Fishery Data Series No. 17-50

Eastside Set Gillnet Chinook Salmon Harvest Composition in Upper Cook Inlet, Alaska, 2016, Including Large Fish Harvest for 2015 and 2016

by

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and

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December 2017

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.)
correlation coefficient (multiple)	R
correlation coefficient (simple)	r
covariance	cov
credibility interval	CI
degree (angular)	°
degrees of freedom	df
expected value	*E*
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	$log_{2,}$ etc.
minute (angular)	'
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
variance	
population	Var
sample	var

FISHERY DATA SERIES NO. 17-50

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ABSTRACT

Chinook salmon were sampled for genetic tissue and age, sex, and length composition from the Upper Cook Inlet Eastside set gillnet commercial fishery in 2016. Mixed-stock analysis was conducted on tissue samples that were collected to represent the harvest by date and area. The 4 reporting groups used to apportion the Chinook salmon harvest were *Kenai River mainstem*, *Kenai River tributaries*, *Kasilof River mainstem*, and *Cook Inlet other*. Reported harvest was 6,759 Chinook salmon, with an estimated composition of 4,972 (74%) *Kenai River mainstem*, 1,667 (25%) *Kasilof River mainstem*, 96 (1%) *Cook Inlet other*, and 24 (<1%) *Kenai River tributaries* fish. *Kenai River mainstem* fish have composed on average 69.8% of the harvest since 2010. Nearly all the remainder of the harvest was composed of *Kasilof River mainstem* fish. In 2016, the harvest of large fish (75 cm mid eye to tail fork and longer) was 2,906 *Kenai River mainstem*, 1,039 *Kasilof River mainstem*, 34 *Cook Inlet other*, and 14 *Kenai River tributaries* fish. Stock composition and stock-specific harvest of large fish by reporting group is also provided for 2015. In 2015, the harvest of large fish was 2,808 *Kenai River mainstem*, 764 *Kasilof River mainstem*, 48 *Cook Inlet other*, and 8 *Kenai River tributaries* fish. Age composition of the 2016 ESSN Chinook salmon harvest was 6.7% age-1.1 fish, 28.5% age-1.2 fish, 36.2% age-1.3 fish, 26.7% age-1.4 fish, and 1.9% age-1.5 fish. The sex composition was 67% males and 33% females. Average mid eye to fork length was 759 mm.

Key words: Chinook salmon, *Oncorhynchus tshawytscha*, Upper Cook Inlet, UCI, Kenai River, Kasilof River, late run, mixed-stock analysis, MSA, ASL, ESSN, Eastside set gillnet commercial fishery

INTRODUCTION

The commercial fishery in Cook Inlet is one of the largest within the state of Alaska in terms of limited entry salmon permits (Clark et al. 2006). Nearly 10% of all salmon permits issued statewide are in Upper Cook Inlet (UCI) and the harvest typically represents approximately 5% of the statewide catch (Shields and Dupuis 2017). The UCI commercial fisheries management area consists of that portion of Cook Inlet north of the Anchor Point Light (lat 50°46.15′N) and is divided into the Central and Northern districts (Figure 1). The Central District is approximately 75 miles long, averages 32 miles in width, and is divided into 6 subdistricts (Figure 1). Both set (fixed) and drift gillnets are used in the Central District, whereas set gillnets are the only gear permitted in the Northern District.

Sockeye salmon (*Oncorhynchus nerka*) compose the majority of the commercial harvest in UCI but all other species of Pacific salmon are harvested, including Chinook salmon (*O. tshawytscha*) (Shields and Dupuis 2017). Harvest statistics are monitored by the Alaska Department of Fish and Game (ADF&G) from fish tickets (Alaska Administrative Code 5 AAC 21.355). Harvest data are available and reported by 5-digit statistical areas (Shields and Dupuis 2017). Most of the UCI commercial Chinook salmon harvest occurs in the directed sockeye salmon fishery in the Upper Subdistrict of the Central District, commonly referred to as the Eastside set gillnet (ESSN) fishery, located along the eastern shore of Cook Inlet between Ninilchik and Boulder Point (Figures 1–2). On average since 1966, the ESSN fishery has accounted for 65.0% of all Chinook salmon harvested in UCI commercial fisheries (Table 1).

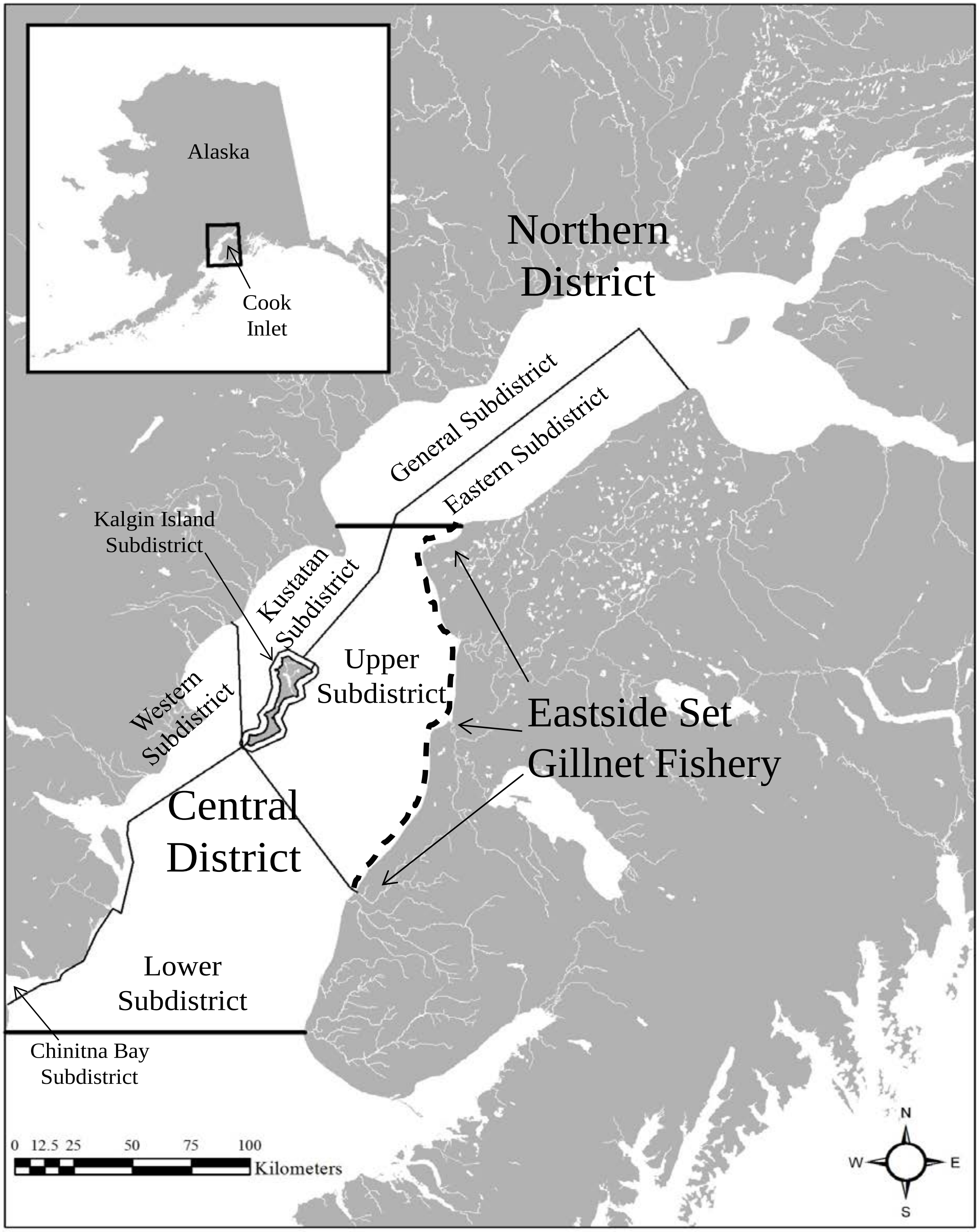

Figure 1.–Map of Upper Cook Inlet commercial fishing districts and subdistricts.

Note: Thick black lines indicate district borders and thin lines indicate subdistrict borders; the thick dashed line near the eastern shore of Cook Inlet denotes the Eastside set gillnet fishery.

