Fishery Data Series No. 13-10

Age, Sex, and Length Composition of Chinook Salmon Harvested in the 2008–2011 Lower Kuskokwim River Subsistence Fishery

Final Report for Study 08-302

USFWS Office of Subsistence Management

Fisheries Resource Monitoring Program

by

Zachary W. Liller

Amy R. Brodersen

Tracy R. Hansen

Douglas B. Molyneaux

and

Eva Patton

March 2013

Alaska Department of Fish and Game **Divisions of Sport Fish and Commercial Fisheries**

Symbols and Abbreviations

The following symbols and abbreviations, and others approved for the Système International d'Unités (SI), are used without definition in the following reports by the Divisions of Sport Fish and of Commercial Fisheries: Fishery Manuscripts, Fishery Data Series Reports, Fishery Management Reports, and Special Publications. All others, including deviations from definitions listed below, are noted in the text at first mention, as well as in the titles or footnotes of tables, and in figure or figure captions.

Weights and measures (metric)

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

Weights and measures (English)

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

Time and temperature

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

Physics and chemistry

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

General

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

Mathematics, statistics

all standard mathematical signs, symbols and abbreviations	
alternate hypothesis	H_A
base of natural logarithm	*e*
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	(F, t, χ^2, etc.)
confidence interval	CI
correlation coefficient (multiple)	R
correlation coefficient (simple)	r
covariance	cov
degree (angular)	°
degrees of freedom	df
expected value	*E*
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	$\log_2$, etc.
minute (angular)	'
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
variance	
population	Var
sample	var

FISHERY DATA SERIES NO. 13-10

AGE, SEX, AND LEGTH COMPOSITION OF CHINOOK SALMON HARVESTED IN THE 2008–2011 LOWER KUSKOKWIM RIVER SUBSISTENCE FISHERY

by
Zachary W. Liller, Amy R. Brodersen, Tracy R. Hansen, Douglas B. Molyneaux
Alaska Department of Fish and Game, Division of Commercial Fisheries, Anchorage
and
Eva Patton
Orutsararmiut Native Council, Bethel

Alaska Department of Fish and Game
Division of Sport Fish, Research and Technical Services
333 Raspberry Road, Anchorage, Alaska, 99518-1565

March 2013

This investigation was partially financed by USFWS Office of Subsistence Management (Project 08-302) Fisheries Resource Monitoring Program under Cooperative Agreement 701818J688.

ADF&G Fishery Data Series was established in 1987 for the publication of Division of Sport Fish technically oriented results for a single project or group of closely related projects, and in 2004 became a joint divisional series with the Division of Commercial Fisheries. Fishery Data Series reports are intended for fishery and other technical professionals and are available through the Alaska State Library and on the Internet: http://www.adfg.alaska.gov/sf/publications/ This publication has undergone editorial and peer review.

Zachary W. Liller, Amy R. Brodersen, Tracy R. Hansen, Douglas B. Molyneaux
Alaska Department of Fish and Game, Division of Commercial Fisheries,
333 Raspberry Rd, Anchorage, AK 99518-1599, USA

Eva Patton
Orutsararmiut Native Council
P.O. Box 927, Bethel, AK 99559, USA

This document should be cited as:
Liller, Z. W., A. R. Brodersen, T. R. Hansen, D. B. Molyneaux, and E. Patton. 2013. Age, sex, and length composition of Chinook salmon harvested in the 2008–2011 Lower Kuskokwim River subsistence fishery. Alaska Department of Fish and Game, Fishery Data Series No. 13-10, Anchorage.

TABLE OF CONTENTS

Page

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LIST OF APPENDICES (Continued)

ABSTRACT

The Kuskokwim River Chinook salmon *Oncorhynchus tshawytscha* subsistence fishery is one of the largest in the state of Alaska and collection of age, sex, and length (ASL) data from the subsistence harvest is an important component of the Kuskokwim Area stock biology program. The Alaska Department of Fish and Game, Division of Commercial Fisheries, and the Orutsararmiut Native Council partnered to recruit local fishermen to collect ASL data from subsistence-caught Chinook salmon during the 2008–2011 fishing seasons, for the purpose of estimating the annual composition of the lower Kuskokwim subsistence Chinook salmon harvest. Participation in this program is voluntary and ranged from 20 to 54 local area subsistence fishermen during the 2008–2011 project years. Fishermen from the villages of Bethel and Tuntutuliak participated in all four years and individuals from Eek, Napakiak, Napaskiak, and Tuluksak participated in at least one year. During each project year, participants sampled between 1,393 and 4,182 Chinook salmon throughout the annual harvest period from a range of gillnet mesh sizes. The majority of samples were collected within 20 mi of the village of Bethel, from gillnets with mesh sizes greater than 8 in, and from the first half of the Chinook salmon run. Sample collection by gear, time, and area conform to our understanding of Chinook salmon subsistence harvest practices in the lower Kuskokwim River, and we believe that the samples collected were reasonably representative of the total subsistence harvest of Chinook salmon in our study area. Across all four study years age-1.3 and -1.4 Chinook salmon combined for 84–89% of the total harvest, followed by age-1.2 (8–13%) and age-1.5 (1–3%). Males comprised 58–66% of the harvest, and average length of Chinook salmon harvested ranged between 747 and 773 mm.

Key words: Chinook salmon, *Oncorhynchus tshawytscha*, Kuskokwim River, subsistence, age, sex, length, ASL composition, gillnet, harvest timing.

INTRODUCTION

The purpose of this study is to estimate the age, sex, and length (ASL) composition of the Chinook salmon *Oncorhynchus tshawytscha* subsistence harvest that occurs in District 1 of the Kuskokwim Management Area, defined as all waters from the mouth of the Kuskokwim River to Bogus Creek at river kilometer (rkm) 203—an area commonly referred to as the "lower Kuskokwim River." This study began in 2001 and has been a core component of the *Kuskokwim Area Stock Biology Program* (Liller et al. 2013) which collects ASL data from harvest and escapement monitoring projects throughout the Kuskokwim Management Area. ASL data collected from the Kuskokwim River subsistence harvest are used to inform a wide range of management decisions and are a necessary component for constructing brood tables and conducting spawner-recruit analyses for the Kuskokwim River Chinook salmon population (e.g., Bue et al. 2012). This report presents the ASL composition of the subsistence harvests of Chinook salmon in the lower Kuskokwim River for project years 2008–2011.

The Kuskokwim River Chinook salmon subsistence fishery is one of the largest in the state (Fall et al. 2011). More Chinook salmon are harvested than any other salmon species in the Kuskokwim River subsistence fishery (Carroll and Hamazaki 2012b). The Alaska Board of Fisheries determined that a harvest of 64,500–83,000 Chinook salmon was considered reasonably necessary to meet the customary and traditional needs of Kuskokwim River subsistence users. Annual harvests have averaged more than 88,000 fish over the past 10 years. That level of harvest has accounted for more than 90% of the total annual inriver harvest (Brazil et al. 2011) and nearly 50% of the statewide subsistence harvest of Chinook salmon (e.g., Fall et al. 2011).

The Alaska Department of Fish and Game (ADF&G), Division of Commercial Fisheries is responsible for management of the Kuskokwim River subsistence fishery. Consistent with Alaska Statute (AS 16.05.258) and the *Kuskokwim River Salmon Management Plan* (5 AAC 07.365), subsistence harvest of Chinook salmon in the Kuskokwim Area is given priority over

commercial and sport harvest. Historically, activities of subsistence salmon fishermen have largely been unregulated. With the exception of a few tributaries, subsistence fishing can occur throughout the Kuskokwim River and at any time (5 AAC 01.260), although specific time and area closures are possible through Emergency Order. Legal methods for subsistence harvest of Kuskokwim salmon include gillnets (set or drift), beach seine, hook and line (attached to a pole), hand line, and fish wheel (5 AAC 01.270). Gillnet mesh size is not regulated; however, there are maximum length and depth limitations.

The specific harvest methods used in a given year by Kuskokwim River subsistence fishermen targeting Chinook salmon are not known exactly, but qualitative data are abundant in the literature (e.g., Molyneaux et al. 2010a; Patton and Carroll 2011; Carroll and Hamazaki 2012b) and through conversations with area residents. Beginning in early June, many families travel from permanent residences to seasonal fish camps located along the mainstem Kuskokwim River, sloughs, and tributary rivers. These camps provide a base from which fishermen travel to traditional fishing locations. Approximately 85% of the annual subsistence harvest of Chinook salmon occurs on the lower Kuskokwim River (Carroll and Hamazaki 2012b). The greatest concentration of subsistence fishermen is within 20 mi of Bethel, which is the largest population center in the area. Harvest typically occurs throughout June and early July (Hamazaki 2008), and peak harvest effort often precedes the peak of the Chinook salmon run. Set and drift gillnets are the most common gear types used by subsistence fishermen (Fall et al. 2011; Patton and Carroll 2011), and a wide range of mesh sizes are used (Molyneaux et al. 2010a). Historically, gillnets hung with large mesh web have been the most common gear type used for targeting Chinook salmon.

The methods used by Kuskokwim River subsistence fishermen create a potential for harvest that is disproportionate to the actual range of age classes, sex ratios, and lengths that make up the Chinook salmon return to the Kuskokwim River. Large mesh nets commonly used by subsistence fishermen for targeting Chinook salmon are selective for large fish (Bromaghin 2005; Howard and Evenson 2010), which tend to be older and are more likely to be female (Molyneaux et al. 2010b). Timing of fishing effort influences the ASL composition of the harvest because the composition of the Chinook salmon return changes as the run progresses (Molyneaux et al. 2010b). In addition, early harvest timing may result in disproportionate harvest of Chinook salmon bound for upriver tributaries, which tend to display an earlier migration timing compared to fish retuning to less distant tributaries (Stuby 2007).

Historically, the ASL composition of the Chinook salmon subsistence harvest was estimated from commercial harvest samples (e.g., Anderson 1995; Huttunen 1986; Molyneaux and Samuelson 1992). Until 1985, this practice was considered reasonable because timing of subsistence and commercial harvests overlapped, both fisheries targeted Chinook salmon, and both fisheries had unrestricted gillnet mesh size. After 1985, the commercial fishery was restricted to use of gillnets with mesh sizes ≤6 inches. Consequently, the composition of the commercial harvest was no longer representative of the subsistence harvest. To address the need for representative samples, ADF&G staff opportunistically sampled subsistence-caught Chinook salmon (e.g., Anderson 1991; DuBois and Molyneaux 2000). However, freshly caught fish were typically not available and agency staff would collect scales from partially processed fish. This was often an imposition on host subsistence fishermen and resulted in small sample sizes, uncertainty about gear type or mesh size used, and incomplete sex and length data. In some

instances, sex and length composition was inappropriately generalized from the commercial fishery (e.g., Anderson 1995; Huttunen 1986).

The current approach used to collect ASL samples relies on subsistence fishermen to opportunistically sample their own harvest. We expected this approach to produce a dataset that would adequately represent the overall harvest by gear, time, and area. We assumed that all fishermen had similar motives to participate, and that having a large number of participants would ensure roughly proportional representation across gear types, areas, and time. Since 2001, this approach has been used to collect samples and annually estimate the ASL composition of the subsistence Chinook harvest. From 2001 to 2003, separate projects were operated in the upper, middle and lower river (Dubois et al. 2002; Molyneaux et al. 2004a, 2004b). Due largely to budget limitations, the middle and upper river projects were discontinued, and since 2004, only the lower Kuskokwim River project has been continued (Molyneaux et al. 2005, 2010a). This report details the results of that study for project years 2008–2011.

OBJECTIVES

1. Estimate the annual age, sex, and length composition of Chinook salmon in the lower Kuskokwim River subsistence harvest during the 2008, 2009, 2010, and 2011 fishing seasons.

In addition, we have provided a summary of the ASL composition of Chinook salmon sampled each year by time strata and gillnet mesh size in Appendices A and B. These data summaries were provided in fulfillment of Cooperative Agreement 08-078 (FRMP 08-302, Objectives 2 and 3) with U.S. Fish and Wildlife Service Office of Subsistence Management Fisheries Resource Monitoring Project 08-302. Our study was not intended to investigate the effects of the subsistence fishery on the Chinook salmon population, and we caution the use of these summaries for any purpose other than evaluating whether the samples collected reasonably represent the subsistence harvest that occurred throughout the lower Kuskokwim River.

METHODS

STUDY AREA

The study area was District 1 of the Kuskokwim Management Area, defined as that portion of the Kuskokwim River upstream from the mouth of the Kuskokwim River to the confluence of Bogus Creek at river kilometer 203. More specifically, the study area includes communities within District 1 along the mainstem Kuskokwim River, and the following tributaries: Eek, Kwethluk, and Tuluksak Rivers (Figures 1 and 2).

STUDY DESIGN

Consistent with previous years of this project, the ASL composition of the lower Kuskokwim River Chinook salmon subsistence harvest was estimated from samples collected by local residents who participated in the harvest of Chinook salmon for subsistence. Subsistence fishermen were recruited among the various lower Kuskokwim River communities to sample from their own harvests or the harvests of others. No constraints were placed on the number of participants, and it was assumed that all participants had equal motivation to collect samples regardless of when, where, and how they harvested. No constraints were placed on the number of samples collected by any individual. We assumed that by recruiting as many participants as

possible to collect as many samples as possible, the resulting samples would adequately represent the harvest across gear, time, and area. A more formal statistical sampling design was not used due to the voluntary nature of participation.

RECRUITING AND TRAINING PARTICIPANTS

Recruiting and training participants was coordinated by ADF&G Division of Commercial Fisheries and Orutsararmiut Native Council (ONC). Staff from ONC was responsible for recruitment in the greater Bethel area, from the community of Napaskiak (rkm 97) upriver to the mouth of the Gweek River (rkm 135; Figure 2). Beginning approximately June 1 each year, ONC staff traveled to fish camps and solicited participation while concurrently conducting their weekly inseason subsistence salmon catch surveys (e.g., Patton and Carroll 2011). From June 1 to June 10, ADF&G recruited throughout the remaining portions of the study area by contacting village councils, city offices, and tribal organizations in select communities and requested they post flyers in appropriate public venues as a means to notify community members of the opportunity. Each year, ADF&G focused recruitment effort on communities and individuals that showed interest in the program in prior years. Documentation of recruitment effort was limited (Appendix C), but each year recruitment flyers were sent to the villages of Tuntutuliak, Eek, and Napakiak. Special effort was made by both ONC and ADF&G staff to contact and encourage prior year participants to continue their involvement in the program. For budgetary purposes, recruitment efforts were curtailed if the total samples collected were anticipated to be greater than 2,000.

Participation in this program was voluntary and participants were paid for each sample collected. Anyone who was interested in participating was responsible for notifying ADF&G or ONC, resulting in a pool of "self-selected" samplers. In the event that participation needed to be limited in order to stay within budgetary constraints, participants were selected on a first-come-first-serve basis. No target participation goals were set for particular communities, in part, because many subsistence fishermen disperse considerable distances from their primary residence to harvest Chinook salmon from fish camps or drift sites located throughout the study area. Rather, effort was made to collect approximately 75% of the samples from subsistence fishermen who fished within 30 rkm from Bethel (rkm 106), because 70–80% of the total historical subsistence harvest of Chinook salmon has occurred in that area (Carroll and Hamazaki 2012b). To the extent possible, effort was made to collect at least some samples from harvests occurring in both the lower and upper portions of the study area. Based on similar recruitment during earlier years of this project (Dubois et al. 2002; Molyneaux et al. 2004a, 2004b, 2005, 2010a) annual participation of 20–35 individuals was expected (Appendix D1).

