Fishery Data Series No. 10-39

Age, Sex, and Length Composition of Chinook Salmon from the 2005–2007 Kuskokwim River Subsistence Fishery

Annual Report for Project 05-306
USFWS Office of Subsistence Management
Fisheries Information Services Division

by

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Symbols and Abbreviations

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Weights and measures (metric)

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

Weights and measures (English)

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

Time and temperature

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

Physics and chemistry

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

General

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

Measures (fisheries)

fork length	FL
mideye to fork	MEF
mideye to tail fork	METF
standard length	SL
total length	TL

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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by
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ABSTRACT

Age, sex, and length (ASL) data were collected from Chinook salmon *Oncorhynchus tshawytscha* harvested during the 2005, 2006, and 2007 Lower Kuskokwim River subsistence fishery to characterize the composition of subsistence harvest. Subsistence fishermen from as many as 30 different households spanning 5 different lower river communities sampled 2,799 Chinook salmon in 2005, 1,917 in 2006, and 2,610 in 2007. Respectively, we were able to determine age for 86%, 88%, and 79% of the total scales sampled each year. Fish were caught with a variety of gillnet mesh sizes, but most were caught in gillnets hung with large mesh web (i.e. ≥ 8 inch; 83.0% in 2005, 91.4% in 2006, and 84.1% in 2007). In 2005, the age composition was estimated to include 5.4% age-1.2 fish, 49.8% age-1.3, 42.7% age-1.4, and 1.8% age-1.5, with females comprising 36.7% overall. In 2006, the age composition was estimated to include 6.3% age-1.2 fish, 35.7% age-1.3, 53.3% age-1.4, and 4.1% age-1.5, with females comprising 42.2% overall. In 2007, the age composition was estimated to include 7.3% age-1.2 fish, 36.9% age-1.3, 52.2% age-1.4, and 2.6% age-1.5, with females comprising 41.8% overall. The lower river harvest accounted for 89%, 87%, and 91% of the 2005–2007 total annual Kuskokwim River Chinook salmon subsistence harvests respectively, and the annual ASL composition derived from the Lower Kuskokwim River samples was applied to the total inriver Chinook salmon subsistence harvest in order to estimate total harvest by age and sex. An estimated 70,393 Chinook salmon were harvested from the entire Kuskokwim River in 2005, while in 2006 and 2007 the estimated harvest was 63,177 and 68,645.

Key words: age, sex, length, ASL composition, Chinook salmon, *Oncorhynchus tshawytscha*, Kuskokwim River, subsistence fishery, gillnet, mesh size.

INTRODUCTION

About half of the total statewide subsistence harvest of Chinook salmon is taken from the Kuskokwim River (ADF&G 2001, 2002, 2003a, 2003b, 2005). The 10-year (1995–2004) mean annual Kuskokwim River subsistence harvest was 77,167 fish and comprised over 90% of the total inriver Chinook salmon harvest inclusive of commercial and sport harvest (Whitmore et al. 2008). Exploitation rate is currently unknown due to an inability to thoroughly estimate spawning escapement. However, average total annual run is believed to be between 200,000 and 300,000 fish (Whitmore et al. 2008), which would result in exploitation rates of 26%–38% over the past 10 years. Consequently, the quality of Chinook salmon escapement can be strongly influenced by selective harvest of the subsistence fishery.

Residents throughout the Kuskokwim River drainage rely heavily on Chinook salmon *Oncorhynchus tshawytscha* for subsistence. Alaska Statue 16.05.258 (i.e., Subsistence use and allocation of fish and game) establishes a subsistence use priority for reasonable harvest opportunities consistent with sustained yield management. In accordance with State statute, the Alaska Board of Fisheries (BOF) determined that 64,500–83,000 Kuskokwim River Chinook salmon were reasonably necessary to meet the customary and traditional needs of subsistence users.

Subsistence harvest of Kuskokwim River Chinook salmon occurs in a fishery that can be described as “gauntlet” and “front-loaded” (Hamazaki 2008). Harvest is comprised of mixed salmon stocks that return to discrete portions of the upper, middle, and lower river. Run timings among these stocks overlap considerably; still, Chinook salmon that travel to more distant tributaries generally pass through the Lower Kuskokwim River earlier than fish traveling to less distant tributaries (Stuby 2007). In route to their spawning grounds, stocks are harvested sequentially by communities along the river; consequently, upper river stocks are more susceptible to harvest than lower river stocks. The susceptibility of early running stocks is magnified by the preference of the subsistence fleet to front-load fishing efforts towards the early portion of the run to capitalize on good weather for drying fish that typically occurs in late May and early June (Hamazaki 2008). Kuskokwim Area fishery biologists are particularly interested in the age, sex, and length (ASL) composition of the inriver Chinook salmon subsistence harvest because of the large number of fish taken each year and the early timing of fishing effort.

Accurate assessments of ASL composition of Kuskokwim River Chinook salmon subsistence harvest is necessary for achieving sustainable management as described in Alaska Statute 5 AAC 39.222 and 5 AAC 39.223 (i.e., Policy For The Management of Sustainable Salmon Fisheries and Policy For Statewide Salmon Escapement Goals). Subsistence ASL data are used in conjunction with information from inriver commercial harvest and spawning escapement to provide a more complete understanding of the ASL composition of the entire annual run. Comparison of ASL data collected from subsistence harvest, commercial harvest, and escapement highlights notable differences and guides research and management initiatives (J. C. Linderman, Commercial Fisheries Biologist, ADF&G, Anchorage; personal communication). For example, ASL data are currently being used to develop Kuskokwim River Chinook salmon stock-recruitment relationships (Molyneaux et al. *In prep*) that will form the basis for a variety of investigations (e.g., run forecasting, run reconstruction, exploitation by age and sex class, development of biological escapement goals, and modeling exercises aimed at exploring affects of alternative management strategies and climatic events). Our goal in this report is to present estimates of ASL composition for the 2005–2007 Lower Kuskokwim River Chinook salmon subsistence harvests.

BACKGROUND

Subsistence fishing is an integral and fundamental part of life for residents of the 29 Kuskokwim River communities (Coffing 1991; Coffing et al. 2001; Collins 2004; Holen et al. 2005; Stokes 1985). Subsistence fishing for Chinook salmon occurs throughout much of the 1,500 km length of the Kuskokwim River and in many of its tributaries. Most subsistence harvest occurs in the Lower Kuskokwim River, particularly the Bethel area (Whitmore et al. 2008). Fishing for Chinook salmon typically begins in late May in the lower river and continues through about mid July in the upper river.

Most subsistence fishermen use gillnets to harvest Chinook salmon in the Kuskokwim River (ADF&G 2003a, 2003b, 2005; Fall et al. 2007; Whitmore et al. 2008); however, beach seine, rod and reel, fish wheel, and spear may also be used (5 AAC 01.270). The aggregate length of gillnets (set or drift) cannot exceed 50 fathoms. Gillnets with 6-inch or smaller mesh must be less than 45 meshes deep, and nets with greater than 6-inch mesh may not exceed 35 meshes in depth. The mesh size used by subsistence fishermen is not regulated, and large mesh nets (i.e., ≥8 inches stretched) are most common (ADF&G 1968; Francisco et al. 1995; Molyneaux et al. 2005). The specific proportion of fishermen using large mesh nets is not known, but the proportion is believed to be high based on existing survey data and comments from members of the Kuskokwim River Salmon Management Working Group (Working Group). Large mesh size is preferred because it simultaneously targets large Chinook salmon while avoiding smaller fish species whose abundance at times greatly exceed Chinook salmon. Understanding the ASL composition of subsistence harvest is essential given selectivity of the fishing gear for larger fish, which are often older-aged females (Molyneaux and Folletti 2007; Molyneaux et al. 2008).

Historically, subsistence harvest ASL composition was estimated from commercial harvest samples (e.g. Huttunen 1986). Until 1985, this practice was a reasonable surrogate because timing of subsistence and commercial harvests overlapped, both fisheries targeted Chinook salmon and both fisheries had unrestricted gillnet mesh size. After 1985, however, the commercial fishery was "restricted" to ≤6 inches mesh sizes, which resulted in the commercial harvest ASL composition no longer being representative of subsistence harvest. Consequently, ADF&G staff opportunistically sampled subsistence-caught Chinook salmon (Anderson 1991). Unfortunately, freshly caught fish were often unavailable and samplers would collect scales from partially processed fish. In these instances, sex and length could not be determined and sex composition was inappropriately generalized from the "restricted" commercial fishery (e.g., Anderson 1995; Huttunen 1986).

More recently, modest efforts to collect formal ASL data from subsistence-caught Chinook salmon occurred in 1993, 1994, and 1995 as a pilot project that relied on subsistence fishermen and their families to collect the data (Molyneaux et al. 2008). The initiative was discontinued due to a lack of resources to oversee the program, but it was reestablished and expanded in 2001 through resources provided by the United States Fish and Wildlife Service Office of Subsistence Management (OSM) in coordination with ADF&G Division of Commercial Fisheries, and various Tribal organizations (DuBois et al. 2002). From 2001 to 2003, OSM funded 3 separate projects aimed at characterizing the ASL composition of subsistence-caught Chinook salmon in the upper, middle and lower river respectively: FIS 01-023; 01-225; and 01-132. Each project relied on a partnership between ADF&G and a local Tribal organization from that portion of the river (Molyneaux et al. 2004a, b). Since 2003, only the Lower Kuskokwim River project has been continued by OSM (project numbers FIS 04-354 and 05-306).

ADF&G Division of Commercial Fisheries began estimating total subsistence harvest in 1960, but the duty was transferred to the Division of Subsistence in 1988. The surveys provided a subsistence harvest estimate for each Kuskokwim Area community. Community totals were summed to estimate total harvest for the Kuskokwim Area. Gear types used for subsistence salmon harvest have been reported since 1996. However, details about mesh size were not typically published, and there has been potential for confusion because fishermen often harvest Chinook salmon with a variety of gillnet mesh sizes (ADF&G 1968; T. Krauthoefer, Division of Subsistence, ADF&G, Bethel; personal communication).

The Alaska Board of Fisheries designated Kuskokwim River Chinook salmon as a stock of "yield concern" in October of 2000 (Burkey et al. 2000), and the finding was continued following the BOF meeting in September of 2003 (Bergstrom and Whitmore 2004). This designation resulted from a general failure to achieve escapement goals in 1998, 1999, and 2000 despite low commercial fishing effort. As part of this finding, the BOF adopted the Kuskokwim River Salmon Management Rebuilding Plan in 2001 which outlined a fishing schedule for subsistence fishermen. The subsistence fishing schedule limited fishing with gillnets and fish wheels to 4 consecutive days each week in June and July (5 AAC 07.365; 2004). It was within the authority of the fishery manager to modify or discontinue this schedule if salmon abundance was adequate to achieve escapement and subsistence needs. The objective of the fishing schedule states: "Reduce subsistence harvest early in the season, when there is a much higher level of uncertainty in projecting total run abundance, and spread subsistence fishing opportunity among users" thereby providing a "reasonable opportunity for all subsistence users" (Burkey et al. 2000). In addition, it was believed the subsistence fishing schedule would reduce harvest of large female Chinook salmon which are typically more abundant early in the season. By Emergency Order Authority, ADF&G fishery managers could discontinue the fishing schedule inseason, but only after compelling evidence suggested that escapement and subsistence needs were being achieved. Such was the case in 2005 and 2006 when improved Chinook salmon abundance led to lifting the subsistence fishing schedule by mid June of each year (Linderman and Bergstrom 2006).

The BOF rescinded the stock of yield concern designation at their 2007 meeting at the recommendation of ADF&G following several years of expected harvests and relatively strong escapements (Linderman and Bergstrom 2006). The subsistence fishing schedule was retained in the management plan to be implemented when warranted. The general management strategy since discontinuing the Chinook salmon stock of concern designations was to implement the subsistence fishing schedule if there was compelling evidence that Chinook or chum salmon runs were considerably below average.

OBJECTIVES

1. Describe the annual ASL composition of Chinook salmon in the lower Kuskokwim River subsistence harvest.
2. Characterize the annual ASL composition of Chinook salmon in the lower Kuskokwim River subsistence harvest by gear type (e.g., gillnets with mesh of ≤6 inches, gillnets with mesh of ≥8 inches, rod and reel).
3. Characterize and compare the annual ASL composition of Chinook salmon in the lower Kuskokwim River subsistence harvest by temporal strata (i.e., fish harvested for early, middle and late portions of the run).
4. Estimate total harvest of Kuskokwim River Chinook salmon by age and sex.

METHODS

STUDY AREA

The study area was selected to approximate the W-1 commercial fishing district (Figure 1). Specifically, the study area included the Kuskokwim River mouth upstream to the community of Tuluksak (rkm 192). North Kuskokwim Bay communities of Kipnuk, Kwigillingok, and Kongiganak typically subsistence fish within the Kuskokwim River, so their harvest was also allocated to the Lower Kuskokwim River.

STUDY DESIGN

From 2005 to 2007, a grab sample design (Geiger et al. 1990) was used to sample the Lower Kuskokwim River subsistence Chinook salmon fishery. ADF&G partnered with Orutsararmiut Native Council (ONC) located in Bethel, AK with the goal of recruiting as many subsistence fishermen as possible throughout the study area to participate in the data collection efforts. Potential participants were contacted based upon referrals from community organizations and respected community members. During the recruitment process, all were encouraged to participate regardless of fishing preferences (i.e., preferred gear type, fishing strategy, timing etc.). Participants were selected based in large part on their willingness to sample all season and to sample all fish caught during each harvest event.

Participating subsistence fishermen were instructed to sample as many fish as possible from their own catches and from catches harvested by their friends or neighbors (i.e., non-participating fishermen). Sampling effort was to be conducted consistently by each participant throughout their respective fishing season, in order to accurately represent harvest by time, space, and gear type. A tentative sample goal of 2,000 fish was set for budgetary purposes only (i.e., the sample goal was not set to achieve a particular level of statistical accuracy or precision). ONC coordinated sampling efforts from the community of Napaskiak (rkm 97) to the mouth of the Gweek River (rkm 135) with the tentative goal of sampling 1,500 fish (Figure 2). ADF&G coordinated efforts in the remaining portion of the study area with the goal of sampling 500 fish. The majority of samples were assigned to ONC, because their responsibility included the community of Bethel, which is the major population center in the region. Sample limits were not placed on individual participants to encourage sampling throughout their entire harvest period. Participating fishermen were compensated monetarily per fish sampled.

Researchers felt that encouraging as many subsistence fishermen to participate as possible from throughout the study area was the most cost effective way to collect representative samples with respect to gear usage, timing, and location of harvest. This approach was based on the assumption that the grab sample strategy would result in a representative "self weighted" dataset, because the data were dependent on the availability of fish harvested, and a large number of participants would represent the preferences of the subsistence fleet. The grab sample design differs from random sampling and systematic sampling in that subsistence-caught fish have an unequal probability of being sampled and every i^{th} fish may not be sampled. Our study design may not optimize sampling efforts with respect to statistical accuracy. However, our emphasis on public participation and budget constraints creates practical limits to implementing other sampling designs.

Several assumptions are explicit in our study design. We assume (1) that our samples are representative of the harvest by gear type, (2) that sampling effort is proportional to harvest through time, and (3) that pooled samples across time represent the true ASL composition of the season total harvest for the Lower Kuskokwim River Reporting Area. The appropriateness of these stated assumptions affect the accuracy of our estimates and any conclusions that we can draw from the observed ASL patterns with respect to time, area, and gear.

DATA COLLECTION

As dictated by the study design, Chinook salmon ASL data were collected by non-ADF&G personnel. Participants ranged from subsistence fishermen, subsistence household members, and local community members. Although an attempt was made to recruit participants from throughout the study area, not all communities were represented. From 2005 to 2007 samples were collected by residents of Kwigillingok (Kuskokwim Bay) Tuntutuliak (rkm 45), Eek (rkm 46), Napaskiak (rkm 97), Oscarville (rkm 97), Bethel (rkm 106) and Akiachak (rkm 143; Figure 2); although, not all communities participated in all years. The entire study area was likely well represented given the spatial distribution of the participating communities and that most fish were sampled from fish camps which were dispersed along the river corridor.

All participants received formal training in sampling techniques by ADF&G and ONC staff. Training was based on ADF&G's salmon ASL sampling procedures outlined by Molyneaux et al. (2008). Staff conducted follow-up visits throughout the season to provide additional guidance, support, and ensure data quality. Each participant was provided a sampling kit, which included: data forms (Appendix A1); detailed instructions (Appendix A2); a clip board; forceps; scale cards; wax paper inserts; and a meter stick. At the beginning of each sampling event, participants recorded the following: participant's name; date and location of capture; gear type used including details such as mesh size; and beginning in 2006, participants also recorded whose harvest their samples came from, in order to better document the total number of households sampled. ASL data were collected from each harvested fish. Sex was determined by cutting the abdomen and inspecting the gonads. Fish length was measured to the nearest mm from mideye to tail fork with a straight edge meter stick. A total of 3 scales were collected from each fish for age determination by ADF&G biologists. Scales were removed from the preferred area of the fish and mounted to scale cards so that the raised annuli were oriented outward (Appendix A2; INPFC 1963). Biological data were numbered so that ASL characteristics could be matched to each fish sampled, and all samples collected during a unique harvest event were organized together.