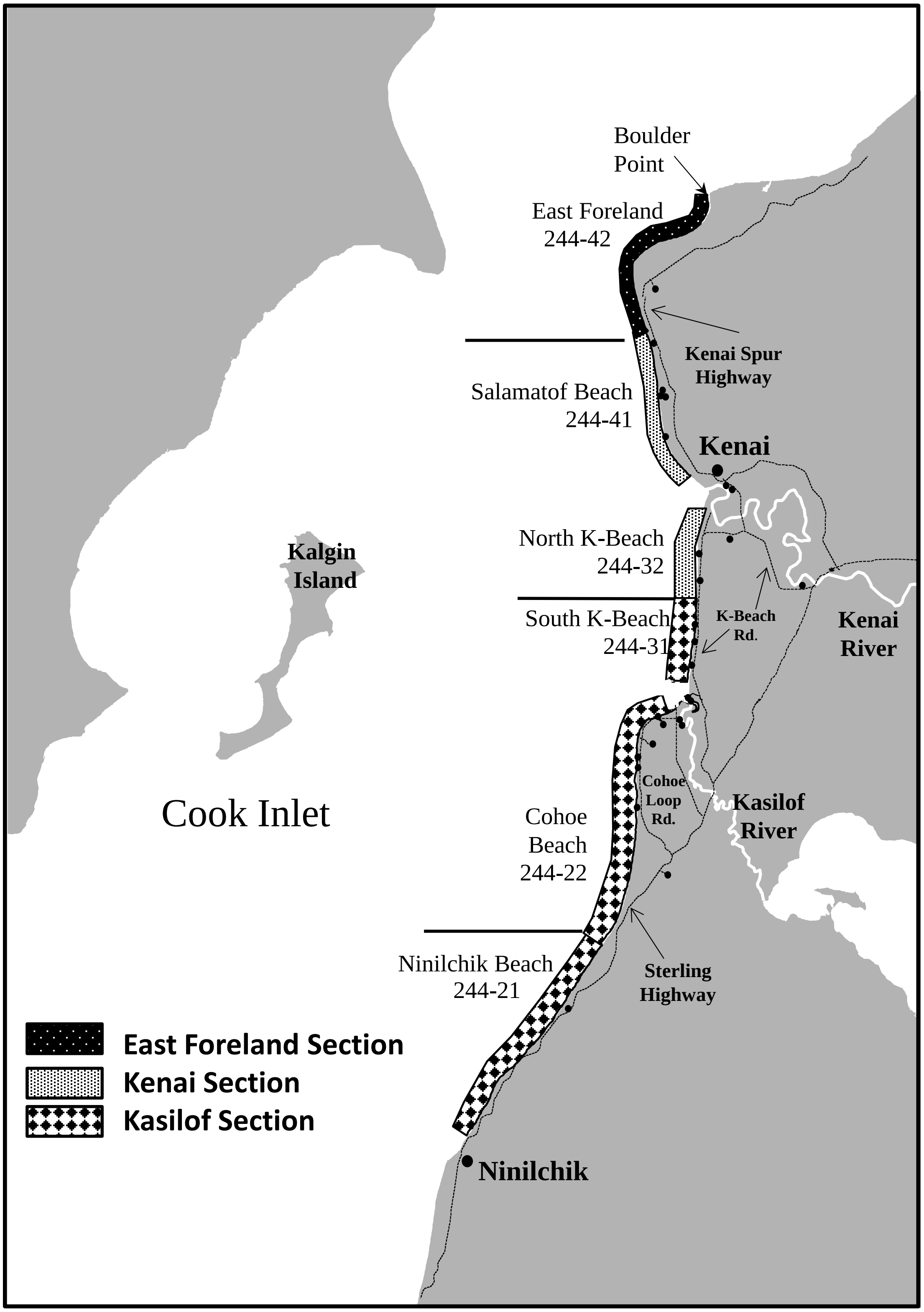

Figure 2.–Map of Upper Cook Inlet Eastside set gillnet commercial fishing statistical areas.

Note: Small circles represent approximate locations of processing plants or receiving sites. KRSHA (244-25) is the Kasilof River Special Harvest Area.

Table 1.–Upper Cook Inlet commercial Chinook salmon gillnet harvest by gear type and area, 1966–2016.

	Central District						Northern District set		
	Eastside set		Drift		Kalgin–Westside set				
Year	Harvest	%	Harvest	%	Harvest	%	Harvest	%	Total
1966	7,329	85.8	392	4.6	401	4.7	422	4.9	8,544
1967	6,686	85.1	489	6.2	500	6.4	184	2.3	7,859
1968	3,304	72.8	182	4.0	579	12.8	471	10.4	4,536
1969	5,834	47.1	362	2.9	3,286	26.5	2,904	23.4	12,386
1970	5,368	64.4	356	4.3	1,152	13.8	1,460	17.5	8,336
1971	7,055	35.7	237	1.2	2,875	14.5	9,598	48.6	19,765
1972	8,599	53.5	375	2.3	2,199	13.7	4,913	30.5	16,086
1973	4,411	84.9	244	4.7	369	7.1	170	3.3	5,194
1974	5,571	84.5	422	6.4	434	6.6	169	2.6	6,596
1975	3,675	76.8	250	5.2	733	15.3	129	2.7	4,787
1976	8,249	75.9	690	6.4	1,469	13.5	457	4.2	10,865
1977	9,730	65.8	3,411	23.1	1,084	7.3	565	3.8	14,790
1978	12,468	72.1	2,072	12.0	2,093	12.1	666	3.8	17,299
1979	8,671	63.1	1,089	7.9	2,264	16.5	1,714	12.5	13,738
1980	9,643	69.9	889	6.4	2,273	16.5	993	7.2	13,798
1981	8,358	68.3	2,320	19.0	837	6.8	725	5.9	12,240
1982	13,658	65.4	1,293	6.2	3,203	15.3	2,716	13.0	20,870
1983	15,042	72.9	1,125	5.5	3,534	17.1	933	4.5	20,634
1984	6,165	61.3	1,377	13.7	1,516	15.1	1,004	10.0	10,062
1985	17,723	73.6	2,048	8.5	2,427	10.1	1,890	7.8	24,088
1986	19,826	50.5	1,834	4.7	2,108	5.4	15,488	39.5	39,256
1987	21,159	53.6	4,552	11.5	1,029	2.6	12,700	32.2	39,440
1988	12,859	44.2	2,237	7.7	1,148	3.9	12,836	44.1	29,080
1989	10,914	40.8	0	0.0	3,092	11.6	12,731	47.6	26,737
1990	4,139	25.7	621	3.9	1,763	10.9	9,582	59.5	16,105
1991	4,893	36.1	246	1.8	1,544	11.4	6,859	50.6	13,542
1992	10,718	62.4	615	3.6	1,284	7.5	4,554	26.5	17,171
1993	14,079	74.6	765	4.1	720	3.8	3,307	17.5	18,871
1994	15,575	78.0	464	2.3	730	3.7	3,193	16.0	19,962
1995	12,068	67.4	594	3.3	1,101	6.2	4,130	23.1	17,893
1996	11,564	80.8	389	2.7	395	2.8	1,958	13.7	14,306
1997	11,325	85.2	627	4.7	207	1.6	1,133	8.5	13,292
1998	5,087	62.6	335	4.1	155	1.9	2,547	31.4	8,124
1999	9,463	65.8	575	4.0	1,533	10.7	2,812	19.6	14,383
2000	3,684	50.1	270	3.7	1,089	14.8	2,307	31.4	7,350
2001	6,009	64.6	619	6.7	856	9.2	1,811	19.5	9,295
2002	9,478	74.5	415	3.3	926	7.3	1,895	14.9	12,714
2003	14,810	80.1	1,240	6.7	770	4.2	1,670	9.0	18,490
2004	21,684	80.5	1,104	4.1	2,208	8.2	1,926	7.2	26,922

-continued-

Table 1.–Page 2 of 2.

	Central District						Northern District set		
	Eastside set		Drift		Kalgin–Westside set				
Year	Harvest	%	Harvest	%	Harvest	%	Harvest	%	Total
2005	21,597	78.1	1,958	7.1	739	2.7	3,373	12.2	27,667
2006	9,956	55.2	2,782	15.4	1,030	5.7	4,261	23.6	18,029
2007	12,292	69.7	912	5.2	603	3.4	3,818	21.7	17,625
2008	7,573	56.8	653	4.9	1,124	8.4	3,983	29.9	13,333
2009	5,588	63.9	859	9.8	672	7.7	1,631	18.6	8,750
2010	7,059	71.3	538	5.4	553	5.6	1,750	17.7	9,900
2011	7,697	68.4	593	5.3	659	5.9	2,299	20.4	11,248
2012	704	27.9	218	8.6	555	22.0	1,049	41.5	2,526
2013	2,988	55.4	493	9.1	590	10.9	1,327	24.6	5,398
2014	2,301	49.4	382	8.2	507	10.9	1,470	31.5	4,660
2015	7,781	72.1	556	5.1	538	5.0	1,923	17.8	10,798
2016	6,759	67.4	606	6.0	460	4.6	2,202	22.0	10,027
Average									
1966–2015[a]	9,418	65.0	961	6.5	1,232	9.3	3,055	19.2	14,573
2006–2015	6,394	59.0	799	7.7	683	8.5	2,351	24.7	10,227

Source: Shields and Dupuis (2017).

[a] Data from 1989 were not used in averages because the drift fleet did not fish due to the Exxon Valdez oil spill, which affected all other fisheries.

MANAGEMENT OF THE EASTSIDE SET GILLNET FISHERY

The ESSN fishery is divided into 3 sections (Kenai, Kasilof, and East Foreland) and 7 statistical areas: Ninilchik Beach (244-22), Cohoe Beach (244-22), South K-Beach (244-31), North K-Beach (244-32), Salamatof Beach (244-41), East Foreland Beach (244-42), and Kasilof River special harvest area (KRSHA, 244-25) (Figure 2). Fishery managers generally regulate the ESSN fishery by sections (groups of statistical areas). The Kasilof Section comprises Ninilchik Beach, Cohoe Beach, and South K-Beach. The Kenai Section comprises North K-Beach and Salamatof Beach. East Foreland Section comprises East Foreland Beach and is fished concurrently with the Kenai Section. Chinook salmon harvest from East Foreland Beach is generally low; consequently, the harvest from the East Foreland Section is grouped with the Kenai Section, and harvest from East Foreland Beach is grouped with harvest from Salamatof Beach in this report.

The Kasilof Section opens by regulation on the first Monday or Thursday on or after 25 June unless ADF&G estimates that 50,000 sockeye salmon are in the Kasilof River prior to that date, at which time the commissioner may open the Kasilof Section by emergency order (EO); however, the Kasilof Section may not open earlier than 20 June (5 AAC 21.310 b. 2.C.[i]). The Kenai and East Foreland sections open by regulation on the first Monday or Thursday on or after 8 July (5 AAC 21.310). KRSHA can be opened separately to concentrate harvest of Kasilof River sockeye salmon while minimizing harvest of other stocks. The ESSN fishery closes on 15 August.

The ESSN fishery was prosecuted differently in 2016 than during 2013–2015. KRSHA was not opened in 2016 but was opened on multiple days during 2013–2015 (Eskelin et al. 2013; Eskelin and Barclay 2015, 2016). There were no Kasilof Section openings restricted to within one-half mile or within 600 ft of the mean high tide line and once the Kenai and East Foreland sections were opened for the season on 11 July, all sections were opened on each of the same days, which had not happened since 2013. See Shields and Dupuis (2017) for more details regarding management of the ESSN fishery and the 2016 fishing season.