All participants received formal training in sampling techniques by ADF&G or ONC staff. Training was based on ADF&G salmon ASL sampling procedures (e.g., Molyneaux et al. 2010b). Orutsararmiut Native Council staff provided onsite demonstration and training for all interested individuals identified during fish camp visits, and provided follow-up support and guidance as needed during subsequent weekly visits. ADF&G staff organized open training sessions in select communities based on the level of interest (Appendix C). ADF&G staff was accessible from Bethel to provide additional guidance to samplers throughout the season. Following training, each participant was provided a sampling kit that included the following items: data forms (Appendices E1 and E2); detailed instructions (Appendix E3); a clip board; forceps; scale cards; wax paper inserts; and a meter stick. Participants were instructed to collect

as many samples as possible from all harvest gears they used and from throughout their entire harvest period.

DATA COLLECTION

For each fish sampled, participants recorded the harvest date, location, and gear type. Participants also recorded whether the samples came from their own harvest or the harvest of another person. Sex was determined by cutting the abdomen and internally inspecting for the presence of ovaries or testes. Length was measured to the nearest mm from mideye to tail fork with a straight edge meter stick. Three scales were collected from each fish for later use in age determination by ADF&G staff. Scales were removed from the preferred area of the fish (INFPC 1963) and mounted on scale cards (Appendix E3). Sampled fish were numbered sequentially by the participant, and sex and length data were paired with the corresponding scale samples from each fish. Samples received were assigned a unique code generated by ADF&G that allowed staff to match samples to participants for the purpose of quality control and determining payment. The identities of participants were held confidential and were not included in the ADF&G database.

Scale cards and data forms were returned to ADF&G staff in a variety of ways. Bethel area samplers delivered samples directly to the ADF&G office in Bethel. Participants collecting samples from more distant locations were provided with pre-paid envelopes for mailing their samples. In addition, ONC staff opportunistically retrieved samples during weekly visits and delivered them to ADF&G on the participant's behalf.

During the 2008 and 2009 project years, samples collected by residents of the Native Village of Tuluksak (Figure 2) and used as part of this study were coordinated by U.S. Fish and Wildlife Service (Harris and Harper 2010). Samples collected from the Tuluksak subsistence harvests by USFWS followed different procedures than those used by ADF&G and ONC. Notable differences in methodology were that samples were collected by USFWS staff (i.e., not the subsistence participant) and length measurements were rounded to the nearest 5 mm (mideye to tail fork).

AGE DETERMINATION

Scales, mounted on gum cards, were impressed in clear cellulose acetate using methods described by Clutter and Whitesel (1956). Scale impressions were magnified with a microfiche reader, and age was estimated 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 two digits, plus one to account for the period prior to the beginning of scale formation.

DATA SUMMARIES AND ANALYSIS

Data describing the sample collection effort were summarized by location based on participant's community of residence (i.e., if the participant resided in Bethel all samples collected by that individual were categorized as Bethel samples regardless of where the harvest occurred). The decision to categorize samples in this way was based on several factors: 1) the observation that most participants collected samples near the area of residence; 2) actual fishing locations were

often poorly documented; and 3) other Kuskokwim Area subsistence harvest studies categorize harvest in this way (e.g., Carroll and Hamazaki 2012a, 2012b).

Only complete samples (i.e., where age was estimated and sex and length data was reported) were used for analysis. Estimates of the annual ASL compositions were based on pooled samples from all gear types, locations, and time periods. Exploratory summaries of ASL composition stratified by gillnet mesh size, and harvest timing are presented in Appendices A and B and were only used for qualitative evaluation of the representativeness of the samples collected.

Confidence intervals (95%) were calculated for the age and sex proportions ($\hat{p}$) given a sample of size n using the following equation:

$$\hat{p} \pm 1.96\sqrt{\frac{\hat{p}(1-\hat{p})}{n-1}}.$$

Confidence intervals for mean length ($\bar{x}$) given a sample of size n with standard error s were estimated using the following equation:

$$\bar{x} \pm 1.96\frac{s}{\sqrt{n}}.$$

RESULTS

SAMPLE COLLECTION AND DISTRIBUTION

The number of participating subsistence fishermen ranged from 20 in 2011 to 54 in 2009 (Table 1). Samples were collected by residents from Eek (rkm 13), Tuntutuliak (rkm 45), Napakiak (rkm 87), Napaskiak (rkm 97), Bethel (rkm 106), and Tuluksak (rkm 192), although not all villages were represented each year. Residents from Tuntutuliak and Bethel participated in the program each year and were the only villages represented in 2011 (Table 1). The total number of samples collected each year ranged between 1,393 in 2011 and 4,182 in 2009 (Table 1). Bethel participants collected a majority of the samples each year (range: 44–81%) followed by residents of Tuntutuliak (range: 19–30%). The timing of the sampling effort by Bethel area participants was generally 3–9 days earlier than run timing of Chinook salmon past Bethel as indicated by the ADF&G gillnet test fishery using 8-in and 5 ⅜-in mesh nets (Figure 3). Each year, gillnets were the only gear type sampled by participants, and a range of small (≤6 in), intermediate (> 6 in and < 8 in), and large (≥ 8 in) mesh sizes were represented. Samples from large mesh gillnets represented majority of the total samples collected annually (range: 67–78%), followed by intermediate (range: 12–25%) and small mesh (range: 5–11%; Tables 2–5).

ANNUAL ASL HARVEST COMPOSITION

Age-1.3 and -1.4 Chinook salmon were the most abundant age classes represented each year in the lower Kuskokwim River subsistence harvest and when combined accounted for 84–89% (Table 6; Figure 4). Age-1.3 was the dominant age class in 2008 (54%), 2010 (49%), and 2011 (48%), and age-1.4 was the dominant age class in 2009 (54%). Across all four study years, age-1.2 fish accounted for 8–13% of the annual harvest and age-1.5 fish made up 1-3%. Age-1.1, -2.2, -2.3, -2.4, and -1.6 fish were represented in the subsistence harvest each year but combined they made up no more than 1% (Table 6).

Males comprised 58–66% of the total annual subsistence harvest (Table 6). Across all four study years, the harvest of age-1.2 Chinook salmon comprised 93–99% males, while males made up 69–80% of age-1.3 fish, 38–46% of age-1.4 fish, and 31–41% of age-1.5 fish in the harvest (Figure 5).

Across all project years, the average length of harvested fish ranged between 747 mm and 773 mm. The average length of harvested females ranged between 813 and 835 mm while the average length of harvest males ranged between 715 and 746 mm (Figure 6). Harvested females were consistently larger than males at age (Table 6).

DISCUSSION

ANNUAL ASL HARVEST COMPOSITION

Our estimates of the ASL composition of the lower Kuskokwim River Chinook salmon subsistence harvest during the 2008–2011 seasons were within the observed ranges of estimates produced in previous project years (Appendix D2; Dubois et al. 2002; Molyneaux et al. 2010a, 2004a, 2004b). Since 2001, project results show that age-1.3 and -1.4 have consistently been the most common age classes harvested, representing 82–93%. Age-1.4 fish have been the most abundant in the harvest during 6 of the 11 project years and age-1.3 fish were the most abundant in the remaining five years. Since 2001, age-1.2 Chinook salmon have composed 5–15% of the annual harvest, and age-1.5 has represented 1–7%. Since 2001, the proportion of the harvest that is female has ranged between 33 and 42% and mean length of the harvest has ranged between 734 and 787 mm.

Similarity in the annual ASL composition of the lower Kuskokwim River subsistence harvest between project years was not surprising. Harvest composition is a function of the ASL composition of the Chinook salmon return, the harvest practices (e.g., gear types and timing) used by subsistence fisherman, and inseason management of the subsistence fishery. Since 2001, majority (69–92%) of the samples collected each year have been from large mesh gillnets nets; although in recent years, samples collected from small and intermediate mesh nets have increased (Appendix D3). Similarly, management of the subsistence fishery has remained unchanged (Brazil et al. 2011), and over the life of this project, has been limited to short-term closures implemented annually from 2001 to 2004 and again in 2011 (e.g., Linderman and Bergstrom 2006). Observed variation in the annual ASL estimates was most likely a function of the underlying composition of the total annual return and some unknown level of bias due to sample error.

STUDY DESIGN

Recruitment and Participation

Attracting effective participation among subsistence fishermen was an annual challenge. The partnership between ADF&G and ONC facilitated recruitment 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 collected. Even with the monetary incentive, our experience was that over half the individuals annually trained and outfitted with sampling kits chose not to participate. The most common reasons given for not following through were related to difficulty modifying the fish processing routine in order to accommodate sampling needs (Eva Patton, ONC Fishery

Biologist, Bethel, personal communication). For example, subsistence families attempt to process fish quickly after harvest and sampling slows the process, and to a lesser extent some fishermen remove the head and entrails while on the river prior to bringing the fish to shore for processing. In past years of this project other reasons were also given for not participating, which included the tedium of the task and inadequate monetary compensation.

Each year, logistical limitations resulted in unequal recruitment effort throughout the study area. Recruitment efforts in the Bethel area (i.e., from the community of Napaskiak to the mouth of the Gweek River) were extensive, as each established fish camp was visited in person by ONC staff. That level of recruitment was only possible because ONC made use of a separate project, the *Lower Kuskokwim River inseason subsistence salmon catch monitoring program* (e.g., Patton and Carroll 2011), which conducted a weekly survey of subsistence users fishing in the Bethel area. Recruitment of participants from the Tuluksak area was also extensive in 2008 and 2009 due to the independent efforts by USFWS staff to estimate the ASL composition of that community's Chinook salmon subsistence harvest (Harris and Harper 2010). Recruitment effort by ADF&G throughout the remainder of the study area was allocated towards communities and individuals who demonstrated consistent past interest in the program. As such, most recruitment effort focused on residents of Eek, Tuntutuliak, and Napakiak (Appendix C1).

Overall, the level of participation from 2008 to 2011 was greater than in earlier project years. From 2001 to 2007, average annual participation was 26 samplers (range: 18–32) compared to an average of 39 samplers from 2008 to 2011 (Appendix D1; Dubois et al. 2002; Molyneaux et al. 2004a, 2004b, 2010a). Estimates of the number of subsistence fishing families in the lower Kuskokwim River have been relatively stable since 2001 (Hamazaki 2011; Carroll and Hamazaki 2012a, 2012b). Increased participation was primarily due to the focused sampling of Tuluksak harvests by USFWS. Participation during the 2011 season was lower than all previous years except 2001, which was the first year of the study. Comments from participants suggested that subsistence closures during the 2011 season affected their willingness or ability to participate in the program (Eva Patton, ONC Fishery Biologist, Bethel, personal communication).

Many of the individuals who agreed to collect ASL data had participated in the program at least once prior. Repeat samplers comprised 30%, 52%, 66%, and 70% of the participants respectively from 2008 to 2011, and some of those samplers have participated in all 11 project years. It has been our experience that encouraging trained volunteers to participate in multiple years has resulted in increased efficiency and data quality.

Data Quality

The quality of the samples collected by the non-agency participants in this study was comparable to studies that rely on agency staff to collect samples. In particular, the percentage of fish that were successfully aged in this study averaged 80% across all four project years, compared to 86% by commercial catch samplers and 81% from escapement projects. Participants were instructed to verify each fish's sex through internal examination; reported compliance was high, and there were no "red flags" such as an unusually high occurrence of females among the age-1.2 and -1.3 age classes. Participants were instructed to measure each fish to the nearest

millimeter; however, review of data suggests that some participants rounded measurements to the nearest 5 or 10 mm. High quality data in recent years is attributable to the high percentage of recurring participants, comprehensive training, improved data forms and sampling aids, and timely feedback.

Representative Samples

We assumed in this study that (1) sampling from individual gear types was proportional to the actual harvest by gear type, (2) sampling effort across time was proportional to the actual harvest effort across time, and (3) pooling of samples adequately represented actual ASL composition of the lower Kuskokwim River subsistence Chinook salmon harvest. It was not possible to formally test the degree to which these assumptions were met because accurate estimates of percent of harvest by gear type and harvest timing are not available for comparison. However, qualitative data is available from inseason and postseason subsistence harvest surveys.

Limited data from independent assessments suggest that volunteer samplers did collect ASL data from the most common gear types and sizes used by subsistence fishermen when targeting Chinook salmon. From 2008–2011, all ASL samples were collected from Chinook salmon harvested with gillnets. Each year, volunteers sampled from a wide range of net sizes but large mesh nets were most common (average: 73%) followed by intermediate sized meshes (average: 19%). Annual post-season subsistence harvest surveys confirm that gillnets were the predominant gear used by fishing families (Carroll and Hamazaki 2012a, 2012b; Chris Shelden, Commercial Fisheries Biologist, ADF&G, personal communication). Inseason surveys of predominately Bethel area fishermen indicated that nets hung with mesh larger than 6 in (i.e., intermediate and large nets) were the most commonly used to target Chinook salmon (Patton and Carroll 2011, 2012). Survey respondents in 2010 and 2011 reported using small mesh nets more than normal in response to low abundance and small size of Chinook salmon (Patton and Carroll 2012; Eva Patton, ONC Biologist, Bethel, personal communication). That reported shift toward more frequent use of small mesh gillnets was not represented in our samples in 2010 or 2011; however, the increased sampling from intermediate mesh nets in 2011 suggests our sampling did detect a reduction in percent use of “traditional” large mesh gillnets by subsistence fishermen targeting Chinook salmon (Appendix D3). Overall, the composition of the samples collected from the different mesh size gillnets followed expected patterns (e.g., larger mesh sizes harvested larger and older fish) which further supports our assertion that the samples collected reasonably represent the subsistence harvest (Appendices A1–A4).

Limited data suggests that volunteer samplers did collect ASL data during time periods when most subsistence fishermen fish for Chinook salmon. The timing of Chinook salmon subsistence harvest is typically greatest during the first half of Chinook salmon run (Hamazaki 2008), and the timing of ASL sample collection efforts conformed to that pattern (Figure 3). Inseason survey data indicated that most Bethel area families began subsistence fishing during the very early phase of the annual run and finished harvesting before the end of the run (Patton and Carroll 2011, 2012), which was consistent with annual sample collection efforts. During the project time period, ADF&G Division of Commercial Fisheries distributed Harvest Calendars to subsistence fisherman as an instrument for examining subsistence harvest timing (e.g., Carroll and Hamazaki 2012a, 2012b). Unfortunately, from 2008 to 2010, only a small percentage of calendars were returned to the Department; still, median harvest date from those calendars was within two days of the median sample date for years 2008–2010 (Figure 3). Calendar data for 2011 harvest timing was not available at the time of this report, but we believe the timing of

sample collection in 2011 was reasonably representative of harvest timing. For example, in 2011 there were three separate subsistence closures (June 16–19, June 23–28, and June 30–July 2) and the timing of those closures was reflected in the timing of sample collection. In addition, the ASL composition of the harvest by time strata did not raise any red flags that would suggest that the samples collected by time were not representative of the subsistence harvest (Appendices B1–B4).