AGE DETERMINATION

Scales, mounted on gum cards, were impressed in clear cellulose acetate using methods described by Clutter and Whitesel (1956). The scale impressions were magnified with a microfiche reader, and age was determined by counting the number of annuli. Ages were reported using European notation, which consists of two digits separated by a decimal. The digit to the left of the decimal refers to the number of freshwater annuli, and the digit to the right of the decimal refers to the number of marine annuli. Total age, which begins at the time the egg is deposited, is equal to the sum of the 2 digits, plus one to account for the period of egg incubation and prior to when scale formation begins.

DATA SUMMARIES AND REPORTING

Objectives 1–3 were addressed by summarizing the annual Lower Kuskokwim River subsistence Chinook salmon ASL data into 3 tables. The first table reports the number of samples collected from each participating community by gear type. This table illustrates the most common gear types used by local subsistence fishermen to harvest Chinook salmon, and it provides insight into the spatial distribution of our samples. The next table reports age and sex composition for the entire sample stratified by gear type and time. Similarly, the final table reports mean length for the entire sample stratified by age class, sex, gear type, and time. The sample size, standard error (SE), and ranges are provided for context when applicable. For summary purposes, data from set and drift gillnets were pooled and data were stratified by mesh size. "Small mesh nets" were defined as any stretch mesh measuring ≤6 inches; while, "large mesh nets" were defined as any stretch mesh measuring ≥8 inches. All mesh sizes >6 and <8 inches stretched were termed "intermediate mesh nets". Stratification was determined postseason based on dates when samples were collected.

Objective 4 was addressed by applying the annual Chinook salmon ASL composition from the Lower Kuskokwim River subsistence harvest to the total Kuskokwim River inriver subsistence harvest, which includes the middle and upper portions of the drainage. Annual estimates of total inriver subsistence harvest were estimated independent of this study by the ADF&G Division of Subsistence (Fall et al. 2007, 2009a, and 2009b). Total subsistence harvest was estimated for each community through a combination of house-to-house surveys, survey postcards, and catch calendars as described in Whitmore et al. (2008). Estimates include an expansion to account for individuals or communities not surveyed in a particular year; although, those expansions are somewhat incomplete for communities with limited survey participation. Community totals are summed to estimate total harvest for the entire Kuskokwim River.

RESULTS

SAMPLE SIZE AND DISTRIBUTION

In 2005, 30 participants sampled 2,799 Chinook salmon from the Lower Kuskokwim River subsistence harvest (Table 1). Some participants may have collected samples from households in addition to their own, but it was not documented. Most samples were collected by participants who resided in Bethel (58.0%) followed by Tuntutuliak (26.6%), Oscarville (8.8%), Eek (6.1%), and Napaskiak (0.5%). Gillnets were the only gear type participants reportedly used for catching sampled fish. Mesh sizes ranged from 5-3/8 to 8-1/4 inches. Nets hung with large mesh sizes accounted for 83% of fish sampled, followed by small mesh (9.3%), and then intermediate mesh (7.7%). Age was estimated for 2,408 (86%) of fish sampled.

In 2006, 20 participants sampled 1,917 Chinook salmon from the Lower Kuskokwim River subsistence harvest (Table 2). A minimum of 3 additional households were sampled by participants; these were households in addition to their own, but details about these additional households is limited (e.g. location fished). Most samples were collected by participants who resided in Bethel (58.2%) followed by Tuntutuliak (34.5%), Eek (3.7%), and Napaskiak (3.7%). Gillnets and rod and reel were the only gear types participants reportedly used for catching sampled fish. Gillnet mesh sizes ranged from 7-1/4 to 8-1/2 inches. Nets hung with large mesh sizes accounted for 91.4% of fish sampled, and intermediate mesh sizes accounted for the remaining 8.5%. Participants did not report use of any small mesh nets. Age was estimated for 1,688 (88%) of fish sampled.

In 2007, 27 participants sampled 2,610 Chinook salmon from the Lower Kuskokwim River subsistence harvest (Table 3). A minimum of 5 additional households were sampled by participants, these were households in addition to their own, but details about these additional households is limited (e.g. location fished). Most samples were collected by participants who resided in Bethel (53.3%) followed by Tuntutuliak (37.4%), Akiachak (6.7%), and Kwigillingok (2.6%). Gillnets were the only gear type participants reportedly used for catching sampled fish. Gillnet mesh sizes ranged from 5-1/2 to 8-1/4 inches. Nets hung with large mesh sizes accounted for 84.1% of samples, followed by small mesh (10.8%), and then intermediate mesh (5.1%). Age was estimated for 2,050 (79%) of fish sampled.

ASL COMPOSITION OF THE LOWER RIVER CHINOOK SALMON SUBSISTENCE HARVEST

Age-1.3 and -1.4 fish collectively accounted for nearly 90% of the Chinook salmon sampled (Tables 4–6). In each year, males were the more common sex (range: 57.8–63.3%). Males predominated by a wide margin among age-1.1, -1.2, and -1.3 fish (range: 76.4–81.9%). Females were modestly more common among age-1.4 and -1.5 fish (range: 52.7–59.9%). A broad range of fish lengths were represented in the samples (range: 370–1,100 mm), with length tending to increase with age, and females tending to be larger at age than males (Tables 7–9).

ASL COMPOSITION OF THE LOWER RIVER CHINOOK SALMON SUBSISTENCE HARVEST BY GEAR TYPE

Age-1.3 and -1.4 Chinook salmon were generally the 2 most common age classes in each of the 3 gillnet mesh size categories (Tables 4–6, Figure 3). The exception was in 2007 when age-1.2

fish made up the majority (44.3%) of the small mesh samples (Table 6). The percentage of age-1.2 fish was notably greater in small mesh than the intermediate and large mesh sizes, in the 2 years when small mesh gillnets were represented in the samples (2005 and 2007). In each year, the percentage of age-1.3 fish was similar regardless of mesh size. In 2005 and 2006, the percentage of age-1.4 Chinook salmon increased slightly with increasing mesh sizes (Tables 4 and 5). In 2007, this pattern was not observed when age-1.4 fish accounted for 22.6%, 62.4%, and 53.5% of the small, intermediate, and large mesh samples respectively (Table 6). Age-1.5 fish accounted for 0.9% to 6.6% of the samples across all years and mesh sizes categories, and their occurrence was least common in the small mesh category.

Sex composition of the subsistence samples was skewed towards male Chinook salmon in all years and all mesh size categories (Tables 4–6). The percentages of males ranged from 52.1–75.7% across all years and mesh size categories and were highest in the small mesh category. In 2005, the percentage of females increased with increasing mesh size, but in 2006 and 2007 the intermediate mesh had the highest percentage of females.

Length ranges of the Chinook salmon overlapped broadly across all age, sex, and mesh size categories (Tables 7–9). Identifying trends in the length data was difficult due to small sample sizes that resulted after stratifying data by age, sex, and mesh size categories; still, there did appear to be some general patterns. In each mesh size category, mean length tended to increase with increasing age for both males and females. Also, mean length at age increased with increasing mesh size for both males and females, especially when comparing samples from small mesh nets to intermediate or large mesh net. The difference in mean length at age when comparing between intermediate and large mesh nets was typically small for both males and females; in fact, intermediate mesh nets often caught larger fish than did large mesh gillnets.

INTER-ANNUAL SHIFTS IN ASL COMPOSITION OF LOWER RIVER CHINOOK SALMON SUBSISTENCE HARVEST

In each year, large mesh gillnets were the only gear type in which samples were consistently collected; consequently, temporal shifts in ASL composition were only investigated for samples collected from large mesh nets. Age-1.3 and -1.4 fish were the most common age classes in each temporal stratum and provided the most meaningful opportunity to investigate inter-annual shifts in age composition. Considering all 3 years, there was little indication for a consistent shift in age composition over time; often, the change in proportions between strata was greater than the change from the first to last stratum (Tables 4–6, Figures 4 and 5). In 2005, there was a general tendency for the percentage of younger-aged fish to increase as the season progressed and for the occurrence of older-aged fish to decrease (Table 4). The percent contribution of age-1.3 fish in the samples increased from 43.0% to 52.9%, while age-1.4 fish decreased from 50.0% to 39.5% (Table 4, Figure 4). The pattern was again seen throughout most of 2006; although, the last strata did not conform (Table 5, Figure 4). In 2007, there was no consistent directional change in age composition over time (Table 6, Figure 4). Although sample sizes were low, occurrence of less common age classes (e.g., age-1.2 and -1.5) generally supported this trend in 2005 and 2006 but not in 2007.

Sex ratios changed considerably across temporal strata (Tables 4–6, Figure 6). Although not consistent across years, the percentage of females tended to increase as the season progressed. The pattern was most evident in 2007 when the percentage of females in the sample increased from 20.0% to 63.6%.

Mean length at age for both males and females varied across temporal strata, but there was no consistent pattern (Tables 7–9, Figure 7). Age-1.3 and -1.4 fish were the only age classes with large samples sizes in each stratum, and neither had consistent inter-annual patterns for males or females. In 2005, the difference between the minimum and maximum mean length of age-1.3 and -1.4 males and females across all 5 strata was <3 cm (Table 7). In 2006 and 2007, that difference increased, but it was still relatively small (generally <9 cm; Tables 8 and 9); although, sample sizes were generally low. Similarly, each year age-1.2 males showed little change in mean length across strata (<3 cm).

AGE AND SEX COMPOSITION OF TOTAL KUSKOKWIM RIVER CHINOOK SALMON SUBSISTENCE HARVEST

Fall et al. (2007, 2009a, and 2009b) reported that the total inriver subsistence harvest of Kuskokwim River Chinook salmon was 70,393 in 2005, 63,177 in 2006, and 68,645 in 2007. Fish harvested from the Lower Kuskokwim River (Tuluksak downstream to Eek, plus north Kuskokwim Bay communities) accounted for 89% of the total Kuskokwim inriver subsistence harvest in 2005, 87% in 2006, and 91% in 2007. Findings for the lower river age and sex composition were applied to total inriver subsistence harvest estimates to generate total annual subsistence harvest estimates by age and sex for the entire Kuskokwim River (Table 10). Age-1.3 and -1.4 fish accounted for most of the annual catch. Harvest estimates for age-1.3 fish were 35,021 in 2005, 22,569 in 2006, and 25,348 in 2007. Harvest estimates for age-1.4 fish were 30,081 in 2005, 33,673 in 2006, and 35,863 in 2007. More males were harvested than females each year: 2005 had 44,580 males compared to 25,813 females; 2006 had 36,491 males to 26,686 females; and 2007 had 39,948 males to 28,697 females.

DISCUSSION

ASL COMPOSITION OF THE LOWER RIVER CHINOOK SALMON SUBSISTENCE HARVEST

Study Design

We assume in this study that (1) sampling was proportional among gear types consistent with the proportion of actual harvest by gear type, (2) sampling effort across time was proportional to the actual harvest effort across time, and (3) pooling of samples across time adequately represents actual ASL composition of the Lower Kuskokwim River subsistence Chinook salmon harvest. However, it was not possible to formally test the degree to which these assumptions were met.

The percentage of subsistence-caught Chinook salmon harvested by gear type, time, and area is largely unknown; consequently, there are limitations and constraints to creating a sampling design to represent actual ASL composition (DuBois et al. 2002; Molyneaux et al. 2004a; b, 2005). Within budget constraints, our strategy was to simply recruit as many participants as possible and to collect as many samples as possible under the assumption that this methodology would be self-weighted toward (1) the most commonly used gear types, (2) the time when most fish are harvested, and (3) the locations most subsistence users fish. This strategy further assumes that a sufficient number of fishermen participate each year so that a representative range of gear types, fishing times, and locations is reflected in the dataset.

Attracting effective participation among subsistence fishermen was an annual challenge. The partnership between ADF&G and ONC facilitated this effort by sharing local contacts, pooling communication and training resources, and fostering trust among local fishermen. Still, the primary enticement for subsistence fishermen to participate in this program was payment for the information they collect. Critics suggest that payment creates an incentive for dishonest sampling practices, but to date we have few known incidences of such dishonesty. Even with the monetary incentive, our experience was that over half the individuals annually trained and outfitted with sampling kits ultimately decided not to participate. Reasons given for not following through include the tedium of the task, inadequate monetary compensation, and difficulty in modifying the fish processing routine in order to accommodate sampling needs. The simplified data form has helped (Appendix A1); still, the task of recording and organizing information was at times daunting enough to dissuade many prospective participants. We continue to foster our relationship with participating fishermen by sharing the results of our finding postseason through handouts (e.g., Appendix A3) and community meetings.

Despite the obstacles, enlisting participation of local subsistence fishermen has resulted in much improved information over what agencies have been able to collect when acting alone. Formerly, ADF&G staff attempted to characterize the ASL composition of the subsistence harvest by using commercial catch samples as a surrogate (e.g., Anderson 1995; Huttunen 1986; Molyneaux and Samuelson 1992), a practice that was not appropriate in all years due to differences in gear types between the two fisheries. Alternatively, staff opportunistically traveled to fish camps to sample freshly caught Chinook salmon (e.g., Anderson 1991; DuBois and Molyneaux 2000), but efforts were largely unproductive due to limited coordination with local fishermen. The result was often an imposition on host subsistence fishermen, small sample sizes, uncertainty about the gear type used (especially gillnet mesh size), and incomplete sex and length data. Our practice of hiring local subsistence fishermen to sample their own catches and the catches of their neighbors was vastly superior to previous methods, and is arguably the most cost effective means for collecting data of sufficient quantity and quality to reasonably estimate actual subsistence harvest ASL composition.

Regardless of the number of participating fishermen, representing the full range of fishing gears and strategies is difficult, if not impossible, to achieve. Many gear types are used when targeting Chinook salmon, but gillnets are by far the most prevalent. Gillnets, however, can be fished either as set or drift nets, have different depths, and can be hung along a continuum of mesh sizes and “hanging ratios” (which refers to how loosely the web is hung to the cork line). In addition, fishermen often switch between gillnets as the season progresses. All of these variables influence the resulting harvest ASL composition. Rather than attempting to represent all the possible gear types used, our aim was to represent the most common.

Ideally, subsistence-caught Chinook salmon would be sampled throughout the lower river proportional to where they are harvested. Our approach towards this aim was to recruit the participation of many fishermen from throughout the study area with the idea that more heavily populated areas would be represented by more participants. Bethel is the main population center in the lower river and annually accounted for 53.3% to 58.2% of sample collection. We report the proportion of participants by resident community. Samples, however, are typically collected from the participant’s fish camps, which are distributed throughout the lower river corridor. In addition, we encouraged participants to sample fish from neighboring fish camps in order to further improve the spatial distribution of our sampling effort. Unfortunately, documentation of the extent that additional fish camps were sampled is likely incomplete, so the reported number of households sampled was conservative. Beginning in 2006 the data forms were updated to better facilitate participants documenting whether they sampled someone else's harvest. The extent to which this option was used is largely unknown. Additional focus on this issue is warranted during preseason training.

ASL Composition by Gear Type

Each year the vast majority of our samples were collected with gillnets, specifically large mesh gillnets. Interpreting the adequacy of the proportion of samples collected by each mesh size is difficult because data representing the true proportional use across all subsistence fishermen is confounded. In 1967, of 588 fishing families surveyed, 517 (88%) reported using "king nets" (which we believed to be consistent with our large mesh category of ≥8 inch mesh) and 71 (12%) reported using "chum nets" (small ≤6 inch mesh) for subsistence fishing (ADF&G 1968). The 1994 annual subsistence survey included information about the gillnet mesh sizes that fishermen used to harvest Chinook salmon, and 51% of 497[1] respondents reported using large mesh sizes, 44% used small mesh sizes, and 5% used intermediate size mesh (Francisco et al. 1995). Present-day gear usage is thought to be closer to that reported in 1967 than 1994 based on comments from members of the Kuskokwim River Salmon Working Group, as well as from formal interviews with subsistence fishermen along the river. Indeed, we suspect the 1994 findings might be in error due to some nuances in how survey questions were asked, but we cannot substantiate the concern.