CHINOOK SALMON RESEARCH

A recent downturn in Chinook salmon productivity and abundance statewide has created social and economic hardships for many communities in Alaska (ADF&G Chinook Salmon Research Team 2013). Fishery management has been responsive to lower run abundances in an attempt to achieve escapement goals. This downturn has also heightened concerns about stock-specific harvest of Chinook salmon. In July 2012, ADF&G initiated a comprehensive Chinook Salmon Research Initiative (CSRI) to increase stock assessment capabilities, address knowledge gaps, and elucidate causal mechanisms behind the observed trend in Chinook salmon productivity and abundance. This plan includes Kenai River Chinook salmon as 1 of 12 statewide indicator stocks and represents an effort to address critical knowledge gaps that limit management capabilities, particularly during times of low abundance. The ESSN Chinook salmon sampling project has been funded by CSRI since 2013 to better assess Kenai River Chinook salmon adult abundance and gain a better understanding of stock-specific harvests in the ESSN fishery.

Estimation of adult abundance requires stock-specific information on the escapement and inriver run as well as marine and freshwater harvests. For mixed-stock harvests from marine and freshwater fisheries, stock-specific harvest can be estimated by using genetic information in a mixed-stock analysis (MSA). This analysis requires a comprehensive genetic baseline that includes genetic data from fish representing all potential populations that may contribute to the harvest. In addition, for available genetic markers, there must be sufficient genetic variation among baseline populations to accurately estimate the contribution of population groups (stocks) in an MSA. These groups of populations are referred to as reporting groups. Stock compositions and stock-specific harvest estimates refer to compositions and harvest by reporting group.

BASELINE AND REPORTING GROUPS

A Chinook salmon genetic baseline for UCI was first developed in 2012 that included 30 populations and 38 genetically variant single nucleotide polymorphism (SNP) loci (Barclay et al. 2012). Since then, the baseline has been augmented with additional collections and previously unrepresented populations, and it is now comprehensive, including 55 populations and 39 variant SNPs (Barclay and Habicht 2015). To minimize misallocation between MSA reporting groups, the Slikok Creek population from the Kenai River drainage was removed from the baseline because it represents a very small number of fish and is genetically similar to the Crooked Creek population from the Kasilof River drainage (Barclay et al. 2012). Therefore, the baseline (Table 2) only includes 54 of the 55 populations reported in Barclay and Habicht (2015).

Reporting groups chosen to apportion the harvest were selected based on 1 or more of the following criteria: 1) the genetic similarity among populations, 2) the expectation that proportional harvest would be greater than 5%, or 3) the applicability for answering fishery management questions. The 4 reporting groups chosen to apportion the ESSN Chinook salmon harvest were as follows: *Kenai River mainstem* (Kenai River mainstem populations and Juneau Creek), *Kenai River tributaries* (Kenai River tributary populations excluding Juneau Creek), *Kasilof River mainstem* (the Kasilof River mainstem population), and *Cook Inlet other* (all remaining UCI baseline populations).

Table 2.–Populations of Chinook salmon in the Upper Cook Inlet genetic baseline, including the sampling location, collection years, the number of individuals from each population included in the baseline (*n*), and the reporting groups used for mixed stock analysis of Chinook salmon harvest in the Eastside set gillnet fishery, Upper Cook Inlet, Alaska.

Map no.[a]	Reporting group	Location	Collection year(s)	*n*
1	Cook Inlet other [b]	Straight Creek	2010	95
2		Chuitna River	2008, 2009	134
3		Coal Creek	2009, 2010, 2011	118
4		Theodore River	2010, 2011, 2012	190
5		Lewis River	2011, 2012	87
6		Red Creek	2012, 2013	111
7		Hayes River	2012, 2013	50
8		Canyon Creek	2012, 2013	91
9		Talachulitna River	1995, 2008, 2010	178
10		Sunflower Creek	2009, 2011	123
11		Peters Creek	2009, 2010, 2011, 2012	107
12		Portage Creek	2009, 2010, 2011, 2013	162
13		Indian River	2013	79
14		Middle Fork Chulitna River	2009, 2010	169
15		East Fork Chulitna River	2009, 2010, 2011, 2013	77
16		Byers Creek	2013	55
17		Spink Creek	2013	56
18		Troublesome Creek	2013	71
19		Bunco Creek	2013	98
20		Upper Talkeetna no name creek	2013	69
21		Prairie Creek	1995, 2008	161
22		East Fork Iron Creek	2013	57
23		Disappointment Creek	2013	64
24		Chunilna Creek	2009, 2012	123
25		Montana Creek	2008, 2009, 2010	213
26		Little Willow Creek	2013	54
27		Willow Creek	2005, 2009	170
28		Deshka River	1995, 2005, 2012	303
29		Sucker Creek	2011, 2012	143
30		Little Susitna River	2009, 2010	228
31		Moose Creek - Matanuska River	1995, 2008, 2009, 2012	149
32		Eagle River	2009, 2011, 2012	77
33		Ship Creek	2009	261
34		Campbell Creek	2010	110
35		Carmen River	2011, 2012	50
36		Resurrection Creek	2010, 2011, 2012	98
37		Chickaloon River	2008, 2010, 2011	128

-continued-

Table 2.–Page 2 of 2.

Map no.[a]	Reporting group	Location	Collection year(s)	*n*
38	Kenai R. tributaries	Grant Creek	2011, 2012	55
39		Quartz Creek	2006, 2007, 2008, 2009, 2010, 2011	131
40		Crescent Creek	2006	164
41		Russian River	2005, 2006, 2007, 2008	214
42		Benjamin Creek	2005, 2006	204
43		Killey River	2005, 2006	255
44		Funny River	2005, 2006	219
45	Kenai R. mainstem	Juneau Creek	2005, 2006, 2007	140
46		Upper Kenai R. mainstem	2009	191
47		Middle Kenai R. mainstem	2003, 2004, 2006	299
48		Lower Kenai R. mainstem	2010, 2011	118
49	Kasilof R. mainstem	Kasilof River mainstem	2005	321
50	Cook Inlet other [c]	Crooked Creek	2005, 2011	306
51		Ninilchik River weir	2006, 2010	209
52		Deep Creek	2009, 2010	196
53		Stariski Creek	2011, 2012	104
54		Anchor River weir	2006, 2010	249

Source: Barclay and Habicht (2015). Note that Table 1 in Barclay and Habitch (2015) shows the number of individuals analyzed in the lab, whereas Table 2 here shows the number of individuals included in the baseline.

[a] Map numbers correspond to sampling locations on Figure 3.

[b] Reporting groups north of the Kenai River.

[c] Reporting groups south of the Kasilof River.

Juneau Creek, a Kenai River tributary, was included in the *Kenai River mainstem* reporting group due to its genetic similarity with Kenai River mainstem populations (Barclay et al. 2012). The results of baseline evaluation tests (proof tests) for the 4 reporting groups are reported in Eskelin et al. (2013). Since that report, 12 additional northern Cook Inlet populations have been added to the baseline. Because northern Cook Inlet populations are included in the *Cook Inlet other* reporting group, which represents a very small component of the ESSN Chinook salmon harvest, the previous proof test results are still a good indicator of the performance of the updated baseline for ESSN Chinook salmon reporting groups. Consequently, this report does not contain updated proof test results.

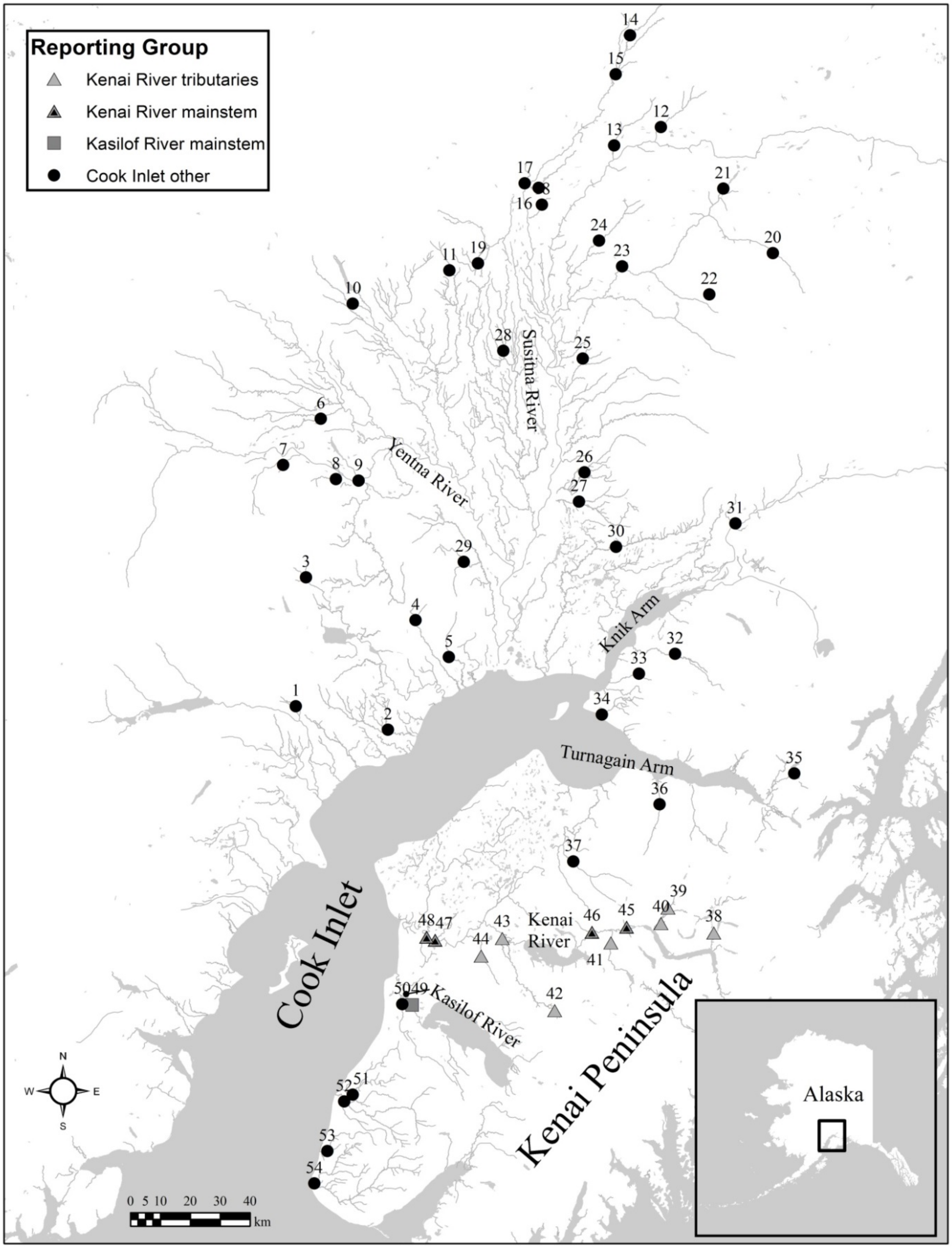

Figure 3.–Sampling locations and reporting groups for Chinook salmon populations included in the genetic baseline used for MSA of Chinook salmon harvested in the Eastside set gillnet fishery in Upper Cook Inlet.

