nets were required to release Chinook salmon for most of the season. In both years, the first few pulses of Chinook salmon were protected by closing subsistence fishing as the pulses migrated upriver. It was assumed that restrictions were similar enough in 2013 and 2014 (harvest pushed towards the tail end of the run, and majority of harvest occurring with gillnets 6.0-inch mesh or smaller) that the stock composition of the harvest were similar between years. The stock composition of harvest group 7, mainstem villages in District 4, was estimated from District 4 harvests in 2013. The rationale was similar to that for harvest groups 1, 2, 4 and 6 where harvest timing and stock composition by location were presumed similar between 2013 and 2014.

The age composition of harvest groups 1, 2, 4, 6, and 7 (non-test fishery harvests in the Coastal District and Districts 1–4) were estimated from samples collected in 2014 at PSTF from gillnets with 6.5-inch or smaller mesh (Tables 1 and 2). The Chinook salmon age composition in 2014 was different from 2013 (Eaton 2016); therefore ages from the current year were used for estimates. The only locations sampled in 2014 with gear and mesh size similar to the legal gear allowed in the subsistence fishery were PSTF, Fort Yukon, and ETF (Appendix A1). Because PSTF is closer to the lower river and coastal districts, it was chosen to estimate age composition. In theory, because legal subsistence gear was restricted to 6.0-inch or smaller mesh, the 6.5-inch from PSTF should not be included. But, excluding the 6.5-inch mesh would have resulted in a sample size of just 65 ages, with nearly half from 4.0-inch mesh, which would probably overestimate the younger age classes.

The stock and age composition from harvest group 1 (Coastal District) has not been assessed for any year. The majority of the Chinook salmon harvest was presumed to be Yukon River origin but may include other stocks as well. In 2014, the Coastal District had similar gear restrictions as Yukon River districts. Because of the relatively small harvest from the Coastal District, any errors in apportioning harvest by stock or age are probably negligible.

Stock and age composition of harvest groups 3 and 5 were estimated from test fishery samples. In Districts 1 and 2, subsistence harvest estimates of Chinook salmon included fish donated to users from test fishery catches. In District 1, age samples from LYTF catches in 2014 and genetic samples from LYTF (2010 and 2011 average) were used to represent the LYTF harvest, which was subsequently donated to subsistence users (harvest group 3, Tables 1 and 2). This stock composition average was chosen because it represented the most recent years that genetic analysis were available for LYTF. However, 2010 and 2011 genetic stock composition estimates only included samples from catches that occurred early in the run. In 2014, District 2 age and genetic samples were collected from PSTF catches donated to subsistence users and that portion of the harvest was estimated directly from these samples (harvest group 5, Tables 1 and 2).

Age samples from Gisasa River escapement in 2014 were used to represent the harvest from Koyukuk River villages (harvest group 8), which was assigned to the Middle stock group based on geographic location (Tables 1 and 2). The Gisasa River was chosen to estimate the age composition of the Koyukuk River harvest because it is a tributary of the Koyukuk River and was the closest sampled location.

In District 5, age composition estimates were based on samples collected from Fort Yukon in 2014 (harvest groups 9–12, Tables 1 and 2). Fort Yukon age samples were chosen to represent all District 5 harvests, and harvest timing and gear types were presumed similar to other District

5 harvests. Stock composition for harvest groups 9–12 were derived from a variety of sources. Subsistence harvests from Tanana, Rampart Rapids, and Fort Yukon residents were sampled for genetic analysis from 2007 through 2012 (e.g., DeCovich and Howard 2011). A comparison of stock composition estimates from these villages' harvests showed that the proportion of the Upper stock group increased further upriver. Because the stock composition of harvests from the mainstem Yukon River between Tanana and Fort Yukon changes as the fish travel upriver; genetic samples from Tanana subsistence (2010–2012 average), were used to represent subsistence harvests from Tanana upstream to Birch Creek (harvest group 9, Tables 1 and 2). This average was chosen because these were the most recent 3 years available; however, harvest timing and gear types between 2014 and the 2010–2012 average may not be comparable. Stock composition estimates from Fort Yukon in 2014 were used to represent harvests from Beaver to Fort Yukon (harvest group 10). Harvests upstream of Fort Yukon to the Canadian border were assigned to the Upper stock group based on location, presuming most of these fish are bound for Canada (harvest group 11). Harvests from Chandalar and Black rivers were assigned to the Middle stock group based on location (harvest group 12).