We believe that samples collected by participating fishermen adequately represented the gear types most commonly used by Lower Kuskokwim River subsistence fishermen. Working Group members confirm that lower river subsistence fishermen prefer gillnets hung with large mesh web when targeting Chinook salmon. The ADF&G Division of Subsistence reported that from 2005–2007, gillnets (set and drift) were the most common gear type used (Table 11; Fall et al. 2007, 2009a, and b), but they did not report details on mesh size. From 2005 to 2007, formal inseason interviews were conducted as part of an independent subsistence catch monitoring program operated by ONC in consultation with ADF&G (Martz and Dull 2006; Dull and Shelden 2007; Smith and Dull 2008). Data collected during the period of most intense Chinook salmon fishing show, in all 3 years, that all contacted fishermen used gillnets. More specifically, 90% of fishermen interviewed in 2005 reported using only mesh sizes larger than 6 inches, 74% in 2006, and 79% in 2007. Given the available information, we assert that our samples are likely an adequate representation of harvest by gear type and mesh size in the Lower Kuskokwim River.

From 2005 to 2007, ADF&G Division of Subsistence found that 11–13% of lower Kuskokwim River households reported using rod and reel for catching some fraction of their Chinook salmon subsistence harvest (Table 11; Fall et al. 2007, 2009a, and b), but that gear type was largely unrepresented in our samples. Findings by the Division of Subsistence only documents the percent of households that reported using a particular gear type at some point during the season to harvest Chinook salmon, rather than the percent of harvest by gear type. Given our knowledge of local harvest practices and the inefficiency of rod and reel gear relative to gillnets, we believe it is unlikely that a large portion of the lower Kuskokwim River Chinook salmon subsistence harvest was taken with rod and reel.

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[1] Francisco et al. (1995) lists total respondents as 490 (p. 29 and Table 26); however, as per discussion with Michael Coffing (ADF&G, Division of Subsistence, Bethel), the actual number of respondents was 497. The percentages presented in this report have been corrected accordingly.

In 2006, none of the fishermen that participated in this study reported using small mesh gillnets to harvest Chinook salmon, but we recognize that this is unlikely to be true among all subsistence fishermen in the lower river that year. Still, small mesh nets are not a dominant mesh size for harvesting Chinook salmon because of fishermen's interest in avoiding incidental catch of chum salmon inherent with smaller mesh sizes. The 2006 inseason interviews with lower river subsistence fishermen indicated that only about 12% of families were using small mesh nets when Chinook salmon were in greatest abundance (Dull and Shelden 2007). We assert that our inability to represent the Chinook salmon harvest from small mesh gear likely had little influence on the total estimated age composition for the lower river.

Our results suggest that use of different mesh sizes may affect Chinook salmon escapement in different ways. All mesh sizes are capable of harvesting the full range of ages, sexes, and lengths; however, the proportional harvest of each ASL category is different depending on the mesh size used. Our study indicates that larger mesh nets are more selective for older, larger, female Chinook salmon compared to small mesh gear, which is consistent with studies in other river systems. For example, in the Yukon River, Howard et al. (2009) demonstrated that larger mesh sizes tend to catch larger individuals (in length, weight, and girth), older individuals, and a greater proportion of females. Their study also documented a striking reduction in the proportion of large individuals (i.e., >900 mm METF) when mesh sizes less than 8 inches were used. Similarly, Bromaghin (2005) used net selectivity models to demonstrate that large mesh nets disproportionally select for larger Chinook salmon, and the resulting escapements would be skewed towards smaller individuals.

Inter-annual Shifts in ASL Composition

It was necessary to annually sample subsistence-caught Chinook salmon proportional to harvest over time in order to characterize both the ASL composition of the overall lower river harvest and to investigate inter-annual shifts in ASL composition. Our strategy was to encourage participants to sample all the Chinook salmon they harvested over their entire fishing season. In all years, sampling kits were generally distributed and training conducted before the start of local subsistence fishing activities. Based on the timeliness of training, the distribution of sample dates, and regular discussions with local fishermen we feel confident that sampling occurred throughout the season and in relative proportion to the harvest.

The results of our study suggested that ASL composition of the Chinook subsistence harvest in the Lower Kuskokwim River did change as the run progressed. Although evidence was not strong in all years, there was a general tendency for the percent contribution of older-aged fish to decrease as the season progressed while the percentage of females increased. These results were not unexpected. Researchers have routinely documented the tendency for female Chinook salmon to arrive at Kuskokwim River spawning grounds later than males (e.g., Molyneaux et al. 2008), and given the higher percentages of females later in the year, our results agree. Quinn (2005) describes an often observed pattern of older or larger fish preceding smaller fish within the migration of a particular stock and across larger mixed stocks. However, these two patterns seem at odds. Females are typically older and larger at age than males, and thus we expected the proportion of older aged fish to increase as the run progressed as a result of an increasing female component. We do not feel that the observed patterns were a product of aging or sexing errors. ADF&G stock biologists aged all scales using proven standardized methods. DuBois and Liller (*In prep*) investigated ADF&G's consistency when aging Yukon River Chinook salmon and showed that ADF&G aging methods produce estimates consistent with other independent scale aging labs. In addition, participating fishermen determined sex of each fish by inspecting the gonads, a considerably more accurate method compared to visual inspection of external sexual characteristics. The detection of more decisive inter-annual trends was likely confounded by a combination of several factors: selectivity of the dominant gear type; disparity in sample sizes across strata; and limitations on the number and variety of participating fishermen. Considering that the objective was to detect temporal shifts in ASL composition for the overall subsistence harvest, analysis in future years should apply a temporal stratification across pooled samples using all gear types. This approach would likely better capture any effects of changing gear preferences as the season progresses and be more appropriate for identifying temporal shifts in ASL composition in the subsistence harvest.

Data Quality

Efforts to monitor and maintain the quality of information collected were made through careful training of prospective participants, followed by repeat site visits, and careful review of the information participants submit. Participants were encouraged to submit samples early and often throughout the season to allow program managers timely opportunity to inspect for problems; however, this was not always achieved. The 4 primary challenges we experienced were: 1) helping participants keep information organized so that fish scales can be matched with the sex and length data; 2) ensuring that participants were diligent about confirming the sex of fish; 3) ensuring participants measured fish to the nearest millimeter rather than rounding; and 4) encouraging participants to keep track of how many households they sample.

Data quality challenges were addressed in large part through training and encouraging diligent samplers to return each year to participate in the program. As this program developed, staff biologists identified innovative ways to tailor training methods, revise instruction materials, and clarify data forms in ways that enhanced sampling efficiency and effectiveness. Biologists also made repeated visits to participating fish camps to support samplers by providing additional demonstrations, answering questions, and assisting with data organization. Over time, this process led to a pool of trained samplers that were encouraged to participate each year, adding to the quality and consistency of data collections. In 2005, 48% of participants had taken part in the program in earlier years. In 2006 and 2007, 30% and 40% of participants had also taken part in previous years. We believe timeliness of training and continuity in the participants across years resulted in improving data quality, because participants were experienced and understood the expectations and data requirements.

Correctly determining the sex of adult Chinook salmon can be challenging, and uncertainty in the accuracy of sexing has compromised a variety of salmon ASL data sets (e.g., Linderman et al. 2003; Molyneaux and Folletti 2007). Our sampling design addressed this challenge by requiring participants to confirm sex by cutting the abdomen and inspecting the gonads. All participants received preseason training and a detailed instruction packet demonstrating the appropriate procedure for determining fish sex. Conversations with participants, as well as details seen in returned data sheets, suggest good adherence to the methodology from 2005 to 2007; unfortunately, compliance in previous years is suspect. Specifically, in years prior to 2004, the subsistence ASL data shows notable percentages (e.g., 15.5% in the 2002 lower river small mesh samples) of age-1.2 Chinook salmon to be female (Molyneaux et al. 2004a), which contradicted results of a study conducted between 1997 and 1999 in which less than 1% of the age-1.2 fish were female (*n*=789; Molyneaux and Folletti 2007). From 2005 to 2007, the ratios of males to females by age class were consistent with our expectation based on the time series of sex confirmed fish from ADF&G sampling of the commercial fishery (Molyneaux et al. 2008). We believe that the suggested increased accuracy of sex determination in recent years is due in large part to improved preseason training, the experience of returning participants, and adherence to the sampling methods. Preseason training efforts should be continued in future years to ensure proper sex determination.

Influence of the Subsistence Fishing Schedule

The subsistence fishing schedule that was instituted in 2001 as part of the Kuskokwim River Salmon Management Rebuilding Plan had little to no impact during our study period. In 2005 and 2006, Chinook salmon abundance improved and in each year the fishing schedule was lifted early in the Chinook salmon run (Linderman and Bergstrom 2006). In 2007, the schedule was discontinued entirely (Linderman and Bergstrom 2006). In addition, a formal analysis of the subsistence fishing schedule revealed that the initiative was largely ineffective in achieving the stated objectives (Hamazaki 2008). Rather than spreading harvest over a more protracted period of time, many fishermen simply fished harder during the early season “open” periods.

ASL Composition of the Total Kuskokwim River Chinook Salmon Subsistence Harvest

In each year of this study (2005–2007), only the lower Kuskokwim River was sampled, however we have used these results to approximate the ASL composition of the entire Kuskokwim River Chinook salmon subsistence harvest. We feel that this method provides a reasonable approximation because most subsistence-caught Chinook salmon are harvested from the lower river (89% in 2005, 87% in 2006, and 91% in 2007). Data from years when subsistence ASL sampling was conducted in the middle and upper river lend additional support for the appropriateness of our methods. Specifically, in 2002 and 2003 the estimated ASL composition of the total subsistence harvest did not differ from the lower river estimate by more than 1% for any age-sex category (Molyneaux 2004a and b). We do not contend that the lower river samples adequately represent the middle and upper river ASL composition; in fact, the ASL compositions do differ somewhat. However, the lower river constitutes such a large proportion of the annual harvest that any differences in the ASL composition from upstream subsistence fishermen are negligible when samples are pooled.

Comparison of Age and Sex Composition between Subsistence and Commercial Harvests, and Escapement

Collection of ASL data from the commercial harvest and escapement monitoring projects has been a standard part of the Kuskokwim Area salmon management program, while sampling subsistence caught fish is a more recent addition. The ASL composition of the Kuskokwim River Chinook salmon subsistence and commercial harvest differs notably (Figure 8). Data from the Kuskokwim Area Age, Sex, and Length Catalogue (Molyneaux et al. 2008) shows that subsistence harvest practices select for older, larger, females compared to the commercial fishery that is more selective for smaller, younger, males (Figure 8). The difference has been attributed to the predominant gear type used in each fishery. Subsistence fishermen that target Chinook salmon most commonly use large mesh gears; whereas, since 1986 commercial fishermen have been restricted to using small mesh gear (i.e., ≤6 inches). As a result, the proportion of age-1.2 Chinook salmon is far lower in the subsistence fishery compared to the commercial fishery.

Conversely, older aged fish, particularly age-1.4, have a far higher proportional occurrence in the subsistence fishery.

Kuskokwim River Chinook salmon are harvested primarily for subsistence uses. Directed Chinook salmon commercial fishing in the Kuskokwim River (Districts 1 and 2) was discontinued in 1987 by regulation (Whitmore et al. 2008). However, incidental harvest of Chinook salmon does occur. A total of 4,784 Chinook salmon were harvested commercially in 2005, while 2,777 and 179 were harvested in 2006 and 2007 respectively (Estensen et al. 2009). These harvest estimates are minimal compared to those of the subsistence fishery where total Chinook salmon subsistence harvests for the Kuskokwim River were 70,393, 63,177, and 68,645 fish in 2005, 2006, and 2007 respectively (Fall et al. 2007, 2009a, and 2009b).

The ASL composition of the escapement is influenced by the selective pressures of the subsistence and commercial fisheries. Given the disparity in harvest numbers, it is reasonable to assume that the subsistence fishery has a greater influence on escapement ASL composition than does the commercial fishery. This has led some to speculate that Kuskokwim River Chinook salmon escapement has been artificially skewed more towards small young males as a result of selectivity for larger fish by the subsistence fleet. This type of directional influence from the long-term use of large mesh gear has been suggested in other parts of Alaska (e.g., Cook Inlet: ADF&G 1981; Yukon River: Bigler et al. 1996; Hyer and Schleusner 2005, JTC 2006, Bromaghin et al. 2008). Currently, the small-mesh commercial fishery does little to mitigate the pressures imposed by the subsistence fishery because relatively few fish are harvested, and in most years, the timing of the two fisheries differs. Resulting escapement age class compositions from 2004 to 2007 appear intermediate to compositions found in the subsistence and commercial fisheries (Figure 8).

It is beyond the scope of this report to speculate on the effects of Kuskokwim River subsistence harvest on Chinook salmon escapement ASL composition, or the potential risks of selective harvest practices. However, it is important to note that many researchers have reported that prolonged use of selective harvest practices can result in directional evolution affecting geneotypic and phenotypic characteristics of fish stocks, and influence production volatility (e.g., Anderson et al. 2008; Conover and Munch 2002; Hankin et al. 1993; Hard 2004; Ricker 1980; Stenseth and Rouyer 2008; Thorpe 1993). The rate of change is largely dependent on the exploitation rate, degree of selectivity, and timing.

In February 2007, the BOF modified the Kuskokwim River Salmon Management Plan with the addition of a guideline commercial harvest of 0–50,000 Chinook salmon (5 AAC 07.365). Under the plan, the default management strategy continues to limit commercial fishermen to gillnets with ≤6-inch mesh sizes; however, the plan provides managers the option of allowing commercial fishermen to use gillnets with up to 8 inch mesh size (5 AAC 07.331). The large mesh option was intended to allow fishermen the opportunity to harvest Chinook salmon, but avoid chum salmon when commercial markets are unfavorable for chum salmon. Under those conditions, it is presumed that commercial fishermen would favor large gillnet mesh sizes, similar to the subsistence fishery. These changes in the management plan have stirred controversy regarding concern for over exploitation of older age classes, and skewing of escapement age composition towards smaller and predominantly male fish.

We feel it would be appropriate and timely to begin a formal investigation on the potential effects of the various management options for harvesting Kuskokwim River Chinook salmon.

Molyneaux et al. (*In prep*) have produced a model that reconstructs the Kuskokwim River Chinook salmon annual return by age and sex composition back to 1976. This time series provides researchers the opportunity to examine annual historical exploitation rates by age class and sex, and to explore the potential effects of alternate management options such as allowing additional harvest with large mesh gillnets compared to small mesh gillnets.

CONCLUSIONS

TOTAL KUSKOKWIM RIVER SUBSISTENCE HARVEST

Age Composition

- The 2005 Kuskokwim River subsistence harvest included 3,771 age-1.2 (5.4%); 35,021 age-1.3 (49.8%); 30,081 age-1.4 (42.7%); and 1,257 age-1.5 (1.8%).
- The 2006 harvest included 3,967 age-1.2 (6.3%); 22,569 age-1.3 (35.7%); 33,673 age-1.4 (53.3%); and 2,590 age-1.5 (4.1%).
- The 2007 harvest included 5,023 age-1.2 (7.3%); 25,348 age-1.3 (36.9%); 35,863 age-1.4 (52.2%); and 1,775 age-1.5 (2.6%).

Sex Composition

- The 2005 harvest included 44,580 males (63.3%) and 25,813 females (36.7%).
- The 2006 harvest included 36,491 males (57.8%) and 26,686 females (42.2%).
- The 2007 harvest included 39,948 males (58.2%) and 28,697 females (41.8%).

INTER-ANNUAL SHIFTS IN ASL COMPOSITION IN THE LOWER KUSKOKWIM RIVER

- There was a tendency for the proportion of younger aged fish and females to increase as the run progressed in 2005 and 2006. This pattern was not observed in 2007. There was no distinct pattern with respect to length in any year.

INFLUENCE OF THE SUBSISTENCE FISHING SCHEDULE

- We do not believe the subsistence fishing schedule affected our ability to collect ASL information from the subsistence harvest because the subsistence fishermen themselves collected the information.
- Our approach of employing subsistence fishermen to sample their own catches captures changes in timing of fishing activities.

ADEQUACY OF SAMPLE SIZES AND PARTICIPATION

- We were not able to quantify how well our samples represent the total subsistence harvest.
- We assume the ASL composition of the pooled samples is adequate to represent total subsistence harvest because:
    - We had good numbers of participating fishermen each year.

- Fishermen were trained in ASL data collection.
- Samples were collected by subsistence fishermen using their preferred fishing strategies as it relates to gear type, location, and timing.
- Majority of samples were collected with large mesh gillnets which are believed to be the preferred gear type for targeting Chinook salmon.
- Participating fishermen collected samples from throughout the lower river.
- Harvest from the lower river comprised over 90% of the total inriver subsistence harvest of Chinook salmon each year.