Note: Numbers correspond to map numbers listed in Table 2.

TISSUE AND AGE, SEX, AND LENGTH SAMPLING AND ANALYSES

Age, sex, and length (ASL) samples have been collected from Chinook salmon harvested in the ESSN fishery since 1983 (Tobias and Willette 2010). Tissue samples for MSA were added to the collection effort beginning in 2010. Stock composition and stock-specific harvest estimates were produced for 2010–2015 except for 2012 due to low sample size. Since 2013, funding provided by CSRI has increased sampling effort which has provided for better coverage of the fishery and increased numbers of samples. As a result of the increased sample size, stock compositions and stock-specific harvest estimates have been stratified by time and area since 2013. Results from these studies have been published in Eskelin et al. (2013) and Eskelin and Barclay (2015 and 2016).

STOCK COMPOSITIONS AND STOCK-SPECIFIC HARVEST ESTIMATES STRATIFIED BY SIZE

Management of Kenai River Chinook salmon is currently undergoing a transition whereby assessment and management will be based on sonar estimates of Chinook salmon that are 75 cm from mid eye to tail fork (METF) and longer (Fleischman and Reimer 2017). There are many reasons for the recommendation, but the primary reason is that inriver sonar estimates of Kenai River Chinook salmon 75 cm METF and longer (hereafter referred to as “large fish”) constitute the most reliable and accurate information available because large fish are easier to distinguish acoustically from other species, and they represent the majority of the stock’s potential reproductive capacity (because “large fish” includes most females). In contrast, estimates of Chinook salmon less than 75 cm METF length (hereafter referred to as “small fish”) are indirect, imprecise, time consuming, and difficult to obtain for effective inseason management because they are difficult to distinguish from other species. Fleischman and Reimer (2017) give a more detailed explanation for the impetus to base management of Kenai River Chinook salmon fisheries on direct sonar estimates of large Chinook salmon. To support that effort, herein we develop methods and analyses to estimate stock composition and stock-specific harvest of ESSN Chinook salmon stratified by size (i.e., large and small fish).

2016 ESSN CHINOOK SALMON SAMPLING PROJECT

This report describes the ASL and genetic tissue sampling effort, analyses, and results from Chinook salmon harvested in the ESSN fishery in 2016. Stock compositions and stock-specific harvest estimates are stratified by time and area. To provide information germane to abundance and analyses of harvest of large Kenai River Chinook salmon, this report also includes stock compositions and stock-specific harvest estimates stratified by size. MSA results of the 2015 ESSN harvest were previously reported in Eskelin and Barclay (2016); however, results were not stratified by size in that report. To provide more than 1 year of size-stratified estimates for comparison, we include stock compositions and stock-specific harvest estimates stratified by size for 2 years: 2015 and 2016. Results from the 2016 sampling project and from large fish stock compositions and stock-specific harvest estimates for 2015 were previously reported in Eskelin and Barclay (2016) to provide as much information as possible for the 2017 Upper Cook Inlet Alaska Board of Fisheries meeting; however, given time constraints prior to the meeting, the report was not finalized and all analyses were not completed and peer reviewed. Thus, data and information in this report supersede those reported in Eskelin and Barclay (2016).

OBJECTIVES

PRIMARY OBJECTIVES

1) Estimate the proportion of Chinook salmon harvested in the UCI ESSN commercial fishery by reporting group (*Kenai River mainstem*, *Kasilof River mainstem*, *Kenai River tributaries*, and *Cook Inlet other*) for temporal and geographic strata such that the estimated proportions are within 13 percentage points of the true values 90% of the time.
2) Estimate the harvest of *Kenai River mainstem* and *Kasilof River mainstem* Chinook salmon in the UCI ESSN commercial fishery for temporal and geographic strata such that the estimates are within 30% of the true value 90% of the time.
3) Estimate the age composition of Chinook salmon harvested by the ESSN fishery such that the estimates are within 10 percentage points of the true values 95% of the time.

SECONDARY OBJECTIVES

1) Sample 30% of the Chinook salmon harvested in the UCI ESSN commercial fishery for tissue, scales, sex, length (METF), and coded wire tags[1].
2) Estimate the harvest of Chinook salmon for the *Kenai River tributaries* and *Cook Inlet other* reporting groups in the UCI ESSN commercial fishery for temporal and geographic strata[2].
3) Estimate the harvest of large *Kenai River tributaries* and *Kenai River mainstem* fish[3].
4) Estimate the sex and length compositions of Chinook salmon harvested in the UCI ESSN commercial fishery overall and for temporal and geographic strata.
5) Determine the sex of small fish (<750 mm METF) by internal examination.

METHODS

STUDY DESIGN

Chinook Salmon Harvest

Harvest of Chinook salmon in the ESSN fishery was recorded on fish tickets when delivered to the processor. Along with the number of fish harvested, the ticket includes information on the date and location of the harvest. Fish ticket information was entered into the ADF&G fish ticket database and reported in Shields and Dupuis (2017). Harvest information for this fishery in 2015 and 2016 was retrieved from this database for these analyses (Shields and Dupuis 2016, 2017).

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[1] The goal to collect samples from 30% of the harvest is a rough guideline, whereas the actual goal was to collect as many representative samples distributed evenly between statistical areas during each sampling day.

[2] Based on previous MSA results, it is anticipated that Chinook salmon harvest of the reporting groups *Kenai River tributaries* and *Cook Inlet Other* will be low (<150 fish), so no precision criteria are set for estimation of these reporting groups. Sample size is driven by Primary Objectives 1 and 2.

[3] No objective precision criteria are set for estimation of harvest of large (750 mm METF and longer) *Kenai River tributaries* and *Kenai River mainstem* fish because methods for estimating harvest of large fish were not developed when this study was designed.

Tissue and Age, Sex, and Length Sampling

During and after fishery openings, 3 ADF&G personnel travelled to receiving sites for fish processing plants after each tide and sampled harvested Chinook salmon for genetic tissue, scales, sex, and length. The number and location of receiving sites can vary from year to year, but there are generally about 18 sampling locations. Approximate locations of the receiving sites and fish processing plants are shown in Figure 2. As many sites as possible were sampled during each fishing period, and many sites were sampled more than once if fishing occurred over multiple tides. Sampling began after the first round of deliveries to the receiving sites had occurred, starting at the southernmost receiving station near Ninilchik and progressing northward. Samplers attempted to collect as many Chinook salmon samples as possible while distributing sampling effort throughout the area. When feasible, additional Chinook salmon samples were collected at fish processing plants the day following each fishing period, if location of harvest by statistical area could be determined. The sampling rate for each statistical area was monitored by the project biologist after every sampling period and if necessary, adjustments were made to increase the sampling rate from the statistical area(s) with the lowest numbers of samples or the lowest sampling rate.

Three scales were removed from the preferred area of each fish and placed on an adhesive-coated gum card (Welander 1940; Clutter and Whitesel 1956). Acetate impressions were made of each scale card, and scales were aged using a microfiche reader (Koo 1962). Sex was generally identified from external morphometric characteristics (i.e., protruding ovipositor on females or a developing kype on males). If permission was granted by the processor or staff at receiving sites, small fish were examined internally for positive sex identification by cutting a small slit in the anal opening using a plastic gut hook. Some large fish were also examined internally if the ADF&G sampler was not positive of sex determination from external morphometric characteristics. All data including statistical area of harvest was recorded on data sheets and then entered onto the project biologist’s computer for analysis.

All fish sampled for scales, sex, and length were also sampled for genetic tissue. A 1⅓ cm (half-inch) piece of the axillary process was removed from each fish and placed on a Whatman[4] paper card in its own grid space, then stapled in place. Whatman cards with tissue samples were then placed in an airtight case with desiccant beads to preserve the tissue for DNA extraction. Each Whatman card had a unique barcode and a numbered grid. Card barcodes and grid position numbers were recorded on data sheets for each sample. Tissue samples were archived at the ADF&G Gene Conservation Laboratory and age, sex, and length data were archived at the Soldotna ADF&G office.

Tissue Selection for MSA

Within the 3 Kasilof Section statistical areas (Ninilchik Beach, Cohoe Beach, or South K-Beach) in June and July, collected harvest samples were divided into 2 temporal strata: 1) before the Kenai and East Foreland sections open (“Early”) and 2) after the Kenai and East Foreland sections open (“Late”). For the North K-Beach and Salamatof–East Foreland beaches, harvest samples collected in July represented 1 stratum each. Samples collected from all areas in August were combined into a single stratum. Outside of this nested design, the Kasilof Section “Early” stratum samples (from all 3 areas) were divided into 2 temporal strata (June and July). The

[4] Product names used in this publication are included for completeness but do not constitute product endorsement.

sample size goal for MSA was 100 fish per stratum when possible. Individual tissue samples were selected to represent the harvest by statistical area and date. Once the number of samples required from a particular day and statistical area was determined, samples were selected randomly from all available tissues sampled on that date and statistical area. When insufficient samples were collected to represent the harvest for a given day, samples from the next closest day(s) were used to create a "harvest-proportional" sample, provided the samples were collected within 3 days of each other. Length was incorporated into the sample selection such that the length distribution of fish selected for MSA (proportions in particular length categories) was approximately equivalent to the length distribution of all sampled fish (proportions in the same length categories) within each stratum. Random MSA samples were then proportionally selected from each length category to compose a total of 100 MSA samples for the stratum. For strata with less than or equal to 100 sampled fish, all tissue samples were included in the MSA.