In District 6 (Tanana River, harvest group 13), age composition from the pooled escapement samples collected from the Chena and Salcha rivers in 2014 was used to represent harvest in the district (Tables 1 and 2). These escapement samples were chosen because they are tributaries of the Tanana River and the only locations sampled in District 6; however, run timing and gear types between the escapement samples and the subsistence harvest may not be comparable. Stock composition of harvest group 13 was assigned to the Middle stock based on location.

The age composition from ETF in 2014 was used to represent all harvests occurring in Canada (harvest group 14, Tables 1 and 2). The ETF age samples were chosen because they are the closest location to Canada; however, gear types between ETF and the Canadian harvest may not be comparable. Harvest age samples have not been routinely or consistently collected in Canada. The harvest was assigned to the Upper stock group based on location.

STOCK AND AGE ASSIGNMENT

Samples by specific mesh sizes, gear types, and locations were pooled within harvest groups. For 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 the fishery or project (*k*), representing harvest group (*h*); and $n_{j,k,h}$ is the number of samples at age (*j*) from the fishery or project (*k*), representing harvest group (*h*).

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

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

Let $Ps_{,i,h}$ be the proportion of stock (*i*), representing the 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:

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

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:

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

RESULTS

The total harvest of Chinook salmon from U.S. and Canada in 2014 was 3,390 fish (Tables 3 and 4). Of this harvest, the Lower stock group contributed 979 fish (28.9%), Middle stock group 853 fish (25.2%), and Upper stock group 1,558 fish (45.9%, Tables 4 and 5). The Canadian harvest was 103 fish, or 3.0% of the total harvest. Age-1.3 fish contributed 2,028 fish to the total harvest, followed by 676 age-1.4 fish, and 432 age-1.2 fish (Table 3).

Compared with the 2009–2013 average, the Lower stock group harvest percentage in 2014 was nearly twice the average and the highest since 2001 (Table 5). This high percentage is a product of where harvest occurred in 2014 and the decision to include the Coastal District harvest for the first time in 2014. Nearly three-quarters of the total harvest was from the Coastal District and Districts 1 and 2 and more than 95% of the Lower stock group harvest was from these districts (Table 3). District 1 had the largest harvest, of which over half were composed of LYTF, of which contributed nearly one-fourth of the total harvest.

The Upper stock group harvest percentage was below the 5-year average and lowest since 1984, due to record low harvest in all areas, particularly in upriver harvest areas in the U.S. and Canada (Table 5). Harvests in U.S. accounted for more than 90% of the total Upper stock harvest.

DISCUSSION

Overall, the 2014 total Yukon Area harvest and harvest by stock group was a record low because of a small run size and management actions that severely limited the harvest of Chinook salmon in Alaska (Estensen et al. 2015). In Canada, fisheries were either reduced (Aboriginal) or closed (commercial and sport; JTC 2015).

For this report, harvests, stock and age proportions were considered as specific point estimates, although there are confidence intervals around each estimate. Furthermore, harvest estimates by stock and age proportions probably have considerable uncertainty because other harvests were used to estimate harvest groups not sampled.

Due to fishing restrictions on Chinook salmon, and expected low run size, only limited biological sampling of subsistence harvests occurred. Of the 2,850 fish in mixed stock harvests (harvest groups 1–7, 9, and 10, summed from Table 1) only 173 fish (6.1%) were directly estimated from samples collected in each respective harvest (harvest groups 5 and 10, summed from Table 1). Compared to stock composition, age composition was based on more information collected in 2014. Of the 3,390 fish harvested, age composition was estimated for 28% (948 fish) from samples collected in harvests which occurred in 2014 (harvest groups 3, 5, and 10, summed from Table 1). However, most of the age composition that was directly estimated was from test fishery harvests donated to subsistence users.