Based on independent estimates of community harvest (Carroll and Hamazaki 2012b), it is apparent that the subsistence ASL sampling efforts were not proportional to harvest by community. Due to the voluntary nature of the program, proportional sampling by communities was not feasible; rather, our intent was to ensure that majority of the samples were collected from the Bethel area. The Bethel community is the largest community in the study area and over the most recent 10 years has harvested on average 38% of the total subsistence Chinook salmon in the lower Kuskokwim River (Carroll and Hamazaki 2012b). The percentage of samples collected from the Bethel area ranged from 44% to 81% during this study. The percentage of samples from smaller communities such as Tuntutuliak and Tuluksak were very high relative to harvest. Consistent with past years of this project, we did not weight samples by harvest to correct for disproportionate sampling. However, we did explore the effects of weighting, and found that our estimates were largely not affected. When 2008–2011 samples were weighted by harvest, estimates of age composition did not differ by more than three percentage points in 2008 and 2009 and not more than one percentage point in 2010 and 2011. It appears that our study design is sufficiently robust against disproportionate sampling.

UTILITY OF LOWER RIVER SUBSISTENCE ASL DATA

Results of this study are specific to the lower Kuskokwim River Chinook salmon subsistence gillnet harvest, and the utility of this data depends on the intended purpose. Results of this study are used by ADF&G staff to approximate the ASL composition of the entire Kuskokwim River Chinook salmon subsistence harvest. Subsistence ASL data is used in conjunction with data collected from commercial harvests and escapements for informing management (Appendix F), estimating the ASL composition of the total annual return of Chinook salmon, and for brood table development (e.g., Bue et al. 2012). The effect of not sampling from subsistence harvest occurring in upper portions of the drainage is probably negligible. For example, from 2001–2003 sampling was conducted in the lower, middle, and upper drainage, although spatial differences in harvest composition were observed, the estimated ASL composition of the total subsistence harvest from all areas did not differ from the lower river estimate by more than 1% for any age-sex category, because in those years nearly all of the harvest occurred in the lower river (Dubois and Molyneaux 2002; Molyneaux 2004a, 2004b). Similarly, from 2008 to 2011, nearly all of the subsistence harvest of Chinook salmon occurred in the lower portion of the Kuskokwim River (Carroll and Hamazaki 2012b; Chris Shelden, Fishery Biologist, Commercial Fisheries, ADF&G, personal communication). As such, our results can be used for a wide range of applications.

Results of this study should not be used to directly represent the ASL composition of middle and upper Kuskokwim River subsistence harvest of Chinook salmon. The ASL harvest compositions do differ along the river (Dubois and Molyneaux 2002; Molyneaux 2004a, 2004b). The observed differences are most likely due to differences in harvest methods used by fishing families and differences in the ASL composition of fish available for harvest, which changes as the run

progresses upriver due to selective harvest in downriver areas and successive escapements into spawning tributaries.

This study was not designed to characterize harvest patterns used by lower Kuskokwim River subsistence fishermen for targeting Chinook salmon or the effects of the subsistence fishery on the Kuskokwim River Chinook salmon population. Although our data does provide insight into those issues and can be used to inform development of more focused studies, those data should be used with caution.

FUTURE CONSIDERATIONS

Staff members from ONC and ADF&G have worked to incorporate this study into efforts to inform the public about fishery issues. Throughout this project, biologists explained to participants the reasons for wanting to understand the composition of the subsistence harvest and how that data is used for salmon research and management. It has been our experience that most participants are genuinely interested in the project and in tracking their harvests systematically to see if the trends they observe show up in the data. Given this level of interest, a successful program requires feedback to the participants and communities who assist with data collection.

The current agreement with USFWS OSM approves funding for this project through the 2015 fishing season. Since the project's inception in 2001, the study design has remained unchanged. Now with 11 years of data, a focused review of the study design would be timely. This review should be focused on potential approaches to streamline sampling efforts. Specific design questions include: 1) what is the optimum number of participants, 2) is it necessary to sample proportional to harvest by community, and 3) is it necessary for participants to sample all fish they harvest in a season.

ACKNOWLEDGMENTS

First and foremost, we wish to thank the many participants and subsistence fishermen who collected samples and made this project possible. We also thank the residents and community leaders of the lower Kuskokwim River who assisted with the recruitment of participants and scheduling training events. Greg Roczicka of ONC served as co-investigator for this project and coordinated all aspects of project operations for ONC. Thanks to ONC staff hired for the *Kuskokwim River salmon inseason subsistence catch monitoring* project that assisted with data collected. Chris Shelden, Ashley Fairbanks, and Emerie Fairbanks of ADF&G provided valuable logistical support for this project. Thanks to Scott Ayers of ADF&G for assistance with data summaries and draft review. Hamachan Hamazaki provided biometric review and Jan Conitz provided Regional review for ADF&G. Don Rivard and Pippa Kenner provided review of this report for the U.S. Fish and Wildlife Service, Office of Subsistence Management. We also thank Shannon Royse, Region III Publication Specialist, for her advice and assistance with formatting and style and for facilitating the review and publication process.

REFERENCES CITED

Anderson, C. J. 1991. Kuskokwim management area salmon catch and escapement statistics, 1987. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Fishery Report No. 91-04, Juneau.

Anderson, C. J. 1995. Kuskokwim Management Area salmon catch and escapement statistics, 1988. Alaska Department of Fish and Game, Commercial Fisheries Management and Development, Technical Fishery Report No. 95-08, Juneau.

Brazil, C., D. Bue, H. Carroll, and T. Elison. 2011. 2010 Kuskokwim area management report. Alaska Department of Fish and Game, Fishery Management Report No. 11-67, Anchorage.

Bromaghin, J. F. 2005. A versatile net selectivity model, with application to Pacific salmon and freshwater species of the Yukon River. Alaska Fisheries Research 74:157-168.

Bue, B. G., K. L. Schaberg, Z. W. Liller, and D. B. Molyneaux. 2012. Estimates of the historic run and escapement for the Chinook Salmon stock returning to the Kuskokwim River, 1976–2011. Alaska Department of Fish and Game, Fishery Data Series No. 12-49, Anchorage.

Carroll, H. C., and T. Hamazaki. 2012a. Subsistence salmon harvest in the Kuskokwim area, 2008 and 2009. Alaska Department of Fish and Game, Fishery Data Series No. 12-35, Anchorage.

Carroll, H. C., and T. Hamazaki. 2012b. Subsistence salmon harvests in the Kuskokwim area, 2010. Alaska Department of Fish and Game, Fishery Data Series No. 12-38, Anchorage.

Clutter, R., and L. Whitesel. 1956. Collection and interpretation of sockeye salmon scales. Bulletin of the International North Pacific Fisheries Commission 9.

DuBois, L., and D. B. Molyneaux. 2000. Salmon age, sex and length catalog for the Kuskokwim area, 1999 progress report. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 3A00-18, Anchorage.

DuBois, L., D. B. Molyneaux, G. Roczicka, W. Morgan, and T. Williams. 2002. Age, sex, and length composition of Chinook salmon from the Kuskokwim River subsistence fishery, 2001. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 3A02-33, Anchorage.

Fall, J. A., C. Brown, N. Braem, J. J. Simon, W. E. Sineone, D. L. Holen, L. Naves, L. Hutchinson-Scarborough, T. Lemons, and T. M. Kreig. 2011, revised. Alaska subsistence salmon fisheries, 2008 report. Alaska Department of Fish and Game Division of Subsistence, Technical Paper No. 359, Anchorage.

Hamazaki, T. H. 2008. Fishery closure "windows" Scheduling as a means of changing the Chinook salmon subsistence fisher pattern: is it an effective management tool? Fisheries 33:(10)495-501.

Hamazaki, T. H. 2011. Reconstruction of subsistence salmon harvests in the Kuskokwim Area, 1990–2009. Alaska Department of Fish and Game, Fishery Manuscript Series No. 11-09, Anchorage.

Harris, F., and K. C. Harper. 2010. Characterization of Tuluksak Chinook salmon subsistence harvests, 2008 and 2009. U.S. Fish and Wildlife Service, Alaska Fisheries Data Series Number 2010-07.

Howard, K. G., and D. F. Evenson. 2010. Yukon River Chinook salmon comparative mesh size study. Alaska Department of Fish and Game, Fishery Data Series No. 10-92, Anchorage.

Huttunen, D. C. 1986. Abundance, age, sex, and size of salmon (*Oncorhynchus* spp.) catches and escapements in the Kuskokwim Area, 1984. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Data Report No. 186, Juneau.

INFPC (International North Pacific Fisheries Commission). 1963. Annual Report, 1961. Vancouver, BC.

Liller, Z. W., A. R. Brodersen, and J. N. Clark. 2013. Salmon age, sex, and length catalog for the Kuskokwim area, 2010 and 2011. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 3A13-01, Anchorage.

REFERENCES CITED (Continued)

Linderman, J. C., Jr., and D. J. Bergstrom. 2006. Kuskokwim River Chinook and chum salmon stock status and Kuskokwim Area fisheries; a report to the Alaska Board of Fisheries. Alaska Department of Fish and Game, Division of Commercial Fisheries, Special Report No. 06-35, Anchorage.

Molyneaux, D. B., and K. T. Samuelson. 1992. Kuskokwim Management Area salmon catch and escapement statistics, 1989. Alaska Department of Fish and Game, Division of Commercial Fisheries, Technical Fishery Report No.92-18, Juneau.

Molyneaux, D. B., D. Folletti, L. DuBois, G. Roczicka, and W. Morgan. 2004a. Age, sex, and length composition of Chinook salmon from the 2002 Kuskokwim River subsistence fishery. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 3A04-13, Anchorage.

Molyneaux, D. B., D. L. Folletti, L. K. Brannian, and G. Roczicka. 2004b. Age, sex, and length composition of Chinook salmon from the 2003 Kuskokwim River subsistence fishery. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 3A04-23, Anchorage.

Molyneaux, D. B, D. L. Folletti, L. K. Brannian, and G. Roczicka. 2005. Age, sex, and length composition of Chinook salmon from the 2004 Kuskokwim River subsistence fishery. Alaska Department of Fish and Game, Fishery Data Series No. 05-45, Anchorage.

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

Molyneaux, D. B., A. R. Brodersen, and C. A. Shelden. 2010b. Salmon age, sex, and length catalog for the Kuskokwim Area, 2009. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 3A10-05, Anchorage.

Patton, E., and H. C. Carroll. 2011. Lower Kuskokwim River inseason subsistence salmon catch monitoring, 2006 to 2009. Alaska Department of Fish and Game, Fishery Management Report No. 11-76, Anchorage.

Patton, E., and H. C. Carroll. 2012. Lower Kuskokwim River inseason subsistence salmon catch monitoring, 2010. Alaska Department of Fish and Game, Fishery Management Report No. 12-34, Anchorage.

Stuby, L. 2007. Inriver abundance of Chinook salmon in the Kuskokwim River, 2002-2006. Alaska Department of Fish and Game, Fishery Data Series No. 07-93, Anchorage.

TABLES AND FIGURES

Table 1.–Samples by community used to represent age, sex, and length composition of Chinook salmon harvest in lower Kuskokwim River subsistence fisheries, 2008–2011.

Year	Community	rkm [a]	Number of Samplers [b]	Harvests Sampled [c]	Sample Size [d]	Percent
2008	Tuntutuliak	45	6	6	776	22.7%
	Napakiak	87	2	2	62	1.8%
	Napaskiak	97	2	2	116	3.4%
	Bethel	106	17	17	1,730	50.6%
	Tuluksak	192	19	19	737	21.5%
	Total		46	46	3,421	100.0%
2009	Tuntutuliak[e]	45	12	13	1,267	30.3%
	Eek	46	1	2	49	1.2%
	Bethel	106	17	17	1,831	43.8%
	Tuluksak	192	24	24	1,035	24.7%
	Total		54	56	4,182	100.0%
2010	Tuntutuliak	45	6	6	464	22.5%
	Napakiak	87	1	2	39	1.9%
	Bethel	106	16	16	1,259	61.1%
	Tuluksak	192	12	12	300	14.5%
	Total		35	36	2,062	100.0%
2011	Tuntutuliak	45	4	4	262	18.8%
	Bethel	106	16	16	1,131	81.2%
	Total		20	20	1,393	100.0%

[a] River kilometer. Distance from the mouth of the Kuskokwim River.

[b] Samples were collected by community residents.

[c] Participants were encouraged to sample from as many households as possible.

[d] Sample sizes include Chinook salmon whose age could not be determined.

[e] One sampler's primary residence was Wasilla, Alaska, but samples were collected from Tuntutuliak.

Table 2.–Percent of samples collected by gillnet mesh size in the lower Kuskokwim River Chinook salmon subsistence fishery, 2008.

Mesh Size[a]	(n=776)	(n=62)	(n=116)	(n=1,730)	(n=737)	(n=3,421)
Small						
3.5 inch	0.0%	0.0%	0%	0.0%	0.3%	0.1%
4 inch	0.0%	0.0%	0%	0.0%	0.1%	0.0%
5 inch	0.0%	0.0%	0%	0.0%	0.8%	0.2%
5.375 inch	0.0%	0.0%	0%	0.0%	5.3%	1.1%
5.5 inch	0.0%	0.0%	0%	0.0%	18.0%	3.9%
5.75 inch	0.0%	0.0%	0%	0.0%	1.1%	0.2%
6 inch	0.0%	0.0%	7%	5.8%	2.2%	3.6%
Subtotal	0.0%	0.0%	6.9%	5.8%	27.8%	9.1%
Intermediate						
6.75 inch	0.0%	0.0%	0%	1.7%	0.0%	0.9%
7 inch	0.0%	51.6%	0%	0.0%	10.9%	3.3%
7.25 inch	8.2%	48.4%	0%	2.3%	6.8%	5.4%
7.5 inch	11.7%	0.0%	0%	9.4%	16.7%	11.0%
Subtotal	20.0%	100.0%	0.0%	13.4%	34.3%	20.5%
Large						
8 inch	60.7%	0.0%	93%	67.3%	21.0%	55.5%
8.25 inch	19.3%	0.0%	0%	11.7%	3.9%	11.2%
Subtotal	80.0%	0.0%	93.1%	79.1%	25.0%	66.7%
Unknown						
Subtotal	0.0%	0.0%	0%	1.7%	12.9%	3.7%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Note: Sample sizes include Chinook salmon whose age could not be determined.

[a] Drift and set gillnets combined.

Table 3.–Percent of samples collected by gillnet mesh size in the lower Kuskokwim River Chinook salmon subsistence fishery, 2009.