LABORATORY ANALYSIS

Assaying Genotypes

We extracted genomic DNA from tissue samples using a NucleoSpin 96 Tissue Kit by Macherey-Nagel (Düren, Germany). DNA was screened for 39 SNP markers. To ensure that DNA concentrations were high enough with the dry sampling method used to preserve samples, preamplification was conducted before screening the DNA.

The concentration of template DNA from samples was increased using a multiplexed preamplification PCR of 42 screened SNP markers. Each reaction was conducted within a 10 µL volume consisting of 4 uL of genomic DNA, 5 µL of 2X Multiplex PCR Master Mix (QIAGEN), and 1 µL of 2 µM SNP unlabeled forward and reverse primers. Thermal cycling was performed on a Dual 384-Well GeneAmp PCR system 9700 (Applied Biosystems) at 95°C hold for 15 minutes followed by 20 cycles of 95°C for 15 seconds, 60°C for 4 minutes, and a final extension hold at 4°C.

We screened the preamplified DNA genotyped using Fluidigm 192.24 Dynamic Array Integrated Fluidic Circuits (IFCs), each of which systematically combines up to 24 assays and 192 samples into 4,608 parallel reactions. The components were pressurized into each IFC using the IFC Controller RX (Fluidigm). Each reaction was conducted in a 9 nL volume chamber consisting of a mixture of 20X Fast GT Sample Loading Reagent (Fluidigm), 2X TaqMan GTXpress Master Mix (Applied Biosystems), Custom TaqMan SNP Genotyping Assay (Applied Biosystems), 2X Assay Loading Reagent (Fluidigm), 50X ROX Reference Dye (Invitrogen), and 60–400 ng/µl DNA. Thermal cycling was performed on a Fluidigm FC1 Cycler using a Fast PCR protocol as follows: an initial "Hot-Start" denaturation of 95°C for 2 minutes followed by 40 cycles of denaturation at 95°C for 2 seconds and annealing at 60°C for 20 seconds, with a final "Cool-Down" at 25°C for 10 seconds. The IFCs were read on a Biomark or EP1 System (Fluidigm) after amplification and genotyped using Fluidigm SNP Genotyping Analysis software.

Genotypes were imported and archived in the Gene Conservation Laboratory's Oracle database, LOKI.

Laboratory Failure Rates and Quality Control

The overall failure rate was calculated by dividing the number of failed single-locus genotypes by the number of assayed single-locus genotypes. An individual genotype was considered a failure when a locus for a fish could not be satisfactorily scored.

Quality control (QC) measures were instituted to identify laboratory errors and to determine the reproducibility of genotypes. In this process, 8 of every 96 fish (1 row per 96-well plate) were reanalyzed for all markers by staff not involved with the original analysis. Laboratory errors found during the QC process were corrected, and genotypes were corrected in the database. Inconsistencies not attributable to laboratory error were recorded, but original genotype scores were retained in the database.

Assuming that the inconsistencies among analyses (original vs. QC genotyping) were due equally to errors in original genotyping and errors during the QC genotyping, and that these analyses are unbiased, error rates in the original genotyping were estimated as one-half the rate of inconsistencies.

DATA ANALYSIS

Data Retrieval and Quality Control

We retrieved genotypes from LOKI and imported them into *R* (R Development Core Team 2011). All subsequent genetic analyses were performed in *R* unless otherwise noted.

Prior to statistical analysis, we performed 2 analyses to confirm the quality of the data. First, we identified individuals that were missing a substantial amount of genotypic data—that is, those individuals missing data at 20% or more of loci (80% rule; Dann et al. 2009). We removed these individuals from further analyses because we suspected samples from these individuals had poor-quality DNA. The inclusion of individuals with poor-quality DNA might introduce genotyping errors into the baseline and reduce the accuracies of MSA.

The second quality control analysis identified individuals with duplicate genotypes and removed them from further analyses. Duplicate genotypes can occur as a result of sampling or extracting the same individual twice, and were defined as pairs of individuals sharing the same alleles in 95% or more of loci screened. The individual with the most missing genotypic data from each duplicate pair was removed from further analyses. If both individuals had the same amount of genotypic data, the first individual was removed from further analyses.

Mixed-Stock Analysis

The stock compositions of the ESSN mixtures were estimated using the software package *BAYES* (Pella and Masuda 2001). *BAYES* employs the Pella-Masuda model via Gibbs sampling algorithm to estimate the most probable contribution of the baseline populations to explain the combination of genotypes in the mixture sample. Within each iterate of the algorithm, each individual is stochastically assigned a hypothetical stock-of-origin based on the statistical likelihood of its genotype in each population. After all assignments are made, they are summarized, deriving the stock composition for that iterate. The process of assigning individuals and deriving stock compositions is repeated many times. *BAYES* outputs a summary of composition estimates by reporting group for each iteration (RGN output) and reporting group assignments for each fish at each iteration (CLS output). We ran 5 Markov chain Monte Carlo chains (MCMC) with 40,000 iterations for each mixture.

The prior distribution used in *BAYES* was based upon the best available information for each mixture analysis. For the 2016 ESSN mixtures, the best available information came from the stock composition estimates of similar strata from the analysis of the 2015 ESSN Chinook salmon samples. However, for the “All Areas” 1–9 August mixture, no estimates were available from a similar stratum analyzed in previous years; therefore, the prior parameters for each reporting group were defined to be equal (i.e., a flat prior). We set the sum of the prior parameters equal to 1, thus minimizing the overall influence of the prior distribution. The chains were run until among-chain convergence was reached (shrink factor <1.2; Pella and Masuda 2001). To reduce the output file size, the *BAYES* output was thinned to include every 100th iteration, resulting in a final output of 400 iterations for each MCMC chain. The first 200 iterations from each MCMC chain were discarded to reduce the influence of the starting values and the remaining iterations from each chain were combined to form the posterior distribution (1,000 iterations). Stock composition estimates and 90% credibility intervals (CIs) for each stratum were calculated by taking the mean and 5% and 95% quantiles of the posterior distribution from the RGN output (Gelman et al. 2004). Credibility intervals differ from confidence intervals in that they are a direct statement of probability: i.e., a 90% credibility interval has a 90% chance of containing the true answer.

Stock Compositions and Stock-Specific Harvest Estimates

Stock-specific harvest estimates and 90% CIs for each stratum were calculated by multiplying the reported harvest from that stratum by its unrounded estimates of reporting group proportions (obtained from MSA) and the upper and lower 90% bounds of that estimate. Results were rounded to the nearest fish. Due to uncertainty in estimates with low stock compositions and low stock-specific harvest estimates, only stock compositions greater than 0.050 and stock-specific harvest estimates with the lower end of the 90% CI at 1 or greater are reported in the text of the results section. These low stock composition and stock-specific estimates are included in the tables and figures but caution should be used in interpretation due to their high uncertainty.

There were 9 nested mixtures for estimating stock composition and stock-specific harvests that compose the following strata: 1) Ninilchik Beach 23 June–9 July, 2) Cohoe Beach 23 June–9 July, 3) South K-Beach 23 June–9 July, 4) Ninilchik Beach 11–28 July, 5) Cohoe Beach 11–28 July, 6) South K-Beach 11–28 July, 7) North K-Beach 11–28 July, 8) Salamatof–E. Foreland beaches 11–28 July, and 9) All Areas 1–9 August.

Stratified stock composition and stock-specific harvest estimates were obtained for the larger geographic areas as follows: a Kasilof Section “Early” 23 June–9 July stratum estimated by combining stock-specific harvest estimates from mixtures 1–3; a Kasilof Section “Late” 11–28 July stratum, estimated by combining stock-specific harvest estimates from mixtures 4–6; and a Kenai and East Foreland sections “Late” 11–28 July stratum, estimated by combining stock-specific harvest estimates from mixtures 7 and 8 (see Equations 1 and 2 below).

To explore temporal differences in stock compositions between June and early July in the Kasilof Section, 24 additional Kasilof Section samples collected in June were selected for MSA and combined with samples from mixtures 1–3 to form 2 mixtures for the Kasilof Section during 23 June–9 July: 23–30 June (mixture 10) and 2–9 July (mixture 11).

Stock composition estimates from mixtures 1–9 were combined to produce the stratified stock-specific harvest estimates for the entire 2016 season by weighting them by their respective harvests (stratified estimator) following the methods of Dann et al. (2009). These harvest estimates, including their upper and lower bounds, were divided by the total harvest among combined strata to derive the overall proportion and credibility interval of each reporting group in the harvest. The stratified estimates $\hat{p}_g$ of the overall proportion of reporting group *g* fish within *S* strata were calculated with the following equation:

$$\hat{p}_g = \frac{\sum_{i=1}^{S} H_i \hat{p}_{g,i}}{\sum_{i=1}^{S} H_i}, \tag{1}$$

where H_i is the overall harvest in stratum *i* and $\hat{p}_{g,i}$ is the proportion of reporting group *g* fish in stratum *i*. Symbol "^" denotes an estimated value in Equation 1 and all following equations.

To calculate credibility intervals for H_g (the overall harvest of reporting group *g*), its distribution was estimated via MCMC by resampling 100,000 draws of the posterior output from each of the constituent strata and applying the harvest to the draws according to this slight modification of Equation 1:

$$\hat{H}_g = \sum_{i=1}^{S} H_i \hat{p}_{g,i}. \tag{2}$$

This method yielded the same point estimate for number of harvested fish within the fishery as would be obtained by simply summing the point estimates from each constituent stratum, but it produced a more appropriate credibility interval than simply summing the lower and upper bounds of the credibility intervals together (*cf*. Piston 2008). This method also accommodated nonsymmetrical CIs.