The need to rely heavily on substitute information to estimate stock and age composition of select harvests in 2014 is problematic, and uncertainty in the estimates presented in this report are probably high. However, the impact of any error associated with the harvest component on subsequent brood table updates and evaluation of Treaty harvest shares is partly ameliorated by the record low harvest in 2014, which was less than 10% of the recent 5-year average (Table 4). Comparisons of the 2014 harvest composition by stock to all prior years are confounded by the decision to include the Coastal District harvest for the first time in 2014. However, the total Chinook salmon harvest that occurs in the Coastal District is relatively small compared to the in-river harvest, and the effect of this decision on harvest proportions will probably be negligible given the uncertainty in the data.

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TABLES AND FIGURES

Table 1.–Estimated harvest of Chinook salmon in the Yukon Area apportioned by harvest group, in 2014.

Harvest group	Fishery	District	Harvest apportioned	Notes	2014 harvest genetic data	2014 age data	Source data used to approximate: Stock	Source data used to approximate: Age composition
1	Subsistence	Coastal	563	Coastal District subsistence	no	no	2013 Y1 & Y2[a] subsistence	Pilot Station test fishery 2014 ≤6.5" mesh
2	Subsistence	1	581	District 1 subsistence harvest less LYTF donated to subsistence	no	no	2013 Y1 & Y2[a] subsistence	Pilot Station test fishery 2014 ≤6.5" mesh
3	Test	1	775	LYTF harvest donated to subsistence	no	yes	2010-2011 Lower Yukon test fishery	2014 Lower test fishery
4	Subsistence	2	536	District 2 subsistence harvest less PSTF donated to subsistence	no	no	2013 Y1 & Y2[a] Subsistence	Pilot Station test fishery 2014 ≤6.5" mesh
5	Test	2	80	PSTF harvest donated to subsistence	yes	yes	Pilot Station sonar test fishery 2014	Pilot Station test fishery 2014
6	Subsistence	3	48	All District 3 harvests	no	no	2013 Y1 & Y2[a] subsistence	Pilot Station test fishery 2014 ≤6.5" mesh
7	Subsistence	4	72	Harvests from mainstem Yukon villages in District 4	no	no	2013 Y4 subsistence	Pilot Station test fishery 2014 ≤6.5" mesh
8	Subsistence	4	60	Harvests from Koyukuk River villages	no	no	Assigned Middle stock	2014 Gisasa
9	Subsistence	5	102	Harvests from mainstem Yukon villages from Tanana to Birch Creek in District 5	no	no	2010-2012 Tanana	2014 Fort Yukon subsistence
10	Subsistence	5	93	Harvests from mainstem Yukon villages from Beaver to Fort Yukon in District 5	yes	yes	2014 Fort Yukon subsistence	2014 Fort Yukon subsistence
11	Subsistence	5	76	Harvests from mainstem Yukon villages upstream of Fort Yukon in District 5	no	no	Assigned Upper stock	2014 Fort Yukon subsistence
12	Subsistence	5	17	Harvests from Chandalar and river villages	no	no	Assigned Upper stock	2014 Fort Yukon subsistence
13	Subsistence	6	284	All District 6 harvests	no	no	Assigned Middle stock	2014 Chena and Salcha rivers
14	All	Canada	103	All harvests in Canada	no	no	Assigned Upper stock	2014 Eagle sonar test fishery

[a] Samples from 7 communities in Districts Y1 and Y2 were pooled into one estimate.

Table 2.–Estimated Chinook salmon stock and age class proportions by harvest group, in 2014.