Mesh Size[a]	(n=1,267)	(n=49)	(n=1,831)	(n=1,035)	(n=4,182)
Small					
4 inch	0.0%	0%	0.0%	0.9%	0.2%
5 inch	0.0%	0%	0.0%	3.7%	0.9%
5.5 inch	0.0%	0%	0.0%	17.0%	4.2%
5.75 inch	0.0%	0%	0.0%	7.3%	1.8%
6 inch	0.0%	0%	3.3%	8.9%	3.7%
Subtotal	0.0%	0.0%	3.3%	37.8%	10.8%
Intermediate					
7 inch	0.0%	0%	0.0%	4.5%	1.1%
7.25 inch	0.2%	0%	0.0%	7.9%	2.0%
7.5 inch	13.9%	0%	9.8%	16.5%	12.6%
7.75 inch	0.0%	0%	0.0%	1.0%	0.2%
7.875 inch	0.0%	0%	0.7%	0.0%	0.3%
Subtotal	14.1%	0.0%	10.5%	30.0%	16.3%
Large					
8 inch	52.2%	100%	70.3%	31.4%	55.6%
8.25 inch	24.8%	0%	12.2%	0.0%	12.8%
8.5 inch	8.1%	0%	0.0%	0.0%	2.4%
Subtotal	85.1%	100.0%	82.5%	31.4%	70.9%
Unknown					
Subtotal	0.8%	0%	3.6%	0.9%	2.0%
Total	100.0%	100.0%	100.0%	100.0%	100.0%

Note: Sample sizes include Chinook salmon whose age could not be determined.

[a] Drift and set gillnets combined.

Table 4.–Percent of samples collected by gillnet mesh size in the lower Kuskokwim River Chinook salmon subsistence fishery, 2010.

Mesh Size[a]	Tuntutuliak (n=464)	Napakiak (n=39)	Bethel (n=1,259)	Tuluksak (n=300)	Total (n=2,062)
Small					
5.5 inch	0.0%	20.5%	0.0%	3.0%	0.8%
5.75 inch	0.0%	15.4%	0.0%	0.0%	0.3%
5.875 inch	0.0%	0.0%	0.0%	1.0%	0.1%
6 inch	0.0%	0.0%	4.7%	4.7%	3.5%
Subtotal	0.0%	35.9%	4.7%	8.7%	4.8%
Intermediate					
7 inch	0.0%	0.0%	0.0%	12.3%	1.8%
7.5 inch	7.3%	0.0%	6.3%	33.3%	10.3%
Subtotal	7.3%	0.0%	6.3%	45.7%	12.1%
Large					
8 inch	66.4%	0.0%	71.9%	45.3%	65.4%
8.25 inch	4.3%	0.0%	13.4%	0.0%	9.2%
8.5 inch	0.0%	64.1%	3.7%	0.0%	3.5%
Subtotal	70.7%	64.1%	89.0%	45.3%	78.1%
Unknown					
Subtotal	22.0%	0.0%	0.0%	0.3%	5.0%
Total	100.0%	100.0%	100.0%	100.0%	100.0%

Note: Sample sizes include Chinook salmon whose age could not be determined.

[a] Drift and set gillnets combined.

Table 5.–Percent of samples collected by gillnet mesh size in the lower Kuskokwim River Chinook salmon subsistence fishery, 2011.

Mesh Size[a]	Tuntutuliak (n=262)	Bethel (n=1,131)	Total (n=1,393)
Small			
3.25 inch	0.0%	0.4%	0.4%
3.5 inch	0.0%	0.1%	0.1%
5.5 inch	0.0%	1.6%	1.3%
6 inch	0.0%	5.5%	4.5%
Subtotal	0.0%	7.6%	6.2%
Intermediate			
7.5 inch	32.8%	17.5%	20.4%
7.75 inch	0.0%	5.2%	4.2%
Subtotal	32.8%	22.7%	24.6%
Large			
8 inch	44.3%	58.9%	56.1%
8.25 inch	22.9%	10.8%	13.1%
Subtotal	67.2%	69.7%	69.2%
Unknown			
Subtotal	0.0%	0.0%	0.0%
Total	100.0%	100.0%	100.0%

Note: Sample sizes include Chinook salmon whose age could not be determined.

[a] Drift and set gillnets combined.

Table 6.–Age, sex, and length (mm) composition of Chinook salmon harvested from the lower Kuskokwim River subsistence fishery, 2008–2011.

Year	Sample Size[a]	Sex	1.2	1.3	1.4	1.5	Other[b]	Total
2008	2,802	Male	8.1%	43.1%	13.0%	1.1%	0.9%	66.2%
		Female	0.1%	10.7%	21.3%	1.5%	0.2%	33.8%
		Total	8.2%	53.8%	34.3%	2.6%	1.1%	100.0%
		Male Mean Length	565	718	796	803	–	715
		SD	72	63	81	89	–	96
		Range	403–999	360–940	544–1077	606–962	–	344–1077
		Female Mean Length	777	785	842	859	–	823.72
		SD	93	64	68	54	–	73
		Range	700–881	550–980	330–995	693–930	–	330–995
2009	3,606	Male	9.6%	27.1%	24.5%	0.5%	0.3%	62.0%
		Female	0.4%	7.6%	29.1%	0.8%	0.1%	38.0%
		Total	10.0%	34.7%	53.6%	1.3%	0.4%	100.0%
		Male Mean Length	592	714	797	831	–	727
		SD	71	70	85	99	–	105
		Range	380–880	290–990	300–1060	720–950	–	290–1060
		Female Mean Length	744	799	848	849	–	835
		SD	124	67	58	60	–	69
		Range	500–930	270–945	1049	760–975	–	270–1092
2010	1,693	Male	7.4%	34.1%	15.1%	0.9%	0.2%	57.7%
		Female	0.4%	15.2%	24.7%	2.1%	0.0%	42.3%
		Total	7.8%	49.3%	39.8%	3.0%	0.2%	100.0%
		Male Mean Length	582	735	788	839	–	730
		SD	71	70	85	99	–	98
		Range	426–840	431–980	360–1001	580–954	–	360–1001
		Female Mean Length	778	802	847	868	–	831
		SD	124	67	58	60	–	66
		Range	560–925	580–1041	625–1010	760–1060	–	560–1060
2011	962	Male	12.4%	37.8%	14.3%	0.7%	0.2%	65.5%
		Female	0.9%	10.2%	22.0%	1.1%	0.2%	34.5%
		Total	13.3%	48.0%	36.4%	1.9%	0.4%	100.0%
		Male Mean Length	570	724	800	824	–	746
		SD	46	62	70	66	–	94
		Range	395–700	310–950	510–980	687–880	–	380–1040
		Female Mean Length	579	778	837	871	–	813
		SD	34	50	63	44	–	76
		Range	530–620	670–885	330–990	810–960	–	330–990

[a] Sample size includes only Chinook salmon that were aged.

[b] Includes minor age classes. Minor age classes were those that comprised less than 0.5% of samples. Includes ages 1.1, 2.2, 2.3, 2.4, and 1.6.

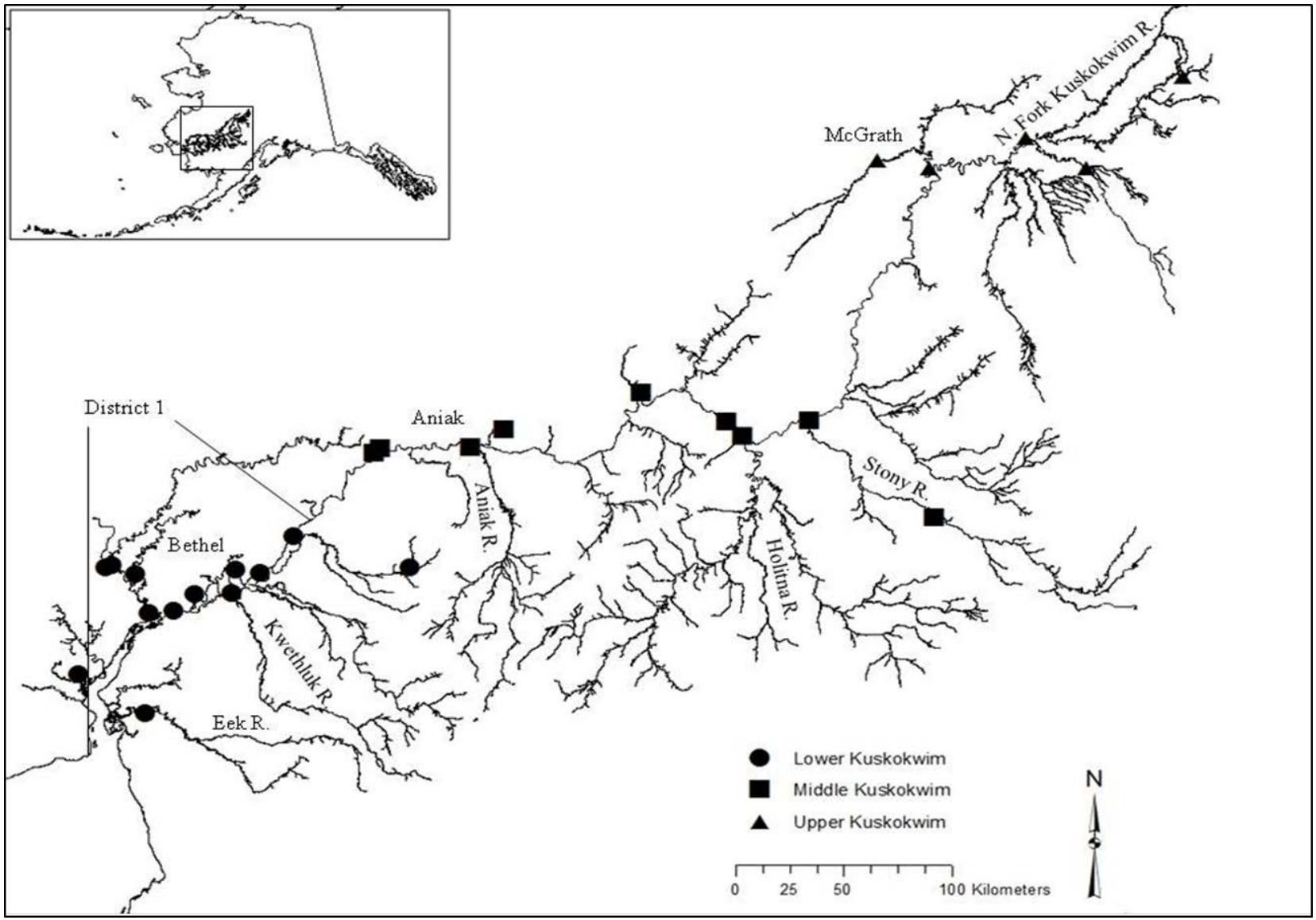


Figure 1.–Map of the Kuskokwim River drainage highlighting communities in the lower, middle, and upper river, commercial fishing District 1, and select tributaries.