Stock composition and stock-specific harvest estimates were stratified by size in 2015 and 2016 to provide harvest estimates for large *Kenai River mainstem* and *Kenai River tributaries* fish. To estimate the stock composition by size for each for reporting group for the 2015 and 2016 ESSN mixtures, we used the posterior distribution for the RGN output as well as the thinned posterior distribution CLS output. Within each iterate, we first summarized the number of fish (n_i) that were assigned to reporting group *i*, along with how many of those were large fish (b_i). We then derived the proportion of the stock of interest that was large fish (β_i) as a draw from a beta distribution with parameters $b_i + \frac{1}{2}$ and $n_i - b_i + \frac{1}{2}$ before it was multiplied by the reporting group's composition (p_i) in the same iterate. This produced the desired parameter $(s_i = p_i\beta_i)$. The proportions (s_i) derived from each iterate were then summarized across iterates to provide estimates $(\hat{s}_i)$ for both large and small fish for each reporting group.

2013–2016 Comparison of Stock Composition Estimates Stratified by Similar Time Periods and Areas

MSA estimates of ESSN harvests from previous years that represented similar dates and areas as the 2016 strata were compiled and summarized. The 2013–2015 strata that were similar to the 2016 strata were the Kasilof Section "Early" stratum, the Kasilof Section "Late" stratum, and the Kenai and East Foreland sections "Late" stratum.

Comparison of Annual Stock Composition Estimates by Year

Total annual ESSN stock composition estimates from the MSA of Chinook salmon harvested in 2010, 2011, and 2013–2016 were compiled and compared.

Large Fish Stock Compositions and Stock-Specific Harvest Estimates

Although this report includes 2015 ESSN MSA mixtures with stock composition and stock-specific harvest estimates previously reported in Eskelin and Barclay (2016), we reanalyzed the mixtures for this report using slightly different methods in order to provide harvest and composition estimates by size. To do this, the *BAYES* CLS output file is required because it contains probabilities for each fish in a mixture from all 40,000 iterations in each MCMC chain, and file sizes can get too large and computationally time intensive to use with current analysis software. To reduce the BAYES CLS output file size, we thinned the BAYES output to include every 100th iteration, whereas in Eskelin and Barclay (2016), MSA estimates were not provided by size and the entire BAYES output was used. Consequently, the sums of the large and small fish stock composition estimates for a given 2015 mixture from this report differ slightly with the estimates from the same mixture in Eskelin and Barclay (2016).

Age, Sex, and Length Composition

Age Composition

The age proportions of Chinook salmon harvested in the commercial ESSN fishery by stratum were estimated as follows:

$$\hat{p}_i^{(z)} = \frac{n_i^{(z)}}{n_i}, \tag{3}$$

where $\hat{p}_i^{(z)}$ is the estimated proportion of salmon of age category z from sampling stratum i, $n_i^{(z)}$ equals the number of fish sampled from sampling stratum i that were classified as age category z, and n_i equals the number of Chinook salmon age determinations from stratum i.

The variance of $\hat{p}_i^{(z)}$ was calculated as follows:

$$\text{var}\left[\hat{p}_i^{(z)}\right] = \left(1 - \frac{n_i}{H_i}\right)\frac{\hat{p}_i^{(z)}\left(1 - \hat{p}_i^{(z)}\right)}{n_i - 1}, \tag{4}$$

where H_i is the reported number of Chinook salmon harvested in stratum i.

The estimates of harvest by age category in each stratum were calculated as follows:

$$\hat{H}_i^{(z)} = H_i \hat{p}_i^{(z)} \tag{5}$$

with variance

$$\text{var}\left[\hat{H}_i^{(z)}\right] = H_i^2 \,\text{var}\left[\hat{p}_i^{(z)}\right]. \tag{6}$$

The total Chinook salmon harvest by age category and its variance were estimated by the following summations:

$$\hat{H}^{(z)} = \sum_{i=1}^{S} \hat{H}_i^{(z)} \tag{7}$$

and

$$\operatorname{var}\left[\hat{H}^{(z)}\right] = \sum_{i=1}^{S} \operatorname{var}\left[\hat{H}_i^{(z)}\right], \tag{8}$$

where $S = 9$ is the number of sampling strata.

Finally, the total proportion of the ESSN Chinook salmon harvest by age category and its variance were estimated by the following:

$$\hat{p}^{(z)} = \frac{\hat{H}^{(z)}}{H} \tag{9}$$

and

$$\operatorname{var}\left[\hat{p}^{(z)}\right] = \frac{\operatorname{var}\left[\hat{H}^{(z)}\right]}{H^2}, \tag{10}$$

where H is the total reported Chinook salmon harvest for 2016.

In addition, age composition of the ESSN Chinook salmon harvest was compiled from 1987 to 2015 and combined with 2016 estimates to discern and depict any trends that may be occurring.

Sex Composition

Sex composition was estimated using the same equations (3–10) used to estimate age composition.

Length Composition

Mean length $\bar{l}_z$ of Chinook salmon in age class z was estimated as follows:

$$\bar{l}_z = \frac{1}{n_z} \sum_{i=1}^{n_z} l_i \tag{11}$$

where l_i is the length of fish i in sample n_z and n_z is the number of Chinook salmon of age class z.

The variance $\operatorname{var}(\bar{l}_z)$ of the mean length-at-age class z was estimated as follows:

$$\operatorname{var}(\bar{l}_z) = \frac{1}{n_z} \frac{\sum_{i=1}^{n_z} (l_i - \bar{l}_z)^2}{n_z - 1}. \tag{12}$$

In addition, average length by age was compiled for ESSN Chinook salmon harvest samples collected during 1987–2015 and combined with 2016 results to observe any trends that may be occurring.

CODED WIRE TAG RECOVERY

All fish sampled for tissue and age, sex, and length were also examined for presence or absence of the adipose fin. Heads of all sampled fish observed to be missing the adipose fin were sacrificed and a numerical cinch strap was affixed to each head, placed in a plastic bag, and brought back to the Soldotna ADF&G office. All collected heads were shipped to the ADF&G Mark Tag and Age Laboratory in Juneau, Alaska for dissection and coded wire tag (CWT) recovery.

RESULTS

CHINOOK SALMON HARVEST

The Chinook salmon harvest of 6,759 fish in 2016 was below the historical (1966–2015) average harvest of 9,418 fish and was also lower than the harvest in 2015 (7,781 fish) but was near the recent 10-year average of 6,394 fish and much higher than harvests observed in 2012 (704 fish), 2013 (2,988 fish), and 2014 (2,301 fish) (Table 1; Shields and Dupuis 2017).

Harvest in 2016 came from the following areas and time periods (Table 3). For the Kasilof Section "Early" stratum, there were 1,141 fish (17% of total) harvested from Ninilchik Beach (465), Cohoe Beach (402), and South K-beach (274). There were 292 fish (4% of total) harvested in the Kasilof Section during 23–30 June and 816 fish (12% of total) harvested in the Kasilof Section during 2–9 July. For the Kasilof Section "Late" stratum, there were 1,681 fish (25% of total) harvested from Ninilchik Beach (437), Cohoe Beach (605), and South K-beach (639). For the Kenai and East Foreland sections "Late" stratum, there were 3,262 fish (48% of total) harvested from North K-beach (715) and Salamatof–East Foreland beaches (2,547). For the "All Areas" 1–9 August stratum, there were 675 fish (10% of total) harvested from all areas.

Details for the ESSN Chinook salmon harvest in 2015 are given in Eskelin and Barclay (2016).

Table 3.–Mixture number (Mix), time period, reported Chinook salmon harvest, number and proportion of fish sampled, number and proportion of harvest selected for MSA, and number of fish analyzed by mixture (not shaded) and combined mixtures (grey shaded) for each stratified temporal and geographic stratum in the Eastside set gillnet fishery, Upper Cook Inlet, Alaska, 2016.

			Harvest		Sampled		MSA		
Mix	Date	Geographic area	No.	Prop.[a]	No.	Prop.[b]	Sel.	Prop.[c]	Used[d]
1	23 Jun–9 Jul	Ninilchik Beach	465	0.07	138	0.30	106	0.23	100
2	23 Jun–9 Jul	Cohoe Beach	402	0.06	207	0.51	100	0.25	96
3	23 Jun–9 Jul	South K-beach	274	0.04	90	0.33	90	0.33	88
1–3	23 Jun–9 Jul	Kasilof Section	1,141	0.17	435	0.38	296	0.26	284
4	11–28 Jul	Ninilchik Beach	437	0.06	92	0.21	91	0.21	90
5	11–28 Jul	Cohoe Beach	605	0.09	249	0.41	104	0.17	104
6	11–28 Jul	South K-Beach	639	0.09	254	0.40	100	0.16	93
4–6	11–28 Jul	Kasilof Section	1,681	0.25	595	0.35	295	0.18	287
7	11–28 Jul	North K-Beach	715	0.11	157	0.22	100	0.14	97
8	11–28 Jul	Salamatof–E.F.	2,547	0.38	538	0.21	100	0.04	97
7–8	11–28 Jul	Kenai–E.F. sections	3,262	0.48	695	0.21	200	0.06	194
9	1–9 Aug	All areas	675	0.10	138	0.20	100	0.15	98
1–9	23 Jun–9 Aug	All areas	6,759	1.00	1,863	0.28	891	0.13	863
10	23–30 Jun	Kasilof Section	292	0.04	138	0.47	100	0.34	98
11	2–9 Jul	Kasilof Section	816	0.12	297	0.36	214	0.26	210

Note: "E.F." means East Foreland, "Sel." is number of fish selected, and "Used" is number of fish used in MSA.

[a] Proportion of total harvest.

[b] Proportion of harvest in stratum that was sampled.

[c] Proportion of harvest in stratum that was selected for MSA.

[d] Number of samples used in MSA.

