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Genetic Stock Identification of Upper Cook Inlet Sockeye Salmon Harvest, 2011

by

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

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)

Mathematics, statistics

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

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ABSTRACT

Mixed stock analysis based on genetic data has been used to estimate the stock compositions of sockeye salmon *Oncorhynchus nerka* harvested in commercial fisheries in Upper Cook Inlet (UCI), Alaska, since 2005. Here we report the analysis of the 2011 commercial drift and set and test drift gillnet fisheries in the Central and Northern districts of UCI. Samples from the offshore test fishery were also analyzed. Postseason analyses were performed using a previously reported baseline of 69 populations and 96 single nucleotide polymorphic markers. Also reported are the 2010 results for one fishery stratum, previously unreported (Western Subdivision set gillnet, June 10 to August 9), after reanalysis with the updated genetic baseline. The commercial fishery samples analyzed represent 97% of the 2011 harvest. Some patterns of stock composition in the commercial fishery were similar to results from previous years: 1) Kenai River fish were present later in the season than Kasilof River fish; 2) eastern fisheries generally captured more Kenai and Kasilof river fish than western and northern fisheries; and 3) the closer set gillnet fisheries were to either the Kenai or Kasilof river mouths, the larger the contribution of the catch originating from those rivers. Other patterns differed from previous years; for example, we did not observe large numbers of Kasilof River fish in the Cohoe/Ninilchik subsection. When comparing overall harvest in the UCI fishery with the 6 previously reported years, we observed above average harvests for all stocks except Kasilof. The offshore test fishery showed a similar pattern as previous years for relative contributions of Kenai and Kasilof river fish through the season (large contributions of Kasilof River fish early in the season; large contributions of Kenai River fish later in the season), but different patterns in the relative contribution of Kenai and Kasilof river fish across stations in the test fishery.

Key words Cook Inlet, sockeye salmon, *Oncorhynchus nerka*, genetic stock identification, mixed stock analysis, MSA, commercial fishery, single nucleotide polymorphism, SNP

INTRODUCTION

BACKGROUND

Sockeye salmon *Oncorhynchus nerka* are the most important species to the commercial fishery in the Upper Cook Inlet (UCI) Management Area, with an average yearly exvessel value of $18.8 million over the 10 years prior to 2011 (Shields and Dupuis 2012). The Alaska Department of Fish and Game (ADF&G), Division of Commercial Fisheries (division), is responsible for managing the commercial fisheries in UCI under the sustained yield principle. Application of the sustained yield principle requires an understanding of the relationship between the number of fish that spawn in a drainage (stock) and the number of their offspring that make it to reproductive adulthood (i.e., brood table). The number of offspring that return for each stock is calculated by adding the number of spawners in the drainage to the number of stock-specific fish harvested before reaching the spawning grounds for each of the 5 major sockeye salmon-producing drainages: Crescent River, Susitna River, Fish Creek, Kenai River, and Kasilof River (Figure 1). The harvest estimate is especially important in UCI where sockeye salmon are harvested at rates from 47% to 72% in mixed stock fisheries (calculated from Tobias and Willette [2013] and Shields and Dupuis [2012). Most of this harvest occurs in the commercial fishery in various UCI districts, subdistricts, and sections (Figures 2–4) by both set gillnet and drift gillnet commercial fisheries (Shields and Dupuis 2012). An offshore test fishery provides inseason forecasts of the total UCI sockeye salmon run and the sockeye salmon run to the Kenai River (Figure 5). The Kenai River late-run sockeye salmon management plan specifies 3 tiers for the inriver sockeye salmon escapement goal and changes in allowable commercial fishing time that are based upon the inseason Kenai sockeye salmon forecast derived from the offshore test fishery.

A key component to develop the brood tables and to assess the offshore test fishery catches is an estimation of the stock composition of the sockeye salmon being caught within the UCI fishery.

A review of previous methods (including a weighted age-composition model and early genetic methods) to assign catches to stocks within the UCI fishery is detailed in Barclay et al. (2010a). Since 2005, ADF&G has used mixed stock analysis (MSA) using genetic data to estimate stock compositions of sockeye salmon collected in selected periods of the Central and Northern district commercial fisheries and from the offshore test fishery (Figure 5; results from 2005 to 2010 in Barclay et al. 2010a, 2010b, 2013). Among the findings were that the greatest harvests of Kenai River fish occurred in the drift gillnet fishery and the greatest harvest of Kasilof River fish occurred in the set gillnet fishery. In the Kasilof Section harvest, within a half mile of shore, the combined contribution of Kenai and Kasilof river fish was 97% to 98%. In the northeastern area of the General Subdistrict (Northern District) set gillnet fishery, fish from Knik and Turnagain Arms contributed the most to the harvest and Susitna River fish contributed very little. In the southwestern area of the General Subdistrict, western Cook Inlet and Susitna River fish had the biggest contributions to the harvest. Interannual deviations in stock composition estimates were also observed. For example, in 2009 (Barclay et al. 2010b) above-average harvests of Crescent River, western Cook Inlet, and Fish Creek fish were observed compared to the 4 years (2005–2008) reported in Barclay et al. (2010a). The most recent report includes the most detailed and precise estimates to date: analyzed strata represented 97% of the commercial harvest and the 90% credibility intervals for the most abundant stocks (Kenai and Kasilof rivers) captured in the largest fisheries (Central District drift gillnet and Upper Subdistrict set gillnet) were within 5% of the point estimate (Barclay et al. 2013). The stock composition and stock-specific harvest estimates were not reported for the Western Subdistrict set gillnet fishery in the 2010 report because the Markov Chain Monte Carlo (MCMC) chains for this mixture failed to converge, however, results are reported here after analysis with an updated baseline. Within the offshore test fishery, the most prominent pattern in stock composition estimates has been the greater percent of Kenai River fish in the easternmost station declining gradually toward the westernmost station, although this pattern varies in strength across years.

In 2012, a new coastwide baseline was published for the Western Alaska Salmon Stock Identification Program (WASSIP; Dann et al. 2012). This baseline doubled the number of markers screened for sockeye salmon populations from Cape Suckling to Kotzebue Sound (see Habicht et al. 2007 for information on previous SNP baseline). This baseline also incorporated new baseline samples (from additional sampling years and populations) and implemented improved methods to detect and handle linked loci. Since the last baseline upgrade, additional test mixtures were also used to evaluate baseline performance for MSA in UCI. Taking advantage of these new data and methods, a new baseline was developed for MSA in UCI, which contains 69 populations representing 10,001 fish screened for 96 SNP loci (Barclay and Habicht 2012). Populations were assigned into reporting groups (stocks) and tested for MSA performance. The following 8 reporting groups (Figure 1) met or exceeded the MSA performance metrics: 1) the largest producer of sockeye salmon on the west side (Crescent River; Crescent), 2) the remaining West Cook Inlet producers (West), 3) the lakes monitored by weirs in the Susitna/Yentna rivers (Judd/Chelatna/Larson lakes) with the addition of the Mama and Papa Bear Lakes and Talkeetna Sloughs population (JCL), 4) the remaining producers in the Susitna/Yentna rivers (SusYen), 5) the only major creek monitored with a weir in the Knik/Turnagain/Northeast Cook Inlet area (Fish Creek; Fish), 6) the remaining Knik/Turnagain/Northeast Cook Inlet producers (KTNE), 7) the composite of all populations within the Kenai River (Kenai), and 8) the composite of all populations within the Kasilof River

(Kasilof). Hereafter, when the terms "Crescent," "West," "JCL," "SusYen," "Fish," "KTNE," "Kenai," and "Kasilof" are used as nouns, they refer to reporting groups (stocks: see definitions).

Here we use the baseline as reported in Barclay and Habicht (2012) with two additional populations in the West reporting group (Harriet Creek and Packers Lake late run) and analyzed samples collected in 2011 from time and area strata that represented 97% of the UCI sockeye commercial catch. We also reanalyzed samples collected from the Western Subdistrict in 2010 and those results, including updated overall stock-specific harvest of the 2010 UCI fishery, are reported here.

DEFINITIONS

To reduce confusion associated with the methods, results, and interpretation of this study, basic definitions of commonly used genetic and salmon management terms are offered here.

Allele. Alternative form of a given gene or DNA sequence.

Brood (year). All salmon in a stock spawned in a specific year.

Credibility Interval. In Bayesian statistics, a credibility interval is a posterior probability interval. Credibility intervals are a direct statement of probability: i.e., a 90% credibility interval has a 90% chance of containing the true answer. This is different than the confidence intervals used in frequentist statistics.

District. Waters open to commercial salmon fishing. Commercial fishing districts, subdistricts and sections in Cook Inlet are defined in Alaska Administrative Code (5 AAC 21.200).

Escapement (or Spawning Abundance or Spawners). The annual estimated size of the spawning salmon stock; quality of escapement may be determined not only by numbers of spawners, but also factors such as sex ratio, age composition, temporal entry into the system, and spatial distribution with the salmon spawning habitat (from 5 AAC 39.222(f)).

Genetic Marker. A known DNA sequence that can be identified by a simple assay.

Genotype. The set of alleles for one or more loci for an individual.

Hardy-Weinberg Equilibrium (H-W). The genotype frequencies that would be expected from given allele frequencies assuming: random mating, no mutation (the alleles don't change), no migration or emigration (no exchange of alleles between populations), infinitely large population size, and no selective pressure for or against any traits.

Harvest. The number of salmon or weight of salmon taken from returning salmon prior to escapement as a result of fishing activities.

Harvest Rate. The fraction of returning salmon harvested.

Locus (plural, loci). A fixed position or region on a chromosome.

Linkage Disequilibrium. A state that exists in a population when alleles at different loci are not distributed independently in the population's gamete pool, often because the loci are physically linked.

Linked Markers. Markers showing linkage disequilibrium, or physical linkage on a chromosome.

Mixed Stock Analysis (MSA). Method using allele frequencies from populations and genotypes from mixture samples to estimate stock compositions of mixtures.

Population. A locally interbreeding group that has little interbreeding with other spawning aggregations other than the natural background stray rate, is uniquely adapted to a spawning habitat, and has inherently unique attributes (Ricker 1958) that result in different productivity rates (Pearcy 1992; NRC 1996). This population definition is analogous to the spawning aggregations described by Baker et al. (1996) and the demes by NRC (1996).

Reporting Group. A group of populations in a genetic baseline to which portions of a mixture are allocated during mixed stock analyses; constructed based on a combination of management needs and genetic distinction. See definition for *Salmon Stock* for breakdown of reporting groups (stocks) in Upper Cook Inlet.

Run. The total number of salmon of a stock surviving to adulthood and returning to the vicinity of the natal stream in any calendar year. The annual run is composed of both the harvest of adult salmon and the escapement in any calendar year. With the exception of pink salmon, the run is composed of several age classes of mature fish from the stock, derived from the spawning of a number of previous brood years (from 5 AAC 39.222(f)).

Single nucleotide polymorphism (SNP). A DNA sequence variation occurring when a single nucleotide (A, T, C, or G) differs among individuals or within an individual between paired chromosomes.

Salmon Stock. A locally interbreeding group of salmon (population) that is distinguished by a distinct combination of genetic, phenotypic, life history, and habitat characteristics or an aggregation of 2 or more interbreeding groups (populations) which occur within the same geographic area and is managed as a unit (from 5 AAC 39.222(f)). For purposes of this study, stocks in Upper Cook Inlet were delineated based on the major population or aggregation of populations for which ADF&G estimates escapement or for a population or aggregation of populations which occur in a geographic area for which ADF&G does not estimate escapement. Upper Cook Inlet stocks are defined as: 1) the largest producer on the west side (Crescent River; *Crescent*), 2) the remaining West Cook Inlet producers (*West*), 3) the lakes with weirs in the Susitna/Yentna rivers (Judd/Chelatna/Larson lakes) and the Mama and Papa Bear Lakes and Talkeetna Sloughs population (*JCL*), 4) the remaining producers in the Susitna/Yentna rivers (*SusYen*), 5) the only major creek with a weir in the Knik/Turnagain/Northeast Cook Inlet area (Fish Creek; *Fish*), 6) the remaining Knik/Turnagain/Northeast Cook Inlet producers (*KTNE*), 7) the composite of all populations within the Kenai River (*Kenai*), and 8) the composite of all populations within the Kasilof River (*Kasilof*).

MANAGEMENT OF UPPER COOK INLET SOCKEYE SALMON

Management Strategy for Years Prior to 2014

UCI commercial fisheries were managed to achieve salmon escapement goals. Salmon were commercially harvested in UCI using drift and set gillnets. Drift gillnet fisheries occurred in the Central District only; whereas set gillnet fisheries occur in both the Central and Northern districts on both eastern and western shores (Figure 2). During each season, regularly scheduled fishery openings occurred for 12 hours on Mondays and Thursdays beginning at 7:00 a.m. Additional fishing time was allowed via emergency orders depending on catches, escapements, and the projected run size of sockeye salmon. Each season generally began in late June and ran through early August for a total of about 14 regularly scheduled fishery openings.

To achieve escapement goals, drift and set gillnet fisheries were sometimes restricted to smaller portions of the district to reduce the harvest of specific salmon stocks (Table 1; Figures 2–4). These area restrictions varied throughout each season and across years. Drift gillnet fisheries were sometimes restricted to areas south of the northern or southern tip of Kalgin Island, or only the Kenai or Kasilof corridor along the eastside beaches, usually to reduce harvest of Susitna/Yentna rivers or Kenai River sockeye salmon. During some seasons, drift and set gillnet fisheries were restricted to only the Kasilof River Special Harvest Area near the mouth of the Kasilof River to harvest Kasilof River sockeye salmon in excess of escapement needs, while minimizing harvests of Kenai River sockeye salmon (Barclay et al. 2010a). The Kenai, East Forelands, and Kasilof sections of Upper Subdistrict were managed as separate units. Set gillnet fisheries were sometimes restricted to harvest within a half-mile of shore in the Kasilof Section and closed in the Kenai and East Forelands sections to reduce harvests of Kenai River populations. Descriptions of the management plans governing these fisheries and details of these restrictions for specific years can be found in the UCI Annual Management Reports (Shields and Dupuis 2012) and in reports to the Alaska Board of Fisheries (BOF). These area restrictions need to be considered when evaluating genetic stock composition estimates in this report because some of the variability in these estimates results from the areas where the fish were caught. All genetic stock composition estimates in this report are linked to information about these area restrictions.

Description of Fishery

In 2011, the preseason forecast for the total UCI sockeye salmon run (6.4 million) was above average, with above average Kasilof (929,000) and Kenai (3,941,000) forecasts, and a below average Susitna (463,000) forecast (Eggers and Carroll 2011). In 2011, the BOF modified the 3-tiered management system in the Kenai River to reflect the new DIDSON[1]-based inriver goal for this system. The 3 tiers were delineated at (1) less than 2.3 million fish, (2) 2.3 to 4.6 million fish, and (3) over 4.6 million fish. Because the Kenai forecast was for a run of greater than 2.3 million sockeye salmon, ADF&G started the season managing for an inriver Kenai sockeye salmon goal range of 1,000,000 to 1,200,000 counted by DIDSON sonar, with 51 hours of additional fishing time allowed in the Upper Subdistrict set gillnet fishery. Inseason projections in late July indicated run timing was late and the Kenai run was greater than 4.6 million, triggering a higher inriver goal range of 1,100,000 to 1,350,000 sockeye salmon. In addition, 84 hours of additional fishing time in the Upper Subdistrict set gillnet fishery were allowed with 1 closed period (windows) each week. To minimize the harvest of Northern District salmon, the Central District drift gillnet fishery was restricted to the expanded corridor on July 11 and drift area 1 and the expanded corridor on July 14 and 21. At the end of the season, the Kasilof sockeye salmon escapement (244,221 DIDSON sonar units) was below the upper optimal escapement goal (390,000), and the Kenai escapement (1,333,217 DIDSON sonar units) was within the inriver goal range (1,100,000–1,350,000). Overall, the total sockeye salmon run (8.6 million) was 34% above the preseason forecast, and the run was 2 days late (Shields and Dupuis 2012).

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[1] Product and company names used in this publication are included for completeness but do not constitute an endorsement. The Alaska Department of Fish and Game does not endorse or recommend any specific company or their products.

OBJECTIVES

1) Collect sockeye salmon tissue samples for genetic analysis throughout the 2011 fishing season from the UCI commercial drift and set gillnet fisheries and offshore test drift gillnet fishery.
2) Subsample tissues in proportion to catch within spatial and temporal strata.
3) Analyze selected tissues for 96 single nucleotide polymorphism markers.
4) Estimate stock proportions of sockeye salmon for each stratum.
5) Estimate stock-specific harvest of sockeye salmon for each stratum and for combined strata.

METHODS

TISSUE SAMPLING

Tissue Handling

Tissue samples for genetic analysis were collected from sockeye salmon caught in the commercial catch without regard to size, sex, or condition following the methods outlined in Barclay et al. (2010a). Briefly, an axillary process was excised from individual fish and placed in ethanol in either an individually labeled 2 ml plastic vial or a single well in a 48 deep-well plate. For data continuity, tissue samples were paired with age, sex, and length information collected from each fish. These data were collated and archived by division staff at ADF&G's office in Soldotna.

Offshore Test Fishery

Field sampling

Offshore test fishery harvests were sampled using the sampling design described in Barclay et al. (2010b, 2013) for the 2009 and 2010 harvest. Genetic samples were collected, generally daily, from offshore test fishery harvests of sockeye salmon taken at 6 fixed stations along a transect from Anchor Point to Red River delta in July of 2011 (Figure 5). Genetic samples were taken from fish harvested at each station. If less than 50 fish were harvested at a station, all were sampled. If more than 50 fish were harvested at a station, a maximum of 50 were randomly sampled. Consecutive daily samples from all stations were combined to form temporal mixtures with a sample size goal of 400 individuals. Samples were also combined across all test fishery days by station to form 6 additional mixtures. The target sample size within strata was set at 400 fish to provide point estimates that are within 5% of the true stock composition 90% of the time (Thompson 1987).