Harvest group	Stock group	Stock prop.	Age class proportion							
			1.1	1.2	1.3	2.2	1.4	2.3	1.5	2.4
1, 2, 4, 6	Lower	0.465	0.083	0.166	0.642	0.000	0.093	0.005	0.010	0.000
	Middle	0.121								
	Upper	0.414								
3	Lower	0.186	0.002	0.011	0.507	0.000	0.452	0.002	0.016	0.010
	Middle	0.264								
	Upper	0.549								
5	Lower	0.275	0.041	0.095	0.660	0.000	0.187	0.009	0.009	0.000
	Middle	0.302								
	Upper	0.423								
7	Lower	0.094	0.083	0.166	0.642	0.000	0.093	0.005	0.010	0.000
	Middle	0.306								
	Upper	0.600								
8	Middle	1.000	0.008	0.176	0.664	0.000	0.137	0.000	0.015	0.000
9	Lower	0.024	0.105	0.248	0.476	0.000	0.152	0.019	0.000	0.000
	Middle	0.279								
	Upper	0.698								
10	Lower	0.003	0.105	0.248	0.476	0.000	0.152	0.019	0.000	0.000
	Middle	0.044								
	Upper	0.954								
11, 12	Upper	1.000	0.105	0.248	0.476	0.000	0.152	0.019	0.000	0.000
13	Middle	1.000	0.015	0.100	0.692	0.001	0.179	0.003	0.009	0.001
14	Upper	1.000	0.002	0.066	0.503	0.002	0.393	0.008	0.012	0.015

Table 3.–Estimated harvest of Chinook salmon in the Yukon Area apportioned by age class and stock group in 2014.

District	Stock group	1.1	1.2	1.3	2.2	1.4	2.3	1.5	2.4	Total
		Age class								
Coastal	Lower	22	43	168	0	24	1	3	0	262
	Middle	6	11	44	0	6	0	1	0	68
	Alaska	27	55	212	0	31	2	3	0	330
	Upper	19	39	150	0	22	1	2	0	233
	Total	47	93	362	0	53	3	6	0	563
1	Lower	23	46	247	0	90	2	5	1	414
	Middle	6	14	149	0	99	1	4	2	275
	Alaska	29	60	396	0	190	2	9	3	690
	Upper	21	45	371	0	215	2	9	4	666
	Total	49	105	766	0	405	4	19	8	1,356
2	Lower	22	43	175	0	27	1	3	0	271
	Middle	6	13	57	0	11	1	1	0	89
	Alaska	28	56	232	0	38	2	4	0	360
	Upper	20	40	165	0	27	1	3	0	256
	Total	48	96	397	0	65	3	6	0	616
3	Lower	2	4	14	0	2	0	0	0	22
	Middle	0	1	4	0	1	0	0	0	6
	Alaska	2	5	18	0	3	0	0	0	28
	Upper	2	3	13	0	2	0	0	0	20
	Total	4	8	31	0	4	0	0	0	48
4	Lower	1	1	4	0	1	0	0	0	7
	Middle	2	14	54	0	10	0	1	0	82
	Alaska	3	15	58	0	11	0	1	0	89
	Upper	4	7	28	0	4	0	0	0	43
	Total	6	22	86	0	15	0	2	0	132
5	Lower	0	1	1	0	0	0	0	0	3
	Middle	5	12	24	0	8	1	0	0	50
	Alaska	5	13	25	0	8	1	0	0	52
	Upper	25	58	112	0	36	4	0	0	236
	Total	30	71	137	0	44	5	0	0	288
6	Middle	4	28	197	0	51	1	2	0	284
Canada	Upper	0	7	52	0	40	1	1	2	103
Total harvest	Lower	69	139	610	0	145	5	11	1	979
	Middle	30	94	528	0	185	4	9	2	853
	Alaska	99	233	1,138	0	330	8	20	4	1,832
	Upper	90	199	890	0	346	10	16	6	1,558
	Total	189	432	2,028	1	676	18	37	10	3,390

Table 4.–Estimated harvest of Chinook salmon in the Yukon Area by stock group for U.S. and Canada, 1981–2014.

			Upper			
Year [a]	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
2014 [b]	979	853	1,455	103	1,558	3,390
Average						
1981–2013	26,406	31,761	60,613	13,004	73,618	131,786
2009–2013	5,330	11,570	16,837	3,327	20,164	37,064

[a] Subsistence harvests from the Coastal District communities of Hooper Bay and Scammon Bay are not included before 2014.

[b] Includes the 2014 subsistence harvest from Hooper Bay and Scammon Bay.