TISSUE AND AGE, SEX, AND LENGTH SAMPLING

In 2016, the ESSN fishery opened on 23 June in the Kasilof Section and on 11 July in the Kenai and East Foreland sections. The Kasilof Section was fished for 27 days during 23 June–9 August. The Kenai and East Foreland sections were fished for 17 days during 11 July–9 August (Shields and Dupuis 2017). Nearly all fishery openings were sampled.

A total of 1,863 tissue samples, or 28% of the total reported harvest in 2016, were collected and identified by statistical area (Table 3). For the Kasilof Section "Early" stratum, 435 samples (38% of the harvest in that stratum) were collected from Ninilchik Beach (138), Cohoe Beach (207), and South K-beach (90). For the Kasilof Section 23–30 June stratum, 138 samples (47% of the harvest in that stratum) were collected. For the Kasilof Section 2–9 July stratum, 297 samples were collected, which was 36% of the harvest in that stratum. For the Kasilof Section "Late" stratum, 595 samples (35% of the harvest in that stratum) were collected from Ninilchik Beach (92), Cohoe Beach (249) and South K-Beach (254). For the Kenai and East Foreland sections "Late" stratum, there were 695 samples (21% of the harvest in that stratum) collected from North K-beach (157) and Salamatof–East Foreland beaches (538). Lastly, for the "All Areas" 1–9 August stratum, 138 samples were collected, which was 20% of the harvest in that stratum.

Details for tissue and age, sex, and length sampling of Chinook salmon harvested in the ESSN fishery in 2015 are given in Eskelin and Barclay (2016).

TISSUE SELECTION FOR MSA

A total of 891 samples, or 13% of the total harvest, were selected for MSA in nested mixtures 1–9, and 863 samples were used in the MSA (Table 3). In the Kasilof Section "Early" stratum (mixtures 1–3), 296 samples were selected from Ninilchik Beach (106), Cohoe Beach (100), and South K-Beach (90), and 284 samples were used in the MSA. For the Kasilof Section "Late" stratum (mixtures 4–6), 295 samples were selected from Ninilchik Beach (91), Cohoe Beach (104), and South K-Beach (100), and 287 samples were used in the MSA. For the Kenai and East Foreland sections "Late" stratum (mixtures 7–8), 200 samples were selected from North K-beach (100) and Salamatof–East Foreland beaches (100), and 194 samples were used in the MSA. For the "All Areas" 1–9 August stratum (mixture 9), 100 samples were selected and 98 samples were used in the MSA. For the Kasilof Section 23–30 June stratum (mixture 10), 100 samples were selected and 98 samples were used in the MSA. For the Kasilof Section 2–9 July stratum (mixture 11), 214 samples were selected and 210 samples were used in the MSA.

Details for tissue selection for MSA in the ESSN fishery in 2015 are given in Eskelin and Barclay (2016).

LABORATORY ANALYSIS

A total of 909 fish were genotyped from the 2016 ESSN Chinook salmon tissue samples. The failure rate was 1.41% and the error rate was 0.27%.

DATA ANALYSIS

Data Retrieval and Quality Control

Based on the 80% rule, 17 individuals were removed from the 2016 ESSN collection. There were 4 duplicate individuals detected in the ESSN collection, which were removed.

Mixed-Stock Analysis

Nested Mixtures

Ninilchik Beach, 23 June–9 July

The stock composition and stock-specific harvest estimates were greatest for *Kenai River mainstem* (0.793, 369 fish, respectively) followed by *Cook Inlet other* (0.121, 56 fish, respectively) (Figure 4, Table 4). All other reporting groups did not exceed 0.05 of the harvest and had lower 90% CIs less than 1 fish.

Cohoe Beach, 23 June–9 July

The stock composition and stock-specific harvest estimates were greatest for *Kenai River mainstem* (0.716, 288 fish, respectively) followed by *Kasilof River mainstem* (0.271, 109 fish, respectively) (Figure 4, Table 4).

South K-Beach, 23 June–9 July

The stock composition and stock-specific harvest estimates were greatest for *Kasilof River mainstem* (0.675, 185 fish, respectively) followed by *Kenai River mainstem* (0.208, 57 fish, respectively), and *Cook Inlet other* (0.098, 27 fish, respectively) (Figure 4, Table 4).

Ninilchik Beach, 11–28 July

The stock composition and stock-specific harvest estimates were greatest for *Kenai River mainstem* (0.712, 311 fish, respectively) followed by *Kasilof River mainstem* (0.273, 199 fish, respectively) (Figure 4, Table 4).

Cohoe Beach, 11–28 July

The stock composition and stock-specific harvest estimates were greatest for *Kasilof River mainstem* (0.601, 364 fish, respectively) followed by *Kenai River mainstem* (0.397, 240 fish, respectively) (Figure 4, Table 4).

South K-Beach, 11–28 July

The stock composition and stock-specific harvest estimates were greatest for *Kasilof River mainstem* (0.623, 398 fish, respectively) followed by *Kenai River mainstem* (0.375, 240 fish, respectively) (Figure 4, Table 4).

North K-Beach, 11–28 July

The stock composition and stock-specific harvest estimates were greatest for *Kenai River mainstem* (0.832, 595 fish, respectively) followed by *Kasilof River mainstem* (0.167, 119 fish, respectively) (Figure 4, Table 4).

Salamatof and East Foreland Beaches, 11–28 July

The stock composition and stock-specific harvest estimates were greatest for *Kenai River mainstem* (0.968, 2,466 fish, respectively) (Figure 4, Table 4). All other reporting groups did not exceed 0.05 of the harvest and had lower 90% CIs less than 1 fish.

All Areas, August 1–9

The stock composition and stock-specific harvest estimates were greatest for *Kenai River mainstem* (0.601, 405 fish, respectively) followed by *Kasilof River mainstem* (0.383, 259 fish, respectively) (Figure 5, Table 5).

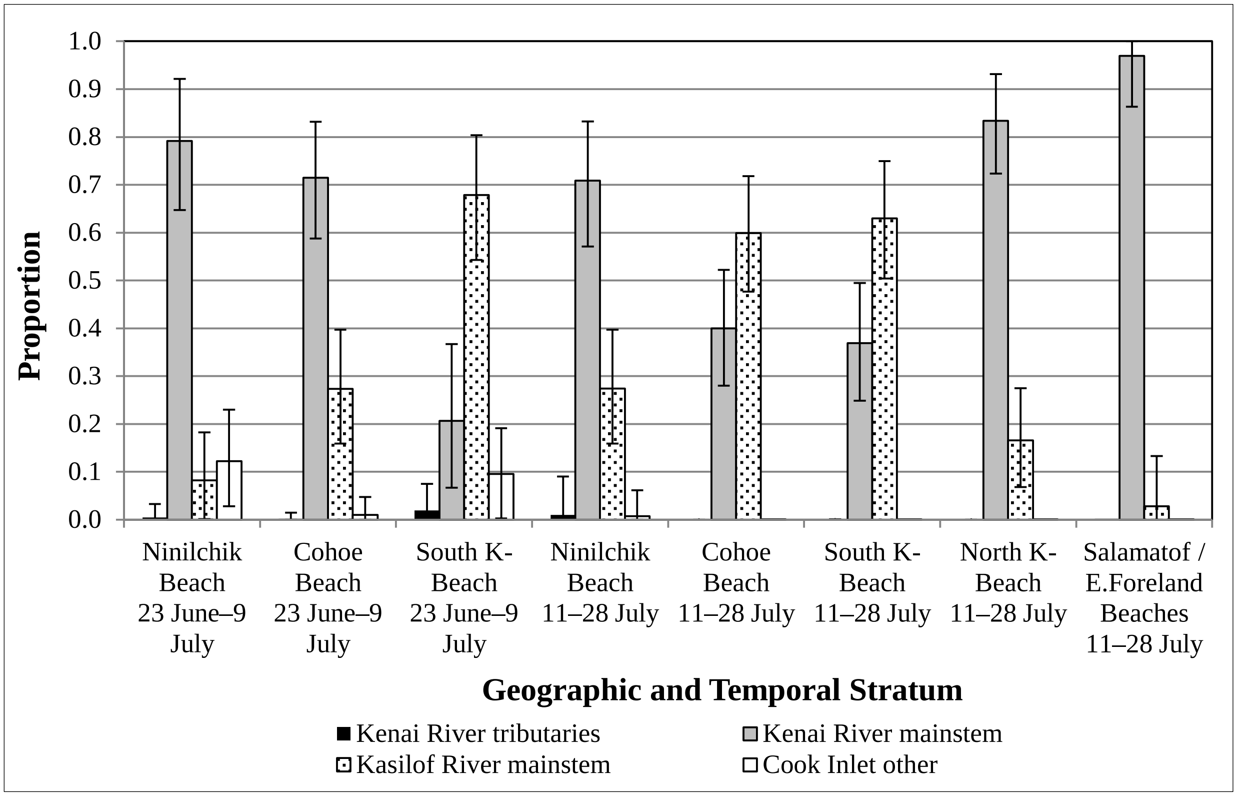

Figure 4.–Stock composition estimates and 90% credibility intervals of Chinook salmon harvested in the Eastside set gillnet fishery by beach and time period in 2016.

Note: Due to uncertainty in estimates with stock composition proportions less than 0.050, these estimates are not reported in the text and caution should be used in their interpretation.

Table 4.–Stock compositions and stock-specific harvest estimates by beach and time period, including mean and 90% credibility intervals (CI) for Chinook salmon harvested during June and July 2016 in the Eastside set gillnet fishery, Upper Cook Inlet, Alaska.