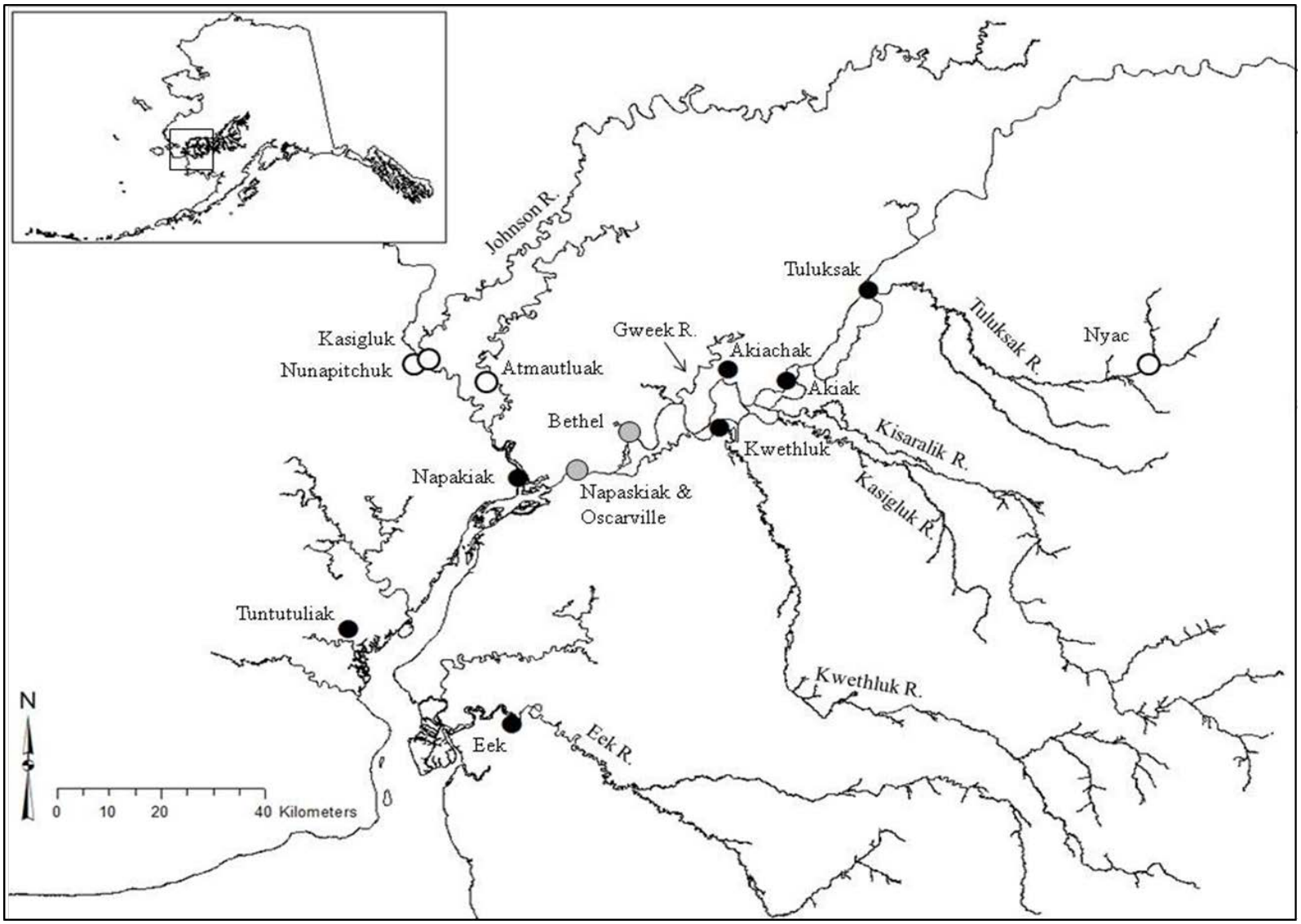
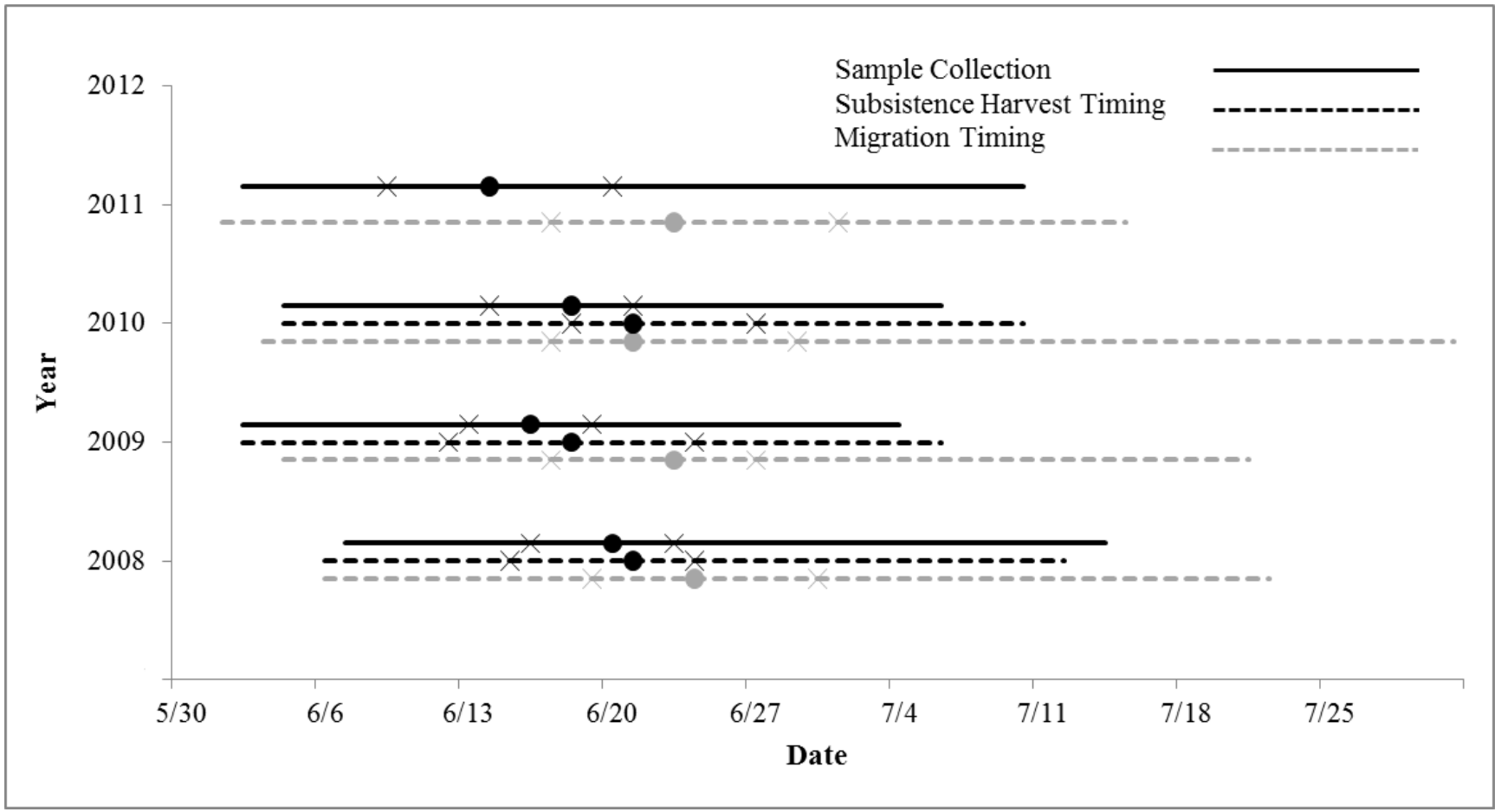
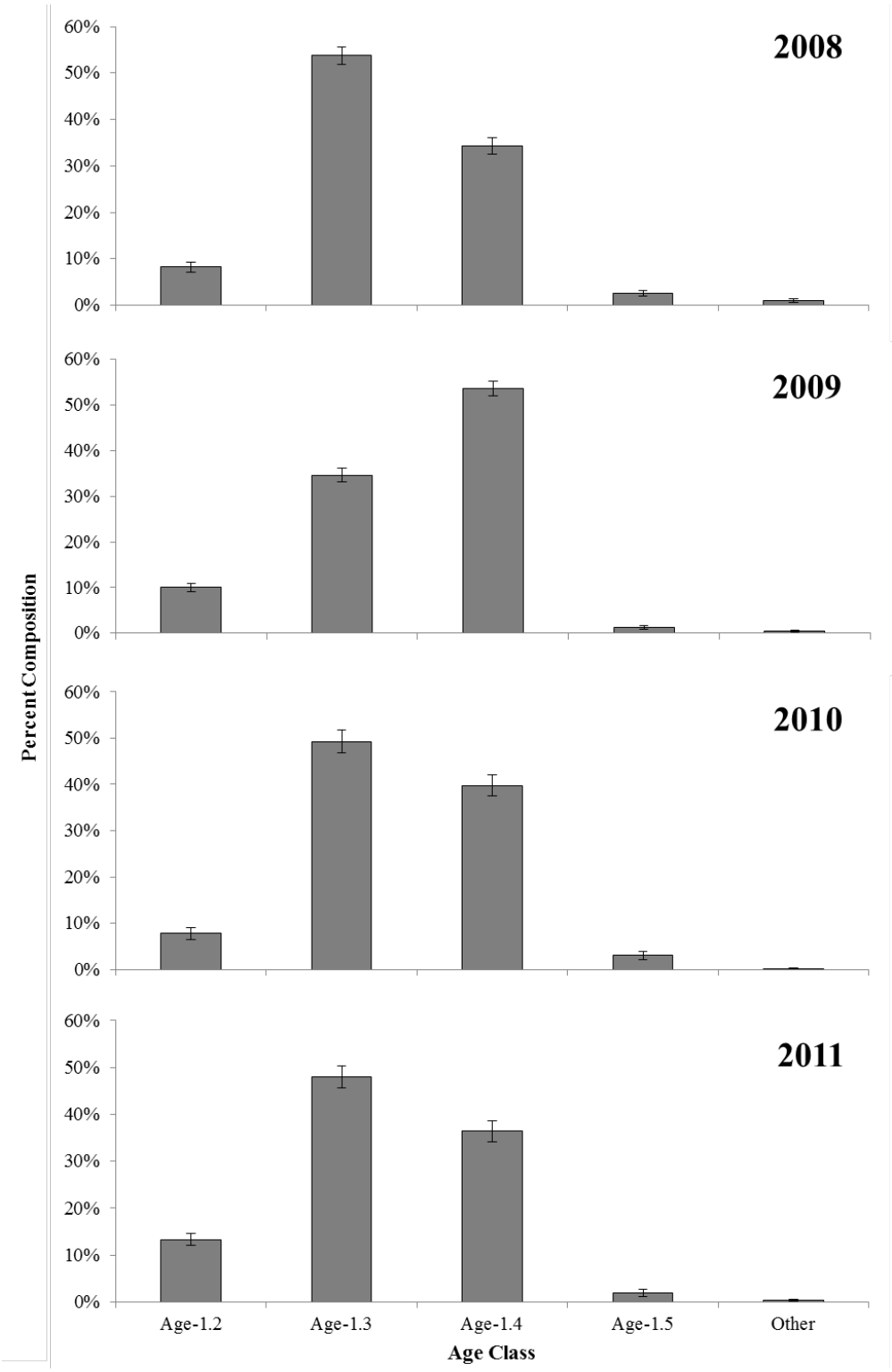


Figure 2.–Map of lower Kuskokwim River communities, highlighting locations where ADF&G (black circles) and Orutsararmiut Native Council (grey circles) recruited local residents to sample age, sex, and length data from subsistence caught Chinook salmon, and locations where active recruitment did not occur (open circles).



Note: Symbols indicate dates of: range (horizontal line), median (circle), 25th and 75th percentiles (X). Harvest timing summary was from a small sample size of voluntary returns of subsistence salmon harvest calendars by Bethel residents (Chris Shelden, Commercial Fisheries Biologist, ADF&G, Anchorage; personal communication) and it is unknown to what degree it accurately represents total Bethel area harvest timing. The purpose of presenting calendar data was to provide some basis for comparison with sample collection dates. Calendar data for 2011 was not available. Migration timing was indexed at the Bethel test fishery using 8 and 5 ⅜-inch gillnets.

Figure 3.–Temporal distribution of ASL samples collected from Chinook salmon harvested in the lower Kuskokwim River subsistence fishery by Bethel Area residents compared to harvest timing and migration timing near Bethel, 2008–2011.



Note: Other includes minor age classes. Minor age classes were those that comprised less than 0.5% of samples. Includes ages 1.1, 2.2, 2.3, 2.4, and 1.6.

Figure 4.–Age class composition of Chinook salmon harvest in the lower Kuskokwim River subsistence fishery, 2008–2011.

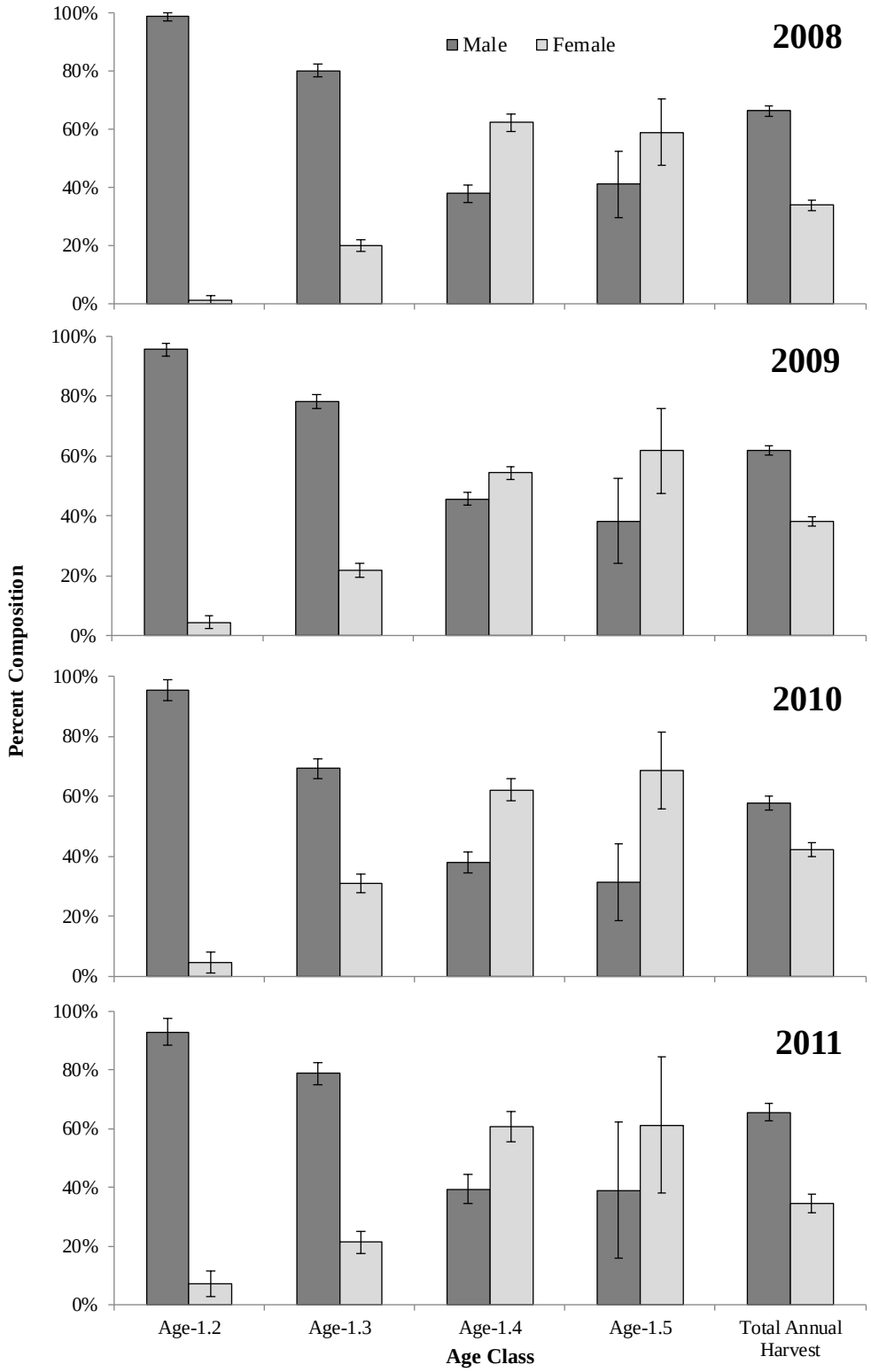


Figure 5.–Sex composition by age class of Chinook salmon harvest in the lower Kuskokwim River subsistence fishery, 2008–2011.

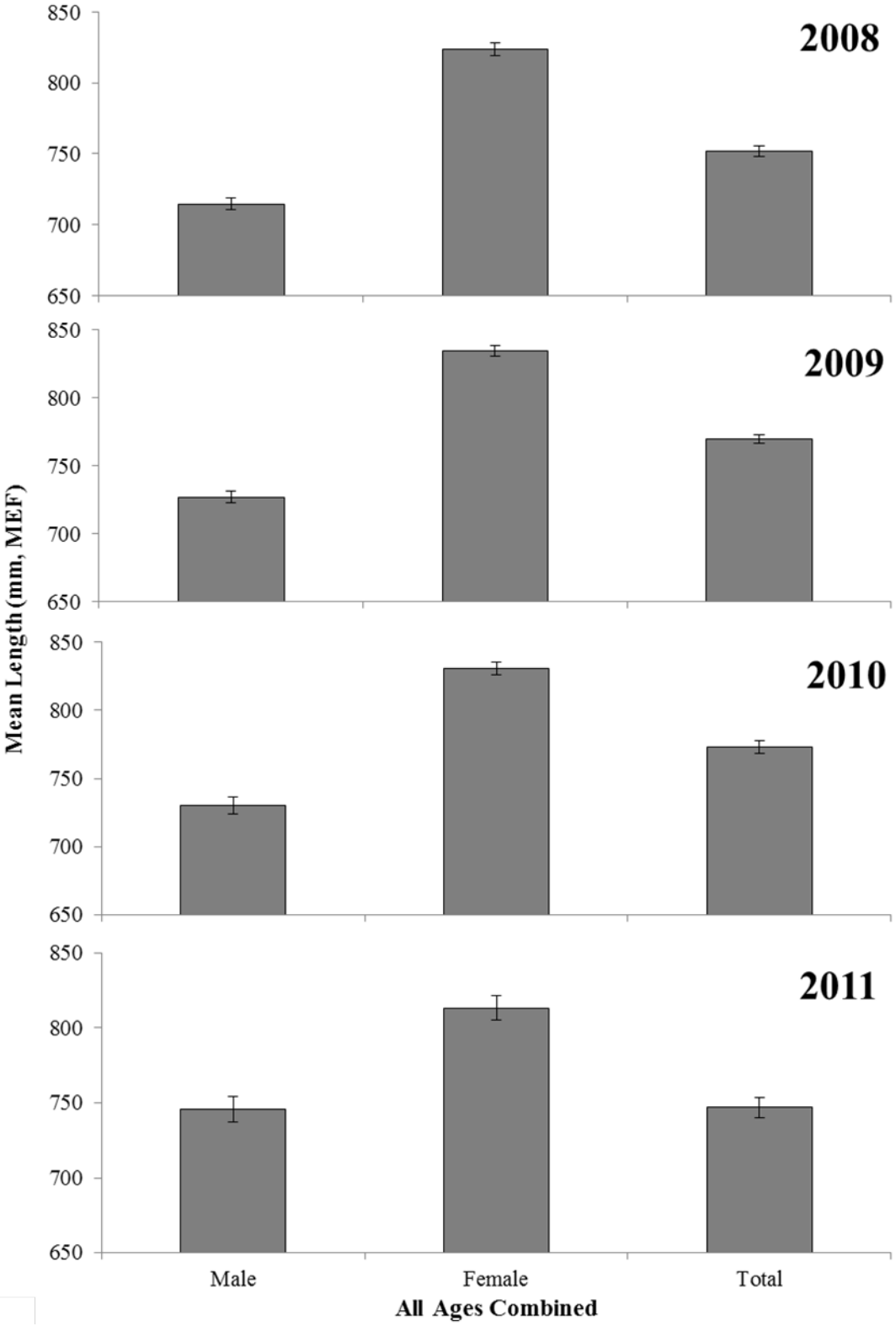


Figure 6.–Mean length of Chinook salmon harvested in the lower Kuskokwim River subsistence fishery, 2008–2011.