RECOMMENDATIONS

- Continue collecting ASL data from subsistence-caught Chinook salmon and continue to apply results to the total annual Kuskokwim River subsistence harvest estimates. These ASL data are a necessary input for the Chinook salmon run reconstruction model, a valuable tool for addressing a wide variety of issues such as: estimating total annual return; estimating total exploitation rate by age and sex; developing biological escapement goals; modeling variations in stock productivity; modeling effects of harvest practices or changing environmental conditions on long-term population trends.
- Continue to improve preseason training. Modify data sheets to accommodate changes in fishing date, gear type, and whose harvest was sampled. Highlight the need for participants to record and report the number of different fishermen sampled. The number of fishermen sampled is probably greater than the number of participants. As such, our level of accuracy is likely greater than we can currently claim. Knowing the true number of fishermen sampled will increase our confidence when stating that our results are representative of the overall Kuskokwim River Chinook salmon subsistence harvest.
- Analyze data from the postseason subsistence survey that documents the degree to which large mesh gillnets are used. Survey results currently identify mesh type as “drift gillnet” and “set gillnet.” These categories could each be divided into “…gillnets with large mesh (8 inch or greater)”, “…gillnets with small mesh (6 inch or smaller)”, and “…gillnets with intermediate mesh size” used for Chinook salmon.
- Increase return of catch calendars and from them estimate harvest through time in order to combine with ASL samples collected from weekly subsistence fishing periods.
- Considering that the objective was to detect temporal shifts in annual subsistence harvest ASL composition, future efforts should consider applying a temporal stratification across pooled samples using all gear types. This approach would likely better capture any effects of changing gear preferences as the season progresses, and be more appropriate for identifying temporal shifts in ASL composition in the subsistence harvest.

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TABLES AND FIGURES

Table 1.–Sample distribution by gear type and location for the 2005 Chinook salmon subsistence harvest sampling program.

	Number of Samples by Community					
Gear Type	Tuntutuliak	Bethel	Oscarville	Eek	Napaskiak	Total
Large Mesh Gill Nets (≥8 inch mesh)						
8-1/4 inch mesh	464	237	0	0	0	701
8 inch mesh	281	1,151	176	0	14	1,622
Subtotal	745	1,388	176	0	14	2,323
Percent	32.1%	59.8%	7.6%	0.0%	0.6%	83.0%
Intermediate Mesh Gill Nets (>6 inch but <8 inch mesh)						
7-7/8 inch mesh	0	4	0	0	0	4
7-3/4 inch mesh	0	58	0	0	0	58
7-1/2 inch mesh	0	117	0	37	0	154
Subtotal	0	179	0	37	0	216
Percent	0.0%	82.9%	0.0%	17.1%	0.0%	7.7%
Small Mesh Gill Nets (≤6 inch mesh)						
6-1/2 inch mesh	0	50	0	10	0	60
6 inch mesh	0	0	69	74	0	143
5-7/8 inch mesh	0	0	0	50	0	50
5-3/8 inch mesh	0	7	0	0	0	7
Subtotal	0	57	69	134	0	260
Percent	0.0%	21.9%	26.5%	51.5%	0.0%	9.3%
Fish Wheels	0	0	0	0	0	0
Rod and Reel	0	0	0	0	0	0
Seine	0	0	0	0	0	0
Spear	0	0	0	0	0	0
Subtotal	0	0	0	0	0	0
Grand Total	745	1,624	245	171	14	2,799
Percent	26.6%	58.0%	8.8%	6.1%	0.5%	100.0%
Number of Participant Samplers	7	16	2	4	1	30
Number of Additional Households Sampled	0	0	0	0	0	0
Total Number of Households[a]	7	16	2	4	1	30

Note: Sample size includes Chinook salmon whose age could not be determined.

[a] Should be considered the minimum number of households as sampling effort beyond the core participants was not well documented.

Table 2.–Sample distribution by gear type and location for the 2006 Chinook salmon subsistence harvest sampling program.

	Number of Samples by Community				
Gear Type	Tuntutuliak	Bethel	Eek	Napaskiak	Total
Large Mesh Gill Nets (≥8 inch mesh)					
8-1/2 inch mesh	35	0	0	0	35
8-1/4 inch mesh	277	177	0	0	454
8 inch mesh	257	936	70	0	1,263
Subtotal	569	1,113	70	0	1,752
Percent	32.5%	63.5%	4.0%	0.0%	91.4%
Intermediate Mesh Gill Nets (> 6 inch but < 8inch mesh)					
7-5/8 inch mesh	73	0	0	0	73
7-1/2 inch mesh	20	0	0	40	60
7-1/4 inch mesh	0	0	0	30	30
Subtotal	93	0	0	70	163
Percent	57.1%	0.0%	0.0%	42.9%	8.5%
Small Mesh Gill Nets (≤6 inch mesh)					
6 inch mesh	0	0	0	0	0
Subtotal	0	0	0	0	0
Percent	0.0%	0.0%	0.0%	0.0%	0.0%
Fish Wheels	0	0	0	0	0
Rod and Reel	0	2	0	0	2
Seine	0	0	0	0	0
Spear	0	0	0	0	0
Subtotal	0	2	0	0	2
Grand Total	662	1,115	70	70	1,917
Percent	34.5%	58.2%	3.7%	3.7%	100.0%
Number of Participant Samplers	7	10	1	2	20
Number of Additional Households Sampled	2	0	1	0	3
Total Number of Households[a]	9	10	2	2	23

Note: Sample size includes Chinook salmon whose age could not be determined.

[a] Should be considered the minimum number of households as sampling effort beyond the core participants was not well documented.

Table 3.–Sample distribution by gear type and location for the 2007 Chinook salmon subsistence harvest sampling program.

	Number of Samples by Community				
Gear Type	Tuntutuliak	Bethel	Akiachak	Kwigillingok[a]	Total
Large Mesh Gill Nets (≥8 inch mesh)					
8-1/4 inch mesh	344	52	0	0	396
8 inch mesh	447	1,300	22	30	1,799
Subtotal	791	1,352	22	30	2,195
Percent	36.0%	61.6%	1.0%	1.4%	84.1%
Intermediate Mesh Gill Nets (>6 inch but <8 inch mesh)					
7-3/4 inch mesh	17	0	10	0	27
7-1/2 inch mesh	0	0	43	0	43
7-3/8 inch mesh	0	30	0	0	30
7-1/4 inch mesh	0	0	33	0	33
Subtotal	17	30	86	0	133
Percent	12.8%	22.6%	64.7%	0.0%	5.1%
Small Mesh Gill Nets (≤6 inch mesh)					
6 inch mesh	7	0	24	37	68
5-7/8 inch mesh	51	0	41	0	92
5-1/2 inch mesh	110	10	2	0	122
Subtotal	168	10	67	37	282
Percent	59.6%	3.5%	23.8%	13.1%	10.8%
Fish Wheels	0	0	0	0	0
Rod and Reel	0	0	0	0	0
Seine	0	0	0	0	0
Spear	0	0	0	0	0
Subtotal	0	0	0	0	0
Grand Total	976	1,392	175	67	2,610
Percent	37.4%	53.3%	6.7%	2.6%	100.0%
Number of Participant Samplers	8	16	3	0	27
Number of Additional Households Sampled	1	0	2	2	5
Total Number of Households[b]	9	16	5	2	32

Note: Sample size includes Chinook salmon whose age could not be determined.

[a] The sampler's primary residence was Haines, Alaska, but samples were collected from Kwigillingok.

[b] This should be considered the minimum number of households as sampling effort beyond the core participants was not well documented.

Table 4.–Age and sex composition of Chinook salmon sampled from the 2005 Kuskokwim River subsistence fishery.

Gear Type and Stratum	Sample Size	Sex	Sample Age Class Composition																	
			1.1		1.2		1.3		2.2		1.4		2.3		1.5		2.4		Total	
			n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	N	%
Small Mesh Gillnets (≤6 inch mesh)																				
6/2-23	174	M	0	0.0	26	14.9	64	36.8	0	0.0	34	19.5	0	0.0	1	0.6	0	0.0	125	71.8
		F	0	0.0	0	0.0	16	9.2	0	0.0	32	18.4	0	0.0	1	0.5	0	0.0	49	28.2
		Total	0	0.0	26	14.9	80	46.0	0	0.0	66	37.9	0	0.0	2	1.1	0	0.0	174	100.0
Intermediate Mesh Gillnets (mesh sizes between 6 and 8 inches)																				
6/8-25	226	M	0	0.0	14	6.2	84	37.2	0	0.0	55	24.4	0	0.0	1	0.4	0	0.0	154	68.1
		F	0	0.0	1	0.4	29	12.8	0	0.0	38	16.8	1	0.4	2	0.9	1	0.4	72	31.9
		Total	0	0.0	15	6.6	113	50.0	0	0.0	93	41.2	1	0.4	3	1.3	1	0.4	226	100.0
Large Mesh Gillnets (≥8 inch mesh)																				
5/28-6/5	100	M	0	0.0	4	4.0	37	37.0	0	0.0	22	22.0	0	0.0	2	2.0	0	0.0	65	65.0
		F	0	0.0	0	0.0	6	6.0	0	0.0	28	28.0	0	0.0	1	1.0	0	0.0	35	35.0
		Subtotal	0	0.0	4	4.0	43	43.0	0	0.0	50	50.0	0	0.0	3	3.0	0	0.0	100	100.0
6/6-12	542	M	0	0.0	27	5.0	215	39.7	0	0.0	123	22.7	3	0.6	5	0.9	0	0.0	373	68.8
		F	0	0.0	2	0.4	51	9.4	0	0.0	110	20.3	0	0.0	6	1.1	0	0.0	169	31.2
		Subtotal	0	0.0	29	5.4	266	49.1	0	0.0	233	43.0	3	0.6	11	2.0	0	0.0	542	100.0
6/13-19	644	M	0	0.0	26	4.0	237	36.8	0	0.0	127	19.7	0	0.0	5	0.8	0	0.0	395	61.3
		F	0	0.0	1	0.2	90	14.0	0	0.0	149	23.2	0	0.0	9	1.4	0	0.0	249	38.7
		Subtotal	0	0.0	27	4.2	327	50.8	0	0.0	276	42.9	0	0.0	14	2.2	0	0.0	644	100.0
6/20-26	550	M	0	0.0	19	3.5	182	33.1	0	0.0	99	18.0	1	0.2	4	0.7	1	0.2	306	55.6
		F	0	0.0	0	0.0	96	17.4	0	0.0	144	26.2	1	0.2	3	0.6	0	0.0	244	44.4
		Subtotal	0	0.0	19	3.5	278	50.5	0	0.0	243	44.2	2	0.4	7	1.3	1	0.2	550	100.0
6/27-7/9	172	M	1	1.3	8	4.6	70	40.7	0	0.0	28	16.3	0	0.0	0	0.0	0	0.0	107	62.2
		F	0	0.0	1	0.6	21	12.2	0	0.0	40	23.2	0	0.0	3	1.7	0	0.0	65	37.8
		Subtotal	1	1.3	9	5.2	91	52.9	0	0.0	68	39.5	0	0.0	3	1.7	0	0.0	172	100.0
Subtotal	2,008	M	1	0.0	84	4.2	741	36.9	0	0.0	399	19.9	4	0.2	16	0.8	1	0.0	1,246	62.1
		F	0	0.0	4	0.2	264	13.1	0	0.0	471	23.5	1	0.0	22	1.1	0	0.0	762	37.9
		Total	1	0.0	88	4.4	1,005	50.0	0	0.0	870	43.3	5	0.2	38	1.9	1	0.0	2,008	100.0
Grand Total	2,408	M	1	0.0	124	5.1	889	36.9	0	0.0	488	20.3	4	0.2	18	0.7	1	0.0	1,525	63.3
(All Gear Types)		F	0	0.0	5	0.2	309	12.8	0	0.0	541	22.5	2	0.1	25	1.0	1	0.0	883	36.7
		Total	1	0.0	129	5.4	1,198	49.8	0	0.0	1,029	42.7	6	0.2	43	1.8	2	0.1	2,408	100.0

Table 5.–Age and sex composition of Chinook salmon sampled from the 2006 Kuskokwim River subsistence fishery.

Gear Type and Sample Dates	Sample Size	Sex	Sample Age Class Composition: 1.1 n	1.1 %	1.2 n	1.2 %	1.3 n	1.3 %	2.2 n	2.2 %	1.4 n	1.4 %	2.3 n	2.3 %	1.5 n	1.5 %	2.4 n	2.4 %	Total N	Total %
Rod and Reel																				
7/3	2	M	0	0.0	2	100.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	100.0
		F	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
		Total	0	0.0	2	100.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	100.0
Intermediate Mesh Gillnets (mesh sizes between 6 and 8 inches)																				
6/8-26	137	M	0	0.0	4	2.9	40	29.2	0	0.0	29	21.2	0	0.0	2	1.5	0	0.0	75	54.7
		F	0	0.0	0	0.0	18	13.1	0	0.0	37	27.0	0	0.0	7	5.1	0	0.0	62	45.3
		Total	0	0.0	4	2.9	58	42.3	0	0.0	66	48.2	0	0.0	9	6.6	0	0.0	137	100.0
Large Mesh Gillnets (≥8 inch mesh)																				
6/6-10	169	M	1	0.6	11	6.5	41	24.2	1	0.6	44	26.1	0	0.0	4	2.4	0	0.0	102	60.4
		F	0	0.0	1	0.6	4	2.4	0	0.0	57	33.7	0	0.0	4	2.3	1	0.6	67	39.6
		Subtotal	1	0.6	12	7.1	45	26.6	1	0.6	101	59.8	0	0.0	8	4.7	1	0.6	169	100.0
6/14-17	627	M	1	0.2	46	7.3	194	30.9	0	0.0	130	20.7	0	0.0	9	1.4	1	0.2	381	60.8
		F	0	0.0	0	0.0	43	6.9	0	0.0	193	30.8	0	0.0	10	1.6	0	0.0	246	39.2
		Subtotal	1	0.2	46	7.3	237	37.8	0	0.0	323	51.5	0	0.0	19	3.0	1	0.2	627	100.0
6/18-24	625	M	1	0.2	24	3.8	160	25.6	0	0.0	137	21.9	1	0.2	12	1.9	0	0.0	335	53.6
		F	0	0.0	0	0.0	49	7.8	0	0.0	223	35.7	1	0.1	17	2.7	0	0.0	290	46.4
		Subtotal	1	0.2	24	3.8	209	33.4	0	0.0	360	57.6	2	0.3	29	4.6	0	0.0	625	100.0
6/25-27	83	M	0	0.0	11	13.3	35	42.2	0	0.0	11	13.2	0	0.0	2	2.4	0	0.0	59	71.1
		F	0	0.0	1	1.2	9	10.8	0	0.0	13	15.7	0	0.0	1	1.2	0	0.0	24	28.9
		Subtotal	0	0.0	12	14.5	44	53.0	0	0.0	24	28.9	0	0.0	3	3.6	0	0.0	83	100.0
7/3-8,15,19	45	M	0	0.0	6	13.3	6	13.3	0	0.0	7	15.6	1	2.2	1	2.2	0	0.0	21	46.7
		F	0	0.0	0	0.0	4	8.9	0	0.0	20	44.4	0	0.0	0	0.0	0	0.0	24	53.3
		Subtotal	0	0.0	6	13.3	10	22.2	0	0.0	27	60.0	1	2.2	1	2.2	0	0.0	45	100.0
Subtotal	1,549	M	3	0.2	98	6.3	436	28.2	1	0.1	329	21.2	2	0.1	28	1.8	1	0.1	898	58.0
		F	0	0.0	2	0.2	109	7.0	0	0.0	506	32.7	1	0.1	32	2.1	1	0.0	651	42.0
		Total	3	0.2	100	6.5	545	35.2	1	0.1	835	53.9	3	0.2	60	3.9	2	0.1	1,549	100.0
Grand Total (All Gear Types)	1,688	M	3	0.2	104	6.2	476	28.2	1	0.1	358	21.2	2	0.1	30	1.8	1	0.1	975	57.8
		F	0	0.0	2	0.1	127	7.5	0	0.0	543	32.2	1	0.1	39	2.3	1	0.1	713	42.2
		Total	3	0.2	106	6.3	603	35.7	1	0.1	901	53.4	3	0.2	69	4.1	2	0.1	1,688	100.0

Table 6–Age and sex composition of Chinook salmon sampled from the 2007 Kuskokwim River subsistence fishery.