Commercial Drift and Set Gillnet Fisheries

Field sampling

Commercial fishery harvests were sampled using the same stratified systematic sampling design that was used in Barclay et al. (2010b, 2013) for the 2009 and 2010 harvest. Area strata were determined *a priori* using established fishery districts and subdistricts (Table 2). Temporal stratification was determined postseason to best represent the harvest, based on catch patterns in each fishery and the number of samples collected. Because samples could not be collected each day, samples collected on individual days were often used to represent harvests over several adjacent days (Table 2). In general, samples collected from a given area were only used to represent harvests within about 1 week of the sampling date. For each area, the first and last temporal strata were sometimes several days long (Table 2) because harvests were low and either building or tapering off during these periods (Shields and Dupuis 2012). Samples representing these strata were generally collected during peak harvests within each stratum, which typically occurred near the end of the first stratum or beginning of the last stratum. Drift and set gillnet harvests were over-sampled in proportion to expected harvest to allow for composite samples to be constructed in proportion to actual harvest postseason. Sampling was conducted over 7 weeks (Table 2).

Drift gillnet sampling

In general, sampling methods follow those reported in Barclay et al. (2010b, 2013) for the 2009 and 2010 harvest. Composite samples were constructed from subsamples collected at 1 or more processors located in the Kenai/Kasilof area and from Icicle Seafoods tenders. Sampling was conducted in proportion to expected daily harvest, and samples were collected from as many boats as possible throughout the delivery period for each fishery opening. The proportion of the catch to sample from each boat was estimated based on the number of boats expected to deliver at each processor and their expected average catch estimated by the processor. Temporal strata were identified postseason, and composite random samples were constructed in proportion to the actual substratum (fishery/processor) harvests. Many different area restrictions were in effect during these harvest periods (Table 2).

Set gillnet sampling

Two management areas, called the Kenai/East Forelands and Kasilof sections, were sampled in the Upper Subdistrict set gillnet fishery. These two management areas were established in the 1990s to provide for separate management of sockeye salmon escapements into the Kenai and Kasilof rivers, if necessary. The Kenai/East Forelands sections are composed of the North Kalifornsky (North K.) Beach and North and South Salamatof statistical areas, and the Kasilof section is composed of the Ninilchik, Cohoe, and South Kalifornsky (South K.) Beach statistical areas (Figure 2).

Sampling methods for the Upper, Western, and Kalgin subdistricts (Central District) and Eastern Subdistrict (Northern District) follow methods described in Barclay et al. (2010b) for the 2009 harvest. Upper Subdistrict (Central District) set gillnet harvests were oversampled to allow composite samples to be constructed postseason in proportion to actual harvest. We determined substratum sample sizes based on the largest proportion of catch observed in each substratum over the last 5 years. Genetic samples were randomly collected at buying stations near the beaches and at processors. Crews attempted to sample from all the buying stations twice during a period, obtaining half their sample after the high tide and half after the low tide. Postseason, random samples (n = 400) were constructed for the Kasilof and Kenai East Forelands (Kenai/EF) sections in proportion to the actual harvests in each subsection/period. Samples taken within the Upper Subdistrict set gillnet fishery were analyzed 2 ways. First, samples were partitioned by section (Kenai/EF and Kasilof) and time. Second, the samples were partitioned by subsection (Cohoe/Ninilchik and South K. Beach, North K. Beach, and North/South Salamatof).

Western and Kalgin Island subdistrict harvests were sampled after each period, when possible. Samples were collected at Kenai Peninsula processors from tenders that deliver fish from these two subdistricts. Goals of 48 to 96 fish were set for each sampling period based on the timing of historical harvests, with the objective of sampling enough fish in each sampling period to construct a sample of 400 fish postseason (weighted by the actual harvest in each period) that would represent the total season harvest.

Eastern Subdistrict (Northern District) harvests were delivered mainly to the Ocean Beauty processing plant in Nikiski. Genetic samples were taken from harvests each period when possible. Goals were set based on timing of historical harvests and observations of number of fish harvested on the sample period date.

General Subdistrict (Northern District) samples were collected at Kenai Peninsula processors from tenders that pick up fish from statistical areas 247-10, 247-20, and 247-30, and in Anchorage at the Ship Creek dock or from Copper River Seafoods where fish from statistical areas 247-30, 247-41, 247-42, and 247-43 were usually delivered (Figure 2). Postseason, one harvest-weighted sample of 400 was constructed to represent the entire General Subdistrict. In 2011, there were not adequate samples collected to represent the Northern and Southern sections separately, as was done in 2009 and 2010 (Tables 1 and 2; Figure 2).

Drift gillnet subsampling for analysis

Composite samples were constructed from subsamples collected at 1 or more processors located in the Kenai/Kasilof area and from Icicle Seafoods tenders. Temporal strata were identified postseason, and composite random samples were constructed in proportion to the actual substratum (fishery/processor) harvests with a stratum goal of 400 fish. Fishery restrictions were incorporated into defining temporal strata.

Set gillnet subsampling for analysis

Samples taken within the Upper Subdistrict set gillnet fishery were analyzed 2 ways. First, samples were partitioned by section (Kenai/EF and Kasilof) and time. Postseason, random samples (n = 400) were constructed for the Kasilof and Kenai/EF sections in proportion to the actual harvests in each subsection/period. Secondly, the samples were partitioned by subsection (Cohoe/Ninilchik and South K. Beach, North K. Beach, and North/South Salamatof).

For the Western, Kalgin Island, and Eastern subdistricts, sockeye salmon were subsampled to construct a sample of 400 fish postseason (weighted by the actual harvest in each period) that would represent the majority of the season harvest (Western and Eastern subdistricts) or the total season harvest (Kalgin Island Subdistrict).

For the General Subdistrict, one harvest-weighted sample of 400 was constructed to represent the areas of the subdistrict.

LABORATORY ANALYSIS

Assaying Genotypes

Genomic DNA was extracted following the methods of Barclay and Habicht (2012) using DNeasy® 96 Tissue Kits by QIAGEN® (Valencia, CA). All baseline and commercial fishery samples were screened for 96 sockeye salmon SNP markers (3 mitochondrial and 93 nuclear DNA) following the methods of Barclay and Habicht (2012).

Laboratory Failure Rates and Quality Control

Genotyping failure rate calculations and quality control measures follow those reported in Barclay et al. (2010a), where they report results for a representative set of baseline collections. Briefly, 8% of all individuals were re-extracted and genotyped from all collections. Here we report on the failure rates and quality control measures for the 2011 commercial and offshore test fishery samples.

STATISTICAL ANALYSIS

Data Retrieval and Quality Control

Methods for data retrieval and quality control are reported in Barclay et al. (2010a). In that report a threshold of 80% scorable markers per individual was established and all individuals that did not meet this threshold were excluded from MSA. This rule (referred to as the "80% rule") was used to filter samples with poor quality DNA and missing data from analyses to decrease errors and reduce estimate variances. We applied this same rule to the 2011 mixture individuals. Baseline development methods are reported in Barclay and Habicht (2012) and included tests for Hardy-Weinberg equilibrium and linkage disequilibrium, methods for pooling collections into populations, testing for temporal stability, and visualizing population structure.

Mixed Stock Analysis

We estimated the stock composition of all test fishery and commercial fishery mixtures (including the reanalysis of the 2010 Western Subdistrict mixture) using the same BAYES protocol as reported in Barclay and Habicht (2012) for the baseline evaluation tests, except for defining the informative Dirichlet priors and analysis of mixtures with nonconverging chains. Informative Dirichlet priors were defined using a similar *step-wise* prior protocol as reported in Barclay et al. (2010a) except that, for the first time stratum within a fishery, the prior parameters were the posterior means from the first period of the same fishery from 2009 (Barclay et al. 2010b; Table 3). For the analysis of the offshore test fishery by station, the informative prior was defined as the stock composition estimate of the same respective station for the previous year.

We assessed the within- and among-chain convergence of these estimates in BAYES using the Raftery-Lewis (within-chain) diagnostic and Gelman-Rubin (among-chain) shrink factor. These compare variation of estimates among iterations within a chain (Raftery and Lewis 1996) and within a chain to the total variation among chains (Gelman and Rubin 1992). If a shrink factor for any stock group estimate was greater than 1.2 and Raftery-Lewis estimate suggested a chain had not converged to stable estimates, we reanalyzed the mixture with 80,000-iteration chains following the same protocol. If the chains still failed to converge, we did not report the estimates. Patterns in stock composition estimates across temporal strata were considered significant only if the credibility intervals did not overlap with other estimates (Mukhopadhyay 2000).

Total Stock-Specific Harvest of Sampled Strata

Methods for applying stock composition estimates to catch to calculate total stock-specific harvest of sampled strata are the same as reported in Barclay et al. (2010a).

RESULTS

TISSUE SAMPLING

Offshore Test Fishery

Field sampling

Tissues suitable for genetic analysis were sampled and analyzed from a total of 1,651 sockeye salmon from the offshore test fishery harvests from July 1 to 30, 2011 (Tables 4 and 5; Figure 5).

Commercial Drift and Set Gillnet Fisheries

Field sampling

Tissues suitable for genetic analysis were sampled from a total of 15,696 sockeye salmon from commercial catches throughout the UCI Central and Northern districts (area strata) in 2011. These fish represented 106 individual collections (Table 2).

Drift gillnet subsampling for analysis

A total of 5 composite random samples of 400 fish each were constructed representing over 95% of the drift gillnet fishery total season harvest (Table 2). The majority of the unrepresented drift gillnet harvest (over 99%) was from periods restricted to the corridor only.

Set gillnet subsampling for analysis

For set gillnet subsampling for analysis of the Upper Subdistrict set gillnet fishery, 3 and 5 composite random samples of 400 fish each were constructed for the Kenai/EF (3) and Kasilof (5) sections, representing the total Upper Subdistrict season harvest (Table 2). Partitioning of these samples by subsection resulted in samples sizes of 1,452 (Cohoe/Ninilchik), 538 (South K. Beach), 202 (North K. Beach), and 947 (North/South Salamatof) fish (Table 6).

For the Kalgin Island, Western, and Eastern subdistricts set gillnet fisheries, composite random samples of 400 fish were constructed for each subdistrict representing 100% (Kalgin Island), 100% (Western), and 77% (Eastern) of the total season harvests (Table 2).

For the General Subdistrict set gillnet fishery, a composite random sample of 400 fish was constructed representing 96% of General Subdistrict season harvests.

LABORATORY ANALYSIS

Laboratory Failure Rates and Quality Control

A total of 8,390 fish were genotyped from the 2011 collections. For the offshore test fishery and commercial harvest samples, failure rates among collections ranged from 0.26% to 3.41%. Discrepancy rates were uniformly low and ranged from 0.03% to 0.74%. Assuming equal error rates in the original and the quality-control analyses, estimated error rates in the samples is half of the discrepancy rate (0.02–0.37%).

STATISTICAL ANALYSIS

Data Retrieval and Quality Control

Data retrieval and quality control results for the baseline collections are reported in Barclay and Habicht (2012). Based upon the 80% scorable marker rule, 0.14% of individuals were removed from commercial harvest and 0.19% were removed from test fishery collections before stock composition estimates were calculated.

Mixed Stock Analysis

Offshore test fishery

A total of 1,641 fish captured in the offshore test fishery were genotyped (Tables 4 and 5). Samples were divided into 4 temporal strata ranging between 4 and 13 days. We observed a consistent pattern in the distribution of stocks over time: the contribution of Kasilof decreased (range: 1.3–8.2%), and the contribution of Kenai increased (range: 48.3–77.8%; Figure 6). The largest contribution of West occurred in the first time stratum (July 1–13; 22.1%) followed by a decrease with slight fluctuations in the last 3 time strata (July 14–30; range: 12.8–15.1%). The largest contribution of Fish was also in the first stratum (3.2%) with a decrease to 0% in the last 2 strata (July 19–30). The contribution of SusYen was 8.4% in the first time stratum (July 1–13) followed by a decrease to around 4% for the last 3 strata (July 14–30; range: 3.7–4.2%). KTNE contributed 2.4% in the first stratum followed by a steady decrease to 0% by the last stratum (July 25–30). The contributions of Crescent (range: 0.0–4.2%) and JCL (range: 0.4–4.2%) showed no discernable pattern.

When the samples were divided into 6 area strata by station, patterns were observed from the east (station 4) to the west (station 8) side of Cook Inlet (Table 5; Figure 7). Kenai (range: 60.9–75.9%) was the largest contributor of the 8 reporting groups at all stations. Kenai was 75.9% at station 4, and maintained a general downward trend across stations 5 to 8 with minimal fluctuation (range: 60.9–68.9%). West (range: 11.2–20.3%) was the second largest contributor of the 8 reporting groups at all stations, and increased from east to west. Crescent was near 0% at station 4 and 5 and increased to be most present at stations 7 and 8 (range: 3.3–10.7%). The contribution of KTNE was 0% at eastern and westernmost stations (stations 4, 7, and 8) and near 2% at the 3 inner stations (stations 5, 6, and 6.5). The contributions of JCL (range: 0.7–2.9%), SusYen (range: 3.5–7.3%), Fish (range: 0.6–2.4%), and Kasilof (range: 1.0–5.9%) had no discernible pattern.

Commercial drift and set gillnet fisheries

From the 106 collections sampled, 8,390 fish were subsampled to create 17 mixtures for which the stock composition and stock-specific harvest were estimated (Table 2). Analyzed mixtures had sample sizes ranging between 350 and 400 fish. In the reanalysis of the data by subsection of the Kenai/EF sections and Kasilof Section set gillnet fisheries (Central District, Upper Subdistrict), the 4 mixtures had sample sizes ranging between 202 and 1,452 fish.

Drift gillnet

For the Central District drift gillnet fishery (excluding corridor-only periods), we analyzed samples representing harvests from June 20 to August 8 (Table 2). We observed a pattern of increasing contribution of Kenai (range: 30.9–90.6%) across the 4 temporal strata (June 20–August 8; Figure 8; Appendix A1). In general, the contribution of Kasilof decreased throughout the season (range: 0.9–34.6%), being largest in period 1 (June 20–July 7; 34.6%) and much smaller in periods 2 through 4 (July 14–August 8 range: 0.9–3.3%). The contribution of West had a similar pattern to Kasilof (range: 5.2–13.7%); however, the first two periods (June 20–July 14) remained relatively stable (range 13–14%) before a decrease in the final 2 periods (July 18–August 8) with slight fluctuation (range 4.2–5.2%). The percent of SusYen (range: 1.8–6.4%)

and JCL (range: 0.7–3.4%) were largest in the first 2 periods and smallest in the last 2 periods with contributions being within 1–3% of each other. The contributions of KTNE (range: 0.8–4.8%) and Fish (range: 0.0–4.5%) generally decreased throughout the season. The contribution of Crescent was greatest during the first period (June 20–July 7; 3.3%) then decreased to 0% for the rest of the season.

For the Central District drift gillnet fishery (corridor-only periods), we analyzed samples representing harvest from July 11 to July 22 (Table 2). This period represented over 83% of the total harvest in corridor-only periods. All of the corridor-only periods after July 9 were expanded corridor openings (Figure 3). The Kenai harvest was dominant (77.7%) with West (5.7%), Kasilof (5.5%), and JCL (4.8%) being the next largest contributors (Appendix A2). The contributions of SusYen, Fish, and KTNE were approximately 2% each and Crescent was present at less than 1%.

Set gillnet

For the Upper Subdistrict set gillnet fishery, we analyzed samples representing harvests from June 25 to August 7 in Kasilof Section and from July 11 to August 7 in the Kenai/EF sections (Table 2; Appendices A3 and A4). We observed a pattern of generally decreasing contributions of Kasilof and generally increasing contributions of Kenai through time in the Kasilof Section, except for the last time stratum, (Figure 8; Appendix A3). Kasilof steadily decreased over time (range: 15.6–88.2%) and Kenai increased over time (range: 9.1–82.8%) through the July 18–24 period. In the final period (July 25–August 7), Kasilof increased from 15.6% to 24.2% and Kenai decreased from 82.8% to 71.9%. The contribution of West ranged between 0.7% and 2.4% for all periods. The contribution of KTNE (range: 0.3–2.8%) was largest in the second period (July 4–July 9) and smaller than 2% in all other periods. The contribution of Fish ranged between 0% and 1.3%. The combined contribution of Crescent, JCL, and SusYen only exceeded 2% in the second period, where it was 2.9%, and the third period, where it was 2.4%.

In the Kenai/EF sections harvest analysis, Kasilof remained relatively stable across the 3 periods (July 11–August 7) with a slight trend upward in the third period; Kenai was similar in the first (95.7%) and third (94.3%) periods with a slight decrease in the second period (Figure 8; Appendix A4). Kenai (range: 87.9–95.7%) was the largest contributor by a considerable margin of the 8 reporting groups in all periods of the Kenai/EF sections harvest analysis. In the first period, the contribution of Kenai was 95.7% (July 11– 24), then decreased to 87.9% in the second period (July 25–31), and increased to 94.3% in the last period (August 1–8). Kasilof (range: 1.9–4.4%) was the second largest contributor in the first (July 11–24) and last (August 1–7) periods, but was exceeded by both SusYen and KTNE in the second period (July 25–31). The contribution of KTNE was 1.1% in the first period, increased to 4.6% in the second period then decreased to 0% in the final period. The contributions of Fish, JCL, and West were steady at less than 1% in all periods and their combined contribution never exceeded 3%. The contribution of SusYen was 0% in the first and last periods, rising to 3% in period 2 (July 25–31). The contribution of Crescent never exceeded 0%.

In the analysis of the Upper Subdistrict set gillnet by subsection, we observed a pattern of generally increasing proportions of Kenai from south to north (Table 6; Figure 9). In the South K. Beach subsection, however, the percentage of Kenai was smaller and the percentage of Kasilof was larger than in the Cohoe\Ninilchik subsection. Larger proportions of Kenai fish were captured in subsections bordering the Kenai River mouth (North K. Beach and North/South

Salamatof). However, in the subsections that border the Kasilof River, more Kasilof fish were captured in the South K. Beach subsection, and more Kenai fish were captured in the Cohoe/Ninilchik subsection. The most southerly (Cohoe/Ninilchik) and northerly (North/South Salamatof) subsections contained higher proportions of non-Kenai and non-Kasilof fish; we observed 6.1% and 5.9% combined contribution respectively of all other groups in the 2 subsections.

For the Kalgin Island Subdistrict set gillnet fishery (Central District), we analyzed samples representing harvests from June 1 to August 22 (Table 2). Kenai (46%) and West (45.9%) were the dominant reporting groups, followed by Kasilof, with a contribution of 5.8% (Appendix A5). The combined contribution of all other reporting groups did not exceed 3%.