APPENDIX A: AGE, SEX, AND LENGTH COMPOSITION OF CHINOOK SALMON HARVESTED FROM THE LOWER KUSKOKWIM RIVER SUBSISTENCE FISHERY BY GILLNET MESH SIZE

Appendix A1.–Age, sex, and length (mm, mideye to tail fork) composition of Chinook salmon harvested from the lower Kuskokwim River subsistence fishery by gillnet mesh size, 2008.

Mesh Size[a]	Sample Size[b]	Sex	Age Class 1.2	1.3	1.4	1.5	Other[c]	Total
	264	Male	29.5%	40.5%	6.1%	0.0%	3.0%	79.2%
Small		Female	0.4%	4.9%	15.5%	0.0%	0.0%	20.8%
≤ 6"		Total	29.9%	45.5%	21.6%	0.0%	3.0%	100.0%
		Male Mean Length	552	677	784	–	–	633
		SD	46	67	115	–	–	104
		Range	480–808	534–940	544–930	–	–	344–940
		Female Mean Length	750	730	819	–	–	797
		SD	–	81	69	–	–	81
		Range	750–750	560–861	612–967	–	–	560–967
	587	Male	7.5%	41.4%	12.1%	0.5%	0.5%	62.0%
Intermediate		Female	0.0%	13.8%	22.0%	1.7%	0.5%	38.0%
> 6 " and < 8"		Total	7.5%	55.2%	34.1%	2.2%	1.0%	100.0%
		Male Mean Length	576	708	777	757	–	706
		SD	83	58	82	118	–	87
		Range	454–999	360–891	560–975	660–889	–	360–999
		Female Mean Length	–	789	837	847	–	819
		SD	–	63	74	66	–	73
		Range	–	610–915	433–982	693–905	–	433–982
	1,834	Male	3.9%	44.3%	14.6%	1.5%	0.7%	64.9%
Large		Female	0.1%	10.5%	22.7%	1.7%	0.1%	35.1%
≥ 8"		Total	4.0%	54.9%	37.2%	3.2%	0.7%	100.0%
		Male Mean Length	571	728	803	808	–	737
		SD	91	61	78	86	–	87
		Range	403–872	407–905	584–1077	606–962	–	403–1077
		Female Mean Length	791	789	847	862	–	830
		SD	128	62	61	51	–	69
		Range	700–881	550–980	691–995	750–930	–	445–995

[a] Drift and set gillnets combined.

[b] Sample size includes only Chinook salmon that were aged.

[c] Includes minor age classes. Minor age classes were those that comprised less than 0.5% of samples. Includes ages 1.1, 2.2, 2.3, 2.4, and 1.6.

Appendix A2.–Age, sex, and length (mm, mideye to tail fork) composition of Chinook salmon harvested from the lower Kuskokwim River subsistence fishery by gillnet mesh size, 2009.

Mesh Size[a]	Sample Size[b]	Sex	Age Class 1.2	1.3	1.4	1.5	Other[c]	Total
	404	Male	33.7%	31.2%	13.1%	0.2%	1.2%	79.5%
Small		Female	0.0%	2.2%	17.8%	0.5%	0.0%	20.5%
≤ 6"		Total	33.7%	33.4%	30.9%	0.7%	1.2%	100.0%
		Male Mean Length	577	675	776	870	–	649
		SD	69	65	86	–	–	97
		Range	455–730	515–880	515–1010	870–870	–	425–1010
		Female Mean Length	–	774	825	880	–	821
		SD	–	54	63	21	–	64
		Range	–	675–855	690–970	865–895	–	675–970
	606	Male	10.7%	29.9%	20.6%	0.2%	0.3%	61.7%
Intermediate		Female	0.8%	9.4%	26.9%	0.7%	0.5%	38.3%
> 6 " and < 8"		Total	11.6%	39.3%	47.5%	0.8%	0.8%	100.0%
		Male Mean Length	584	709	800	925	–	718
		SD	63	59	64	–	–	97
		Range	380–695	540–860	650–1025	925–925	–	380–1025
		Female Mean Length	624	753	838	885	–	811
		SD	64	66	69	95	–	88
		Range	540–700	610–888	650–1092	774–975	–	345–1092
	2,519	Male	5.5%	25.9%	27.3%	0.6%	0.2%	59.5%
Large		Female	0.3%	7.8%	31.5%	0.9%	0.0%	40.5%
≥ 8"		Total	5.8%	33.7%	58.8%	1.5%	0.2%	100.0%
		Male Mean Length	609	723	798	823	–	747
		SD	87	70	79	69	–	96
		Range	425–880	290–990	300–1060	720–950	–	290–1060
		Female Mean Length	786	814	852	840	–	844
		SD	141	70	55	40	–	61
		Range	500–880	270–945	555–995	760–915	–	270–995

[a] Drift and set gillnets combined.

[b] Sample size includes only Chinook salmon that were aged.

[c] Includes minor age classes. Minor age classes were those that comprised less than 0.5% of samples. Includes ages 1.1, 2.2, 2.3, 2.4, and 1.6.

Appendix A3.–Age, sex, and length (mm, mideye to tail fork) composition of Chinook salmon harvested from the lower Kuskokwim River subsistence fishery by gillnet mesh size, 2010.

Mesh Size[a]	Sample Size[b]	Sex	Age Class 1.2	1.3	1.4	1.5	Other[c]	Total
	75	Male	36.0%	28.0%	12.0%	0.0%	0.0%	76.0%
Small		Female	1.3%	12.0%	10.7%	0.0%	0.0%	24.0%
≤ 6"		Total	37.3%	40.0%	22.7%	0.0%	0.0%	100.0%
		Male Mean Length	561	669	779	–	–	635
		SD	43	69	144	–	–	109
		Range	490–630	530–782	530–903	–	–	490–903
		Female Mean Length	560	771	853	–	–	795
		SD	–	77	37	–	–	92
		Range	560–560	600–869	815–920	–	–	560–920
	179	Male	11.7%	36.3%	11.7%	0.6%	0.6%	60.9%
Intermediate		Female	0.0%	16.2%	21.8%	1.1%	0.0%	39.1%
> 6 " and < 8"		Total	11.7%	52.5%	33.5%	1.7%	0.6%	100.0%
		Male Mean Length	567	723	822	787	–	710
		SD	61	67	87	–	–	110
		Range	469–740	576–930	684–1001	787–787	–	424–1001
		Female Mean Length	–	845	865	763	–	854
		SD	–	86	70	4	–	77
		Range	–	630–990	748–1010	760–766	–	630–1010
	1,353	Male	5.5%	33.6%	16.4%	1.1%	0.1%	56.8%
Large		Female	0.4%	15.3%	25.4%	2.2%	0.0%	43.2%
≥ 8"		Total	5.8%	48.9%	41.8%	3.3%	0.1%	100.0%
		Male Mean Length	593	737	785	842	–	738
		SD	78	68	81	101	–	92
		Range	426–840	431–980	360–990	580–954	–	360–990
		Female Mean Length	822	797	844	873	–	828
		SD	70	63	58	58	–	65
		Range	744–925	580–1041	625–1010	790–1060	–	580–1060

[a] Drift and set gillnets combined.

[b] Sample size includes only Chinook salmon that were aged.

[c] Includes minor age classes. Minor age classes were those that comprised less than 0.5% of samples. Includes ages 1.1, 2.2, 2.3, 2.4, and 1.6.

Appendix A4.–Age, sex, and length (mm, mideye to tail fork) composition of Chinook salmon harvested from the lower Kuskokwim River subsistence fishery by gillnet mesh size, 2011.

Mesh Size[a]	Sample Size[b]	Sex	1.2	1.3	1.4	1.5	Other[c]	Total
	58	Male	62.1%	20.7%	0.0%	0.0%	1.7%	84.5%
Small		Female	1.7%	3.4%	10.3%	0.0%	0.0%	15.5%
≤ 6"		Total	63.8%	24.1%	10.3%	0.0%	1.7%	100.0%
		Male Mean Length	558	642	–	–	–	574
		SD	47	122	–	–	–	87
		Range	395–661	310–793	–	–	–	310–793
		Female Mean Length	537	735	753	–	–	725
		SD	–	21	215	–	–	184
		Range	537–537	720–750	330–890	–	–	330–890
	226	Male	9.3%	42.5%	14.2%	0.4%	0.4%	66.8%
Intermediate		Female	0.9%	14.2%	16.8%	0.9%	0.4%	33.2%
> 6 " and < 8"		Total	10.2%	56.6%	31.0%	1.3%	0.9%	100.0%
		Male Mean Length	580	711	814	687	–	715
		SD	49	49	72	–	–	87
		Range	484–669	552–820	675–980	687–687	–	484–980
		Female Mean Length	615	753	831	873	–	793
		SD	7	57	49	74	–	72
		Range	610–620	670–876	703–940	820–925	–	610–940
	678	Male	9.1%	37.8%	15.6%	0.9%	0.0%	63.4%
Large		Female	0.9%	9.4%	24.8%	1.3%	0.1%	36.6%
≥ 8"		Total	10.0%	47.2%	40.4%	2.2%	0.1%	100.0%
		Male Mean Length	574	732	795	847	–	727
		SD	44	59	69	28	–	91
		Range	480–700	556–950	510–969	800–880	–	480–969
		Female Mean Length	573	791	841	871	–	822
		SD	31	42	53	41	–	67
		Range	530–620	688–885	710–990	810–960	–	530–990

[a] Drift and set gillnets combined.

[b] Sample size includes only Chinook salmon that were aged.

[c] Includes minor age classes. Minor age classes were those that comprised less than 0.5% of samples. Includes ages 1.1, 2.2, 2.3, 2.4, and 1.6.

APPENDIX B: AGE, SEX, AND LENGTH COMPOSITION OF CHINOOK SALMON HARVESTED FROM THE LOWER KUSKOKWIM RIVER SUBSISTENCE FISHERY OVER TIME

Appendix B1.–Age, sex, and length (mm, mideye to tail fork) composition of Chinook salmon harvested from the lower Kuskokwim River subsistence fishery over time, 2008.

Temporal Strata	Sample Size[a]	Sex	Age Class 1.2	1.3	1.4	1.5	Other[b]	Total
Early	844	Male	4.6%	49.3%	14.6%	0.7%	0.8%	70.0%
05/31-06/18		Female	0.1%	8.9%	19.8%	1.1%	0.1%	30.0%
		Total	4.7%	58.2%	34.4%	1.8%	0.9%	100.0%
		Male Mean Length	556	711	803	768.7	–	720
		SD	65	64	77	83	–	88
		Range	435–808	407–940	580–985	660–895	–	407–985
		Female Mean Length	750	777	842	855.9	–	823
		SD	–	66	59	58	–	68
		Range	750–750	600–940	703–991	750–904	–	600–991
Middle	987	Male	10.0%	43.6%	12.9%	1.2%	0.9%	68.6%
06/19–06/23		Female	0.2%	8.5%	20.5%	1.8%	0.4%	31.4%
		Total	10.2%	52.1%	33.3%	3.0%	1.3%	100.0%
		Male Mean Length	575	715	800	830	–	711
		SD	80	63	76	72	–	98
		Range	403–999	360–891	584–1060	747–962	–	344–1060
		Female Mean Length	791	795	836	849	–	824
		SD	128	57	75	52	–	75
		Range	700–881	610–940	330–995	750–904	–	330–995
Late	971	Male	9.3%	37.3%	11.6%	1.2%	0.9%	60.4%
06/24–07/17		Female	0.0%	14.4%	23.6%	1.6%	0.0%	39.6%
		Total	9.3%	51.7%	35.2%	2.9%	0.9%	100.0%
		Male Mean Length	557	728	785	794	–	713
		SD	63	62	89	104	–	101
		Range	454–810	530–905	544–1077	606–955	–	345–1077
		Female Mean Length	–	783	847	871	–	824
		SD	–	67	68	54	–	74
		Range	–	550–980	433–993	693–930	–	433–993

Note: Temporal strata was determined by ordering all samples by sample date and dividing the number of samples into thirds such that each of the early, middle, and late strata contain one-third of the samples collected.

[a] Sample size includes only Chinook salmon that were aged.

[b] Includes minor age classes. Minor age classes were those that comprised less than 0.5% of samples. Includes ages 1.1, 2.2, 2.3, 2.4, and 1.6.

Appendix B2.–Age, sex, and length (mm, mideye to tail fork) composition of Chinook salmon harvested from the lower Kuskokwim River subsistence fishery over time, 2009.

Temporal Strata	Sample Size[a]	Sex	Age Class 1.2	1.3	1.4	1.5	Other[b]	Total
Early 05/31-06/15	1,087	Male	7.1%	29.7%	28.5%	0.8%	0.3%	66.4%
		Female	0.6%	7.9%	24.3%	0.6%	0.1%	33.6%
		Total	7.7%	37.6%	52.8%	1.5%	0.4%	100.0%
		Male Mean Length	604	714	790	834	–	736
		SD	72	58	81	80.8	–	91
		Range	465–835	504–875	300–1001	720–950	–	300–1001
		Female Mean Length	737	789	841	854	–	826
		SD	121	76	62	51.0	–	75
		Range	580–880	610–945	555–980	787–951	–	345–980
Middle 06/16–06/20	1,410	Male	9.3%	26.4%	25.9%	0.5%	0.3%	62.3%
		Female	0.5%	7.0%	29.4%	0.6%	0.1%	37.7%
		Total	9.8%	33.4%	55.3%	1.1%	0.4%	100.0%
		Male Mean Length	589	713	800	836	–	731
		SD	72	77	72	61	–	105
		Range	425–880	290–990	540–1000	740–925	–	290–1000
		Female Mean Length	716	808	850	848	–	841
		SD	165	81	57	65	–	68
		Range	500–930	270–930	690–995	774–975	–	270–995
Late 06/21–07/11	1,109	Male	12.4%	25.4%	18.8%	0.2%	0.5%	57.2%
		Female	0.2%	7.9%	33.4%	1.2%	0.2%	42.8%
		Total	12.5%	33.4%	52.1%	1.4%	0.6%	100.0%
		Male Mean Length	587	716	804	800	–	716
		SD	69	70	82	85	–	109
		Range	380–870	495–920	515–1060	740–860	–	380–1060
		Female Mean Length	865	799	851	847	–	842
		SD	21	54	58	43	–	60
		Range	850–880	610–930	680–1092	760–915	–	610–1092

Note: Temporal strata was determined by ordering all samples by sample date and dividing the number of samples into thirds such that each of the early, middle, and late strata contain one-third of the samples collected.