Gear Type and Sample Dates	Sample Size	Sex	Sample Age Class Composition																	
			1.1		1.2		1.3		2.2		1.4		2.3		1.5		2.4		Total	
			n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	N	%
Small Mesh Gillnets (≤6 inch mesh)																				
6/8-27	115	M	0	0.0	49	42.6	28	24.4	0	0.0	10	8.7	0	0.0	0	0.0	0	0.0	87	75.7
		F	0	0.0	2	1.7	9	7.8	0	0.0	16	13.9	0	0.0	1	0.9	0	0.0	28	24.3
		Total	0	0.0	51	44.3	37	32.2	0	0.0	26	22.6	0	0.0	1	0.9	0	0.0	115	100.0
Intermediate Mesh Gillnets (mesh sizes between 6 and 8 inches)																				
6/13-29	117	M	0	0.0	5	4.3	26	22.2	0	0.0	28	23.9	0	0.0	1	0.8	1	0.9	61	52.1
		F	0	0.0	0	0.0	7	6.0	0	0.0	45	38.5	0	0.0	3	2.6	1	0.8	56	47.9
		Total	0	0.0	5	4.3	33	28.2	0	0.0	73	62.4	0	0.0	4	3.4	2	1.7	117	100.0
Large Mesh Gillnets (≥8 inch mesh)																				
6/2	5	M	0	0.0	1	20.0	2	40.0	0	0.0	1	20.0	0	0.0	0	0.0	0	0.0	4	80.0
		F	0	0.0	0	0.0	0	0.0	0	0.0	1	20.0	0	0.0	0	0.0	0	0.0	1	20.0
		Subtotal	0	0.0	1	20.0	2	40.0	0	0.0	2	40.0	0	0.0	0	0.0	0	0.0	5	100.0
6/3-9	105	M	0	0.0	0	0.0	20	19.0	0	0.0	37	35.2	0	0.0	1	1.0	0	0.0	58	55.2
		F	0	0.0	0	0.0	3	2.9	0	0.0	38	36.2	0	0.0	6	5.7	0	0.0	47	44.8
		Subtotal	0	0.0	0	0.0	23	21.9	0	0.0	75	71.4	0	0.0	7	6.7	0	0.0	105	100.0
6/10-16	499	M	0	0.0	22	4.4	160	32.1	0	0.0	111	22.2	1	0.2	5	1.0	2	0.4	301	60.3
		F	0	0.0	1	0.2	35	7.0	0	0.0	152	30.5	1	0.2	7	1.4	2	0.4	198	39.7
		Subtotal	0	0.0	23	4.6	195	39.1	0	0.0	263	52.7	2	0.4	12	2.4	4	0.8	499	100.0
6/17-23	905	M	0	0.0	60	6.6	265	29.3	0	0.0	202	22.3	4	0.4	9	1.0	1	0.1	541	59.8
		F	0	0.0	3	0.4	94	10.4	0	0.0	250	27.6	0	0.0	14	1.5	3	0.3	364	40.2
		Subtotal	0	0.0	63	7.0	359	39.7	0	0.0	452	49.9	4	0.4	23	2.5	4	0.4	905	100.0
6/24-30	252	M	0	0.0	7	2.8	64	25.4	0	0.0	47	18.6	0	0.0	2	0.8	1	0.4	121	48.0
		F	0	0.0	0	0.0	23	9.1	0	0.0	104	41.3	0	0.0	3	1.2	1	0.4	131	52.0
		Subtotal	0	0.0	7	2.8	87	34.5	0	0.0	151	59.9	0	0.0	5	2.0	2	0.8	252	100.0
7/2,6-7	41	M	0	0.0	0	0.0	9	22.0	0	0.0	6	14.6	0	0.0	0	0.0	1	2.4	16	39.0
		F	0	0.0	0	0.0	8	19.5	0	0.0	17	41.5	0	0.0	0	0.0	0	0.0	25	61.0
		Subtotal	0	0.0	0	0.0	17	41.5	0	0.0	23	56.1	0	0.0	0	0.0	1	2.4	41	100.0
7/9,11	11	M	0	0.0	0	0.0	3	27.3	0	0.0	1	9.1	0	0.0	0	0.0	0	0.0	4	36.4
		F	0	0.0	0	0.0	1	9.1	0	0.0	5	45.4	0	0.0	1	9.1	0	0.0	7	63.6
		Subtotal	0	0.0	0	0.0	4	36.4	0	0.0	6	54.5	0	0.0	1	9.1	0	0.0	11	100.0
Subtotal	1,818	M	0	0.0	90	5.0	523	28.8	0	0.0	405	22.3	5	0.3	17	0.9	5	0.3	1,045	57.5
		F	0	0.0	4	0.2	164	9.0	0	0.0	567	31.2	1	0.0	31	1.7	6	0.3	773	42.5
		Total	0	0.0	94	5.2	687	37.8	0	0.0	972	53.5	6	0.3	48	2.6	11	0.6	1,818	100.0
Grand Total	2,050	M	0	0.0	144	7.0	577	28.1	0	0.0	443	21.6	5	0.2	18	0.9	6	0.3	1,193	58.2
(All Gear Types)		F	0	0.0	6	0.3	180	8.8	0	0.0	628	30.6	1	0.0	35	1.7	7	0.3	857	41.8
		Total	0	0.0	150	7.3	757	36.9	0	0.0	1,071	52.2	6	0.3	53	2.6	13	0.6	2,050	100.0

Table 7.–Mean length (mm) of Chinook salmon sampled from the 2005 Kuskokwim River subsistence fishery.

Gear Type and Sample Dates	Sex		Age Class 1.1	1.2	1.3	2.2	1.4	2.3	1.5	2.4
Small Mesh Gillnets (≤6 inch mesh)										
6/2-23	M	Mean Length		555	730		802		840	
		SE		10	7		14		-	
		Range		440-670	620-885		635-992		840-840	
		Sample Size	0	26	64	0	34	0	1	0
	F	Mean Length			776		859		890	
		SE			18		7		-	
		Range			610-887		755-915		890-890	
		Sample Size	0	0	16	0	32	0	1	0
Intermediate Mesh Gillnets (mesh sizes between 6 and 8 inches)										
6/8-25	M	Mean Length		583	721		805		972	
		SE		11	6		12		-	
		Range		525-660	510-845		500-1000		972-972	
		Sample Size	0	14	84	0	55	0	1	0
	F	Mean Length		760	771		839	850	868	820
		SE		-	10		8	-	8	-
		Range		760-760	670-865		770-960	850-850	860-875	820-820
		Sample Size	0	1	29	0	38	1	2	1
Large Mesh Gillnets (≥8 inch mesh)										
5/28-6/5	M	Mean Length		584	736		815		985	
		SE		25	9		13		105	
		Range		510-620	645-915		710-940		880-1090	
		Sample Size	0	4	37	0	22	0	2	0
	F	Mean Length			774		851		820	
		SE			12		11		-	
		Range			735-811		750-950		820-820	
		Sample Size	0	0	6	0	28	0	1	0
6/6-12	M	Mean Length		585	736		799	746	891	
		SE		13	4		7	14	47	
		Range		445-708	520-960		608-994	725- 774	805-1041	
		Sample Size	0	27	215	0	123	3	5	0
	F	Mean Length		560	790		830		828	
		SE		30	7		6		42	
		Range		530-590	630-885		650-992		684-940	
		Sample Size	0	2	51	0	110	0	6	0

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Table 7.–Page 2 of 2.

Gear Type Stratum	Sex		Age Class 1.1	1.2	1.3	2.2	1.4	2.3	1.5	2.4
6/13-19	M	Mean Length		569	748		813		828	
		SE		14	4		6		21	
		Range		425-720	600-920		663-1000		771-900	
		Sample Size	0	26	237	0	127	0	5	0
	F	Mean Length		650	792		847		887	
		SE		-	6		5		20	
		Range		650-650	663-900		669-991		790-960	
		Sample Size	0	1	90	0	149	0	9	0
6/20-26	M	Mean Length		607	740		815	745	857	810
		SE		11	4		7	-	61	-
		Range		520-680	605-995		660-995	745-745	706-980	810-810
		Sample Size	0	19	182	0	99	1	4	1
	F	Mean Length			788		836	760	843	
		SE			4		4	-	27	
		Range			645-887		609-955	760-760	790-875	
		Sample Size	0	0	96	0	144	1	3	0
6/27-7/9	M	Mean Length	380	566	748		794			
		SE	-	23	6		13			
		Range	380-380	500-670	600-940		650-920			
		Sample Size	1	8	70	0	28	0	0	0
	F	Mean Length		600	799		834		929	
		SE		-	9		5		34	
		Range		600-600	737-900		770-900		875-993	
		Sample Size	0	1	21	0	40	0	3	0
Subtotal	M	Mean Length	380	583	742		808	746	875	810
		SE	-	7	2		4	14	26	-
		Range	380-380	425-720	520-995		608-1,000	725-774	706-1,090	810-810
		Sample Size	1	84	741	0	399	4	16	1
	F	Mean Length		593	790		839	760	868	
		SE		30	3		3	-	17	
		Range		530-650	630-900		609-992	760-760	684-993	
		Sample Size	0	4	264	0	471	1	22	0
Grand Total (All Gear Types)	M	Mean Length	380	577	739		807	746	878	810
		Range	380-380	425-720	510-995		500-1,000	725-774	706-1,090	810-810
		Sample Size	1	124	889	0	488	4	18	1
	F	Mean Length		626	788		840	805	868	820
		Range		530-760	610-900		609-992	760-850	684-993	820-820
		Sample Size	0	5	309	0	541	2	25	1

Table 8.–Mean length (mm) of Chinook salmon sampled from the 2006 Kuskokwim River subsistence fishery.

Gear Type and			Age Class							
Sample Dates	Sex		1.1	1.2	1.3	2.2	1.4	2.3	1.5	2.4
Hook and Line										
7/3	M	Mean Length		598						
		SE		13						
		Range		585-610						
		Sample Size	0	2	0	0	0	0	0	0
	F	Mean Length								
		SE								
		Range								
		Sample Size	0	0	0	0	0	0	0	0
Intermediate Mesh Gillnets (mesh sizes between 6 and 8 inches)										
6/8-26	M	Mean Length		578	720		794		891	
		SE		32	8		15		111	
		Range		500-630	615-870		640-958		780-1,001	
		Sample Size	0	4	40	0	29	0	2	0
	F	Mean Length			784		839		848	
		SE			12		9		16	
		Range			610-860		730-990		770-890	
		Sample Size	0	0	18	0	37	0	7	0
Large Mesh Gillnets (≥8 inch mesh)										
6/6-10	M	Mean Length	390	580	753	590	867		881	
		SE	-	14	8	-	14		76	
		Range	390-390	510-661	665-885	590-590	712-1,100		740-1030	
		Sample Size	1	11	41	1	44	0	4	0
	F	Mean Length		570	812		889		860	830
		SE		-	30		8		51	-
		Range		570-570	740-889		759-1,009		780-993	830-830
		Sample Size	0	1	4	0	57	0	4	1
6/14-17	M	Mean Length	380	574	724		812		782	780
		SE	-	7	4		6		18	-
		Range	380-380	446-668	535-830		694-1,090		700-874	780- 780
		Sample Size	1	46	194	0	130	0	9	1
	F	Mean Length			777		862		879	
		SE			10		4		20	
		Range			615-882		700-996		810-990	
		Sample Size	0	0	43	0	193	0	10	0

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Table 8.–Page 2 of 2.

Gear Type and Sample Dates	Sex		Age Class 1.1	1.2	1.3	2.2	1.4	2.3	1.5	2.4
6/18-24	M	Mean Length	370	574	728		819	714	844	
		SE	-	11	5		7	-	23	
		Range	370-370	500-740	450-850		660-1,012	714-714	731-1,000	
		Sample Size	1	24	160	0	137	1	12	0
	F	Mean Length			787		848	845	843	
		SE			7		3	-	11	
		Range			570-871		650-975	845-845	775-927	
		Sample Size	0	0	49	0	223	1	17	0
6/25-27	M	Mean Length		605	692		792		875	
		SE		9	10		20		5	
		Range		550-660	570-790		690-890		870-880	
		Sample Size	0	11	35	0	11	0	2	0
	F	Mean Length		610	732		838		780	
		SE		-	12		17		-	
		Range		610-610	670-790		740-940		780-780	
		Sample Size	0	1	9	0	13	0	1	0
7/3-8,15,19	M	Mean Length		577	739		846	760	800	
		SE		25	24		23	-	-	
		Range		500-650	660-830		750-940	760-760	800-800	
		Sample Size	0	6	6	0	7	1	1	0
	F	Mean Length			794		866			
		SE			14		9			
		Range			755-820		790-940			
		Sample Size	0	0	4	0	20	0	0	0
Subtotal	M	Mean Length	380	578	726	590	822	737	830	780
		SE	-	5	3	-	4	-	16	-
		Range	370-390	446-740	450-885	590-590	660-1,100	714-760	700-1,030	780-780
		Sample Size	3	98	436	1	329	2	28	1
	F	Mean Length		590	780		858	845	854	830
		SE		-	5		2	-	11	-
		Range		570-610	570-889		650-1,009	845-845	775-993	830-830
		Sample Size	0	2	109	0	506	1	32	1
Grand Total (All Gear Types)	M	Mean Length	380	585	723	590	808	737	861	780
		Range	370-390	446-740	450-885	590-590	660-1,100	714-760	700-1,030	780-780
		Sample Size	3	104	476	1	358	2	30	1
	F	Mean Length		590	782		849	845	851	830
		Range		570-610	570-889		650-1,009	845-845	775-993	830-830
		Sample Size	0	2	127	0	543	1	39	1

Table 9.–Mean length (mm) of Chinook salmon sampled from the 2007 Kuskokwim River subsistence fishery.

Gear Type and			Age Class							
Sample Dates	Sex		1.1	1.2	1.3	2.2	1.4	2.3	1.5	2.4
Small Mesh Gillnets (≤6 inch mesh)										
6/8-27	M	Mean Length		556	681		779			
		SE		6	13		28			
		Range		460-680	510-790		630-890			
		Sample Size	0	49	28	0	10	0	0	0
	F	Mean Length		580	724		772		920	
		SE		-	18		29		-	
		Range		580-580	610-780		390-890		920-920	
		Sample Size	0	2	9	0	16	0	1	0
Intermediate Mesh Gillnets (mesh sizes between 6 and 8 inches)										
6/13-29	M	Mean Length		605	700		807		830	790
		SE		15	7		16		-	-
		Range		565-660	620-760		664-1,000		830-830	790-790
		Sample Size	0	5	26	0	28	0	1	1
	F	Mean Length			760		844		860	790
		SE			18		8		10	-
		Range			690-810		720-970		841-870	790-790
		Sample Size	0	0	7	0	45	0	3	1
Large Mesh Gillnets (≥8 inch mesh)										
6/2	M	Mean Length		560	721		1,100			
		SE		-	11		-			
		Range		560-560	710-732		1,100-1,100			
		Sample Size	0	1	2	0	1	0	0	0
	F	Mean Length					750			
		SE					-			
		Range					750-750			
		Sample Size	0	0	0	0	1	0	0	0
6/3-9	M	Mean Length			742		850		900	
		SE			9		12		-	
		Range			669-800		720-1,070		900-900	
		Sample Size	0	0	20	0	37	0	1	0
	F	Mean Length			810		877		885	
		SE			10		7		20	
		Range			800-830		774-960		820-950	
		Sample Size	0	0	3	0	38	0	6	0
6/10-16	M	Mean Length		559	732		817	675	818	803
		SE		12	4		7	-	36	23
		Range		458-700	609-850		685-1,020	675-675	725-910	780-825
		Sample Size	0	22	160	0	111	1	5	2
	F	Mean Length		584	770		857	770	901	793
		SE		-	6		4	-	18	8
		Range		584-584	680-835		710-1,000	770-770	850-970	785-800
		Sample Size	0	1	35	0	152	1	7	2
6/17-23	M	Mean Length		557	725		816	740	810	707
		SE		7	3		5	38	18	-
		Range		450-680	560-840		650-1,040	680-850	735-890	707-707
		Sample Size	0	60	265	0	202	4	9	1
	F	Mean Length		536	764		850		873	844
		SE		33	5		4		12	18
		Range		471-574	542-890		720-1,090		800-960	815-876
		Sample Size	0	3	94	0	250	0	14	3

-continued-

Table 9.–Page 2 of 2.