For the Western Subdistrict set gillnet fishery (Central District), we analyzed samples representing harvests from June 16 to August 22 (Table 2). The contributions of Crescent, West, and Kenai were largest at 78.1% (Crescent), 20.8% (West), and 0.5% (Kenai; Appendix A6). All other reporting groups did not exceed 1%.

Samples were reanalyzed from the 2010 Western Subdistrict set gillnet fishery (Central District), representing June 21 to August 9, using the updated baseline. In the original BAYES analysis, the Crescent, West, and SusYen reporting groups had Gelman-Rubin shrink factors >1.2, indicating lack of convergence among chains. After augmenting the analysis from 40,000 to 80,000 iterations, Crescent and West still had shrink factors exceeding 1.2. Due to lack of convergence among chains, no estimates were reported in 2010. In the reanalysis of the 2010 Western Subdistrict harvest samples using the updated baseline, the BAYES chains converged for all reporting groups (Appendix A7). In 2010, the 2 dominant reporting groups were Crescent and West at 90.1% (Crescent) and 9.7% (West). All other reporting groups did not exceed 1%. Appendix A7 contains both converging and nonconverging results.

For the Eastern Subdistrict set gillnet fishery (Northern District), we analyzed samples representing harvest from July 4 to August 22 (Table 2). KTNE, Kenai, and Fish made up the largest portions of the harvest at 35.8% (KTNE), 32.5% (Kenai), and 15.0% (Fish; Appendix A8). West (8.4%), JCL (4.9%), SusYen (2.2%), and Kasilof (1.3%) were the main contributors to the rest of the harvest. Crescent contributed less than 1% to the harvest.

For the General Subdistrict set gillnet fishery (Northern District), we analyzed samples representing the combined harvest from the northeastern and southwestern harvest areas from July 5 to August 16 (Table 2; Appendix A9). Fish (26.7%) SusYen (25.4%) and West (20.0%) made up the largest portion of the harvest, and JCL (16.1%) and KTNE (11.6%) were the next largest contributors. The combined contribution of Kenai, Kasilof, and Crescent was less than 1%.

Total Stock-Specific Harvest of Sampled Strata

As expected, the stratified estimates for combined temporal strata within years produced the same point estimates of harvest as the summed individual time strata, but with narrower credibility intervals (Tables 7 and 8). The relative error, as measured by credibility intervals, was smaller for larger harvest estimates (1% for Kenai and 7% for Kasilof) and greater for smaller harvest estimates (25% for KTNE, 23% for both Fish and JCL, and 22% for SusYen; Table 8).

Central District drift gillnet (excluding corridor-only periods)

Over 99% of the Central District drift gillnet harvest (excluding corridor-only periods) was represented by MSA samples (Table 2). In the represented strata, harvest was greatest for Kenai (1,753,556; Table 7) followed by the combined harvest of western stocks (Crescent and West) at 184,919. The combined harvest of Susitna and Yentna river stocks (SusYen and JCL) was the next largest at 129,801, with Kasilof harvest following at 112,146. Finally, the combined harvest of northern stocks, excluding Susitna and Yentna rivers, (Fish and KTNE) made up the remainder of the harvest at 81,160.

Central District drift gillnet (corridor-only periods)

More than 29% of the Central District drift gillnet harvest was from corridor-only periods, and more than 83% of the corridor-only harvest was represented by MSA samples (Table 2). The dominant stock represented in the harvest was Kenai at 607,031 (Table 7). The combined harvest of the Susitna and Yentna Rivers (SusYen and JCL) was next largest at 53,067, followed by the combined harvest of western stocks (West and Crescent) at 45,897 and Kasilof (43,173). The combined harvest of the northern stocks (Fish and KTNE) made up the remainder of the harvest (31,977).

Central District, Upper Subdistrict set gillnet

All of the Upper Subdistrict set gillnet (Central District) harvest was represented by MSA samples (Table 2). Harvests were greatest for Kenai (1,497,218) and Kasilof (309,728; Table 7). The combined harvest of the northern stocks, excluding Susitna and Yentna rivers, (Fish and KTNE) was the next largest at 36,391, followed by the combined harvest of Susitna and Yentna stocks (SusYen and JCL) at 21,803, and the combined harvest of western stocks (Crescent and West) made up the remainder of the harvest at 12,522.

Central District, Western and Kalgin Island subdistricts set gillnet

All of the Central District, Western and Kalgin Island subdistricts set gillnet harvest was represented by MSA samples (Table 2). In the represented strata, the combined harvest of western stocks (Crescent and West) was greatest at 110,257 (Table 7). Harvest was next largest for Kenai at 41,216, followed by Kasilof at 5,170. The combined harvest of Susitna and Yentna river stocks (SusYen and JCL) and the northern stocks, excluding Susitna and Yentna rivers, (Fish and KTNE) made up the remainder of the harvest with 3,055.

Northern District, Eastern, and General subdistricts set gillnet

Over 90% of the set gillnet harvest in the Northern District, Eastern, and General subdistricts was represented by MSA samples (Table 2). In the represented strata, northern stocks (JCL, SusYen, Fish, and KTNE) accounted for 24,008 (Table 7). The combined harvest of western stocks (Crescent and West) was the next largest at 5,591. The combined harvest of Kenai and Kasilof made up the remainder of the harvest with 2,513.

All strata combined

In 2011, 97% of total commercial harvest was represented by MSA samples (Table 8). In the represented strata, harvest estimates were greatest for Kenai (3,901,393) and Kasilof (470,318). The combined harvest of western stocks (Crescent and West) were the next largest at 351,812. The combined harvest of northern stocks (JCL, SusYen, Fish, and KTNE) made up the remainder of the harvest with 381,225. Relative errors of stock-specific harvest estimates were greatest for small harvests (e.g., 25% for KTNE) and least for large harvests (e.g., 1% for Kenai).

DISCUSSION

This report used genetic data from a previously reported sockeye salmon baseline (Barclay and Habicht 2012) and samples collected during selected periods of the Central and Northern Cook Inlet district commercial fisheries in 2011 to estimate the stock composition of the harvest. Here we report on the evaluation of results from harvest sampling for 2011 looking at temporal and spatial distributions of stocks in the harvest.

DIFFERENCES IN FISHERY SAMPLING DESIGNS AMONG YEARS

The fishery sampling design was the same as used from 2006 to 2009 but differed from the sampling design followed in 2005, as discussed in Barclay et al. (2010a).

APPLICATION OF DATA TO BROOD TABLE REFINEMENT

The primary goal of this project was to accurately estimate the stock composition of the 2011 commercial harvest in UCI. Knowledge of the composition of the mixed-stock catch is critical to determine the total run of each stock, because sockeye salmon stocks in UCI can be exploited by the commercial fleet at rates from 50% to 75% (calculated from Tobias and Willette [2004] and Shields [2009]). The previous age-composition method for estimating stock composition and developing brood tables probably underestimated the productivity of some stocks and overestimated the productivity of other stocks, directly affecting development of escapement goals and calculation of harvest rates.

Stock composition estimates from MSA are improving our understanding of stock productivity as more accurate data are incorporated into brood tables. However, constructing brood tables and estimating stock productivity using these data requires 1) estimating stock composition by age class; 2) estimating stock composition of unsampled harvests; and 3) recognizing that the relative errors of stock composition estimates are correlated with stock size—introducing uncertainty into spawner-recruit analyses for small stocks. In the 2011 review of Kenai and Kasilof sockeye salmon escapement goals (Fair et al. 2010), brood tables were constructed using the weighted age composition model beginning with brood year 1969, and MSA estimates were used to estimate stock composition of harvests from 2006 to 2009. A comparison of MSA and weighted age-composition estimates (2006–2009) indicated that historical stock composition estimates and brood tables could not be readily adjusted using MSA data. In 2014, ADF&G will begin conducting genetic analyses of archived scales and developing a run reconstruction model (Cunningham et al. 2012) to better estimate stock composition of historical harvests and adjust brood tables. This effort will likely take several years to complete.

RELATIVE ERRORS ACROSS STOCKS

As expected, relative errors of stock-specific harvest estimates in mixtures were generally smaller for stocks with large contributions and were larger for stocks with low contributions (Tables 7 and 8). For example, a stock composition estimate of 4% with a credibility interval of ± 2% represents a relative error of ±50%, whereas a stock composition estimate of 80% with the same credibility interval represents a relative error of ±2.5%. This affected estimates for northern stocks (JCL, SusYen, Fish, KTNE) and one western stock (Crescent), which generally had small contributions to UCI fishery mixtures.

As reported in Barclay et al. (2010a), relative errors of stock-specific harvest estimates were generally greater for individual fishery estimates (Table 7) and lower for pooled annual totals (Table 8). For example, relative errors of Kenai harvest estimates in individual fisheries ranged from 2% in the Central District drift gillnet fishery to 13% in the Eastern and General subdistricts in 2011 (Table 7), whereas relative error of the Kenai harvest estimate in the total commercial harvest was 1% (Table 8). Similar patterns can be seen when examining the relative errors of harvest estimates for other stocks. In 2011, relative error rates were lower in the total commercial harvest for the Kenai stock, while others stayed the same or increased slightly when compared to rates for 2005 to 2010. This observation is due to the smaller contributions of the less numerous stocks (non-Kenai and Kasilof) in 2011 compared with 2005 to 2010 (Table 8).

ACCOUNTING FOR UNSAMPLED AND UNREPRESENTED STRATA

Despite efforts to sample all strata, a small number of strata were not sampled due to logistical reasons or because the strata represented small harvests. The strata not sampled in 2011 due to logistical reasons represented relatively small harvests: about 3% of the total harvest. This is in contrast to the unsampled strata from 2005 to 2008 where the unsampled fractions of the total harvest were 22% (2005), 7% (2006), 5% (2007), and 6% (2008; Barclay et al. 2010a). However, this is an increase from 2009, where the unsampled fraction was less than 1% of the harvest (Barclay et al. 2010b), and the same percentage as the unsampled fraction in 2010 (less than 3%). As in previous years, most of the unsampled strata in 2011 were also for fisheries conducted in the corridor section of the Central District drift gillnet fishery (Table 2). However, harvest not represented in the corridor in 2011 was higher (157,842) than 2006 to 2010 (Barclay et al. 2010b; Barclay et al. 2013), but lower than 2005 (859,345). Harvest not represented in the Central District drift gillnet (excluding corridor-only periods) in 2011 was much lower (465) than 2005 to 2009 (1,138–19,573), but slightly higher than 2010 (206). The harvest not represented from unsampled strata in the Kalgin Island and Western subdistricts was reduced to zero for the first time since 2005, with all harvest being represented from these subdistricts in 2011. The Northern District also saw a decrease in unrepresented harvest between 2010 (6,833) and 2011 (3,092). It is beyond the scope of this report to extrapolate the stock compositions of harvest in sampled strata to harvest in unsampled strata.

2010 WESTERN SUBDISTRICT REANALYSIS

In the previously reported analysis of the 2010 UCI fishery harvest, one fishery stratum (Western Subdistrict set gillnet from June 10 to August 9) had nonconverging chains (Barclay et al. 2013). Because the issue of nonconvergence among chains could not be resolved by additional iterations, the stock composition and harvest estimates for this stratum were not provided with the other 2010 estimates. In that analysis, the BAYES chains failed to converge only for the West and SusYen reporting groups, which suggested the baseline was missing a population (or populations) within those reporting groups. Because the Western Subdistrict primarily targets fish bound for the Crescent River (Shields and Dupuis 2012), efforts were made to add additional baseline collections from spawning streams adjacent to the Crescent River.

In 2012, sampling crews searched streams from Tuxedni River north along the western shore to the Drift River and on Kalgin Island. Two streams were found that had sufficient numbers of sockeye salmon for a baseline collection: Harriet Creek and Packers Lake Creek. Harriet Creek lies directly west of the south end of Kalgin Island, just north of Harriet Point, and was not previously represented in the baseline. Packers Lake Creek is located on Kalgin Island and supports an early and late run of sockeye salmon (Gary Fandrei, executive director, Cook Inlet Aquaculture Association, Kenai, Alaska, unpublished progress report, 1995). This creek was previously represented in the baseline by samples collected in 1992; however, it was unknown if this collection was sampled from the early or late run, so a new collection was made from late-run spawners. These two new collections were added to the baseline reported in Barclay and Habicht (2012). The analysis of the updated baseline indicated that Harriet Creek sockeye salmon are genetically distinct from other Cook Inlet baseline populations and that the new Packer Lake Creek collection was genetically similar to the collection made in 1992; however, it was significantly different enough to be included as a new baseline population. A new baseline collection from the early Packers Lake Creek run will be made in the near future to verify that the old (1992) collection was from the early run.

In the reanalysis of the 2010 Western Subdistrict harvest samples using the updated baseline, the BAYES chains converged for all reporting groups. As a result, the combined contribution of Crescent and West increased and the contribution of JCL dropped by 1.2% from the previously unreported results with nonconverging chains (Appendix A7). The difference in the two analyses demonstrates the importance of having a comprehensive baseline and that BAYES analyses with nonconvergence should not be reported.

Because the analysis of the updated baseline indicated Harriet Creek is genetically distinct from other baseline populations, it is likely that a large portion of the 2010 Western Subdistrict harvest sample was from this population, which caused the nonconvergence of BAYES chains in the analysis without this population included in the baseline (Barclay et al. 2013).

PATTERNS IN FISHERY STOCK COMPOSITIONS AND HARVESTS

As in past years, the distribution of stock-specific harvest across fisheries varied (Barclay et al. 2010a, 2010b, 2013). The largest harvests of Kenai sockeye salmon occurred in the drift gillnet fishery (Table 7). The largest harvests of Kasilof sockeye salmon occurred in the Upper Subdistrict set gillnet fishery, with the majority of Kasilof fish being harvested in the Kasilof Section (Table 7; Appendix A3). The largest harvests of Susitna and Yentna (SusYen and JCL) sockeye salmon occurred in the drift gillnet fishery (excluding corridor-only periods; Table 7).

Within the offshore test fishery, the same temporal pattern in stock composition was observed in the catch as previous years—a decreasing trend in the contribution of Kasilof fish and an increasing trend in the contribution of Kenai fish as the season progressed (Table 4). This pattern was expected given the early run timing of Kasilof relative to Kenai sockeye salmon. Stock composition estimates from the offshore test fishery compiled in this study cannot be used to estimate total run by stock because genetic samples were not collected in proportion to abundance. In the test fishery, genetic samples were collected from all sockeye salmon harvested when the catch was less than 50, but when the catch exceeded 50, only 50 samples were collected. Because catches tended to be higher near the center of the transect (Shields and Willette 2007), this sampling protocol resulted in stock composition estimates that gave insufficient weight to samples taken within the primary migratory pathway. In 2010, catch exceeded 50 fish in 22 sets comprising about 12% of the total number of sets. Stock composition estimates will be weighted by CPUE in the future to correct for harvest size (Dupuis et al. *In prep*).

This report provides a third year of bystation reporting of stock compositions based on genetic data for the offshore test fishery samples. In 2009, a pattern of Kenai fish peaking at station 4 on the east side and declining to station 8 on the west side was observed (Barclay et al. 2010b). A similar pattern was observed in 2010; however, the peak of Kenai at station 4 was not observed and station 5 had the largest contribution of Kenai fish (Barclay et al. 2013; Table 6; Figure 7). In 2011, the pattern returned to the peak of Kenai fish occurring at the easternmost station (Station 4; Table 5; Figure 7). One notable pattern observed in this report and the 2010 report that was not observed in 2009 was a steady increase in the contribution of West fish from station 4 to station 8. Although these stock composition estimates suggest that Kenai fish enter UCI more toward the east side and West fish enter more toward the west side, the product of stock composition estimates and total CPUE (stock-specific CPUE) at each station indicated Kenai fish were most abundant at station 6 and least abundant at stations 4 and 8 (Shields and Willette 2011). A similar pattern might be expected for Kasilof, but here the contribution of Kasilof remained relatively constant across stations and the product of the stock composition estimates and CPUE at each station indicated that the abundance of Kasilof fish increased overall from stations 4 to 7 and dropped at station 8.

Within the Central District drift gillnet fishery, some of the temporal patterns observed in 2011 were similar to patterns observed in Barclay et al. (2010b, 2013) for the fishery in 2009 and 2010. For example, an increase in the contribution of Kenai and a corresponding decrease of Kasilof sockeye salmon in drift gillnet fishery harvests (excluding corridor-only periods) during the season occurred in all 3 years (Appendix A1). The estimated peak harvest date of July 18–23 for Kenai sockeye salmon was slightly later than observations in 2009 and 2010, when peak harvests of Kenai sockeye salmon were July 13–16 (2009) and July 12 (2010). This corresponds with the postseason analysis of run timing data showing the 2011 sockeye run occurred 2 days late compared to the historical mean (Shields et al. 2013).

Within the Upper Subdistrict (Central District) set gillnet fishery, we observed a pattern of decreasing contributions of Kasilof and increasing contributions of Kenai sockeye salmon in July in the Kasilof Section (Appendix A3). This was similar to the patterns observed in the Kenai/EF sections and the Kasilof Section in 2009 (Barclay et al. 2010b). However, this pattern was not observed in the Kenai/EF sections in 2010 or 2011 where, instead of increasing throughout the season, the contribution of Kenai sockeye salmon decreased slightly. Consistent with findings from 2009 and 2010 (Barclay et al. 2010b, 2013), most of the catch in the Upper Subdistrict was comprised of either Kenai or Kasilof fish (Figure 8; Appendix A3 and A4).

Within the Kenai/EF and Kasilof sections, by subsection we observed the same pattern of higher contributions of non-Kenai and non-Kasilof stocks in subsections farthest from the Kenai and Kasilof river mouths, as was observed in the 2009 and 2010 (Barclay et al. 2010b, 2013). However, we did not observe a larger contribution of Kasilof fish in the Cohoe/Ninilchik Subsection as was observed in previous years (Barclay et al. 2010a, 2010b).

This report does not provide stock composition estimates separately for the northeastern and southwestern portions of the General Subdistrict set gillnet fishery, so comparison to patterns between northeastern and southwestern portions of the General Subdistrict set gillnet fishery cannot be made (Northern District; Figure 2; Appendix A7).