Table 5.–Estimated harvest (percentage) of Chinook salmon in the Yukon Area by stock group for U.S. and Canada, 1981–2014.

			Upper		
Year [a]	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
2014 [b]	28.9	25.2	42.9	3.0	45.9
Average					
1981–2013	20.0	24.4	45.9	9.7	55.6
2009–2013	14.6	31.3	45.8	8.3	54.0

[a] Subsistence harvests from the Coastal District communities of Hooper Bay and Scammon Bay are not included before 2014.

[b] Includes the 2014 subsistence harvest from Hooper Bay and Scammon Bay.

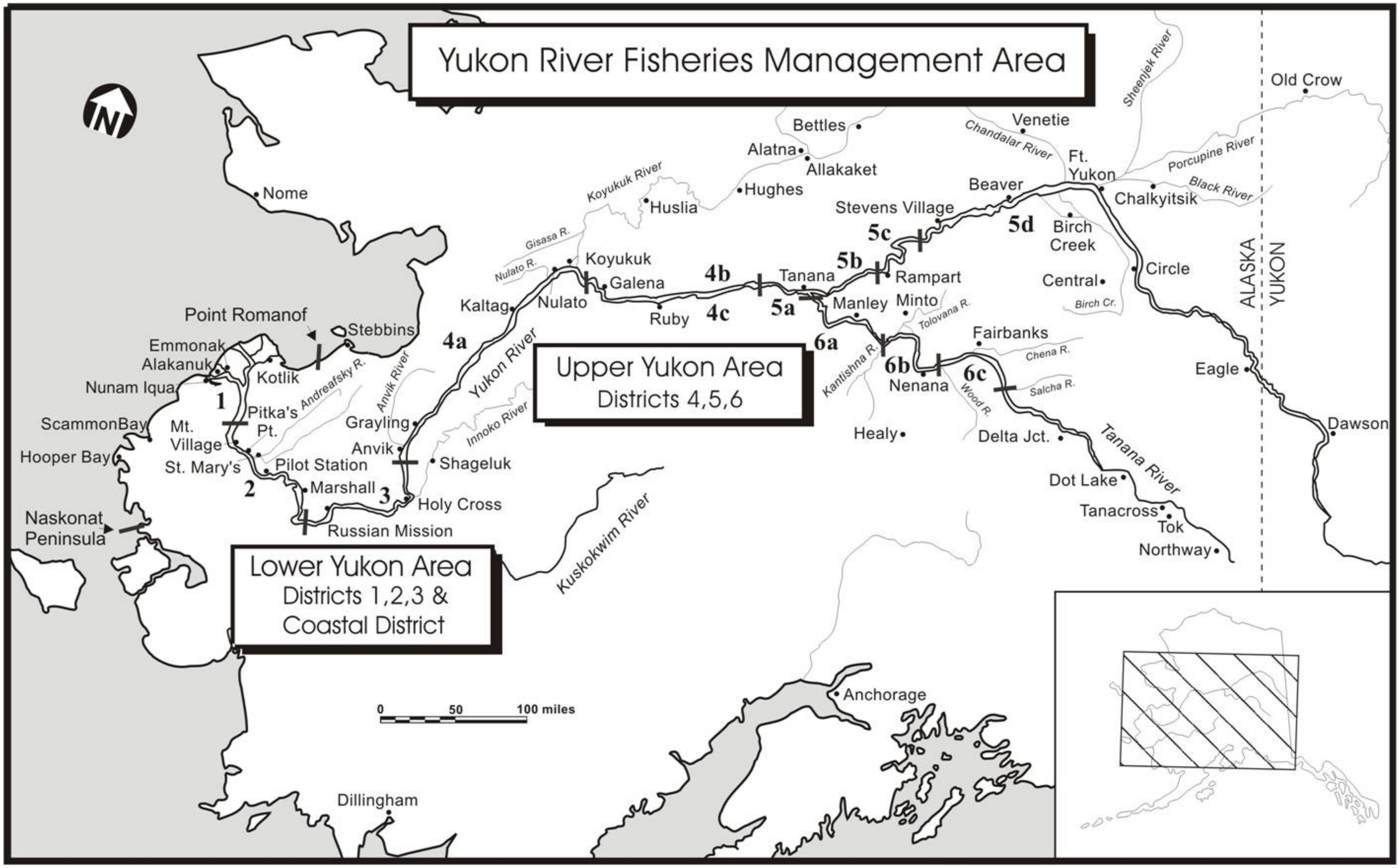

Figure 1.–Alaska portion of the Yukon River drainage with district boundaries and major spawning tributaries.