Gear Type and Sample Dates	Sex		Age Class 1.1	1.2	1.3	2.2	1.4	2.3	1.5	2.4
6/24-30	M	Mean Length		543	725		808		738	995
		SE		20	6		9		73	-
		Range		460-638	610-813		670-940		665-810	995-995
		Sample Size	0	7	64	0	47	0	2	1
	F	Mean Length			776		866		850	820
		SE			9		6		25	-
		Range			669-834		720-1,100		800-881	820-820
		Sample Size	0	0	23	0	104	0	3	1
7/2,6-7	M	Mean Length			724		790			750
		SE			11		17			-
		Range			665-765		735-850			750-750
		Sample Size	0	0	9	0	6	0	0	1
	F	Mean Length			779		847			
		SE			8		12			
		Range			745-815		760-920			
		Sample Size	0	0	8	0	17	0	0	0
7/9,11	M	Mean Length			697		879			
		SE			29		-			
		Range			650-750		879-879			
		Sample Size	0	0	3	0	1	0	0	0
	F	Mean Length			830		862		820	
		SE			-		26		-	
		Range			830-830		800-940		820-820	
		Sample Size	0	0	1	0	5	0	1	0
Season	M	Mean Length		556	728		819	727	809	811
		SE		6	2		3	38	18	23
		Range		450-700	560-850		650-1,100	675-850	665-910	707-995
		Sample Size	0	90	523	0	405	5	17	5
	F	Mean Length		548	769		856	770	878	823
		SE		33	4		2	-	9	11
		Range		471-584	542-890		710-1,100	770-770	800-970	785-876
		Sample Size	0	4	164	0	567	1	31	6
Grand Total	M	Mean Length		572	703		802	727	820	801
(All Gear Types)		Range		450-700	560-850		630-1,100	675-850	665-910	707-995
		Sample Size	0	144	577	0	443	5	18	6
		Mean Length		564	751		845	770	886	807
		Range		471-584	542-890		700-1,100	770-770	800-970	785-876
	F	Sample Size	0	6	180	0	628	1	35	7

Table 10.–Estimated age and sex composition of Chinook salmon in the Kuskokwim River subsistence harvest, 2005–2007.

Reporting Area	Sex	Age Class															
		1.2		1.3		2.2		1.4		1.5		2.4		Other [a]		Total	
		Harvest	%	Harvest	%	Harvest	%	Harvest	%	Harvest	%	Harvest	%	Harvest	%	Harvest	%
Year 2005																	
Lower Kuskokwim River[b]	M	3,217	5.1	23,061	36.9	0	0.0	12,659	20.3	467	0.7	26	0.0	130	0.2	39,559	63.3
	F	130	0.2	8,016	12.8	0	0.0	14,034	22.5	649	1.0	26	0.0	52	0.1	22,905	36.7
	Subtotal	3,346	5.4	31,076	49.8	0	0.0	26,692	42.7	1,115	1.8	52	0.1	182	0.3	62,464	100.0
Middle Kuskokwim River[c]	Subtotal							Not Sampled								6,462	
Upper Kuskokwim River[d]	Subtotal							Not Sampled								1,467	
Total Kuskokwim River	M	3,625	5.1	25,988	36.9	0	0.0	14,266	20.3	526	0.7	29	0.0	146	0.2	44,580	63.3
	F	146	0.2	9,033	12.8	0	0.0	15,815	22.5	731	1.0	29	0.0	58	0.1	25,813	36.7
	Total	3,771	5.4	35,021	49.8	0	0.0	30,081	42.7	1,257	1.8	58	0.1	140	0.3	70,393	100.0
Year 2006																	
Lower Kuskokwim River[b]	M	3,375	6.2	15,447	28.2	55	0.1	11,558	21.1	986	1.8	55	0.1	165	0.3	31,640	57.8
	F	65	0.1	4,121	7.5	0	0.0	17,638	32.2	1,260	2.3	0	0.0	53	0.1	23,137	42.2
	Subtotal	3,440	6.3	19,568	35.7	55	0.1	29,196	53.3	2,246	4.1	55	0.1	214	0.4	54,777	100.0
Middle Kuskokwim River[c]	Subtotal							Not Sampled								6,009	
Upper Kuskokwim River[d]	Subtotal							Not Sampled								2,391	
Total Kuskokwim River	M	3,892	6.2	17,815	28.2	63	0.1	13,330	21.1	1,137	1.8	63	0.1	190	0.3	36,491	57.8
	F	75	0.1	4,753	7.5	0	0.0	20,343	32.2	1,453	2.3	0	0.0	61	0.1	26,686	42.2
	Total	3,967	6.3	22,569	35.7	63	0.1	33,673	53.3	2,590	4.1	63	0.1	252	0.4	63,177	100.0
Year 2007																	
Lower Kuskokwim River[b]	M	4,406	7.0	17,654	28.1	0	0.0	13,554	21.6	481	0.9	160	0.3	36501	0.2	36,501	58.2
	F	184	0.3	5,507	8.8	0	0.0	19,214	30.6	1,071	1.7	187	0.3	26220	0.0	26,220	41.8
	Subtotal	4,589	7.3	23,161	36.9	0	0.0	32,768	52.2	1,622	2.6	347	0.6	214	0.3	62,721	100.0
Middle Kuskokwim River[c]	Subtotal							Not Sampled								4,334	
Upper Kuskokwim River[d]	Subtotal							Not Sampled								1,590	
Total Kuskokwim River	M	4,822	7.0	19,321	28.1	0	0.0	14,834	21.6	555	0.9	185	0.3	39948	0.2	39,948	58.2
	F	201	0.3	6,027	8.8	0	0.0	21,029	30.6	1,172	1.7	216	0.3	28697	0.0	28,697	41.8
	Total	5,023	7.3	25,348	36.9	0	0.0	35,863	52.2	1,775	2.6	401	0.6	252	0.3	68,645	100.0

Sources: Harvest estimates by Fall et al. 2007, Fall et al. 2009a, Fall et al. 2009b. Age and sex composition from this study.

Note: Harvest estimates based on postseason subsistence harvest surveys conducted by ADF&G Division of Subsistence.

[a] Includes age-0.2, -1.1, -2.3, -1.6, and -2.5 Chinook salmon combined.

[b] Includes Kuskokwim River communities from Eek and Tuntutuliak upstream through Tuluksak, plus North Kuskokwim Bay communities of Kipnuk, Kwigillingok, and Kongiganak.

[c] Includes communities from Lower Kalskag upstream through Chuathbaluk.

[d] Includes Crooked Creek and all communities upstream of Crooked Creek.

Table 11.–Reported gear types used to harvest Chinook salmon in the Kuskokwim River subsistence fishery, 2005–2007.

Reporting Area and Year	Reporting Households	Gear Type Usage by Reporting Households (HH) [a]															
		Set Gillnet		Drift Gillnet		Fish Wheel		Rod & Reel		Seine		Spear		Other Gear Unspecified		Not Reported	
		HH		HH		HH		HH		HH		HH		HH		HH	
Lower Kuskokwim River [b]																	
2005	699	137	20%	553	79%	1	0%	74	11%	0	0%	0	0%	0	0%	48	7%
2006	608	81	13%	500	82%	0	0%	80	13%	0	0%	0	0%	0	0%	21	3%
2007	538	62	12%	446	83%	-		66	12%	-		-		2	0%	48	9%
Middle Kuskokwim River [c]																	
2005	151	26	17%	109	72%	1	1%	80	53%	0	0%	0	0%	0	0%	3	2%
2006	114	18	16%	74	65%	1	1%	45	39%	0	0%	0	0%	0	0%	9	8%
2007	126	14	11%	86	68%	-		56	44%	-		-		0	0%	15	12%
Upper Kuskokwim River [d]																	
2005	44	15	34%	22	50%	0	0%	12	27%	0	0%	0	0%	0	0%	7	16%
2006	60	23	38%	22	37%	2	3%	15	25%	0	0%	0	0%	0	0%	9	15%
2007	49	12	24%	17	35%	-		16	33%	-		-		0	0%	11	22%

Sources: Fall et al. 2007, Fall et al. 2009a, Fall et al. 2009b.

Note: Data based on postseason subsistence harvest surveys conducted by ADF&G Division of Subsistence.

Note: Dashes represent unspecified gear types.

[a] Subsistence fishermen often use multiple gear types over the course of the season to harvest salmon, so annual percentage sum to over 100%.

[b] Includes Kuskokwim River communities from Eek and Tuntutuliak upstream through Tuluksak, plus North Kuskokwim Bay communities of Kipnuk, Kwigillingok, and Kongiganak.

[c] Includes communities from Lower Kalskag upstream through Chuathbaluk.

[d] Includes Crooked Creek and all communities upstream of Crooked Creek.

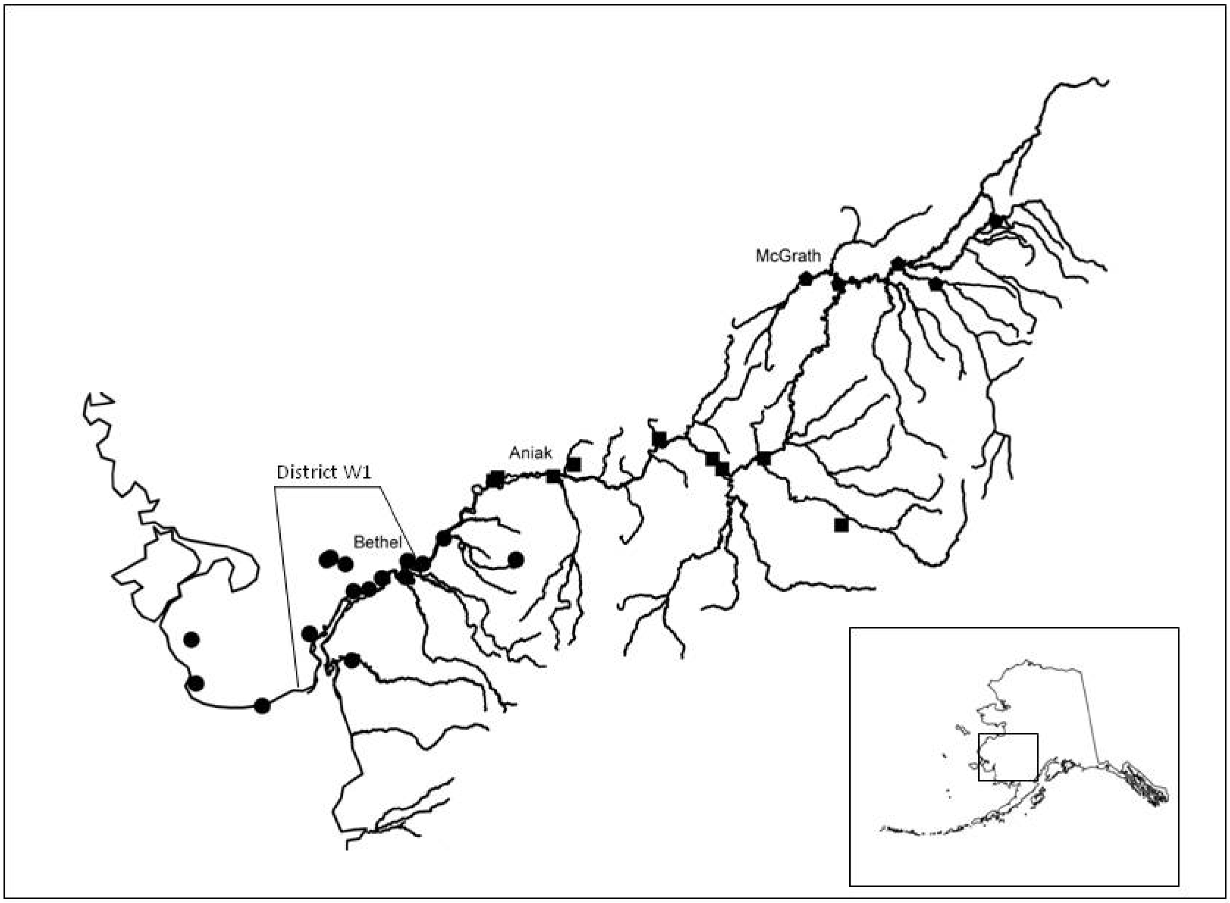


Figure 1.–Map of the Kuskokwim River drainage, highlighting the location of commercial fishing District W1 and major population centers in the lower (circles), middle (squares) and upper river (diamonds) reporting areas.

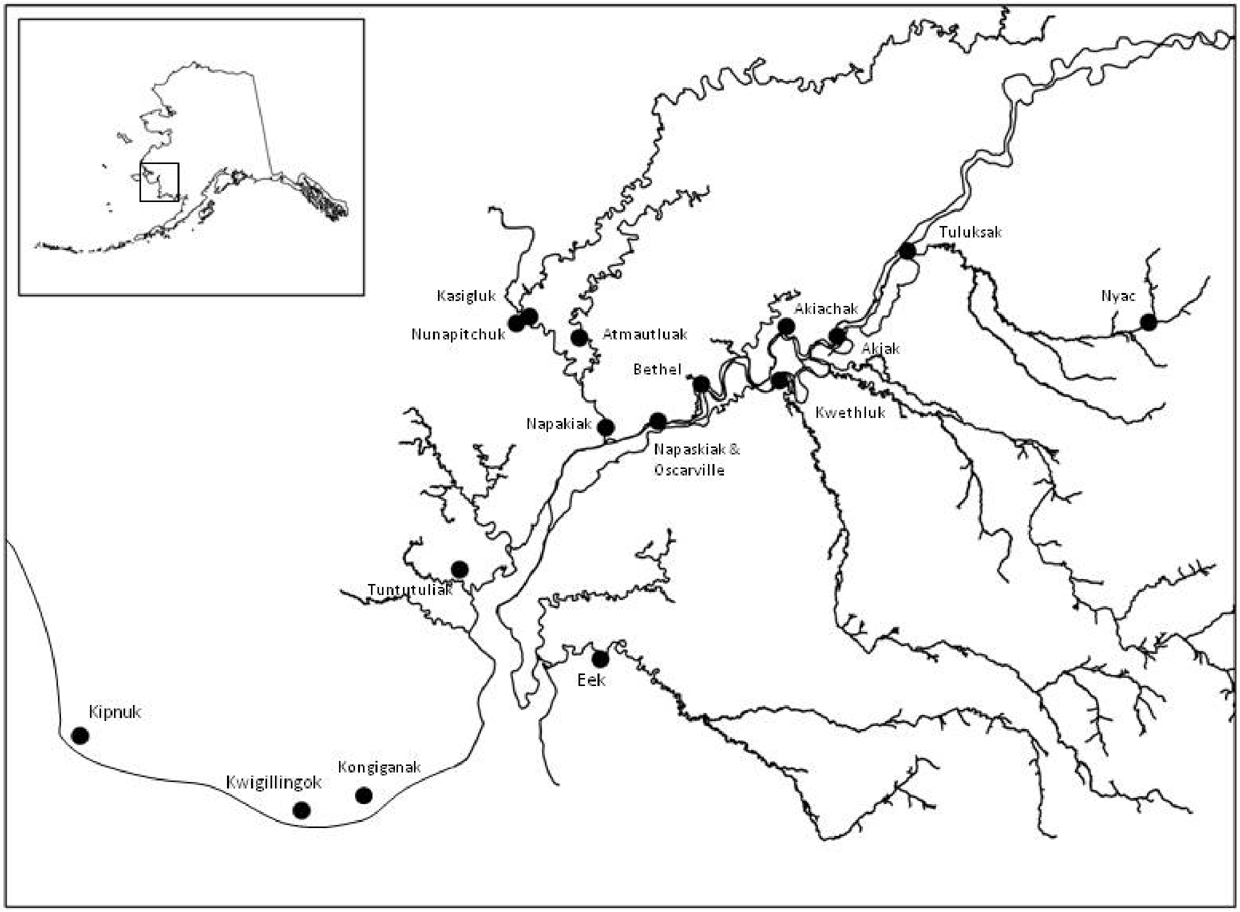
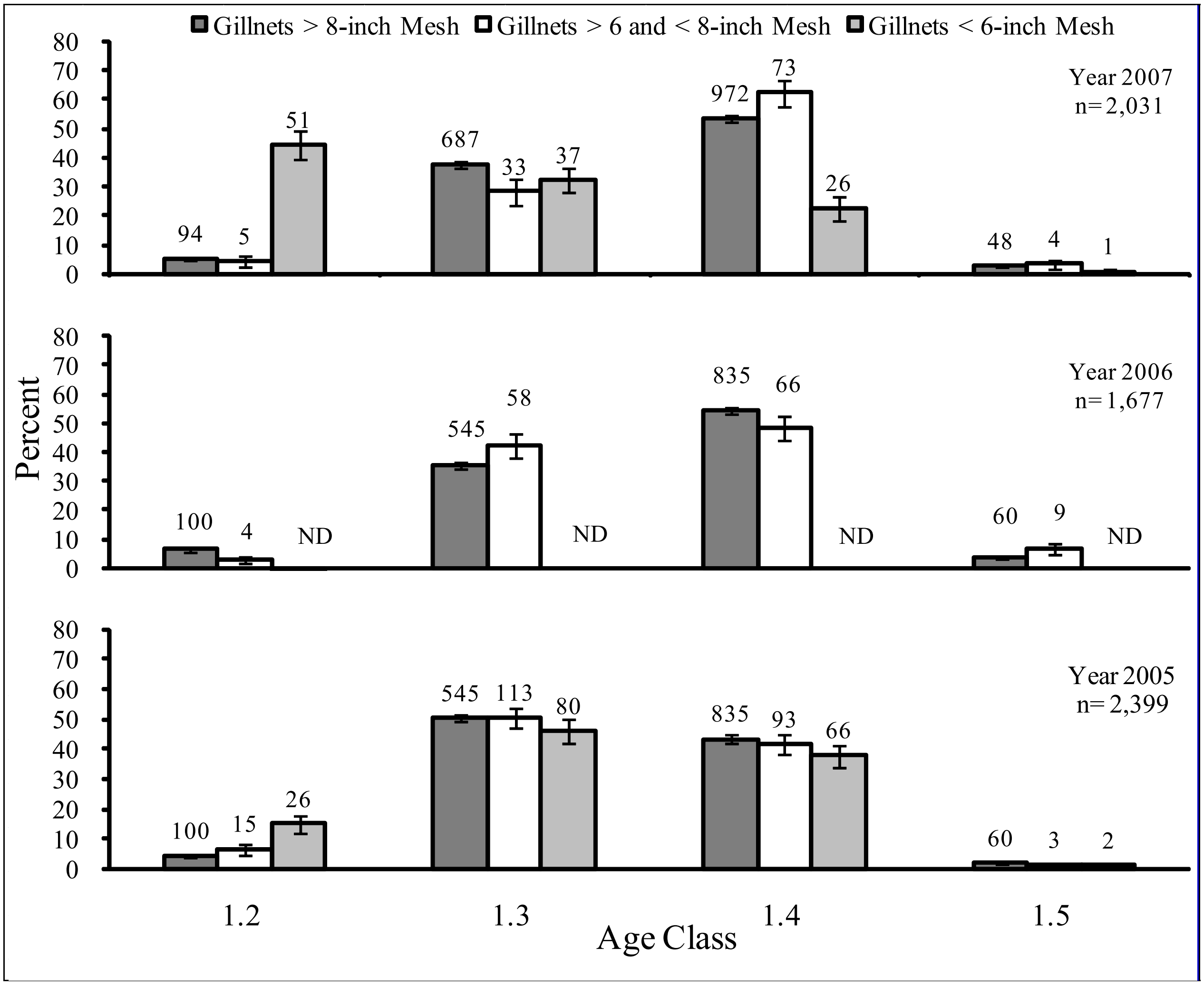


Figure 2.–The Lower Kuskokwim River Reporting Area, with notation of community locations, and communities where samples were collected (open symbols).