When comparing overall harvest in the UCI fishery in 2011 with the 6 previously reported years (2005–2010; Barclay et al. 2010a, 2010b, 2013), we observed above average harvests for all stocks except for Kasilof (Table 8; Figure 10). Among the stocks with above average harvests (Crescent, West, JCL, SusYen, Fish, KTNE, and Kenai), West, SusYen, KTNE, and Kenai had larger harvests than have been observed in the 6 prior years. The estimated harvest of Susitna/Yentna rivers sockeye salmon in 2011 (125,036) was over double that of 2010 (58,425), which corresponds to the nearly doubling of the estimated run to Susitna River from 2010 (253,000) to 2011 (530,852; Shields and Dupuis 2012). The estimated harvest of Kasilof stock in the fishery was lower than prior years. The harvest of Kenai stock for 2011 (3,901,393) was also over double the number of fish when compared with the 2010 harvest (1,821,553) and the 5-year average (1,517,492) and corresponds to the nearly doubling of the estimated run to Kenai River from 2010 (3,330,000) to 2011 (6,199,394; Shields and Dupuis 2012).

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TABLES AND FIGURES

Table 1.–Descriptions of fishery restrictions and coordinates (decimal degrees, WGS1984) to corresponding map points and lines on Figures 2 and 3.

Restriction #	Area Common Name	Description (Common Name)	Map Figure #	Map Point	Map Line	Latitude	Longitude
1	N/A	No restrictions	N/A				
2[a]	Kasilof Corridor	Statistical Area 244-61	2				
3[a]	Kenai Corridor	Statistical Area 244-51	2				
4	Area 1	Northern boundary (Latitude of the southern point of Kalgin Island)	3		a	60.3405	
		Southern boundary (Latitude of the Anchor Point light)			b	59.7698	
5	Area 2	Southwest point	3	1		60.3405	–151.9138
		Northwest point		2		60.6847	–151.6500
		Northeast point		3		60.6847	–151.4000
		Eastern midpoint (Blanchard Line corridor boundary)		4		60.4517	–151.4283
		Southeast point		5		60.3405	–151.4758
6	N/A	Miscellaneous areas representing small catches including; drift Areas 3 and 4 and Chinitna Bay. See Shields (2010).	N/A				
7	N/A	Within 1/2 mile of shore	N/A				
8	N/A	Fishing with set gillnets in the portion of the Western Subdistrict (Central District) south of the latitude of Redoubt Point.	2		c	60.2871	
9	N/A	One set gillnet no more than 35 fathoms in length	N/A				
10	N/A	Statistical Areas 247-41, 42, 43	2				
11	N/A	Statistical Areas 247-10, 20, 30	2				

[a] In 2011, the Expanded Kenai Section and Expanded Kenai sections (areas 2 miles to the west of current corridors) were defined and are now referred to collectively as the Expanded Corridor, Stat Area 244-56. Kasilof Expanded Section became Stat Area 244-62 and Kenai Expanded Section became 244-52 (Shields and Dupuis 2012).

Table 2.–Details for commercial fishery openings for sockeye salmon in Upper Cook Inlet with corresponding information for tissue sampling for genetic analysis in 2011.

Area Strata	Restrictions[a] /Subsection[b]	Date(s) sampled	Harvest on sample date	Represented date(s)	Harvest represented	Mixture date(s)	Sample Size Analyzed	Sample Size Collected
Central District drift gillnet (excluding corridor-only periods)								
	1	6/20	3,140	6/20	3,140	6/21–7/1	8	37
	1	6/23	4,164	6/23	4,164		8	96
	1	6/27	15,597	6/27	15,597		39	192
	1,2	6/30	37,017	6/30	37,017		85	384
	1,2	7/4	31,833	7/4	31,833		83	480
	1,2	7/7	86,442	7/7	86,442		177	480
	1,2[1],3[1]	7/14	691,622	7/14	691,622	7/14	400	840
	1,2[1],3[1]	7/18	529,850	7/18	529,850	7/18–23	205	240
	2[1],3[1],4	7/21	392,787	7/21	392,787		127	480
	2[1],3[1],4	7/23	224,003	7/23	224,003		68	240
	1	7/25	129,245	7/25	129,245	7/25–8/8	218	240
	1	7/28	37,271	7/27–7/28	83,389		136	480
	1,2[1],3[1]	8/1	23,670	8/1,8/4,8/8	32,493		46	384
	6			8/11-9/1	465		-	-
				Total Harvest	2,262,047			
Central District drift gillnet (corridor-only periods)								
	2			6/25	144		-	-
	2			6/29	922		-	-
	2			7/2	1,240		-	-
	2			7/6	2,884		-	-
	2			7/9	3,647		-	-
	2,3	7/11,7/16	324,086	7/11,7/16,7/19, 7/20,7/22	781,146	7/11–7/22	400	720
	2,3			7/24	57,648		-	-
	2,3			7/26	47,724		-	-
	2,3			7/29	11,696		-	-
	2,3			7/30	21,963		-	-
	2,3			7/31	8,605		-	-
	2,3			8/2	938		-	-
	2,3			8/6	388		-	-
	2,3			8/7	43		-	-
				Total Harvest	938,988			

-continued-

Table 2.–Page 2 of 5.

District Strata	Restrictions[a] /Subsection[b]	Date(s) sampled	Harvest on sample date	Represented date(s)	Harvest represented	Mixture date(s)	Sample Size	
							Analyzed	Collected
Kasilof Section set gillnet (Central District, Upper Subdistrict)								
	1a	6/27	16,477	6/25–27	29,105	6/25–7/2	126	192
	1b	6/27	1,772	6/25–27	12,683		55	144
	1a	6/30	10,534	6/29–7/2	33,158		143	192
	1b	6/30	4,793	6/29–7/2	17,510		76	96
	1a	7/4	15,098	7/4–7/6	25,598	7/4–7/09	155	192
	1b	7/4	5,726	7/4–7/6	9,226		56	96
	1a	7/7	10,436	7/7–7/9	26,394		160	192
	1b	7/7	2,116	7/7–7/9	4,802		29	144
	1a	7/11	18,994	7/11	18,994	7/11–7/16	20	240
	1b	7/11	1,449	7/11	1,449		2	144
	7a,b	7/13	54,852	7/13	56,861		60	240
	1a	7/14	24,292	7/14–7/16	226,430		239	240
	1b	7/14	1,225	7/14–7/16	75,261		79	144
	1a	7/18	130,365	7/18–7/20	222,789	7/18–7/24	213	240
	1b	7/18	29,571	7/18–7/20	61,350		59	192
	1a	7/21	17,078	7/21–7/24	107,951		103	240
	1b	7/21	4,259	7/21–7/24	25,833		25	144
	1a	7/25	11,118	7/25	11,118	7/25–8/07	72	192
	1b	7/25	6,831	7/25	6,831		44	192
	1a	7/28	2,960	7/27–7/30	10,679		69	192
	1b	7/28	2,756	7/27–7/30	8,491		55	144
	1a	8/1	3,325	7/31–8/02	7,784		51	152
	1b	8/1	1,736	7/31–8/02	5,668		37	96
	1a	8/4	2,606	8/4–8/7	7,377		48	96
	1b	8/4	1,365	8/4–8/7	3,645		24	96
				Total harvest	1,016,987			

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Table 2.–Page 3 of 5.

District Strata	Restrictions[a] /Subsection[b]	Date(s) sampled	Harvest on sample date	Represented date(s)	Harvest represented	Mixture date(s)	Sample Size Analyzed	Sample Size Collected
Kenai/EF sections set gillnet (Central District, Upper Subdistrict)								
	1c	7/11	1,588	7/11	1,588	7/11–7/24	1	96
	1d	7/11	4,538	7/11	4,538		3	240
	1c	7/14	871	7/14	871		1	96
	1d	7/14	2,819	7/14	2,819		2	240
	1c	7/18	18,745	7/16–7/18	67,967		44	144
	1d	7/18	73,260	7/16–7/18	220,012		142	300
	1c	7/21	5,259	7/20–7/24	66,467		43	96
	1d	7/21	45,529	7/20–7/24	254,551		164	300
	1c	7/25	9,398	7/25–7/27	15,158	7/25–7/31	37	96
	1d	7/25	40,362	7/25–7/27	61,822		149	300
	1c	7/28	5,650	7/28–7/31	12,402		30	96
	1d	7/28	18,550	7/28–7/31	76,712		184	240
	1c	8/1	3,192	8/01–8/02	4,995	8/1–8/7	24	96
	1d	8/1	20,132	8/01–8/02	26,930		159	192
	1c	8/4	2,196	8/4–8/7	5,052		23	48
	1d	8/4	23,294	8/4–8/7	38,791		144	144
				Total Harvest	860,675			

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Table 2.–Page 4 of 5.

District Strata	Restrictions[a] /Subsection[b]	Date(s) sampled	Harvest on sample date	Represented date(s)	Harvest represented	Mixture date(s)	Sample Size Analyzed	Sample Size Collected
Kalgin Island Subdistrict set gillnet (Central District)								
	1	6/1	2,247	6/1–6/3	6,368	6/1–8/22	29	96
	1	6/6	2,059	6/6	2,059		9	48
	1	6/8	1,232	6/8	1,232		6	48
	1	6/13	707	6/10–6/13	1,837		8	48
	1	6/15	526	6/15–6/17	1,759		8	48
	1	6/20	535	6/20–6/24	1,528		7	48
	1	6/27	1,260	6/27–6/30	2,093		9	96
	1	7/4	1,809	7/4	1,809		8	48
	1	7/7	2,047	7/7	2,047		9	48
	1	7/11	2,914	7/11–7/14	3,473		16	48
	1	7/18	14,912	7/18	14,912		48	48
	1	7/21	13,784	7/21	13,784		81	96
	1	7/25	7,922	7/25–7/28	15,222		68	192
	1	8/1	5,003	7/30–8/1	14,175		64	96
	1	8/4	2,349	8/4	2,349		11	48
	1	8/7	576	8/7–8/11	2,325		10	48
	1	8/15	1,615	8/15–8/22	1,969		9	25
				Total Harvest	88,941			
Western Subdistrict set gillnet (Central District)								
	1	6/23	1,438	6/16–6/30	6,762	6/16–8/22	38	48
	1,11	7/6	4,870	7/03–06	10,823		61	96
	1,11	7/7	4,244	7/7–9	8,618		49	96
	1,11	7/10	4,669	7/10	4,669		26	48
	1,11	7/11	2,548	7/11–13	6,710		38	48
	1,11	7/14	3,938	7/14–15	5,688		32	48
	1,11	7/18	309	7/16–18	6,172		35	48
	1,11	7/21	694	7/19–22	11,647		66	96
	1,11	7/25	2,311	7/23–26	6,162		35	48
	1,11	7/28	1,407	7/27–29	2,492		14	48
	1	8/1	433	8/1–8	742		4	48
	1	8/15	54	8/11–27	272		2	22
				Total Harvest	70,757			

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Table 2.–Page 5 of 5.

District Strata	Restrictions[a] /Subsection[b]	Date(s) sampled	Harvest on sample date	Represented date(s)	Harvest represented	Mixture date(s)	Sample Size Analyzed	Sample Size Collected
Eastern Subdistrict set gillnet (Northern District)								
				5/30-6/30	2,163		-	-
	1	7/11	197	7/4–7/11	841	7/04–8/22	45	96
	1	7/14	236	7/14	236		13	144
	1	7/18	2,223	7/18	2,223		120	144
	8	7/21	519	7/21	519		28	96
	8	7/25	807	7/25	807		43	96
	8	7/28	494	7/28	494		27	96
	8	8/1	509	8/01	509		27	48
	8	8/4	653	8/04	653		35	48
	1	8/8	432	8/8	432		23	48
	1	8/11	232	8/11	232		12	48
	1	8/15	161	8/15–22	482		26	39
				8/25–9/15	98		-	-
				Total Harvest	9,689			
General Subdistrict set gillnet								
	1			05/30–6/27	778		-	-
	1	7/4	854	6/30–7/4	1,341	7/05–8/16	14	48
	1	7/7	1,449	7/7	1,449		24	63
	1	7/11	980	7/11	980		27	57
	1	7/14	1071	7/14	1071		7	40
	1	7/18	9,501	7/18	9,501		104	63
	8	7/21	3,924	7/21	3,924		103	105
	8	7/25	3,130	7/25	3,130		49	80
	8	7/28	1,748	7/28	1,748		47	81
	8	8/1	832	8/1	832		14	112
	8	8/4	210	8/4	210		4	48
	1	8/8	209	8/8–8/15	498		7	24
				8/18–8/25	53		-	-
				Total Harvest	25,515			

Note: Corresponding restrictions to the fisheries and substrata are provided when applicable. Harvest numbers are given for all strata, including those that were not analyzed for stock composition.

[1] Indicates expansion of respective fishing corridor 2 miles to the west (see Table 1 and Figure 3).

[a] For description of restrictions see Table 1 and Figures 2–4.

[b] a) Cohoe/Ninilchik; b) South K. Beach; c) North K. Beach; d) North and South Salamatof.

Table 3.–Predetermined priors based on the best available information for the first stratum within each Upper Cook Inlet district, subdistrict, section, subsection, and test fishery in 2011. See text for methods used for determining priors.

		Reporting Group							
Gillnet fishery	Date	Crescent	West	JCL	SusYen	Fish	KTNE	Kenai	Kasilof
Central District drift (no corridor-only)	June 20–July 7	0.02	0.16	0.02	0.03	0.06	0.05	0.24	0.41
Central District drift (corridor-only)	July 17	0.00	0.00	0.01	0.03	0.00	0.01	0.40	0.55
Kasilof Section set	June 27–July 3	0.00	0.02	0.00	0.00	0.01	0.02	0.12	0.83
Kenai/EF sections set	July 19–24	0.00	0.00	0.01	0.01	0.06	0.04	0.83	0.05
Kalgin Island Subdistrict set	June 2–August 16	0.02	0.57	0.00	0.01	0.01	0.01	0.30	0.08
Western Subdistrict set	June 21–August 9	0.95	0.05	0.00	0.00	0.00	0.00	0.00	0.00
Eastern Subdistrict set	July 5–August 16	0.00	0.07	0.04	0.04	0.23	0.37	0.23	0.01
General Subdistrict set	July 3–August 25	0.00	0.05	0.19	0.13	0.09	0.54	0.00	0.00
Cohoe/Ninilchik Subsection set	July 12–August 4	0.00	0.07	0.01	0.00	0.01	0.01	0.48	0.42
South K. Beach Subsection set	July 14–August 4	0.00	0.02	0.00	0.00	0.01	0.00	0.42	0.55
North K. Beach Subsection set	July 11–August 4	0.00	0.00	0.00	0.00	0.00	0.00	0.78	0.22
North/South Salamatof Subsection set	July 11–August 4	0.00	0.02	0.02	0.02	0.03	0.05	0.84	0.03
Offshore Test Fishery	July 1–13	0.08	0.16	0.03	0.03	0.02	0.05	0.39	0.23
Offshore Test Fishery (station 4)	July 1–26	0.05	0.10	0.04	0.04	0.04	0.03	0.63	0.07
Offshore Test Fishery (station 5)	July 1–27	0.02	0.10	0.04	0.02	0.02	0.04	0.69	0.07
Offshore Test Fishery (station 6)	July 2–30	0.02	0.13	0.04	0.04	0.05	0.03	0.63	0.06
Offshore Test Fishery (station 6.5)	July 1–30	0.01	0.15	0.04	0.04	0.04	0.03	0.64	0.06
Offshore Test Fishery (station 7)	July 1–30	0.05	0.15	0.04	0.02	0.02	0.03	0.60	0.08
Offshore Test Fishery (station 8)	July 2–30	0.09	0.15	0.01	0.01	0.03	0.05	0.58	0.06

Note: All priors for subsequent strata are based upon the posterior distribution (i.e., stock composition estimates) of preceding strata from the same district, subdistrict, section, subsection, or test fishery. See *Methods* for details. Priors for a given stratum may not sum to 1 due to rounding error.

Table 4.–Cook Inlet offshore test fishery, 2011, temporal strata 1–4. Reporting group stock composition estimates (%) including mean, 90% credibility intervals (CI), and standard deviation (SD).

	Stratum 1 (7/1–7/13; *n* = 449)				Stratum 2 (7/14–7/18; *n* = 423)				Stratum 3 (7/19–7/24; *n* = 382)			
		90% CI				90% CI				90% CI		
Reporting Group	Mean	5%	95%	SD	Mean	5%	95%	SD	Mean	5%	95%	SD
Crescent	4.2	2.6	6.1	1.1	2.8	1.5	4.3	0.9	1.9	0.8	3.3	0.8
West	22.1	18.7	25.6	2.1	12.8	10.2	15.6	1.7	14.9	12.0	18.1	1.9
JCL	3.2	1.9	4.7	0.9	2.2	1.1	3.6	0.8	0.4	0.0	1.1	0.4
SusYen	8.4	5.9	11.2	1.6	3.8	2.2	5.7	1.1	3.7	2.0	5.7	1.2
Fish	3.2	1.9	4.7	0.8	1.9	1.0	3.1	0.7	0.3	0.0	1.0	0.3
KTNE	2.4	1.2	4.0	0.9	2.0	0.9	3.5	0.8	0.8	0.2	1.8	0.5
Kenai	48.3	44.2	52.4	2.5	72.1	68.3	75.7	2.3	75.8	71.8	79.6	2.4
Kasilof	8.2	6.1	10.5	1.4	2.4	1.2	3.8	0.8	2.1	0.8	3.7	0.9

	Stratum 4 (7/25–7/30; *n* = 387)			
		90% CI		
Reporting Group	Mean	5%	95%	SD
Crescent	0.0	0.0	0.0	0.0
West	15.1	12.2	18.3	1.9
JCL	1.5	0.6	2.8	0.7
SusYen	4.2	2.5	6.3	1.2
Fish	0.0	0.0	0.0	0.0
KTNE	0.0	0.0	0.0	0.0
Kenai	77.8	74.0	81.3	2.2
Kasilof	1.3	0.4	2.6	0.7

Note: Stock composition estimates may not sum to 100% due to rounding errors.

Note: *n* is the final number of samples used in genetic analyses.

Table 5.– Cook Inlet offshore test fishery, 2011, 6 area strata (Stations 4–8). Reporting group stock composition estimates (%) including mean, 90% credibility intervals (CI), and standard deviation (SD).