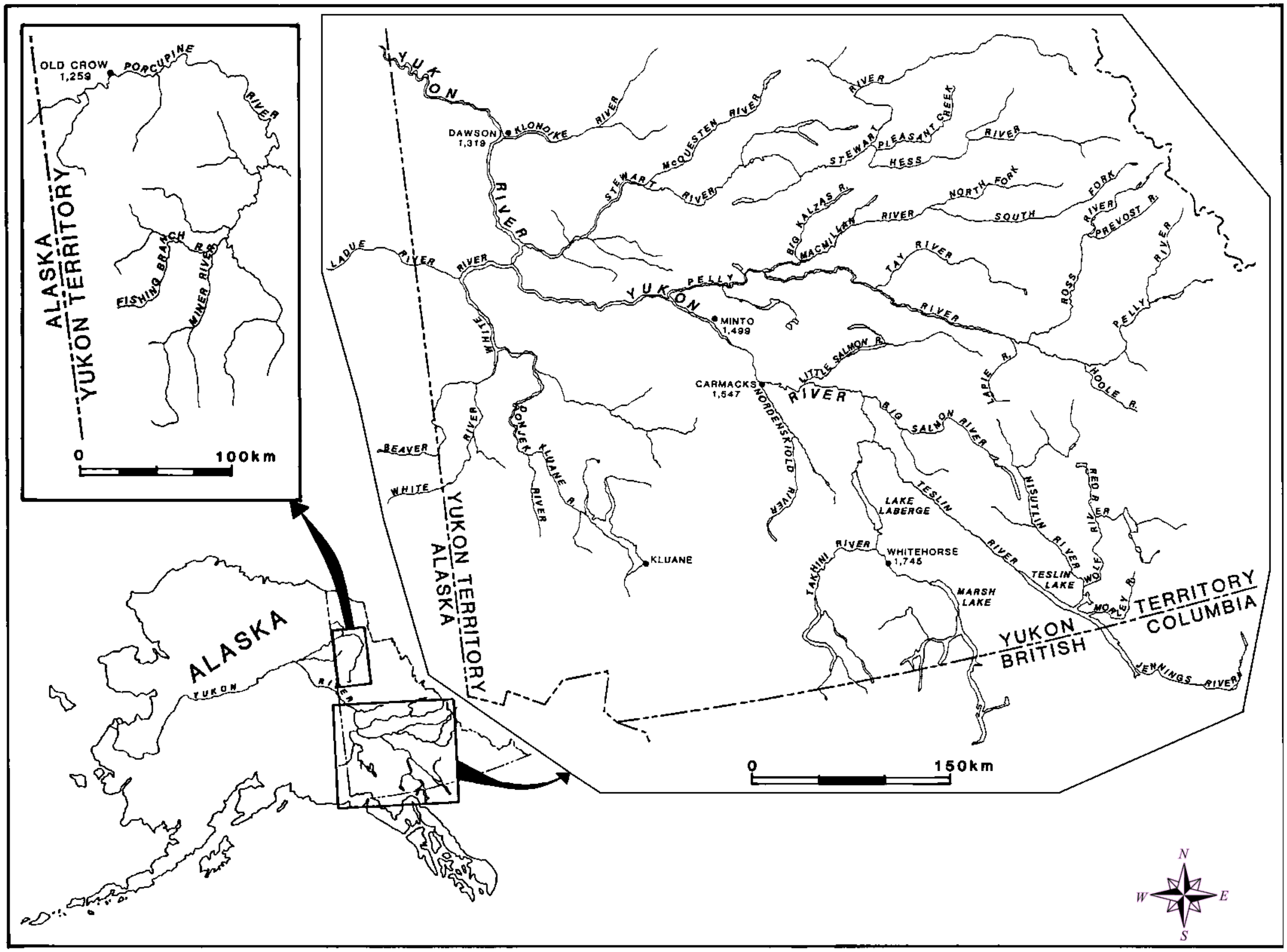

Figure 2.–Canadian portion of the Yukon River drainage and major spawning tributaries.