[a] Sample size includes only Chinook salmon that were aged.

[b] Includes minor age classes. Minor age classes were those that comprised less than 0.5% of samples. Includes ages 1.1, 2.2, 2.3, 2.4, and 1.6.

Appendix B3.–Age, sex, and length (mm, mideye to tail fork) composition of Chinook salmon harvested from the lower Kuskokwim River subsistence fishery over time, 2010.

Temporal Strata	Sample Size[a]	Sex	Age Class 1.2	1.3	1.4	1.5	Other[b]	Total
Early 06/02-06/17	544	Male	8.1%	31.4%	18.8%	0.9%	0.0%	59.2%
		Female	0.6%	14.7%	24.1%	1.5%	0.0%	40.8%
		Total	8.6%	46.1%	42.8%	2.4%	0.0%	100.0%
		Male Mean Length	590	732	778	866	–	729
		SD	90	80	89	79	–	104
		Range	460–840	431–980	500–990	740–954	–	431–990
		Female Mean Length	775	805	840	873	–	828
		SD	191	86	68	97	–	81
		Range	560–925	580–1041	625–1010	760–1060	–	560–1060
Middle 06/18–06/21	576	Male	8.0%	39.6%	12.2%	1.4%	0.0%	61.1%
		Female	0.3%	15.5%	20.1%	3.0%	0.0%	38.9%
		Total	8.3%	55.0%	32.3%	4.3%	0.0%	100.0%
		Male Mean Length	585	734	779	802	–	725
		SD	62	65	88	115	–	92
		Range	426–780	520–940	360–923	580–920	–	360–940
		Female Mean Length	787	792	847	868	–	826
		SD	61	60	54	52	–	63
		Range	744–830	600–930	720–1006	766–955	–	600–1006
Late 06/22–07/11	573	Male	6.3%	31.1%	14.5%	0.5%	0.5%	52.9%
		Female	0.2%	15.4%	29.8%	1.7%	0.0%	47.1%
		Total	6.5%	46.4%	44.3%	2.3%	0.5%	100.0%
		Male Mean Length	569	740	807	890	–	737
		SD	56	66	73	56	–	100
		Range	469–715	560–950	664–1001	830–941	–	390–1001
		Female Mean Length	770	810	851	865	–	838
		SD	–	50	52	40	–	54
		Range	770–770	670–910	725–1010	805–930	–	670–1010

Note: Temporal strata was determined by ordering all samples by sample date and dividing the number of samples into thirds such that each of the early, middle, and late strata contain one-third of the samples collected.

[a] Sample size includes only Chinook salmon that were aged.

[b] Includes minor age classes. Minor age classes were those that comprised less than 0.5% of samples. Includes ages 1.1, 2.2, 2.3, 2.4, and 1.6.

Appendix B4.–Age, sex, and length (mm, mideye to tail fork) composition of Chinook salmon harvested from the lower Kuskokwim River subsistence fishery over time, 2011.

Temporal Strata	Sample Size[a]	Sex	Age Class 1.2	1.3	1.4	1.5	Other[b]	Total
Early 06/02–06/11	301	Male	8.0%	36.5%	17.6%	0.7%	0.3%	63.1%
		Female	1.0%	14.3%	20.6%	1.0%	0.0%	36.9%
		Total	9.0%	50.8%	38.2%	1.7%	0.3%	100.0%
		Male Mean Length	576	727	811	764	–	732
		SD	38	48	71	108	–	89
		Range	498–700	618–874	633–980	687–840	–	498–980
		Female Mean Length	605	757	838	854	–	801
		SD	18	51	53	34	–	72
		Range	585–620	670–842	735–970	820–888	–	585–970
Middle 06/12–06/19	318	Male	17.9%	39.6%	14.8%	1.3%	0.0%	73.6%
		Female	0.9%	6.0%	18.6%	0.6%	0.3%	26.4%
		Total	18.9%	45.6%	33.3%	1.9%	0.3%	100.0%
		Male Mean Length	570	715	788	850	–	697
		SD	42	71	68	36	–	102
		Range	480–669	310–855	510–940	800–880	–	310–940
		Female Mean Length	539	778	836	873	–	813
		SD	10	42	85	18	–	95
		Range	530–550	700–850	330–990	860–886	–	330–990
Late 06/20–07/17	343	Male	11.1%	37.3%	11.1%	0.3%	0.3%	60.1%
		Female	0.9%	10.5%	26.5%	1.7%	0.3%	39.9%
		Total	12.0%	47.8%	37.6%	2.0%	0.6%	100.0%
		Male Mean Length	567	730	798	840	–	711
		SD	56	62	69	0	–	100
		Range	395–661	600–950	688–960	840–840	–	335–960
		Female Mean Length	592	802	837	879	–	824
		SD	–	43	52	55	–	63
		Range	575–620	690–885	710–940	810–960	–	575–960

Note: Temporal strata was determined by ordering all samples by sample date and dividing the number of samples into thirds such that each of the early, middle, and late strata contain one-third of the samples collected.

[a] Sample size includes only Chinook salmon that were aged.

[b] Includes minor age classes. Minor age classes were those that comprised less than 0.5% of samples. Includes ages 1.1, 2.2, 2.3, 2.4, and 1.6.

APPENDIX C: RECRUITMENT OF SUBSISTENCE SAMPLERS BY VILLAGE

Appendix C1.–Recruitment of subsistence samplers by village, 2008–2011.

Year	Village	Flyer Date [b]	Individual Contact [c]	Training [a]		Total Packets Distributed [d]
				Date	No. of Participants	
2008	Tuntutuliak	6/2/2008	2	6/5/2008	10	10
	Eek	6/2/2008	2	6/8/2008	Unknown	Unknown
	Kasigluk [e]	–	–	–	–	–
	Nunapitchuk [e]	–	–	–	–	–
	Atmautluak [e]	–	–	–	–	–
	Napakiak	6/2/2008	1	Unknown	8	8
	Kwethluk	–	–	–	–	–
	Akiachak	–	1	–	–	–
	Akiak	–	–	–	–	–
	Tuluksak [f]	–	–	–	–	–
2009	Tuntutuliak	6/3/2009	5	6/2/2009	15	15
	Eek	6/3/2009	2	6/8/2009	4	4
	Kasigluk [e]	–	–	–	–	–
	Nunapitchuk [e]	–	–	–	–	–
	Atmautluak [e]	–	–	–	–	–
	Napakiak	6/3/2009	1	6/4/2009	1	1
	Kwethluk	–		–	–	–
	Akiachak	–	1	–	–	–
	Akiak	–	–	–	–	–
	Tuluksak [f]	–	–	–	–	–
2010	Tuntutuliak	Unknown	15	6/7/2010	10	10
	Eek	Unknown	4	6/10/2010	2	2
	Kasigluk [e]	–	–	–	–	–
	Nunapitchuk [e]	–	–	–	–	–
	Atmautluak [e]	–	–	–	–	–
	Napakiak	Unknown	1	6/8/2010	2	2
	Kwethluk	–	–	–	–	–
	Akiachak	Unknown	1	–	–	1
	Akiak	–	–	–	–	–
	Tuluksak [f]	–	–	–	–	–
2011	Tuntutuliak	6/6/2011	10	6/8/2011	5	5
	Eek	6/6/2011	2	6/7/2011	2	2
	Kasigluk [e]	–	–	–	–	–
	Nunapitchuk [e]	–	–	–	–	–
	Atmautluak [e]	–	–	–	–	–
	Napakiak	6/6/2011	1	6/10/2011	5	5
	Kwethluk	–	–	–	–	–
	Akiachak	6/6/2011	1	–	–	–
	Akiak	–	–	–	–	–
	Tuluksak [f]	–	–	–	–	–

Note: Only villages that ADF&G was responsible for coordinating recruitment are shown.

[a] ADF&G traveled to village to conduct hands-on age, sex, length training.

[b] Date recruitment flyer was faxed to Tribal Council office or similar community organization.

[c] Number of individual subsistence fishermen contacted by ADF&G staff. Limited documentation, number should be considered minimum.

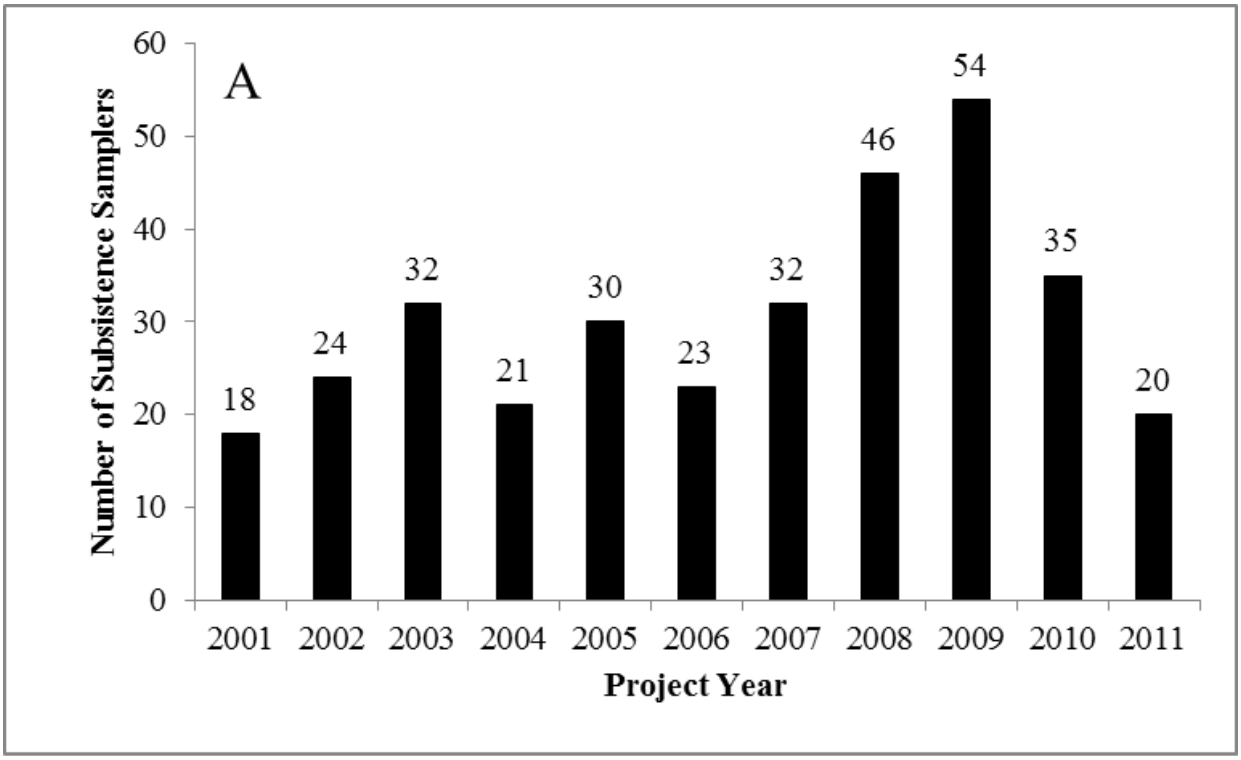
[d] Limited documentation, number should be considered minimum.

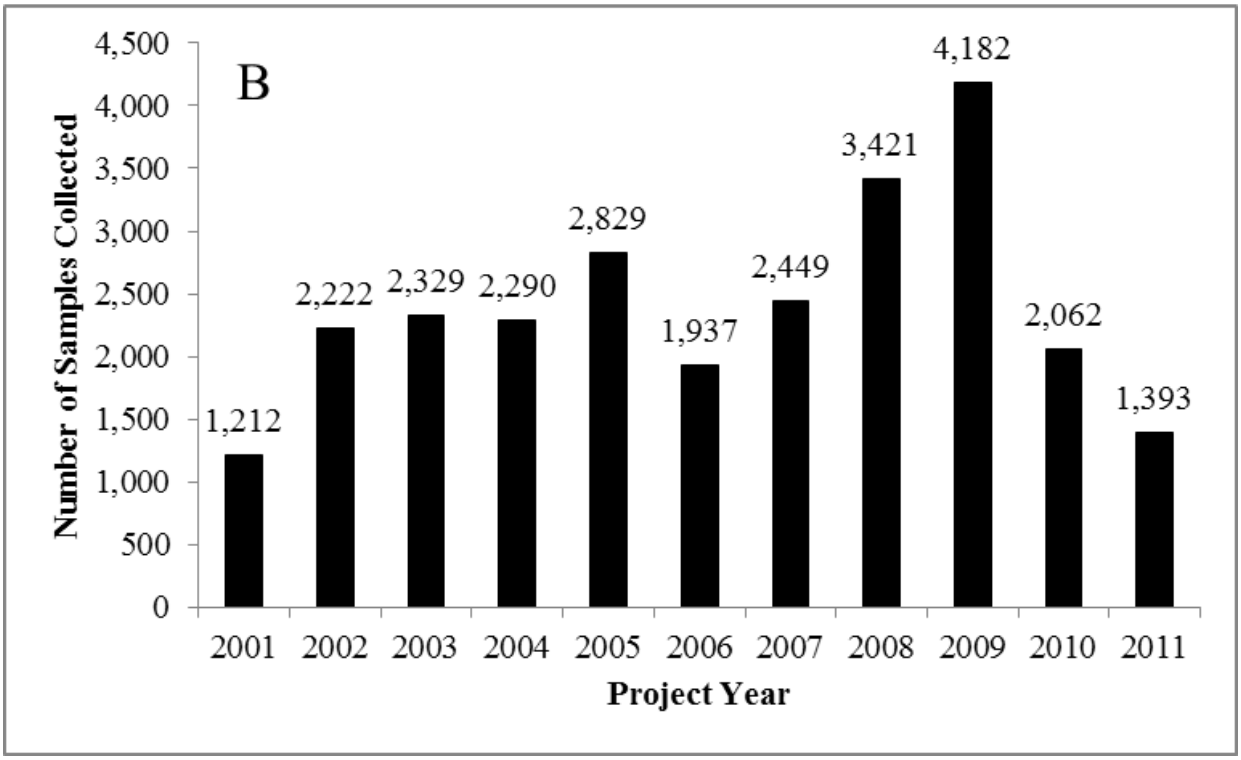
[e] Villages have not been recruited directly by ADF&G.

[f] Recruitment was coordinated by U.S. Fish and Wildlife Service (Harris and Harper 2010).

APPENDIX D:

Appendix D1.–Historical participation and number of Chinook salmon samples collected by lower Kuskokwim River Subsistence fishermen, 2001–2011.





Appendix D2.–Estimated age, sex, and length (mm, mideye to tail fork) composition of Chinook salmon in the lower Kuskokwim River subsistence harvest, 2001–2011.