	Station 4; *n* = 128				Station 5; *n* = 253				Station 6; *n* = 425			
		90% CI				90% CI				90% CI		
Reporting Group	Mean	5%	95%	SD	Mean	5%	95%	SD	Mean	5%	95%	SD
Crescent	0.3	0.0	1.5	0.6	0.1	0.0	0.4	0.2	1.6	0.6	3.0	0.7
West	11.2	6.9	16.2	2.8	13.3	9.9	17.0	2.2	15.7	12.7	18.8	1.8
JCL	2.3	0.6	4.9	1.3	2.9	1.2	5.0	1.2	1.4	0.6	2.5	0.6
SusYen	3.5	0.9	7.0	1.9	7.3	4.4	10.5	1.9	4.9	3.1	7.0	1.2
Fish	2.4	0.7	4.9	1.3	2.3	1.0	4.1	1.0	1.2	0.5	2.2	0.5
KTNE	0.0	0.0	0.2	0.2	2.4	0.9	4.3	1.0	2.4	1.1	4.0	0.9
Kenai	75.9	69.2	82.2	4.0	66.0	60.8	70.9	3.1	68.4	64.4	72.4	2.4
Kasilof	4.3	1.7	7.8	1.9	5.9	3.5	8.7	1.6	4.4	2.7	6.3	1.1

	Station 6.5; *n* = 348				Station 7; *n* = 343				Station 8; *n* = 144			
		90% CI				90% CI				90% CI		
Reporting Group	Mean	5%	95%	SD	Mean	5%	95%	SD	Mean	5%	95%	SD
Crescent	1.4	0.5	2.7	0.7	3.3	1.8	5.1	1.0	10.7	6.4	15.6	2.8
West	18.0	14.6	21.6	2.1	18.1	14.7	21.7	2.1	20.3	14.9	26.1	3.4
JCL	2.6	1.3	4.2	0.9	1.9	0.8	3.4	0.8	0.7	0.0	2.2	0.7
SusYen	4.2	2.4	6.3	1.2	4.3	2.3	6.6	1.3	5.0	2.1	8.7	2.0
Fish	0.6	0.1	1.4	0.4	2.0	1.0	3.4	0.8	1.4	0.3	3.3	1.0
KTNE	1.7	0.6	3.2	0.8	0.1	0.0	0.4	0.2	0.1	0.0	0.5	0.3
Kenai	68.9	64.6	73.1	2.6	66.8	62.4	71.1	2.7	60.9	53.6	68.0	4.4
Kasilof	2.6	1.3	4.2	0.9	3.5	1.9	5.4	1.1	1.0	0.0	3.2	1.1

Note: Stock composition estimates may not sum to 100% due to rounding errors.

Note: *n* is the final number of samples used in genetic analyses.

Table 6.–Reporting group stock composition estimates (%) including mean, 90% credibility intervals (CI), standard deviation (SD), and sample size (*n*) for mixtures of sockeye salmon harvested in the Kenai/EF sections and Kasilof Section set gillnet fisheries (Central District, Upper Subdistrict) analyzed by subsection in 2011.

	Cohoe/Ninilchik (6/25–8/7; *n* = 1452)				South K. Beach (6/25–8/7; *n* = 538)				North K. Beach (7/11–8/7; *n* = 202)				North/South Salamatof (7/11–8/7; *n* = 947)			
		90% CI				90% CI				90% CI				90% CI		
Reporting Group	Mean	5%	95%	SD	Mean	5%	95%	SD	Mean	5%	95%	SD	Mean	5%	95%	SD
Crescent	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
West	1.9	1.3	2.7	0.5	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.6	0.2	1.1	0.3
JCL	0.6	0.3	1.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.2	1.0	0.3
SusYen	0.9	0.4	1.4	0.3	0.0	0.0	0.3	0.2	0.0	0.0	0.0	0.1	1.4	0.6	2.3	0.5
Fish	1.0	0.6	1.5	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.9	0.5	1.5	0.3
KTNE	1.7	1.1	2.4	0.4	0.4	0.1	0.9	0.3	0.0	0.0	0.0	0.1	2.4	1.6	3.5	0.6
Kenai	58.4	56.1	60.7	1.4	39.3	35.8	42.9	2.2	87.8	83.7	91.5	2.4	93.2	91.7	94.7	0.9
Kasilof	35.5	33.3	37.7	1.3	60.2	56.6	63.8	2.2	12.1	8.4	16.2	2.4	0.9	0.4	1.5	0.3

Note: Stock composition estimates may not sum to 100% due to rounding errors.

Note: *n* is the final number of samples used in genetic analyses.

Table 7.–Stock-specific harvest, standard deviation (SD), and 90% credibility intervals calculated using a stratified estimator (see text) for combined temporal strata in the Central (4 area strata) and Northern (1 area stratum) districts and based on genetic analysis of mixtures of sockeye salmon harvested in the Upper Cook Inlet in 2011.

Area strata	Reporting Group	Harvest	SD	90% CI 5%	90% CI 95%	Relative Error
Central District drift gillnet (excluding corridor-only periods)						
	Crescent	6,076	1,862	3,435	9,292	48%
	West	178,843	17,652	150,956	208,979	16%
	JCL	39,009	8,512	26,239	54,075	36%
	SusYen	90,792	14,616	68,193	116,105	26%
	Fish	42,595	9,078	29,050	58,691	35%
	KTNE	38,565	9,524	24,602	55,675	40%
	Kenai	1,753,556	26,983	1,708,636	1,797,112	3%
	Kasilof	112,146	12,545	92,941	134,128	18%
	Harvest represented	2,261,582				
	Harvest unanalyzed	465				
	Total harvest	2,262,047				
Central District drift gillnet (corridor-only periods)						
	Crescent	1,515	2,628	0	7,112	235%
	West	44,381	9,566	43,774	61,115	20%
	JCL	37,810	8,804	37,186	53,284	21%
	SusYen	15,258	7,681	14,136	29,466	50%
	Fish	15,716	5,713	15,062	26,097	35%
	KTNE	16,262	6,390	15,529	27,872	38%
	Kenai	607,031	17,607	607,380	635,308	2%
	Kasilof	43,173	9,751	42,513	60,256	21%
	Harvest represented	781,146				
	Harvest unanalyzed	157,842				
	Total harvest	938,988				
Central District, Upper Subdistrict set gillnet						
	Crescent	132	481	0	756	285%
	West	12,389	3,088	7,844	17,914	41%
	JCL	10,248	3,412	5,421	16,460	54%
	SusYen	11,555	4,033	5,802	18,846	56%
	Fish	14,153	4,001	8,379	21,349	46%
	KTNE	22,238	5,012	14,714	31,056	37%
	Kenai	1,497,218	14,770	1,472,514	1,521,181	2%
	Kasilof	309,728	12,951	288,821	331,351	7%
	Harvest represented	1,877,662				
	Harvest unanalyzed	0				
	Total harvest	1,877,662				

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Table 7.–Page 2 of 2.

Area strata	Reporting Group	Harvest	SD	90% CI 5%	95%	Relative Error
Central District, Western and Kalgin Island subdistricts set gillnet						
	Crescent	55,489	1,573	52,847	58,017	5%
	West	54,768	2,781	50,227	59,386	8%
	JCL	1,067	503	382	2,005	76%
	SusYen	993	663	0	2,193	110%
	Fish	5	35	0	12	129%
	KTNE	991	644	209	2,245	103%
	Kenai	41,216	2,300	37,422	44,967	9%
	Kasilof	5,170	1,116	3,467	7,112	35%
	Harvest represented	159,698				
	Harvest unanalyzed	0				
	Total harvest	159,698				
Northern District, Eastern and General subdistricts set gillnet						
	Crescent	19	53	0	126	331%
	West	5,572	544	4,695	6,486	16%
	JCL	4,347	494	3,559	5,187	19%
	SusYen	6,441	615	5,448	7,471	16%
	Fish	7,704	583	6,762	8,686	12%
	KTNE	5,516	487	4,747	6,346	14%
	Kenai	2,412	183	2,112	2,718	13%
	Kasilof	101	46	40	186	72%
	Harvest represented	32,112				
	Harvest unanalyzed	3,092				
	Total harvest	35,204				

Note: Stock-specific harvest numbers may not sum to the total harvest due to rounding error.

Table 8.–Stock-specific harvest, standard deviation (SD), and 90% credibility intervals calculated using a stratified estimator (see text) for combined temporal strata in all fishing area strata and based on genetic analysis of mixtures of sockeye salmon harvested in the Upper Cook Inlet, 2005–2011.

				90% CI		
Year	Reporting Group	Harvest	SD	5%	95%	Relative Error
2005	Crescent	14,569	8,876	64	30,065	103%
	West	33,352	8,588	21,097	48,742	41%
	JCL	27,178	6,600	17,361	38,890	40%
	SusYen	27,748	8,854	15,231	43,673	51%
	Fish	3,935	2,910	108	9,440	119%
	KTNE	14,820	5,975	6,866	26,026	65%
	Kenai	2,936,487	38,418	2,872,816	2,999,501	2%
	Kasilof	1,019,935	36,141	960,699	1,079,433	6%
	Harvest represented	4,078,024				
	Harvest unanalyzed[a]	1,157,465				
	Total harvest	5,235,489				
2006	Crescent	27,109	1,673	25,279	30,476	10%
	West	53,574	5,264	45,402	62,677	16%
	JCL	16,230	2,445	12,415	20,434	25%
	SusYen	28,231	4,075	21,944	35,250	24%
	Fish	333	503	7	1,248	186%
	KTNE	17,350	3,010	12,645	22,526	28%
	Kenai	577,512	11,902	558,050	597,296	3%
	Kasilof	1,324,611	11,635	1,305,342	1,343,687	1%
	Harvest represented	2,044,950				
	Harvest unanalyzed[a]	143,252				
	Total harvest	2,188,202				
2007	Crescent	54,001	4,772	46,973	62,559	14%
	West	153,205	14,739	129,922	178,433	16%
	JCL	134,100	13,723	112,161	157,216	17%
	SusYen	104,842	19,335	74,128	137,684	30%
	Fish	8,199	3,192	3,955	14,181	62%
	KTNE	74,235	11,628	55,825	94,015	26%
	Kenai	1,920,986	30,389	1,870,844	1,970,492	3%
	Kasilof	687,091	25,806	645,072	730,015	6%
	Harvest represented	3,136,659				
	Harvest unanalyzed[a]	177,662				
	Total harvest	3,314,321				

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Year	Reporting Group	Harvest	SD	90% CI 5%	90% CI 95%	Relative Error
2008	Crescent	20,145	2,359	16,499	24,243	19%
	West	63,717	5,880	54,582	73,860	15%
	JCL	66,315	6,848	55,472	77,926	17%
	SusYen	47,092	8,162	34,396	61,204	28%
	Fish	3,516	1,490	1,471	6,181	67%
	KTNE	47,826	5,582	39,180	57,511	19%
	Kenai	875,430	19,876	842,868	908,403	4%
	Kasilof	1,111,226	19,076	1,079,760	1,142,403	3%
	Harvest represented	2,235,267				
	Harvest unanalyzed[a]	142,378				
	Total harvest	2,377,645				
2009	Crescent	59,630	4,182	54,305	67,836	11%
	West	163,460	10,286	147,142	181,011	10%
	JCL	45,224	6,127	35,567	55,619	22%
	SusYen	57,296	9,153	42,976	72,923	26%
	Fish	37,648	5,514	29,186	47,195	24%
	KTNE	54,198	6,080	44,734	64,676	18%
	Kenai	943,784	18,379	913,625	974,061	3%
	Kasilof	670,243	15,395	645,021	695,614	4%
	Harvest represented	2,031,483				
	Harvest unanalyzed[a]	9,797				
	Total harvest	2,041,280				
2010[b]	Crescent	51,025	3,061	46,488	56,471	10%
	West	204,880	10,994	187,225	223,412	9%
	JCL	55,659	6,145	46,040	66,191	18%
	SusYen	58,425	7,162	47,185	70,616	20%
	Fish	93,905	7,564	81,844	106,611	13%
	KTNE	78,996	7,339	67,408	91,554	15%
	Kenai	1,821,553	17,926	1,791,885	1,850,751	2%
	Kasilof	423,296	11,346	404,928	442,293	4%
	Harvest represented	2,787,738				
	Harvest unanalyzed[a]	36,494				
	Total harvest	2,824,232				

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Year	Reporting Group	Harvest	SD	90% CI 5%	90% CI 95%	Relative Error
2011	Crescent	57,411	3,556	52,694	64,108	10%
	West	294,401	20,423	261,908	328,917	11%
	JCL	92,479	12,697	72,660	114,384	23%
	SusYen	125,036	16,963	98,494	154,174	22%
	Fish	80,172	11,467	62,586	100,157	23%
	KTNE	83,537	12,561	64,303	105,449	25%
	Kenai	3,901,393	35,525	3,842,334	3,959,274	1%
	Kasilof	470,318	20,471	437,614	504,768	7%
	Harvest represented	5,104,748				
	Harvest unanalyzed[c]	161,399				
	Total harvest	5,266,147				

Note: Stock-specific harvest numbers may not sum to the total harvest represented due to rounding error.

[a] Excludes unrepresented harvest from Kustatan (2005, 2,666 fish; 2006, 3,896 fish; 2007, 2,453 fish; 2008, 1,852 fish; 2009, 4,495 fish; 2010, 2,553 fish; and 2011, 3,841 fish) and Chinitna (2005, 13 fish; 2006, 108 fish; 2007, 4 fish; 2008, 4 fish; and 2009, 18 fish) subdistricts.

[b] Harvest from the Western Subdistrict is reported here for 2010 after analysis with the updated baseline.

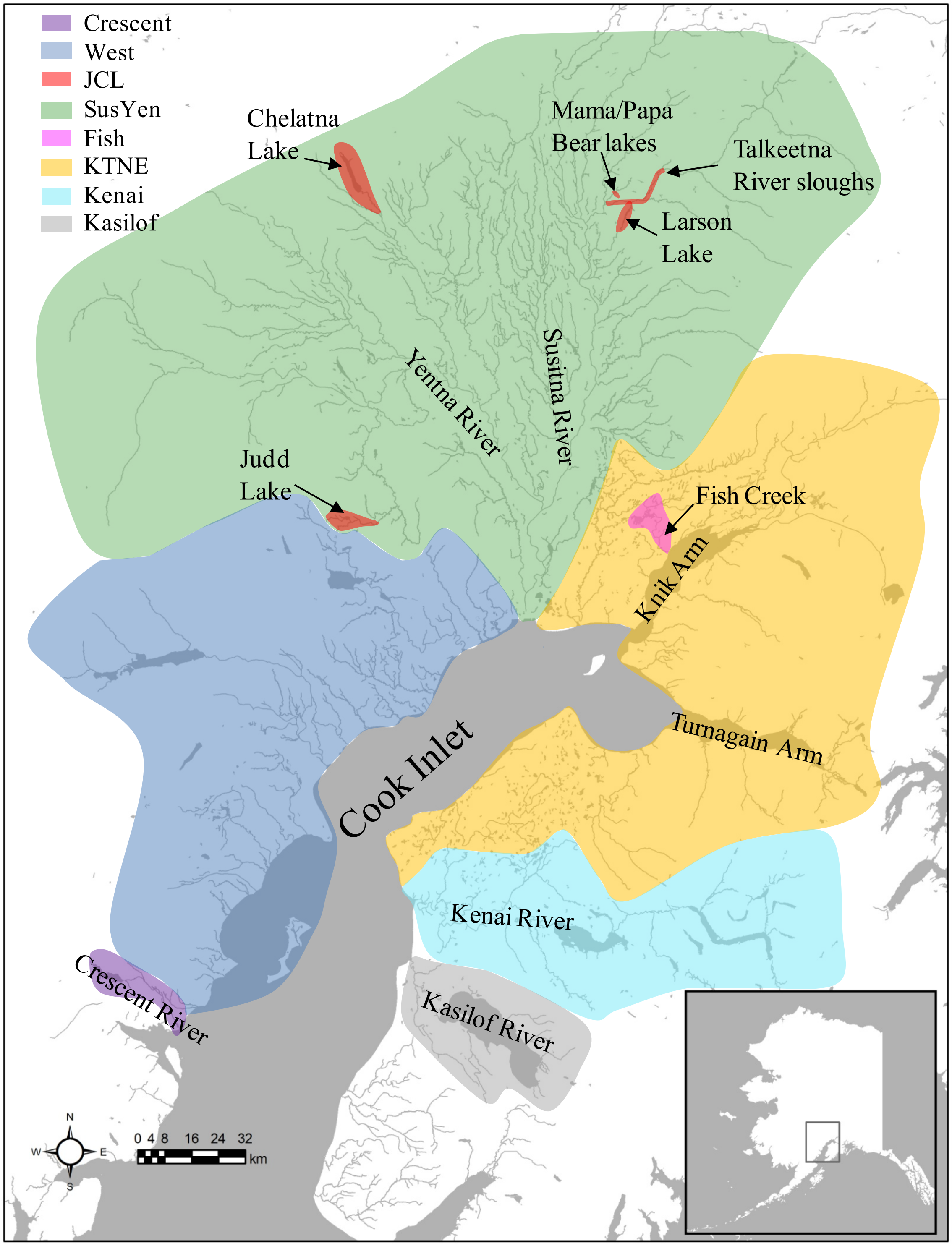

Figure 1.–Map of Upper Cook Inlet showing reporting group areas for mixed stock analysis using genetic markers for sockeye salmon.