APPENDIX A

Appendix A1.–Gear used to harvest Chinook salmon in 2014.

Project / fishery	Gear and mesh size
Lower Yukon test fishery	8.5-inch set gillnet
Pilot Station sonar test fishery	2.75-, 4-, 5-, 5.25-, 5.75-, 6.5-, 7.5-, 8.5-inch drift gillnet
Eagle Sonar test fishery	5.25-, 6.5-, 7.5-, 8.5-inch drift gillnet
Fort Yukon subsistence harvest	4-, 5.5-, 6-inch set gillnet
Legal gear in subsistence harvest	≤6-inch gillnet (set and drift), fish wheels

Appendix A2.–Genetic stock composition of Chinook salmon sampled in the Yukon Area by district, project, and fishery, used to estimate harvest by stock group in 2014.

District	Project and fishery	Year sampled [a]	Stock group	Sample size	Estimate	90% CI
1	Lower Yukon	2010–2011	Lower		0.186	[b]
	test fishery	Average	Middle		0.264	
			Upper		0.549	
1 & 2[c]	Subsistence	2013	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	2014	Lower	419	0.275	0.235–0.317
	sonar test fishery		Middle		0.302	0.245–0.362
			Upper		0.423	0.364–0.480
4	Subsistence	2013	Lower	124	0.094	0.007–0.248
	Anvik/Galena/Ruby		Middle		0.306	0.118–0.582
			Upper		0.600	0.336–0.813
5	Subsistence	2010–2012	Lower		0.024	[c]
	Tanana	Average	Middle		0.279	
			Upper		0.698	
5	Subsistence	2014	Lower	114	0.003	0.000–0.014
	Fort Yukon		Middle		0.044	0.004–0.099
			Upper		0.954	0.898–0.994

[a] Data from prior years were substituted when representative data from 2014 were not available.
[b] Stock composition estimates were averaged across years; 90% CI not available.
[c] Samples from 7 communities in Districts Y1 and Y2 were pooled into 1 estimate.

Appendix A3.–Age class composition (percentage) of Chinook salmon sampled in the Yukon Area by district or tributary, project, and fishery, used for analysis in 2014.

Year	District	Project	Sample size	Age class [a] 1.1	1.2	1.3	2.2	1.4	2.3	1.5	2.4
2014	1	Lower Yukon test fishery	615	0.2	1.1	50.7	0.0	45.2	0.2	1.6	1.0
2014	2	Pilot Station sonar test fishery Mesh ≤6.5" (2.75, 4, 5, 5.25, 5.75, 6.5)	193	8.3	16.6	64.2	0.0	9.3	0.5	1.0	0.0
2014	2	Pilot Station sonar test fishery All mesh (2.75, 4, 5, 5.25, 5.75, 6.5, 7.5, 8.5)	444	4.1	9.5	66.0	0.0	18.7	0.9	0.9	0.0
2014	4	Gisasa River escapement	131	0.8	17.6	66.4	0.0	13.7	0.0	1.5	0.0
2014	5	Fort Yukon subsistence	105	10.5	24.8	47.6	0.0	15.2	1.9	0.0	0.0
2014	6	Chena / Salcha rivers escapement	689	1.5	10.0	69.2	0.1	17.9	0.3	0.9	0.1
2014	5	Eagle sonar test fishery	606	0.2	6.6	50.3	0.2	39.3	0.8	1.2	1.5

[a] Percentage by age class were derived from data housed in the ADF&G AYKDBMS (Arctic-Yukon-Kuskokwim Database Management System) website: http://www.adfg.alaska.gov/CommFishR3/Website/AYKDBMSWebsite/DataTypes/ASL.aspx