Year	Number of Samplers	Sample Size	Total Harvest[a]	Percent by Age Class									Percent Females	Mean Length
				(1.1)	(1.2)	(1.3)	(2.2)	(1.4)	(2.3)	(1.5)	(2.4)	(1.6)		
2001	18	1,059	76,397	0.0	4.7	30.2	0.0	60.6	0.0	4.3	0.1	0.0	33.6	777
2002	24	2,015	79,633	0.0	7.8	33.0	0.0[b]	53.9	0.0	5.2	0.0	0.0[b]	40.5	769
2003	32	2,035	65,131	0.2	6.7	44.2	0.0	42.1	0.0	6.7	0.0	0.0	37.3	781
2004	21	2,032	94,125	0.1	15.2	35.9	0.3	45.9	0.0[b]	2.6	0.0	0.0	33.2	759
2005	30	2,409	83,554	0.0[b]	5.4	49.8	0.0	42.7	0.2	1.8	0.1	0.0	36.7	776
2006	23	1,684	88,356	0.2	6.3	35.7	0.1	53.3	0.2	4.1	0.1	0.0	42.3	787
2007	32	1,987	94,171	0.0	6.5	37.1	0.0	52.8	0.3	2.6	0.7	0.0	42.2	734
2008	46	2,802	96,435	0.2	8.2	53.8	0.0[b]	34.4	0.6	2.6	0.2	0.0	33.8	752
2009	54	3,606	77,373	0.1	10.0	34.7	0.1	53.6	0.1	1.3	0.1	0.0[b]	38.0	770
2010	35	1,695	64,586	0.1	7.8	49.3	0.1	39.8	0.0	3.0	0.0	0.0	42.3	773
2011	20	968	NA[c]	0.1	13.3	48.0	0.0	36.4	0.2	1.9	0.0	0.1	34.5	746

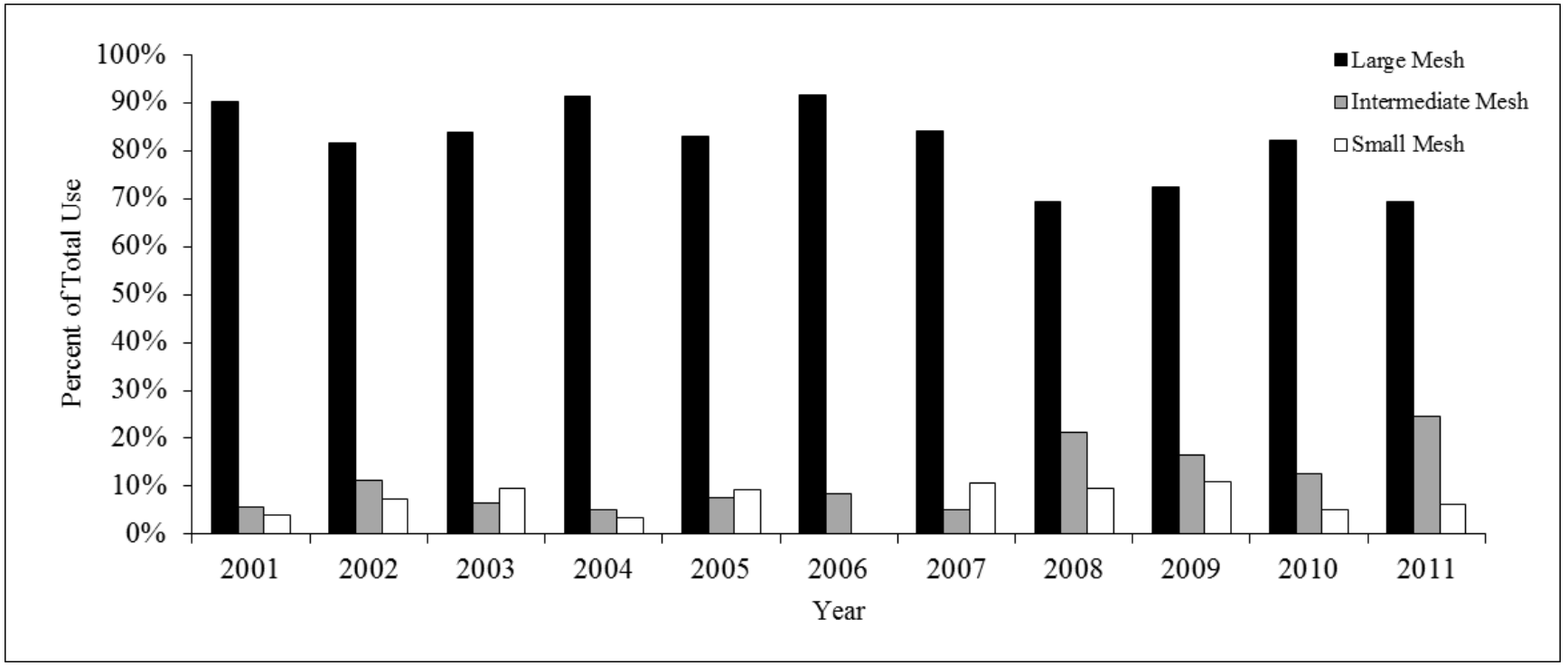
Note: Results prior to 2008 was recalculated based on data archived in the AYK DBMS as of December 2012. Estimates may differ slightly from previous publications. Sum errors across age classes are attributed to rounding.

[a] Total subsistence harvest of Kuskokwim River Chinook salmon. From Carroll and Hamazaki 2012 a and b.

[b] Age class was present but represented less than 0.1%.

[c] Harvest estimate was not available at time of publication.

Appendix D3.–Percent of Chinook salmon age, sex, and length samples collected from large (>8 inch), intermediate (>6 inch and <8 inch), and small mesh (<6 inch) gillnets by lower Kuskokwim River subsistence fishermen , 2001–2011.



APPENDIX E: SAMPLE DATA FORMS

Appendix E1.–Sample data form used in the 2008–2010 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 E2.–Sample data form used in the 2011 Chinook salmon subsistence harvest age, sex, length sampling program.

SUBSISTENCE KING SALMON DATA FORM

Sampler Name: _____ Scale Card Number(s) (*ex. 001 or 001-005*): _____

Sampler Address: _____ SSN (*ex. XXX-XX-XXX*): _____

Phone Number: _____

Sampler's Fish Camp location (*ex. Straight Slough, or near the Old Bethel Air Port*):

Who's fish did you sample? (*circle one*) **YOURS** **SOMEONE ELSE'S**

If you sampled **SOMEONE ELSE'S** fish, where is their Fish Camp? (*ex. Oscarville Slough*)

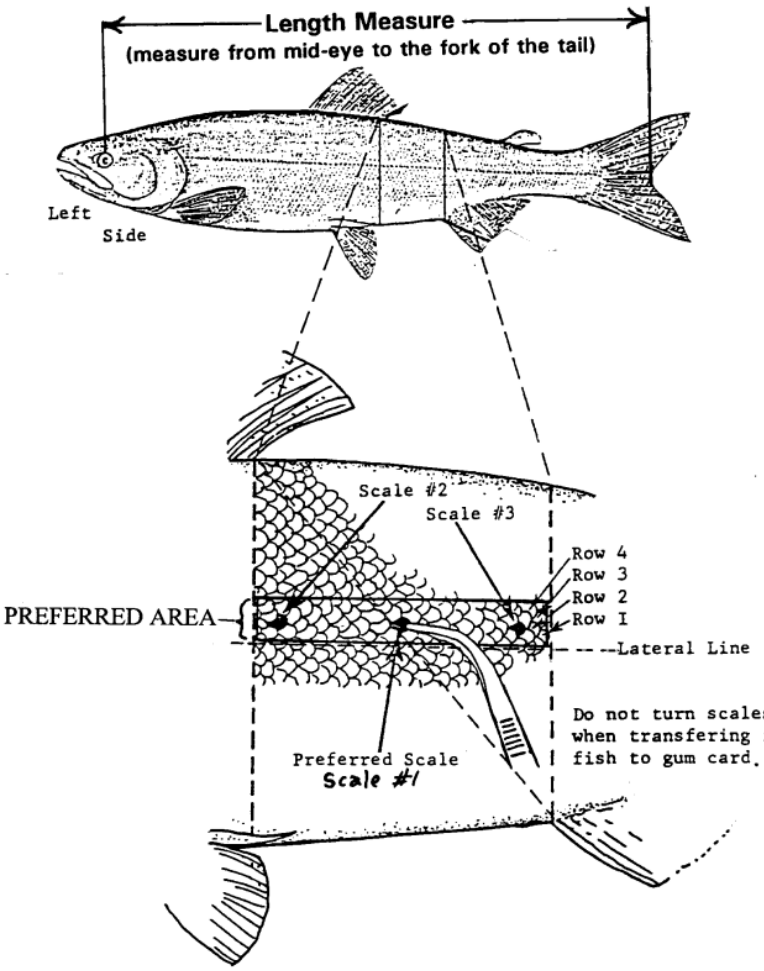
Net Location? (*ex. Drifted between Kwethluk Y and Bethel*)

Gear Type (*circle one*): **DRIFT GILLNET** **SET GILLNET** **ROD & REEL** **OTHER**

Please TURN Over

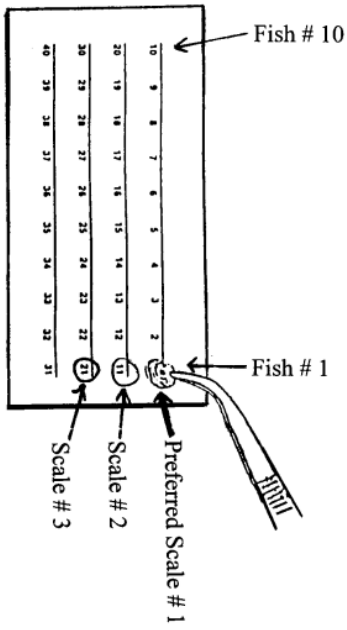
Sample Date	Scale Card Number (*ex. 1, 2…*)	Fish Number (*ex. 1, 2…*)	Sex		Did you Cut the fish to verify its sex?		Length (**mm**)	Mesh Size (**inches**)	Comments
			M	**F**	**Y**	**N**			
			M	**F**	**Y**	**N**			
			M	**F**	**Y**	**N**			
			M	**F**	**Y**	**N**			
			M	**F**	**Y**	**N**			
			M	**F**	**Y**	**N**			
			M	**F**	**Y**	**N**			
			M	**F**	**Y**	**N**			
			M	**F**	**Y**	**N**			
			M	**F**	**Y**	**N**			

Appendix E3.–Sample instruction form used in the 2008–2011 Chinook salmon subsistence harvest age, sex, length sampling program.



KUSKOKWIM RIVER SAMPLING PROGRAM FOR SUBSISTENCE KING SALMON

ADF&G (Bethel) 543-2433
ONC (Bethel) 543-2608
KNA (Aniak) 675-4384
MNVC (McGrath) 524-3023



Age-Sex-Length Sampling Instructions

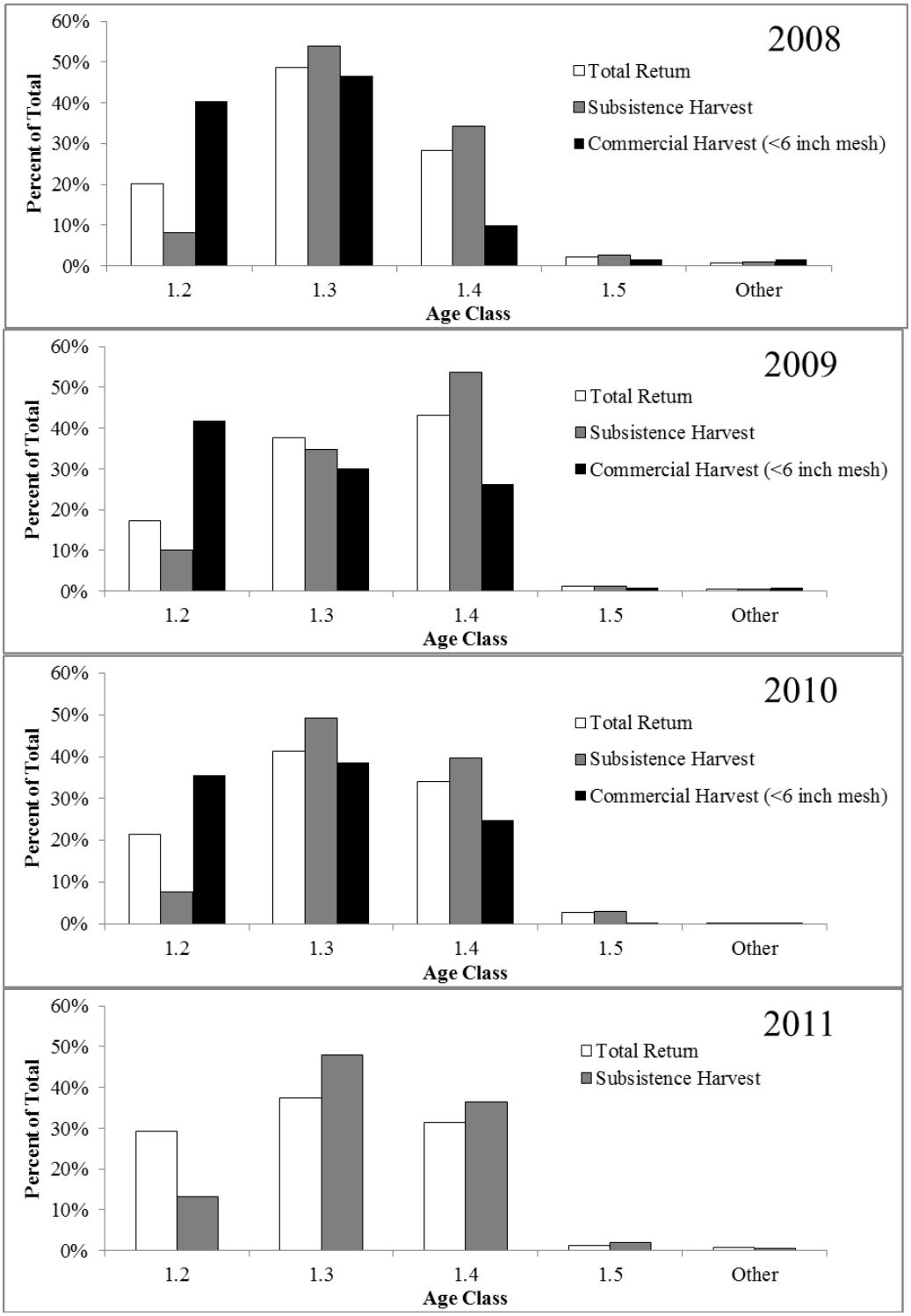
1) Position king salmon left side up.
2) Take preferred scale #1 located two rows above the lateral line and intersecting a diagonal line from the back of the dorsal fin to the front of the anal fin.
3) Clean scale by removing slime.
4) Place scale directly over number on gum card. Be careful to keep 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 F: AGE COMPOSITION OF THE TOTAL RETURN OF CHINOOK SALMON TO THE KUSKOKWIM RIVER

Appendix F1.–Age composition of the total return of Chinook salmon to the Kuskokwim River and the component of the return harvested by the subsistence and commercial fisheries, 2008–2011.



Source: Bue et al. 2012.

Note: Age composition of the total return was constructed by combining age composition estimates from escapement monitoring projects, the commercial harvest, and the subsistence harvest. Chinook salmon harvested in the commercial fishery were not sold in 2011, no ASL sampling occurred.