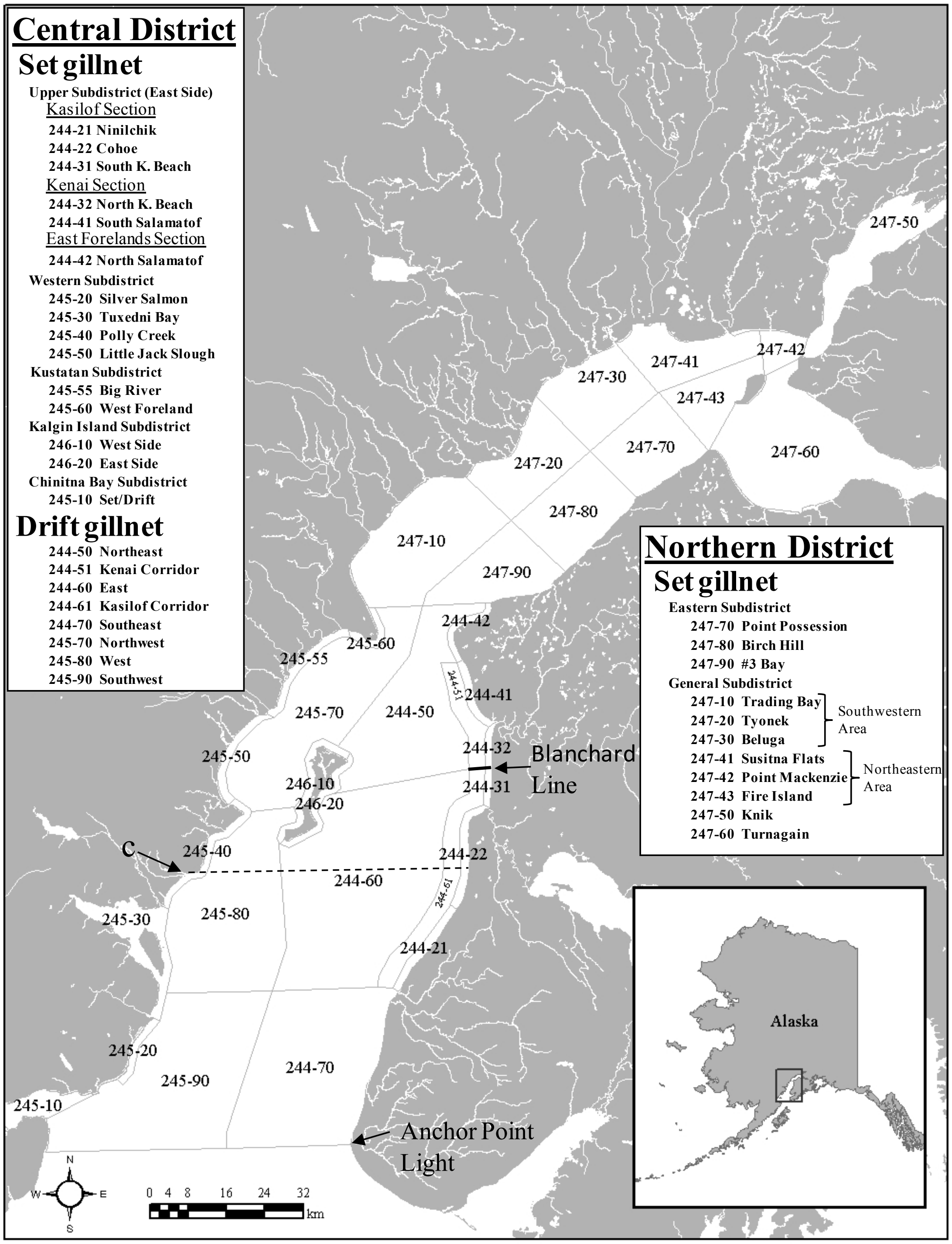

Figure 2.–Map of Upper Cook Inlet showing commercial fishing boundaries (statistical areas) for subdistricts and selected sections and subsections within the Northern and Central districts for both set and drift gillnet fisheries (see Table 1 for description of lines labeled with letters).

Note: Districts, subdistricts, and sections are defined in Alaska Administrative Code (5 AAC 21.200). For the purposes of this report the statistical areas in Upper Subdistrict (Central District) are referred to as subsections.

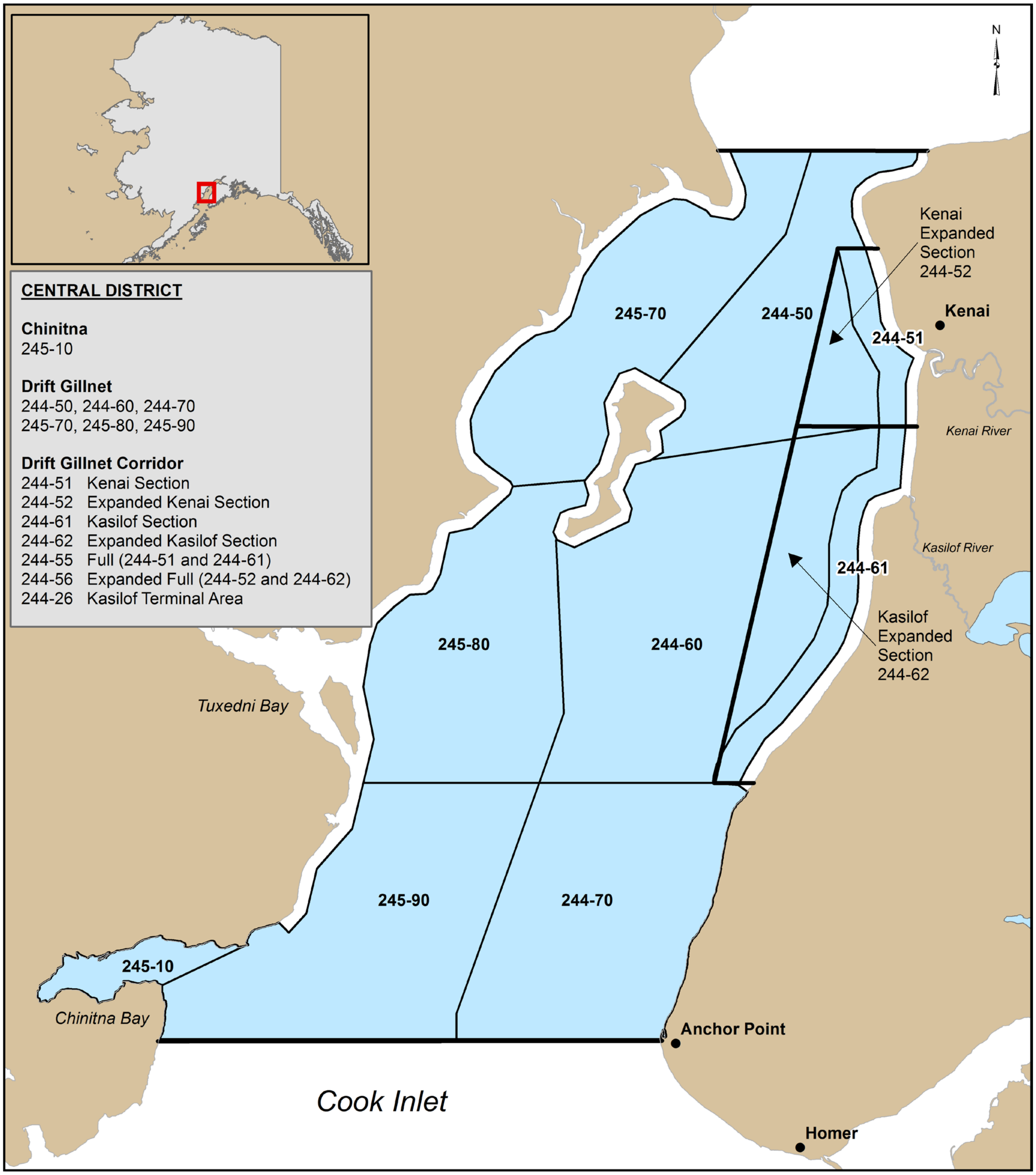

Figure 3.–Map of Upper Cook Inlet showing commercial fishing boundaries (statistical areas) within the Central district drift gillnet fishery, including expanded sections (see Table 1 and text).

Note: Districts, subdistricts, and sections are defined in Alaska Administrative Code (5 AAC 21.200). For the purposes of this report the statistical areas in Upper Subdistrict (Central District) are referred to as subsections.

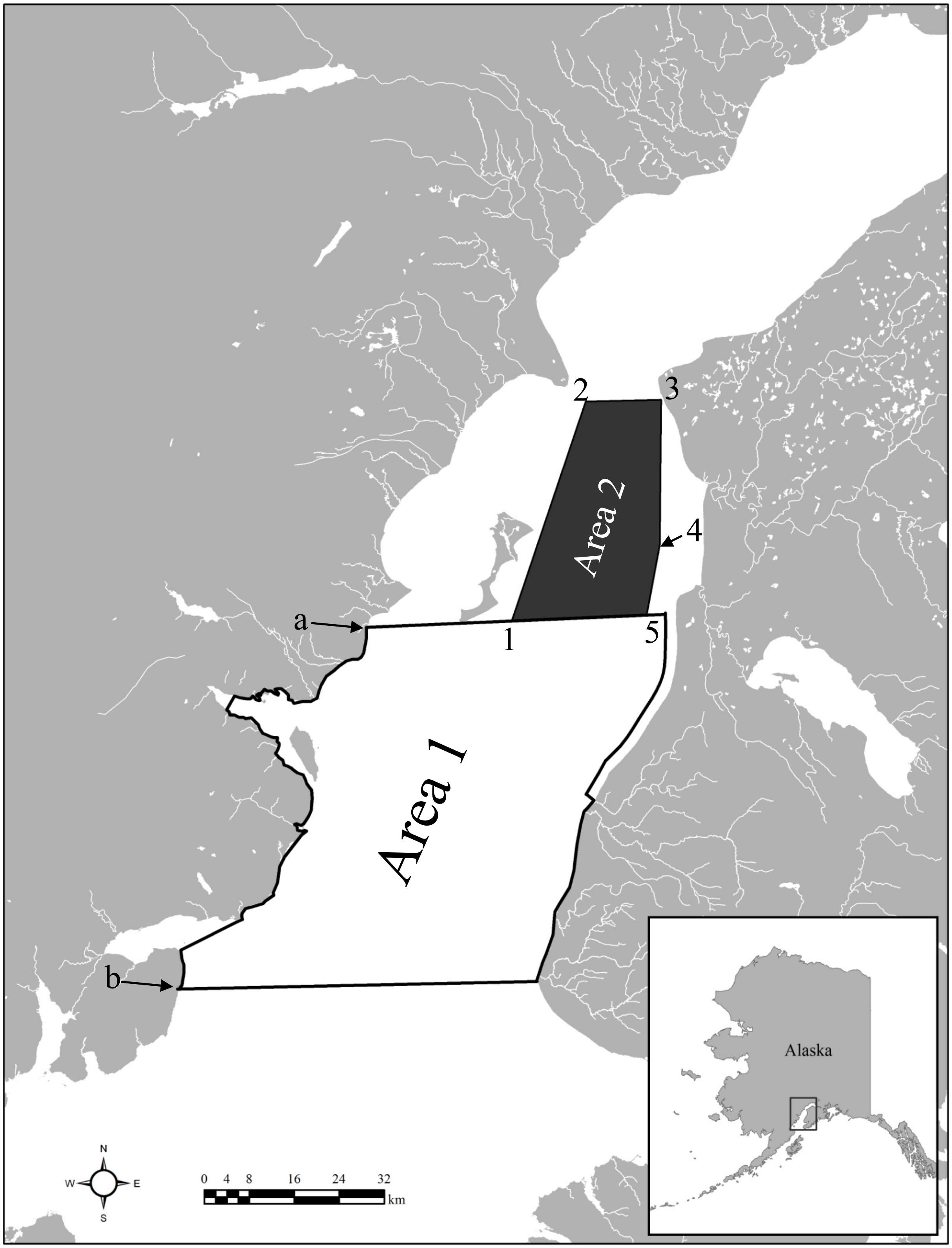

Figure 4.–Map of Upper Cook Inlet showing management fishing boundaries for the Central District drift gillnet fishery (see Table 1 for description of points [numbers] and lines [letters]).

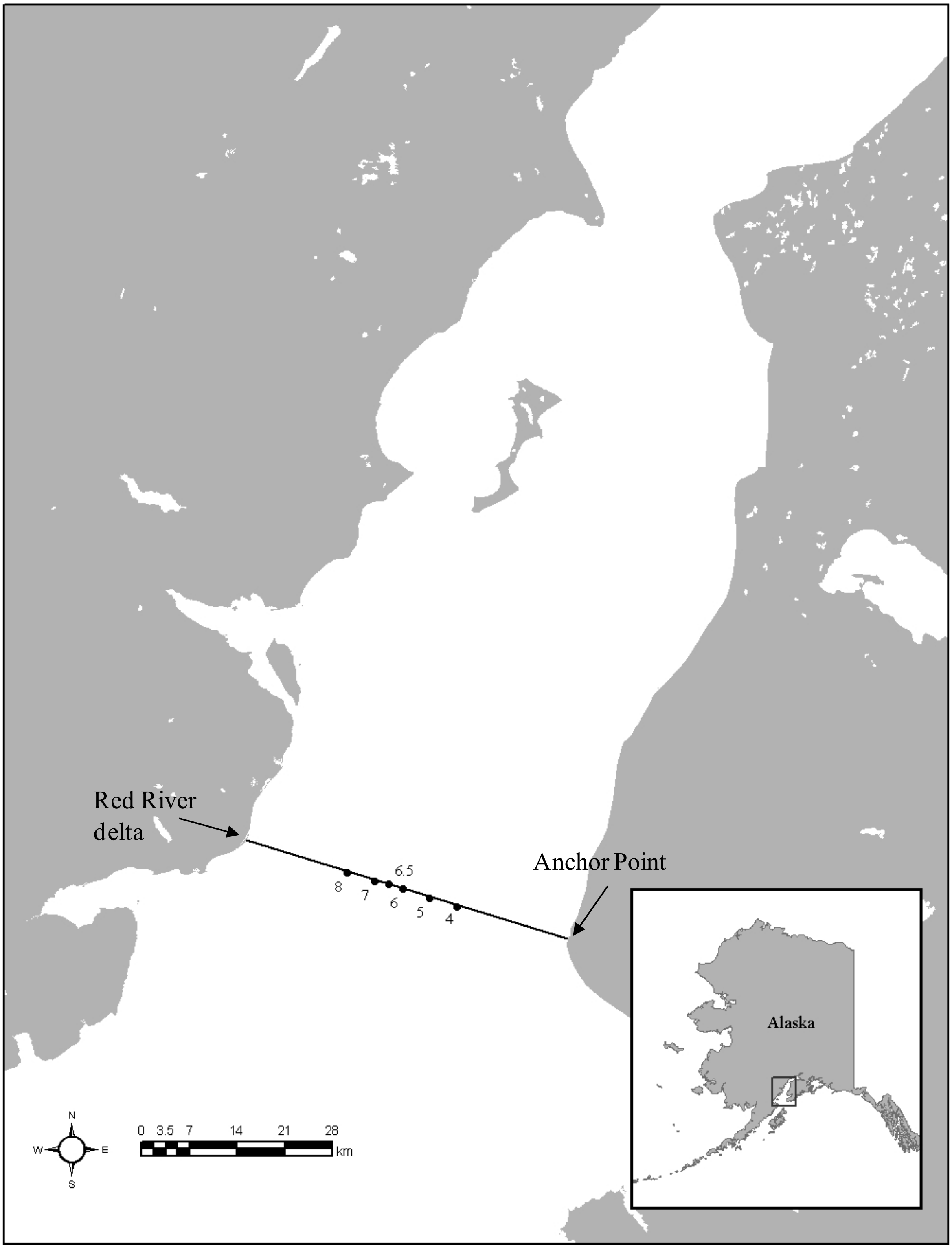

Figure 5.–Offshore test fishery stations for sockeye salmon migrating into Upper Cook Inlet, Alaska.

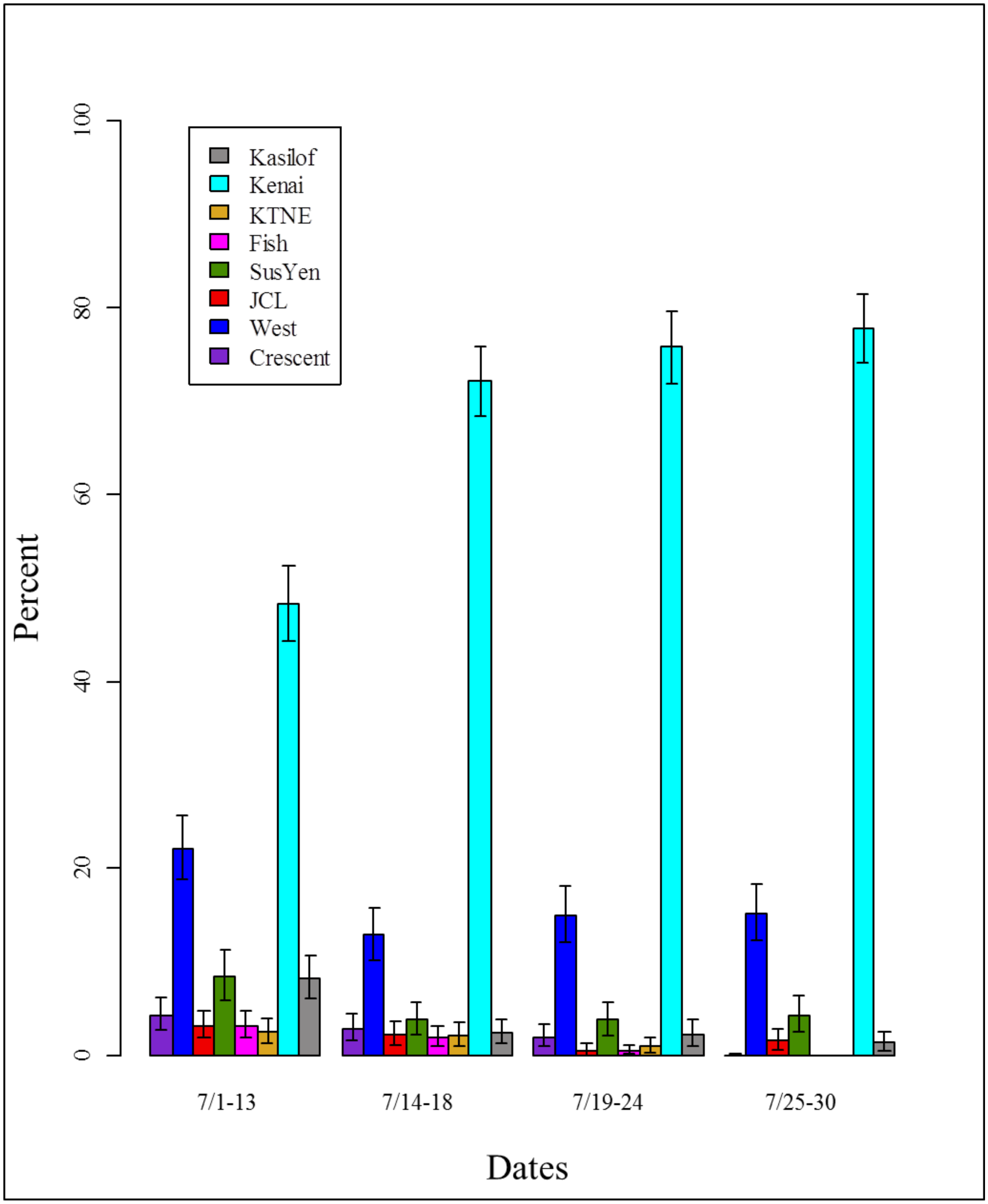

Figure 6.–Stock composition estimates and 90% credibility intervals by temporal stratum for the offshore test fishery from 2011.