Note: The number at the top of each bar is the sample size, 2005–2007.

Figure 3.–Historical age class composition by gear type of Chinook salmon harvest in the lower Kuskokwim River subsistence fishery.

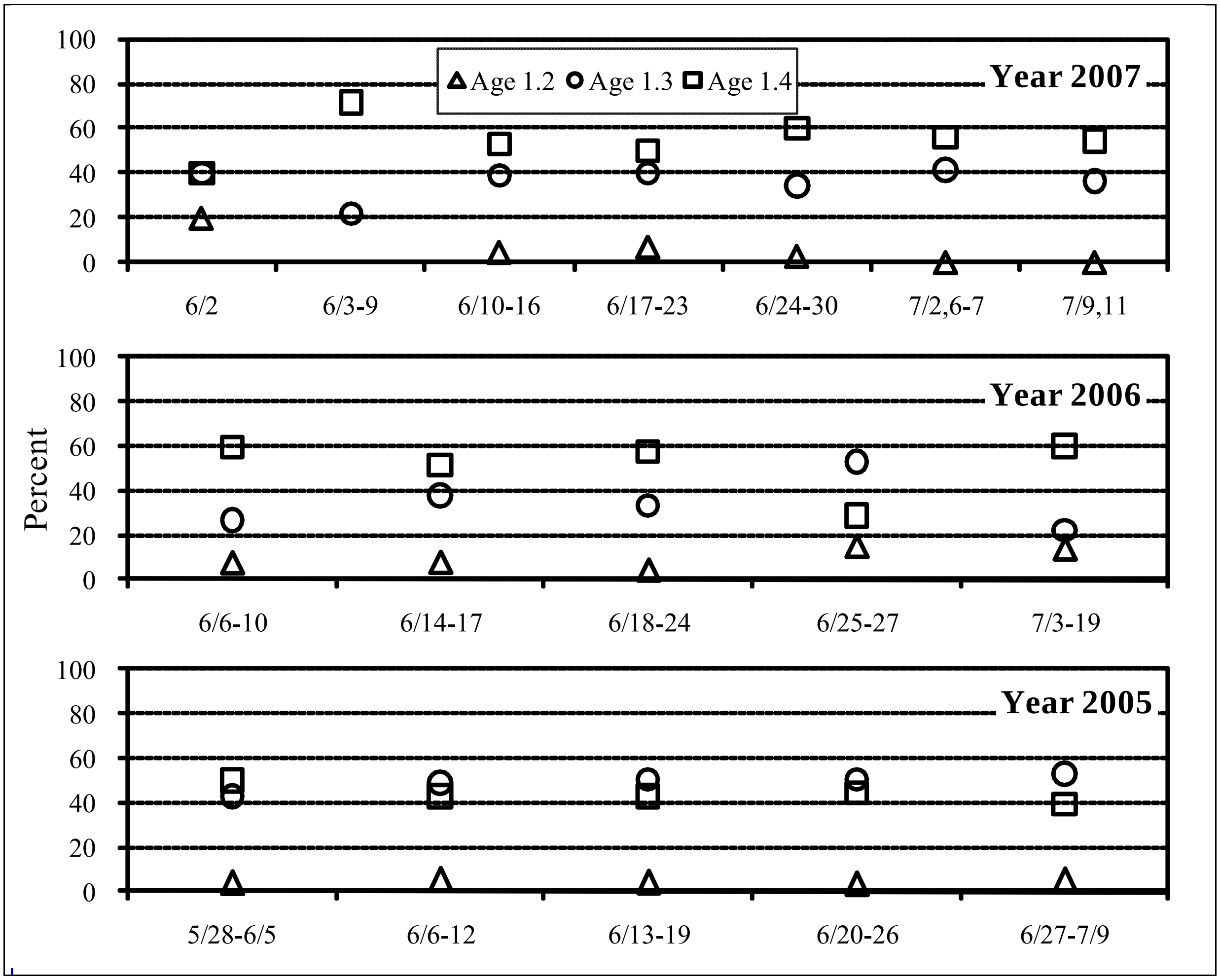


Figure 4.–Temporally stratified age composition of Chinook salmon harvested in the lower Kuskokwim River subsistence fishery with gillnets ≥8 inch mesh, 2005–2007.

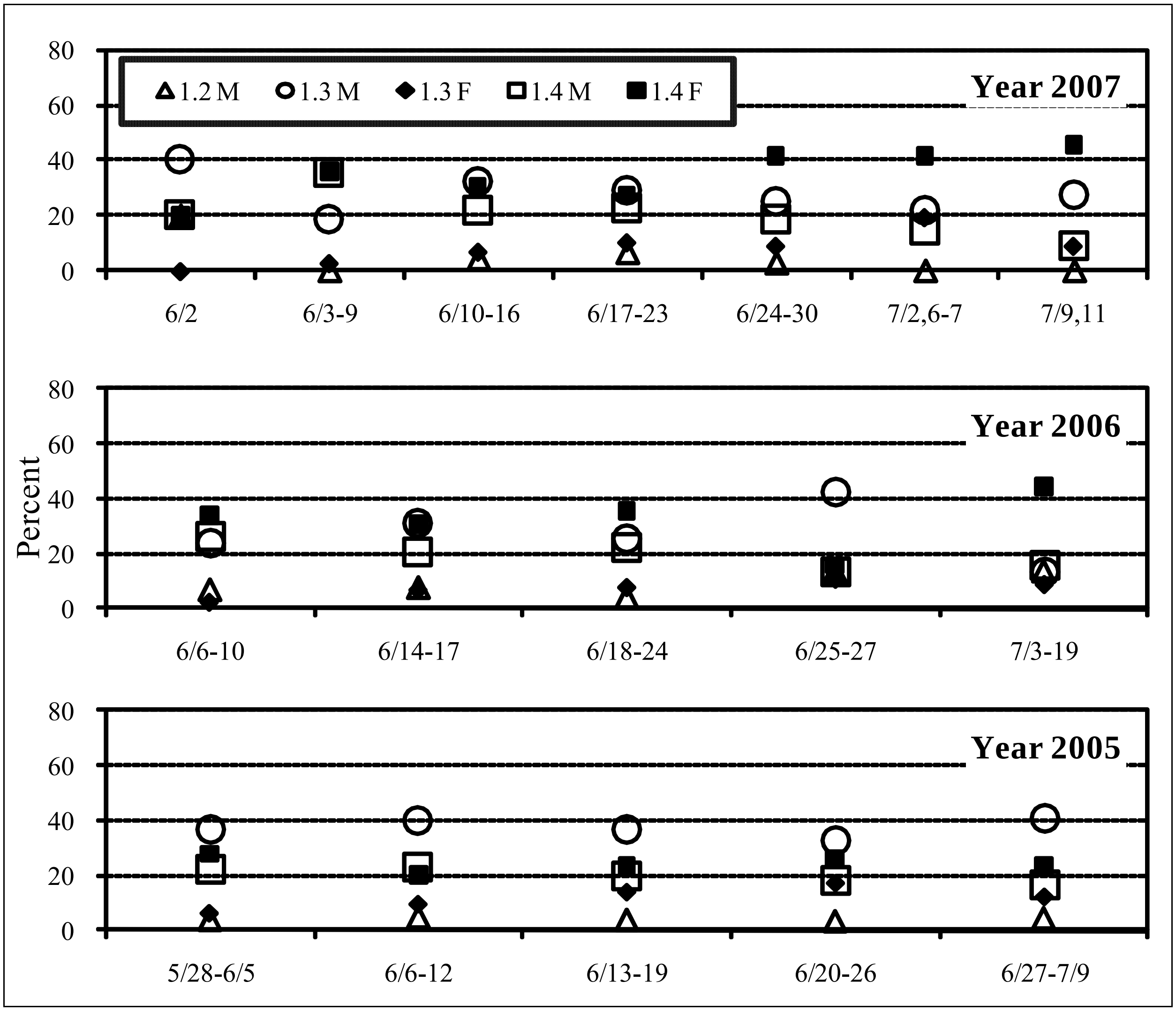


Figure 5.–Temporally stratified age composition by sex (M = male, F = female) of Chinook salmon harvested in the lower Kuskokwim River subsistence fishery with gillnets ≥8 inch mesh, 2005–2007.

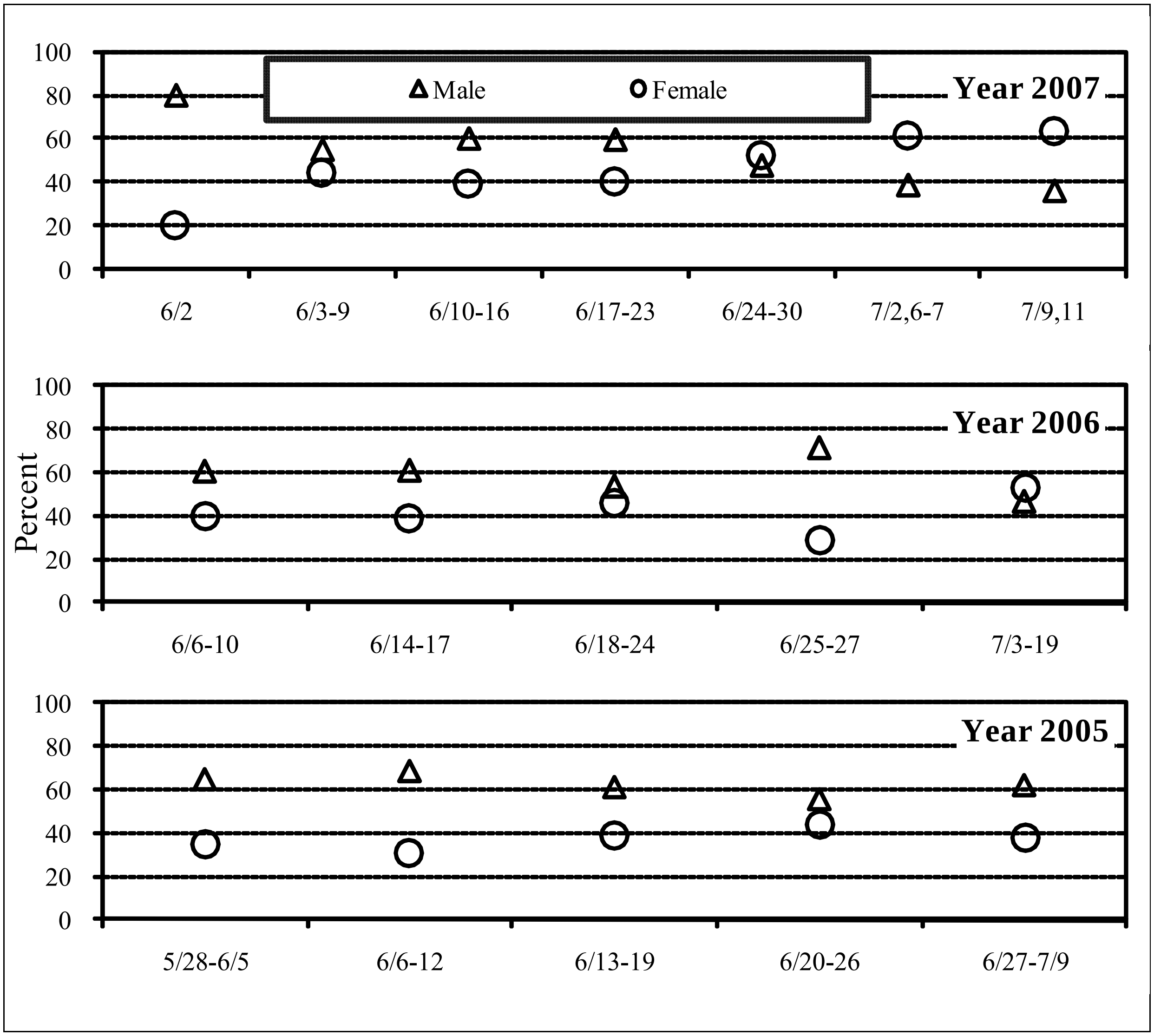


Figure 6.–Temporally stratified sex composition (M = male, F = female) of Chinook salmon harvested in the lower Kuskokwim River subsistence fishery with gillnets ≥8 inch mesh, 2005–2007.

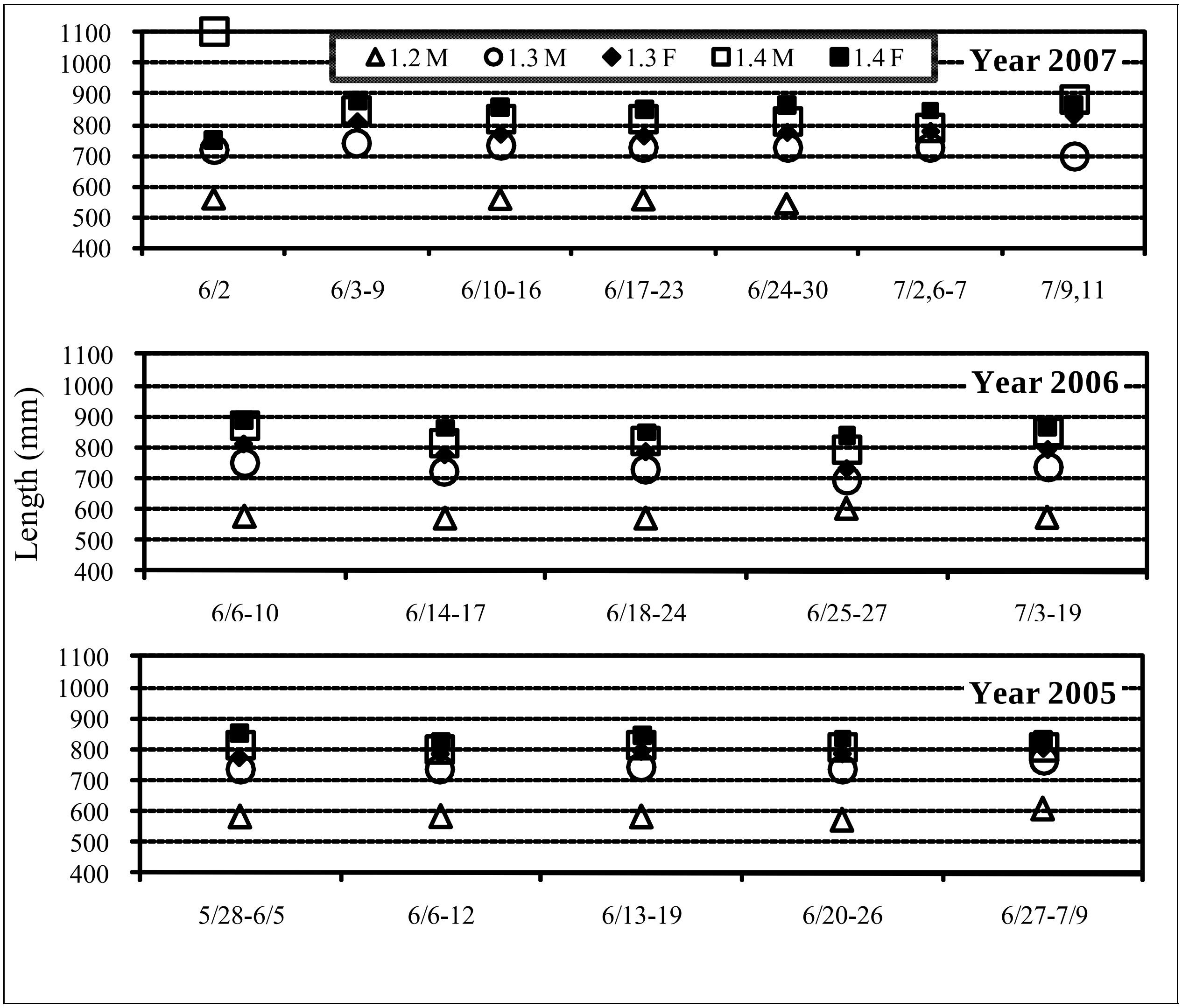


Figure 7.–Temporally stratified mean length by age-sex category of Chinook salmon harvested in the lower Kuskokwim River subsistence fishery with gillnets ≥8 inch mesh size, 2005–2006.