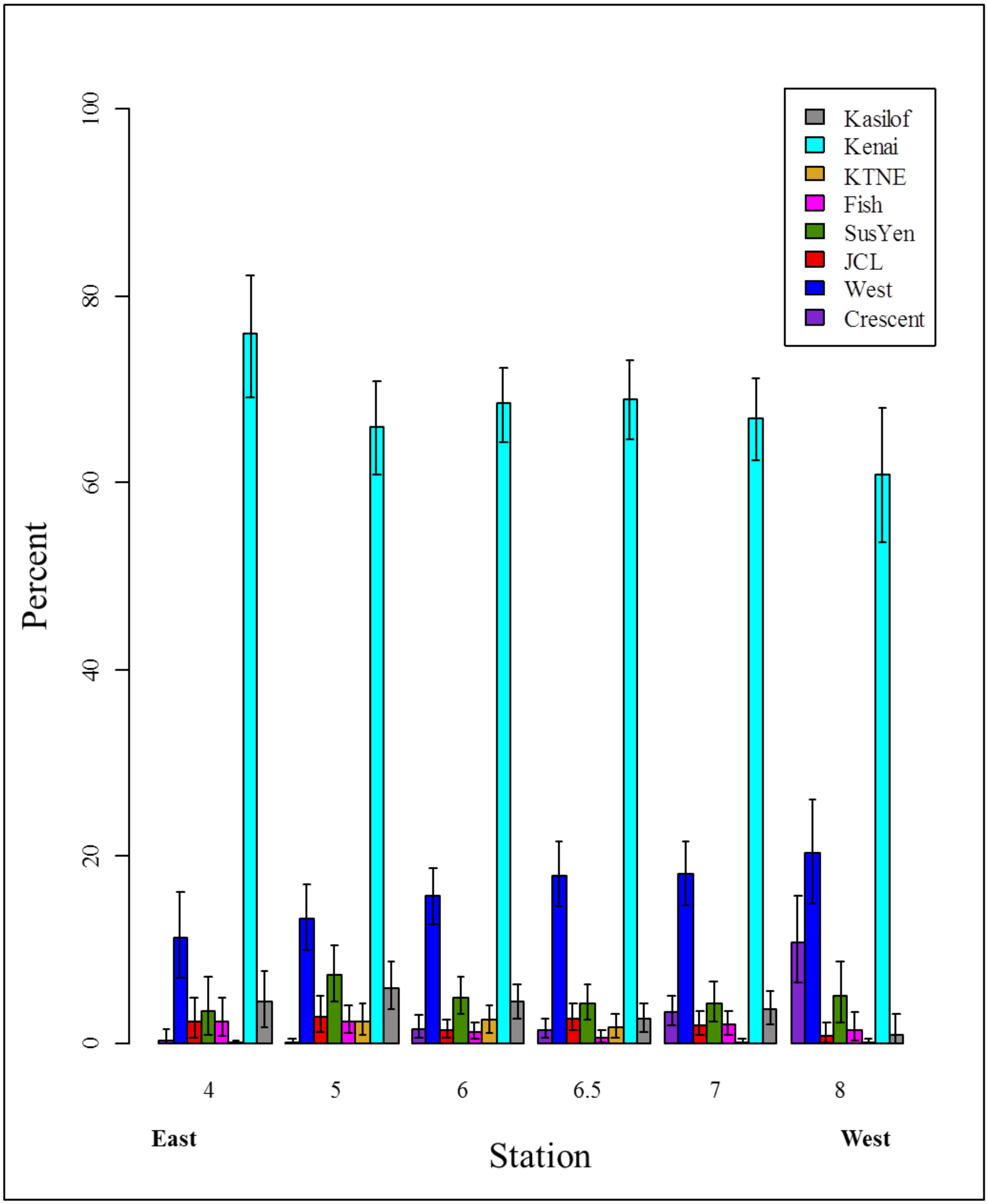

Figure 7.–Stock composition estimates, the proportion of unanalyzed samples, and 90% credibility intervals by station for the offshore test fishery from 2011.

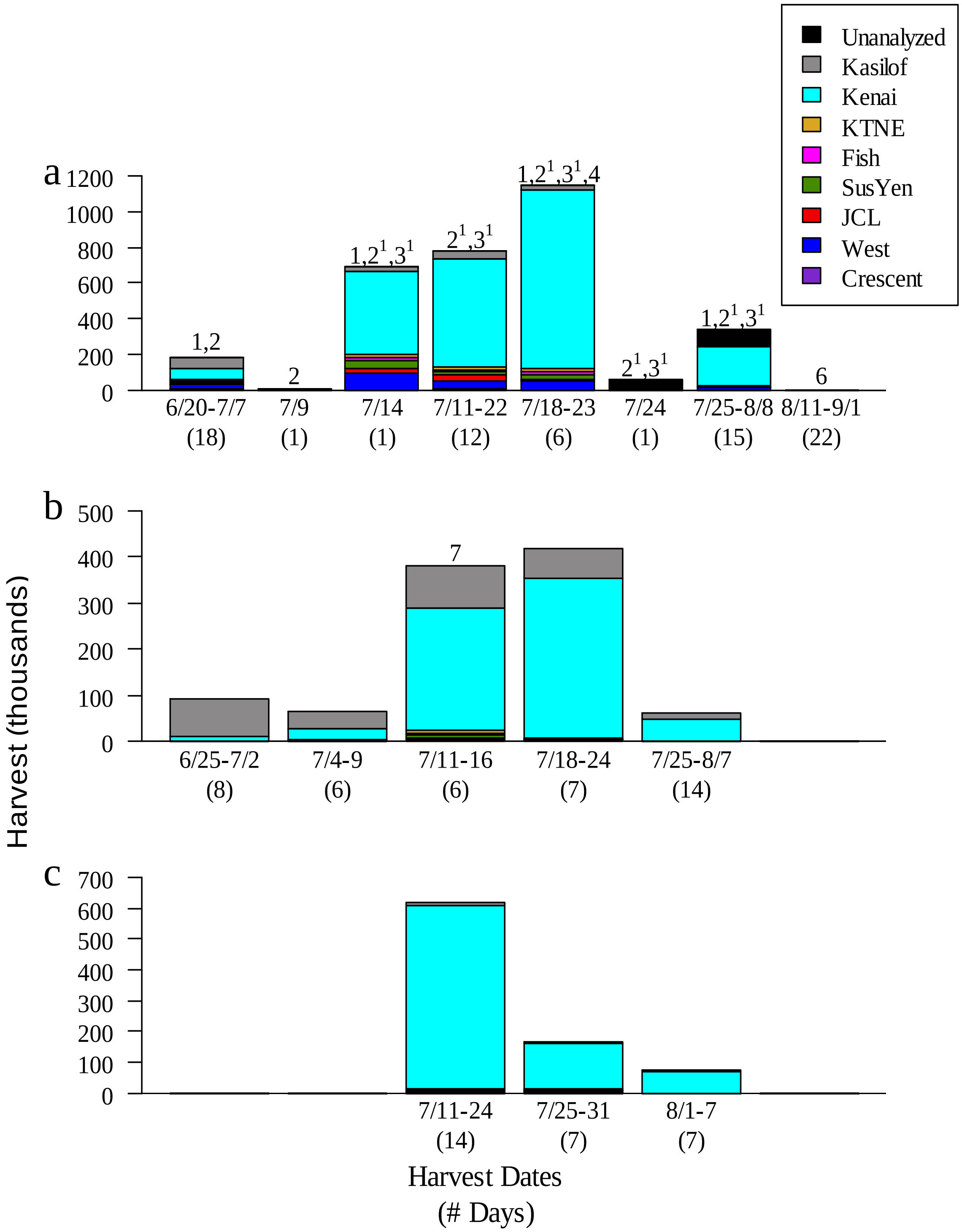

Figure 8.–Estimates of harvest by stock for the a) Central District drift gillnet fishery (including corridor-only periods); b) Kasilof Section set gillnet fishery (Central District, Upper Subdistrict); and c) Kenai/East Forelands sections set gillnet fishery (Central District, Upper Subdistrict) in 2011 for specified date ranges (number of days). Numbers above the bars indicate the fishery restrictions during temporal strata (see Tables 1 and 2). Only 1 fishery a) Central District drift gillnet fishery (including corridor-only periods) contains unrepresented (unanalyzed) strata.

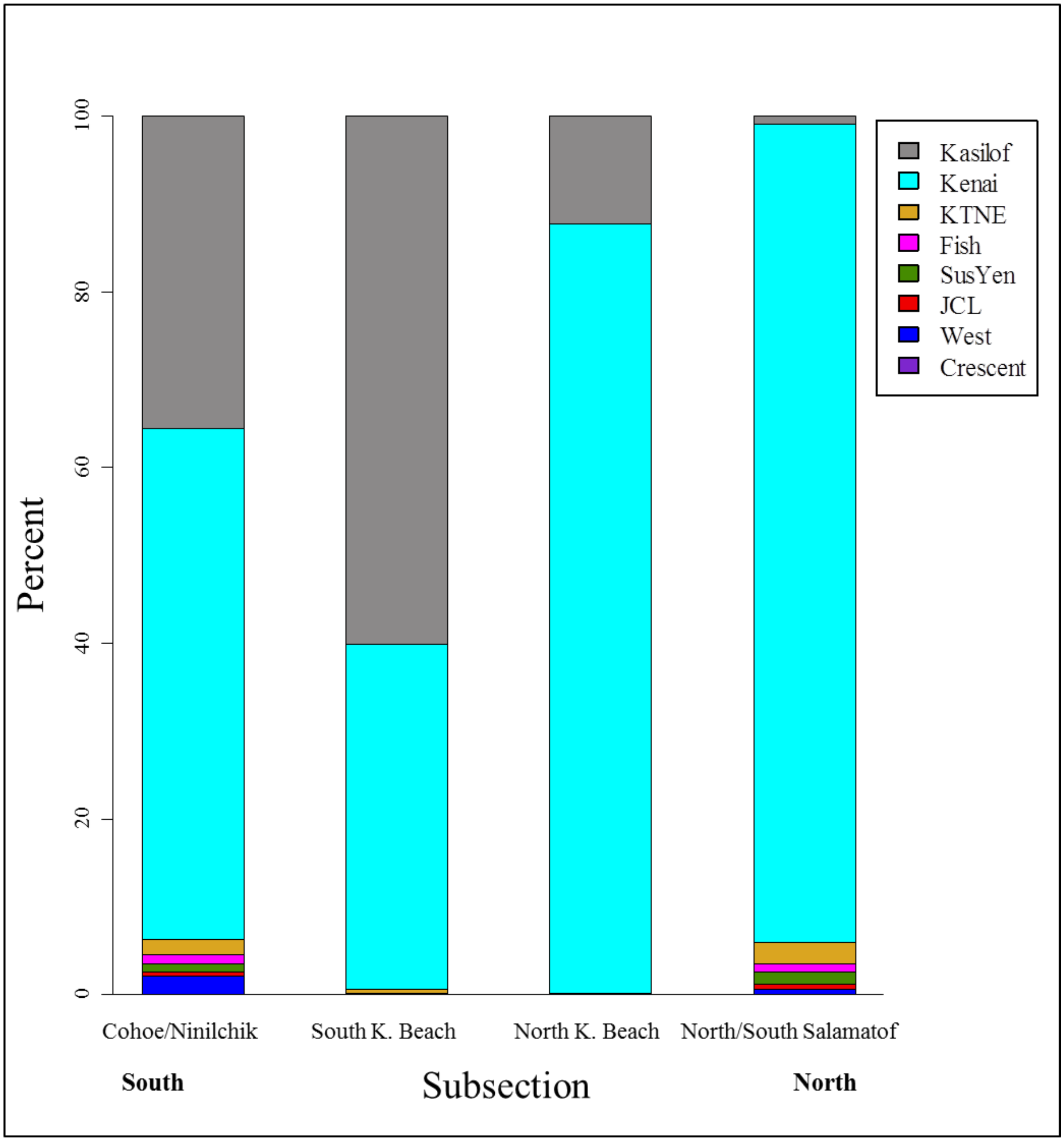

Figure 9.–Stock composition estimates for the Kasilof and Kenai/East Forelands sections set gillnet fisheries (Central District, Upper Subdistrict) in 2011 divided into subsections.

Note: There are 2 subdistricts for each section and they are displayed from south to north.

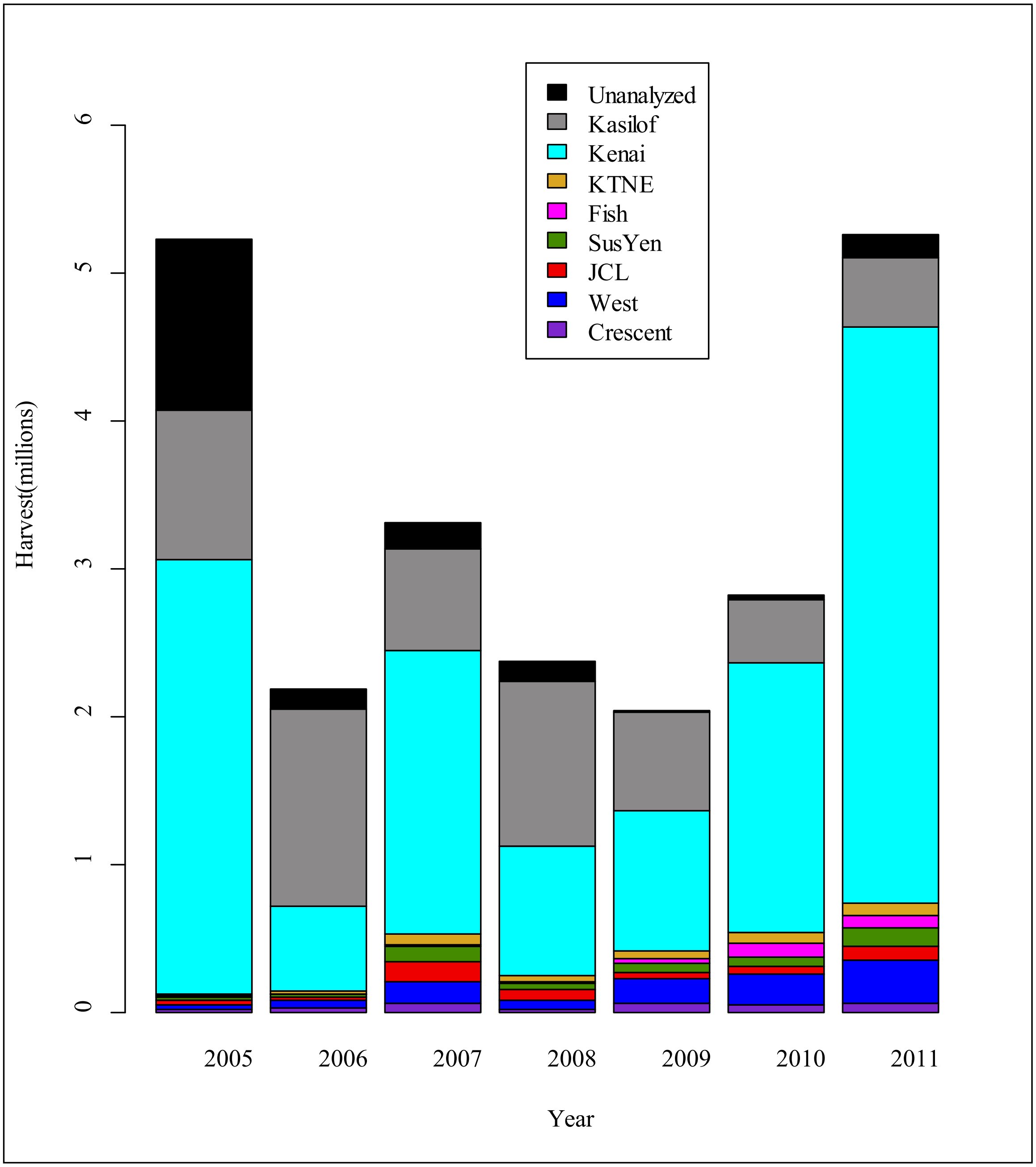

Figure 10.–Estimates of commercial harvest by stock in the Upper Cook Inlet sockeye salmon fishery calculated using a stratified estimator for all strata, 2005–2011.

APPENDIX A

Appendix A1.–Stock composition estimates (%) and extrapolated harvest, including mean, 90% credibility interval (CI), sample size (*n*), and standard deviation (SD), for mixtures of sockeye salmon harvested in the Central District drift gillnet fishery (excluding corridor-only periods) in 2011.

Dates: 6/20–7/7	Stock composition (*n* = 400)				Harvest = 178,193		
		90% CI				90% CI	
Reporting Group	Mean	5%	95%	SD	Mean	5%	95%
Crescent	3.3	1.9	5.1	1.0	5,931	3,374	9,005
West	13.0	10.1	16.1	1.8	23,135	18,078	28,609
JCL	3.0	1.7	4.7	0.9	5,422	3,011	8,351
SusYen	5.9	3.7	8.4	1.4	10,487	6,606	14,909
Fish	4.5	2.9	6.3	1.1	8,007	5,186	11,307
KTNE	4.8	3.0	6.8	1.2	8,508	5,361	12,188
Kenai	30.9	26.8	35.1	2.5	55,083	47,814	62,465
Kasilof	34.6	30.5	38.8	2.5	61,619	54,363	69,051

Dates: 7/14	Stock composition (*n* = 399)				Harvest = 691,622		
		90% CI				90% CI	
Reporting Group	Mean	5%	95%	SD	Mean	5%	95%
Crescent	0.0	0.0	0.0	0.0	63	0	275
West	13.7	11.0	16.7	1.8	95,042	75,849	115,724
JCL	3.4	2.0	5.1	0.9	23,797	14,079	35,400
SusYen	6.4	4.3	8.8	1.4	44,149	29,422	60,915
Fish	3.0	1.7	4.6	0.9	20,966	12,052	31,674
KTNE	1.8	0.8	3.3	0.8	12,733	5,263	22,675
Kenai	68.2	64.2	72.2	2.4	471,900	443,788	499,195
Kasilof	3.3	1.9	5.0	0.9	22,972	13,332	34,545

Dates: 7/18–7/23	Stock composition (*n* = 397)				Harvest = 1,146,640		
		90% CI				90% CI	
Reporting Group	Mean	5%	95%	SD	Mean	5%	95%
Crescent	0.0	0.0	0.0	0.1	71	0	37
West	4.2	2.6	6.0	1.0	47,825	29,962	68,828
JCL	0.7	0.1	1.5	0.4	8,048	1,713	17,674
SusYen	2.8	1.4	4.4	0.9	31,703	16,312	50,404
Fish	1.2	0.4	2.2	0.6	13,613	4,770	25,696
KTNE	1.4	0.5	2.6	0.7	15,483	5,343	29,411
Kenai	87.6	84.6	90.4	1.8	1,004,475	970,008	1,036,433
Kasilof	2.2	1.0	3.7	0.8	25,423	11,614	42,911

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Dates: 7/25–8/8	Stock composition (n = 393)				Harvest = 245,127		
		90% CI				90% CI	
Reporting Group	Mean	5%	95%	SD	Mean	5%	95%
Crescent	0.0	0.0	0.0	0.0	11	0	4
West	5.2	3.4	7.4	1.2	12,841	8,285	18,076
JCL	0.7	0.1	1.6	0.5	1,742	341	3,936
SusYen	1.8	0.6	3.4	0.9	4,454	1,540	8,306
Fish	0.0	0.0	0.0	0.0	8	0	5
KTNE	0.8	0.1	1.7	0.5	1,842	348	4,153
Kenai	90.6	87.8	93.1	1.6	222,098	215,337	228,196
Kasilof	0.9	0.2	1.9	0.5	2,132	481	4,619

Note: The 90% credibility intervals of harvest estimates may not include the point estimate for the very low extrapolated harvest numbers because fewer than 5% of iterations had values above zero.

Note: Stock composition and harvest estimates may not sum to 100% due to rounding errors.

Note: n is the final number of samples used in genetic analyses.

Appendix A2.–Stock composition estimates (%) and extrapolated harvest, including mean, 90% credibility interval (CI), sample size (*n*), and standard deviation (SD), for mixtures of sockeye salmon harvested in the Central District drift gillnet fishery (corridor-only period) in 2011.

Dates: 7/11–7/22	Stock composition (*n* = 399)				Harvest = 781,146		
		90% CI				90% CI	
Reporting Group	Mean	5%	95%	SD	Mean	5%	95%
Crescent	0.2	0.0	0.9	0.3	1,515	0	7,112
West	5.7	3.8	7.8	1.2	44,381	29,773	61,115
JCL	4.8	3.1	6.8	1.1	37,810	24,475	53,284
SusYen	2.0	0.6	3.8	1.0	15,258	4,755	29,466
Fish	2.0	1.0	3.3	0.7	15,716	7,572	26,097
KTNE	2.1	0.9	3.6	0.8	16,262	7,116	27,872
Kenai	77.7	73.9	81.3	2.3	607,031	577,416	635,308
Kasilof	5.5	3.6	7.7	1.2	43,173	28,365	60,256

Note: The 90% credibility intervals of harvest estimates may not include the point estimate for the very low extrapolated harvest numbers because fewer than 5% of iterations had values above zero.

Note: Stock composition and harvest estimates may not sum to 100% due to rounding errors.

Note: *n* is the final number of samples used in genetic analyses.

Appendix A3.–Stock composition estimates (%) and extrapolated harvest, including mean, 90% credibility interval (CI), sample size (*n*), and standard deviation (SD), for mixtures of sockeye salmon harvested in the Kasilof Section set gillnet fishery (Central District, Upper Subdistrict) in 2011.

Dates: 6/25–7/2	Stock composition (*n* = 396)				Harvest = 92,456		
		90% CI				90% CI	
Reporting Group	Mean	5%	95%	SD	Mean	5%	95%
Crescent	0.0	0.0	0.0	0.0	2	0	1
West	2.4	1.2	3.9	0.8	2,219	1,103	3,596
JCL	0.0	0.0	0.0	0.0	6	0	3
SusYen	0.0	0.0	0.0	0.1	8	0	7
Fish	0.0	0.0	0.0	0.0	2	0	1
KTNE	0.3	0.0	0.8	0.3	239	7	724
Kenai	9.1	6.6	11.8	1.6	8,411	6,134	10,906
Kasilof	88.2	85.3	90.9	1.7	81,568	78,834	84,079

Dates: 7/4–7/9	Stock composition (*n* = 400)				Harvest = 66,020		
		90% CI				90% CI	
Reporting Group	Mean	5%	95%	SD	Mean	5%	95%
Crescent	0.0	0.0	0.0	0.1	5	0	3
West	0.3	0.0	1.0	0.3	206	6	652
JCL	0.9	0.3	1.9	0.5	611	175	1,229
SusYen	2.0	0.8	3.5	0.8	1,301	523	2,298
Fish	1.1	0.4	2.2	0.6	740	240	1,429
KTNE	2.8	1.5	4.4	0.9	1,836	984	2,881
Kenai	33.3	29.2	37.4	2.5	21,964	19,281	24,716
Kasilof	59.6	55.3	63.8	2.6	39,357	36,524	42,128

Dates: 7/11–7/16	Stock composition (*n* = 400)				Harvest = 378,995		
		90% CI				90% CI	
Reporting Group	Mean	5%	95%	SD	Mean	5%	95%
Crescent	0.0	0.0	0.0	0.1	62	0	159
West	1.0	0.3	1.9	0.5	3,816	1,292	7,386
JCL	1.2	0.4	2.2	0.6	4,432	1,565	8,345
SusYen	1.2	0.2	2.7	0.8	4,637	610	10,197
Fish	1.3	0.5	2.4	0.6	5,071	2,012	9,263
KTNE	1.4	0.3	2.7	0.7	5,311	1,158	10,422
Kenai	70.3	66.3	74.2	2.4	266,520	251,292	281,224
Kasilof	23.5	20.0	27.2	2.2	89,146	75,726	103,185

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Dates: 7/18–7/24	Stock composition (*n* = 398)				Harvest = 417,923		
		90% CI				90% CI	
Reporting Group	Mean	5%	95%	SD	Mean	5%	95%
Crescent	0.0	0.0	0.0	0.1	27	0	12
West	0.7	0.2	1.6	0.4	2,976	639	6,564
JCL	0.2	0.0	0.8	0.3	971	0	3,210
SusYen	0.1	0.0	0.9	0.4	535	0	3,937
Fish	0.5	0.0	1.2	0.4	1,940	171	4,988
KTNE	0.0	0.0	0.0	0.1	57	0	114
Kenai	82.8	79.4	86.1	2.0	346,052	331,664	359,663
Kasilof	15.6	12.5	18.9	1.9	65,365	52,385	79,156

Dates: 7/25–8/7	Stock composition (*n* = 396)				Harvest = 61,593		
		90% CI				90% CI	
Reporting Group	Mean	5%	95%	SD	Mean	5%	95%
Crescent	0.0	0.0	0.0	0.1	5	0	3
West	2.4	0.5	4.8	1.3	1,506	322	2,958
JCL	0.0	0.0	0.0	0.0	2	0	1
SusYen	0.0	0.0	0.0	0.1	5	0	2
Fish	0.5	0.1	1.3	0.4	335	60	790
KTNE	0.8	0.0	2.0	0.6	490	28	1,231
Kenai	71.9	67.8	75.8	2.4	44,257	41,740	46,684
Kasilof	24.3	20.7	28.1	2.3	14,994	12,764	17,328

Note: The 90% credibility intervals of harvest estimates may not include the point estimate for the very low extrapolated harvest numbers because fewer than 5% of iterations had values above zero.

Note: Stock composition and harvest estimates may not sum to 100% due to rounding errors.

Note: *n* is the final number of samples used in genetic analyses.

Appendix A4.–Stock composition estimates (%) and extrapolated harvest, including mean, 90% credibility interval (CI), sample size (*n*), and standard deviation (SD), for mixtures of sockeye salmon harvested in the Kenai/East Forelands sections set gillnet fishery (Central District, Upper Subdistrict) in 2011.

Dates: 7/11–7/24	Stock composition (*n* = 400)				Harvest = 618,813		
		90% CI				90% CI	
Reporting Group	Mean	5%	95%	SD	Mean	5%	95%
Crescent	0.0	0.0	0.0	0.0	20	0	7
West	0.0	0.0	0.0	0.0	30	0	13
JCL	0.5	0.1	1.3	0.4	3,318	586	7,803
SusYen	0.0	0.0	0.3	0.2	273	0	1,889
Fish	0.7	0.1	1.5	0.4	4,140	804	9,496
KTNE	1.1	0.3	2.1	0.6	6,657	1,868	13,250
Kenai	95.7	93.8	97.4	1.1	592,492	580,582	602,629
Kasilof	1.9	0.9	3.3	0.8	11,883	5,288	20,443

Dates: 7/25–7/31	Stock composition (*n* = 399)				Harvest = 166,094		
		90% CI				90% CI	
Reporting Group	Mean	5%	95%	SD	Mean	5%	95%
Crescent	0.0	0.0	0.0	0.1	10	0	4
West	0.9	0.1	2.0	0.6	1,524	236	3,275
JCL	0.5	0.1	1.3	0.4	907	160	2,148
SusYen	2.8	1.1	4.9	1.1	4,603	1,848	8,060
Fish	0.8	0.2	1.6	0.4	1,275	331	2,692
KTNE	4.6	2.8	6.7	1.2	7,635	4,656	11,095
Kenai	87.9	84.9	90.8	1.8	146,060	140,964	150,760
Kasilof	2.5	1.3	3.9	0.8	4,082	2,110	6,537

Dates: 8/1–8/7	Stock composition (*n* = 350)				Harvest = 75,768		
		90% CI				90% CI	
Reporting Group	Mean	5%	95%	SD	Mean	5%	95%
Crescent	0.0	0.0	0.0	0.0	2	0	1
West	0.1	0.0	0.7	0.3	113	0	519
JCL	0.0	0.0	0.0	0.0	2	0	1
SusYen	0.3	0.0	1.0	0.4	193	0	743
Fish	0.9	0.2	1.8	0.5	650	177	1,357
KTNE	0.0	0.0	0.1	0.1	12	0	61
Kenai	94.3	91.9	96.4	1.4	71,462	69,667	73,021
Kasilof	4.4	2.6	6.5	1.2	3,334	1,981	4,935

Note: The 90% credibility intervals of harvest estimates may not include the point estimate for the very low extrapolated harvest numbers because fewer than 5% of iterations had values above zero.

Note: Stock composition and harvest estimates may not sum to 100% due to rounding errors.

Note: *n* is the final number of samples used in genetic analyses.

Appendix A5.–Stock composition estimates (%) and extrapolated harvest, including mean, 90% credibility interval (CI), sample size (*n*), and standard deviation (SD), for mixtures of sockeye salmon harvested in the Kalgin Island Subdistrict set gillnet fishery (Central District) in 2011.

Dates: 6/1–8/22	Stock composition (*n* = 400)				Harvest = 88,941		
		90% CI				90% CI	
Reporting Group	Mean	5%	95%	SD	Mean	5%	95%
Crescent	0.2	0.0	0.9	0.3	218	0	818
West	45.0	40.8	49.2	2.5	40,031	36,306	43,755
JCL	1.2	0.4	2.2	0.6	1,065	386	1,996
SusYen	1.1	0.0	2.4	0.7	966	0	2,147
Fish	0.0	0.0	0.0	0.0	3	0	2
KTNE	0.7	0.2	1.6	0.4	654	161	1,396
Kenai	45.9	41.7	50.1	2.6	40,836	37,093	44,593
Kasilof	5.8	3.9	8.0	1.3	5,168	3,472	7,109

Note: The 90% credibility intervals of harvest estimates may not include the point estimate for the very low extrapolated harvest numbers because fewer than 5% of iterations had values above zero.

Note: Stock composition and harvest estimates may not sum to 100% due to rounding errors.

Note: *n* is the final number of samples used in genetic analyses.

Appendix A6.–Stock composition estimates (%) and extrapolated harvest, including mean, 90% credibility interval (CI), sample size (*n*), and standard deviation (SD), for mixtures of sockeye salmon harvested in the Western Subdistrict set gillnet fishery (Northern District) in 2011.

Dates: 6/16–8/22	Stock composition (*n* = 400)				Harvest = 70,757		
		90% CI				90% CI	
Reporting Group	Mean	5%	95%	SD	Mean	5%	95%
Crescent	78.1	74.4	81.6	2.2	49,450	47,129	51,661
West	20.8	17.2	24.6	2.3	13,184	10,870	15,588
JCL	0.0	0.0	0.0	0.0	2	0	1
SusYen	0.0	0.0	0.1	0.2	24	0	47
Fish	0.0	0.0	0.0	0.0	2	0	1
KTNE	0.5	0.0	2.0	0.7	301	0	1,267
Kenai	0.5	0.1	1.3	0.4	340	61	805
Kasilof	0.0	0.0	0.0	0.0	2	0	1

Note: The 90% credibility intervals of harvest estimates may not include the point estimate for the very low extrapolated harvest numbers because fewer than 5% of iterations had values above zero.

Note: Stock composition and harvest estimates may not sum to 100% due to rounding errors.

Note: *n* is the final number of samples used in genetic analyses.

Appendix A7.– A comparison of stock composition estimates (%) and extrapolated harvest, including mean, 90% credibility interval (CI), sample size (n), and standard deviation (SD), generated by BAYES analysis for mixtures whose Markov Chain Monte Carlo (MCMC) chains (a) did converge and (b) did not converge of sockeye salmon harvested areas within the Western Subdistrict set gillnet fishery (Central District) in 2010.

a)	Dates: 6/21–8/9	Stock composition (n=400)				Harvest = 44,428		
			90% CI				90% CI	
Area strata	Reporting Group	Mean	5%	95%	SD	Mean	5%	95%
Western (reportable estimates that converged after 40,000 iterations in analysis using updated baseline)								
	Crescent	90.1	87.3	92.7	1.7	40,051	38,783	41,199
	West	9.7	7.1	12.6	1.7	4,316	3,172	5,579
	JCL	0.0	0.0	0.0	0.0	1	0	0
	SusYen	0.0	0.0	0.0	0.1	8	0	20
	Fish	0.0	0.0	0.0	0.0	1	0	0
	KTNE	0.0	0.0	0.0	0.0	1	0	0
	Kenai	0.0	0.0	0.0	0.0	1	0	0
	Kasilof	0.1	0.0	0.5	0.2	48	0	244

b)	Dates: 6/21–8/9	Stock composition (*n* = 400)				Harvest = 44,428		
			90% CI				90% CI	
Area strata	Reporting Group	Mean	5%	95%	SD	Mean	5%	95%
Western (previously unreported estimates that did not converge after 80,000 iterations in analysis)								
	Crescent	89.9	85.5	96.4	3.3	39,948	37,983	42,808
	West	8.8	3.0	14.3	3.9	3,892	1,334	6,362
	JCL	1.2	0.0	6.7	2.4	531	0	2,991
	SusYen	0.0	0.0	0.0	0.0	1	0	0
	Fish	0.0	0.0	0.0	0.0	1	0	0
	KTNE	0.0	0.0	0.0	0.0	1	0	0
	Kenai	0.0	0.0	0.0	0.0	1	0	0
	Kasilof	0.1	0.0	0.6	0.2	53	0	254

Note: The 90% credibility intervals of harvest estimates may not include the point estimate for the very low extrapolated harvest numbers because fewer than 5% of iterations had values above zero.

Note: Stock composition and harvest estimates may not sum to 100% due to rounding errors.

Note: *n* is the final number of samples used in genetic analyses.

Appendix A8.–Stock composition estimates (%) and extrapolated harvest, including mean, 90% credibility interval (CI), sample size (*n*), and standard deviation (SD), for mixtures of sockeye salmon harvested in the Eastern Subdistrict set gillnet fishery (Northern District) in 2011.

Dates: 7/4–8/22	Stock composition (*n* = 397)				Harvest = 7,428		
		90% CI				90% CI	
Reporting Group	Mean	5%	95%	SD	Mean	5%	95%
Crescent	0.0	0.0	0.2	0.2	3	0	15
West	8.4	5.7	11.4	1.7	623	422	845
JCL	4.9	3.2	6.8	1.1	361	235	507
SusYen	2.2	0.6	4.0	1.0	160	47	299
Fish	15.0	12.1	18.1	1.8	1,114	902	1,342
KTNE	35.8	31.6	40.1	2.6	2,657	2,344	2,976
Kenai	32.5	28.4	36.6	2.5	2,411	2,110	2,718
Kasilof	1.3	0.5	2.4	0.6	99	39	181

Note: The 90% credibility intervals of harvest estimates may not include the point estimate for the very low extrapolated harvest numbers because fewer than 5% of iterations had values above zero.

Note: Stock composition and harvest estimates may not sum to 100% due to rounding errors.

Note: *n* is the final number of samples used in genetic analyses.

Appendix A9.–Stock composition estimates (%) and extrapolated harvest, including mean, 90% credibility interval (CI), sample size (*n*), and standard deviation (SD), for mixtures of sockeye salmon harvested in the northeastern and southwestern areas within the General Subdistrict set gillnet fishery (Northern District) in 2011 (Figure 2).

Dates: 7/5–8/16	Stock composition (*n* = 373)				Harvest = 24,684		
		90% CI				90% CI	
Reporting Group	Mean	5%	95%	SD	Mean	5%	95%
Crescent	0.1	0.0	0.5	0.2	16	0	119
West	20.0	16.6	23.7	2.1	4,949	4,104	5,841
JCL	16.1	13.0	19.5	2.0	3,986	3,206	4,809
SusYen	25.4	21.5	29.6	2.5	6,282	5,298	7,300
Fish	26.7	23.0	30.6	2.3	6,589	5,667	7,551
KTNE	11.6	8.7	14.7	1.8	2,859	2,159	3,628
Kenai	0.0	0.0	0.0	0.0	1	0	0
Kasilof	0.0	0.0	0.0	0.1	2	0	1

Note: The 90% credibility intervals of harvest estimates may not include the point estimate for the very low extrapolated harvest numbers because fewer than 5% of iterations had values above zero.

Note: Stock composition and harvest estimates may not sum to 100% due to rounding errors.

Note: *n* is the final number of samples used in genetic analyses.