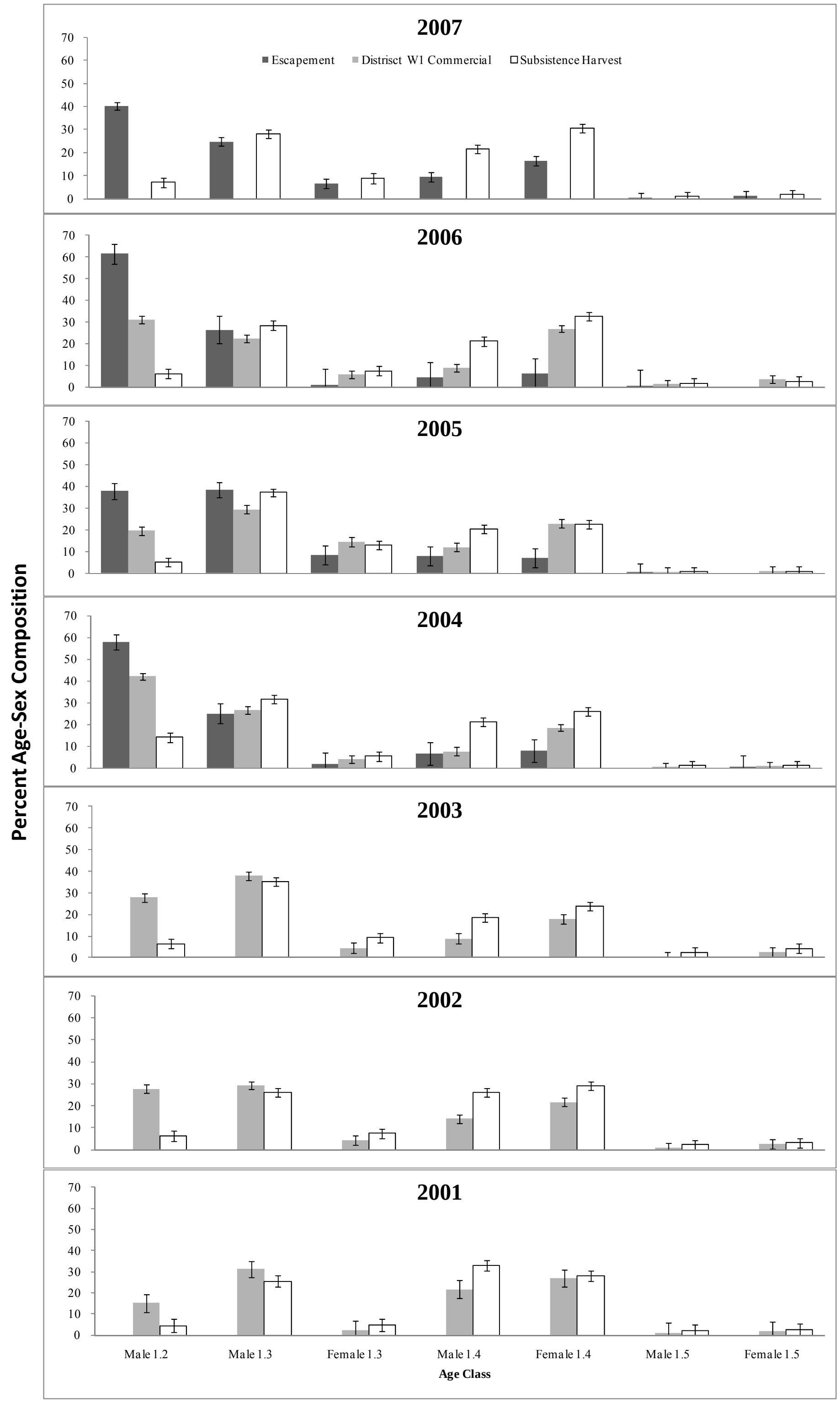


Figure 8.–Historical composition of Kuskokwim River Chinook salmon in the commercial harvest, escapement, and subsistence harvest by age-sex category (+/-SE), 2001 to 2007.

APPENDIX A: SAMPLE MATERIALS

Appendix A1.–Sample data form used in the 2005–2007 Chinook salmon subsistence harvest age, sex, length sampling program.

SUBSISTENCE KING SALMON DATA FORM

Name: ______________________ Scale Card Number: ____________

Address: ______________________

Sample Date: ____________ (month/ day/ year) SSN: ____________

Location: ______________________ (examples: Kuskokwim River near Bethel, Kuskokwim River near Akiak)

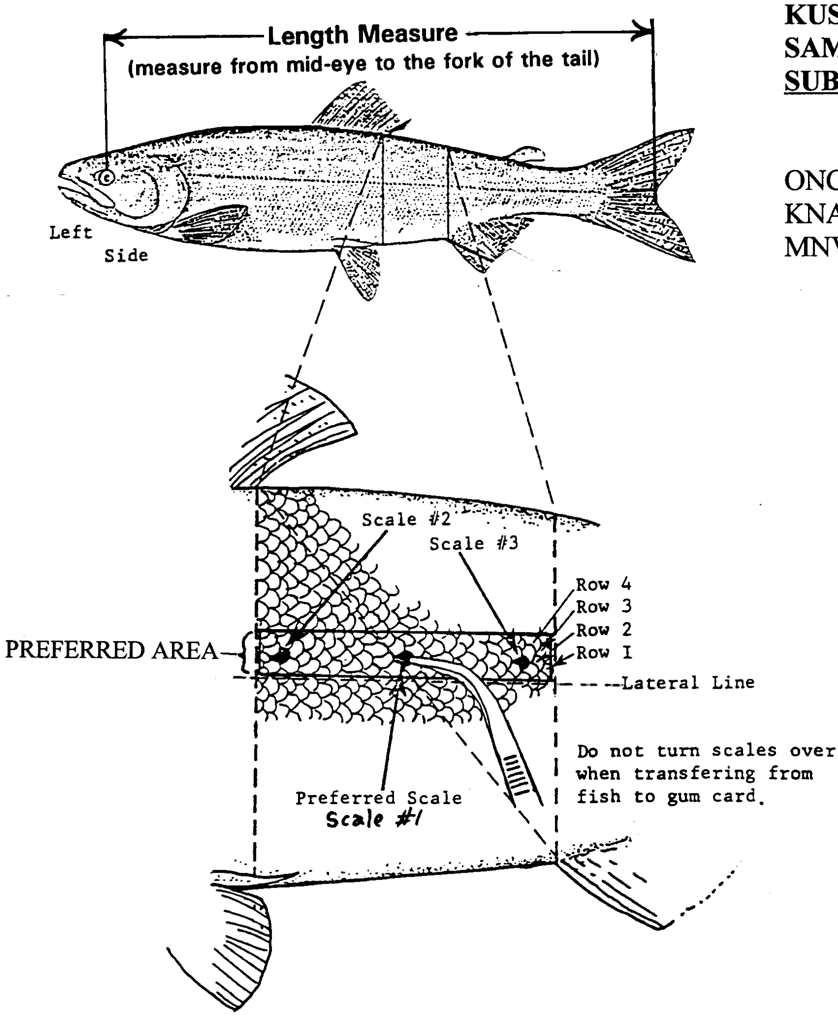
Gear Type: Drift Gillnet Set Gillnet Rod & Reel Fishwheel

Mesh Size: ____________ Did you cut every fish to look for eggs? Yes or No

Fish Camps: Your Own Other Person's Location of other person fish camp ____________

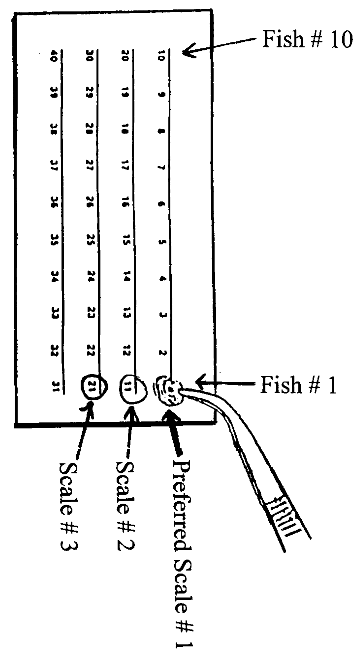
Fish Number	Sex (M or F)	Length (mm)	Comments
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

Appendix A2.–Sample instruction form used in the 2005–2007 Chinook salmon subsistence harvest age, sex, length sampling program.



KUSKOKWIM RIVER SAMPLING PROGRAM FOR <u>SUBSISTENCE KING SALMON</u>

ONC (Bethel) 543-2608
KNA (Aniak) 675-4384
MNVC (McGrath) 524-3023



Age-Sex-Length Sampling Instructions

1) Position king salmon left side up.
2) Take preferred scale #1 located two rows above the lateral line and intersecting a diagonal line from the back of the dorsal fin to the front of the anal fin.
3) Clean scale by removing slime.
4) Place scale directly over number on gum card. Be cafeful to keep scale right side up and mount scale in same orientation.
5) Repeat above steps for scales #2 and #3 (see picture).
6) Measure length (mm) from mid-eye to fork of tail.
7) Cut fish belly and determine sex.

Payment requires the following information for each king salmon:

1) Three readable scales from each fish.
2) Sex of each fish.
3) Length of each fish.
4) Gear type and mesh size.
5) Date of capture.
6) Location of capture.
7) Your name on data form and scale card.

Appendix A3.–Sample project summary distributed to participating fishermen following the 2006 subsistence harvest sampling program.

Age-Sex-Length Sampling from Subsistence Harvested Chinook Salmon in 2006.

Subsistence fishers in the Kuskokwim River collected information from their Chinook salmon harvests to help biologists better understand the needs of subsistence users. The following information is a summary of those findings:

(1) Twenty samplers from local communities participated in the Kuskokwim River age-sex-length sampling program in 2006.

(2) A total of 1,973 Chinook salmon were sampled from Kuskokwim River harvests near Tuntutuliak, Eek, Bethel and Napasiak.

(3) Samples were collected from a variety of gear types (Figure 1):

(a) 6 drift gillnet mesh sizes (7 1/4, 7 1/2, 7 5/8, 8, 8 1/4 and 8 1/2 inches).

(b) 2 set gillnet mesh sizes (7 1/2, 8),

(c) 1 hook and line.

(d) 91% were from gillnets with mesh size of 8 inches or larger.

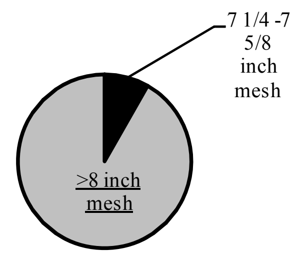


Figure 1. Mesh size composition of Chinook salmon samples collected in the Kuskokwim River subsistence fishery.

(4) Sex composition by mesh size was (Figure 2):

(a) 45.3 % female for 7 1/4 - 7 5/8 inch mesh,

(b) and 42.0% female for greater than or equal to 8 inch mesh.

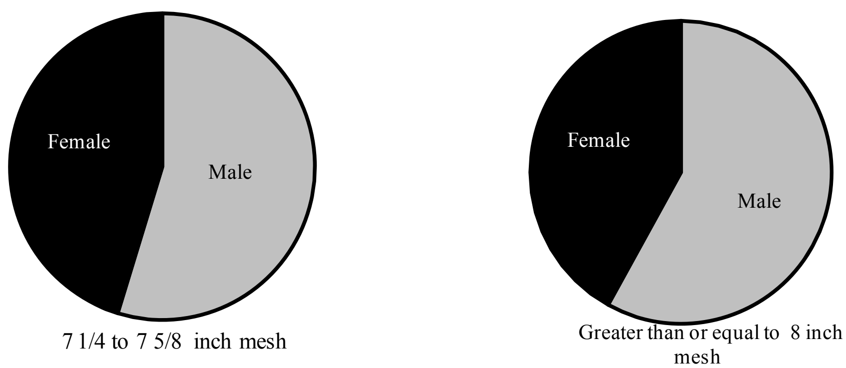


Figure 2. Sex composition, by mesh size, of Chinook salmon sampled in the Kuskokwim River subsistence fishery.

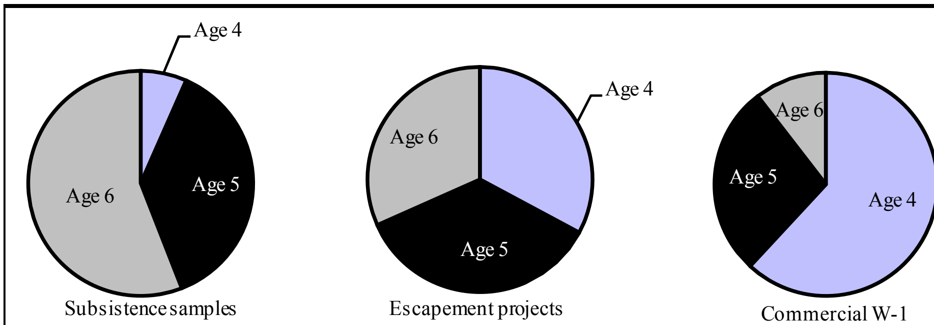


Figure 3. Age composition from Chinook salmon in the subsistence fishery, escapement projects, and commercial W-1.

This project was funded by the Federal Office of Subsistence Management under grant FIS#06-023, FIS#06-132 and FIS#06-225. These grants were administered by ADF&G and Orutsararmiut Native Council.

APPENDIX B: HARVEST ESTIMATES

Appendix B1.–Kuskokwim River subsistence Chinook salmon harvests, 2005–2007.

	Year		
Community	2005	2006	2007
LOWER KUSKOKWIM RIVER REPORTING AREA			
Kipnuk	-	-	-
Kwigillingok	-	-	-
Kongiganak	1,508	1,429	-
Tuntutuliak	4,508	3,341	3,295
Eek	2,899	272	110
Kasigluk	-	157	-
Nunapitchuk	3,480	3,357	4,664
Atmautluak	1,720	-	1,364
Napakiak	2,695	4,109	2,318
Napaskiak	4,262	3,983	4,965
Oscarville	987	825	1,048
Bethel	24,473	23,095	29,548
Kwethluk	5,402	5,581	4,924
Akiachak	4,611	4,389	7,021
Akiak	3,420	3,407	3,463
Tuluksak	2,498	830	-
Lower Kuskokwim Subtotal	62,463	54,775	62,721
MIDDLE KUSKOKWIM RIVER REPORTING AREA			
Lower Kalskag	1,387	2,227	1,043
Upper Kalskag	2,225	1,154	407
Aniak	1,987	2,011	2,737
Chuathbaluk	863	618	147
Middle Kuskokwim Subtotal	6,462	6,009	4,334
UPPER KUSKOKWIM RIVER REPORTING AREA			
Crooked Creek	826	383	0
Red Devil	191	197	284
Sleetmute	393	582	903
Stony River	-	250	-
Lime Village	-	-	-
McGrath	54	501	392
Takotna	-	0	0
Nikolai	3	479	0
Telida	-	0	-
Upper Kuskokwim Subtotal	1,467	2,392	1,579
Kuskokwim River Total	70,393	63,177	68,645

Source: Fall et al. 2007, 2009a, and 2009b.

Note: Includes harvests using rod and reel and harvests from the removal of salmon from commercial harvests as well as harvests from subsistence nets.

Note: If fewer than 30 or <50% of households in a community were contacted, then reported harvest is used for estimated harvest.

Note: Dash (-) means the community was not contacted and data is not available