Stratum			Stock composition			Stock-specific harvest		
				90% CI			90% CI	
Area	Date	Reporting group	Mean	5%	95%	Harvest	5%	95%
Ninilchik Beach	23 June–9 July	Kenai River tributaries	0.005	0.000	0.027	2	0	12
		Kenai River mainstem	0.793	0.654	0.923	369	304	429
		Kasilof R. mainstem	0.081	0.001	0.182	38	0	84
		Cook Inlet other	0.121	0.033	0.222	56	15	103
Cohoe Beach	23 June–9 July	Kenai River tributaries	0.003	0.000	0.019	1	0	8
		Kenai River mainstem	0.716	0.584	0.835	288	235	336
		Kasilof R. mainstem	0.271	0.157	0.402	109	63	162
		Cook Inlet other	0.010	0.000	0.046	4	0	18
South K-Beach	23 June–9 July	Kenai River tributaries	0.018	0.000	0.073	5	0	20
		Kenai River mainstem	0.208	0.072	0.363	57	20	99
		Kasilof R. mainstem	0.675	0.535	0.800	185	147	219
		Cook Inlet other	0.098	0.006	0.189	27	2	52
Ninilchik Beach	11–28 July	Kenai River tributaries	0.010	0.000	0.091	4	0	40
		Kenai River mainstem	0.712	0.574	0.838	311	251	366
		Kasilof R. mainstem	0.273	0.157	0.389	119	69	170
		Cook Inlet other	0.005	0.000	0.040	2	0	18
Cohoe Beach	11–28 July	Kenai River tributaries	0.001	0.000	0.000	0	0	0
		Kenai River mainstem	0.397	0.275	0.528	240	166	319
		Kasilof R. mainstem	0.601	0.470	0.724	364	284	438
		Cook Inlet other	0.001	0.000	0.000	0	0	0
South K-Beach	11–28 July	Kenai River tributaries	0.001	0.000	0.001	1	0	1
		Kenai River mainstem	0.375	0.261	0.497	240	167	318
		Kasilof R. mainstem	0.623	0.501	0.737	398	320	471
		Cook Inlet other	0.000	0.000	0.000	0	0	0
North K-Beach	11–28 July	Kenai River tributaries	0.001	0.000	0.000	0	0	0
		Kenai River mainstem	0.832	0.716	0.926	595	512	662
		Kasilof R. mainstem	0.167	0.073	0.284	119	52	203
		Cook Inlet other	0.001	0.000	0.000	0	0	0
Salamatof/ E.Foreland beaches	11–28 July	Kenai River tributaries	0.002	0.000	0.002	4	0	4
		Kenai River mainstem	0.968	0.860	1.000	2,466	2,189	2,547
		Kasilof R. mainstem	0.030	0.000	0.135	76	0	344
		Cook Inlet other	0.000	0.000	0.000	1	0	0

Note: Due to uncertainty in estimates with stock composition proportions less than 0.050 and stock-specific harvest estimates with the lower end of the 90% CI less than 1 fish, these estimates are not reported in the text and caution should be used in their interpretation.

Note: Stock-specific harvest within each stratum may not sum to overall stock-specific harvest due to rounding. The 90% credibility intervals of harvest estimates may not include the point estimate for very low harvest numbers because fewer than 5% of iterations had values above zero.

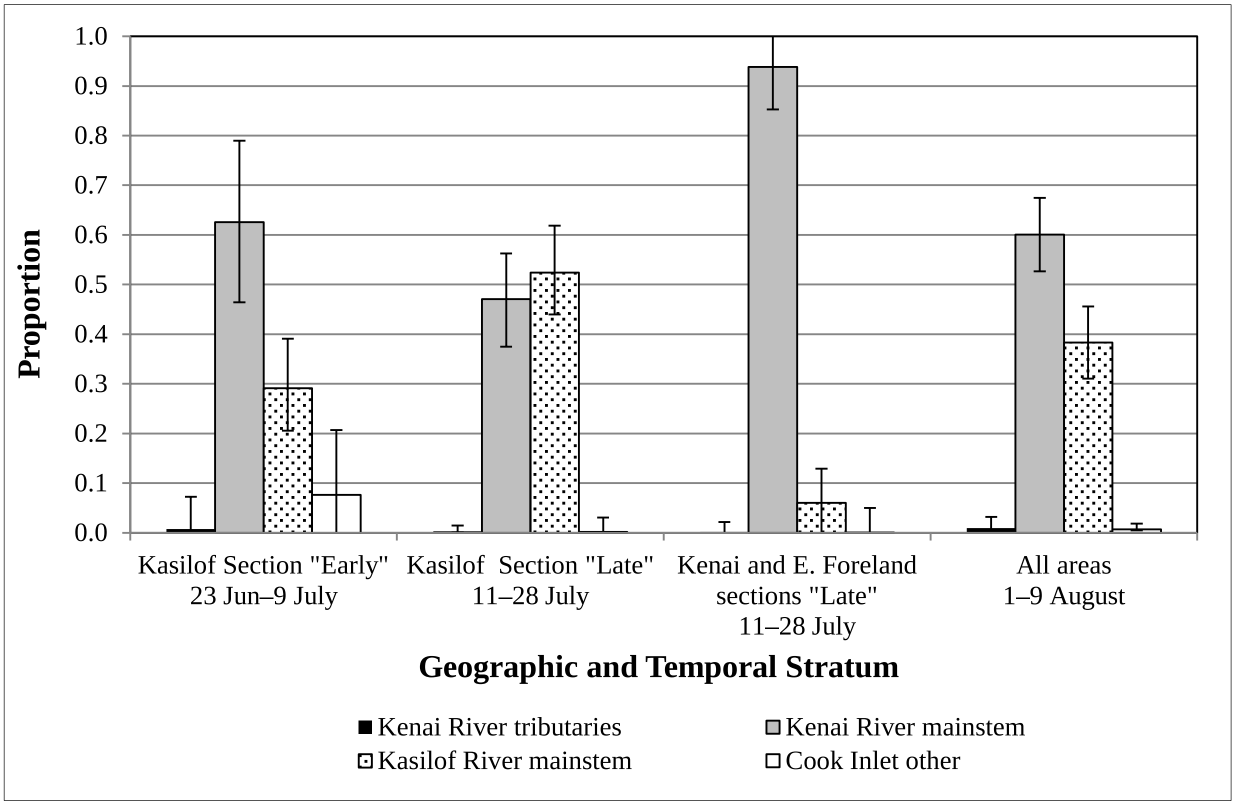

Figure 5.–Stock composition estimates and 90% credibility intervals of Chinook salmon harvested in the Eastside set gillnet fishery by geographic and temporal strata, 2016.

Note: Due to uncertainty in estimates with stock composition proportions less than 0.050, these estimates are not reported in the text and caution should be used in their interpretation.

Table 5.–Stock composition and stock-specific harvest estimates, including mean and 90% credibility intervals (CI) calculated using a stratified estimator for Chinook salmon harvested in the Eastside set gillnet fishery, Upper Cook Inlet, Alaska, 2016.

Stratum			Stock composition			Stock-specific harvest		
				90% CI			90% CI	
Area	Date	Reporting group	Mean	5%	95%	Harvest	5%	95%
Entire 2016 season (all areas)								
		Kenai River tributaries	0.004	0.000	0.012	24	0	81
		Kenai River mainstem	0.736	0.687	0.770	4,972	4,645	5,205
		Kasilof River mainstem	0.247	0.215	0.293	1,667	1,451	1,982
		Cook Inlet other	0.014	0.007	0.024	96	44	160
Date-and-area stratified estimates								
Kasilof	23–30	Kenai River tributaries	0.031	0.000	0.096	9	0	28
Section	June	Kenai River mainstem	0.532	0.371	0.697	155	108	203
		Kasilof River mainstem	0.173	0.088	0.273	51	26	80
		Cook Inlet other	0.264	0.134	0.394	77	39	115
Kasilof	2–9	Kenai River tributaries	0.002	0.000	0.013	2	0	11
Section	July	Kenai River mainstem	0.626	0.530	0.718	511	433	586
		Kasilof River mainstem	0.360	0.276	0.455	294	225	371
		Cook Inlet other	0.011	0.000	0.040	9	0	33
Kasilof	23 June–	Kenai River tributaries	0.007	0.000	0.027	8	0	31
Section	9 July	Kenai River mainstem	0.625	0.540	0.700	714	616	799
"Early"		Kasilof River mainstem	0.291	0.230	0.360	332	262	411
		Cook Inlet other	0.076	0.034	0.126	87	38	144
Kasilof	11–28	Kenai River tributaries	0.003	0.000	0.026	5	0	43
Section	July	Kenai River mainstem	0.471	0.397	0.545	791	667	916
		Kasilof River mainstem	0.524	0.451	0.597	881	759	1,003
		Cook Inlet other	0.002	0.000	0.013	3	0	22
Kenai and	11–28	Kenai River tributaries	0.001	0.000	0.003	5	0	11
E. Foreland	July	Kenai River mainstem	0.938	0.850	0.980	3,061	2,773	3,197
sections		Kasilof River mainstem	0.060	0.019	0.147	195	62	478
		Cook Inlet other	0.000	0.000	0.001	1	0	3
All Areas [a]	1–9	Kenai River tributaries	0.009	0.000	0.042	6	0	29
	August	Kenai River mainstem	0.601	0.477	0.722	405	322	487
		Kasilof River mainstem	0.383	0.266	0.506	259	180	341
		Cook Inlet other	0.007	0.000	0.031	5	0	21

Note: Due to uncertainty in estimates with stock composition proportions less than 0.050 and stock-specific harvest estimates with the lower end of the 90% CI less than 1 fish, these estimates are not reported in the text and caution should be used in their interpretation.

Note: Harvest values given by reporting group with each stratum may not sum to overall total for each reporting group due to rounding.

[a] The "All Areas" 1–9 August stratum was analyzed as a single mixture in *BAYES*; therefore, the estimates for this stratum were not calculated using a stratified estimator.

Stratified Mixtures

Kasilof Section, 23–30 June

The stock composition and stock-specific harvest estimates were greatest for *Kenai River mainstem* (0.532, 155 fish, respectively) followed by *Cook Inlet other* (0.264, 77 fish, respectively) and *Kasilof River mainstem* (0.173, 51 fish, respectively) (Figure 6, Table 5).

Kasilof Section, 2–9 July

The stock composition and stock-specific harvest estimates were greatest for *Kenai River mainstem* (0.626, 511 fish, respectively) followed by *Kasilof River mainstem* (0.360, 294 fish, respectively) (Figure 6, Table 5).

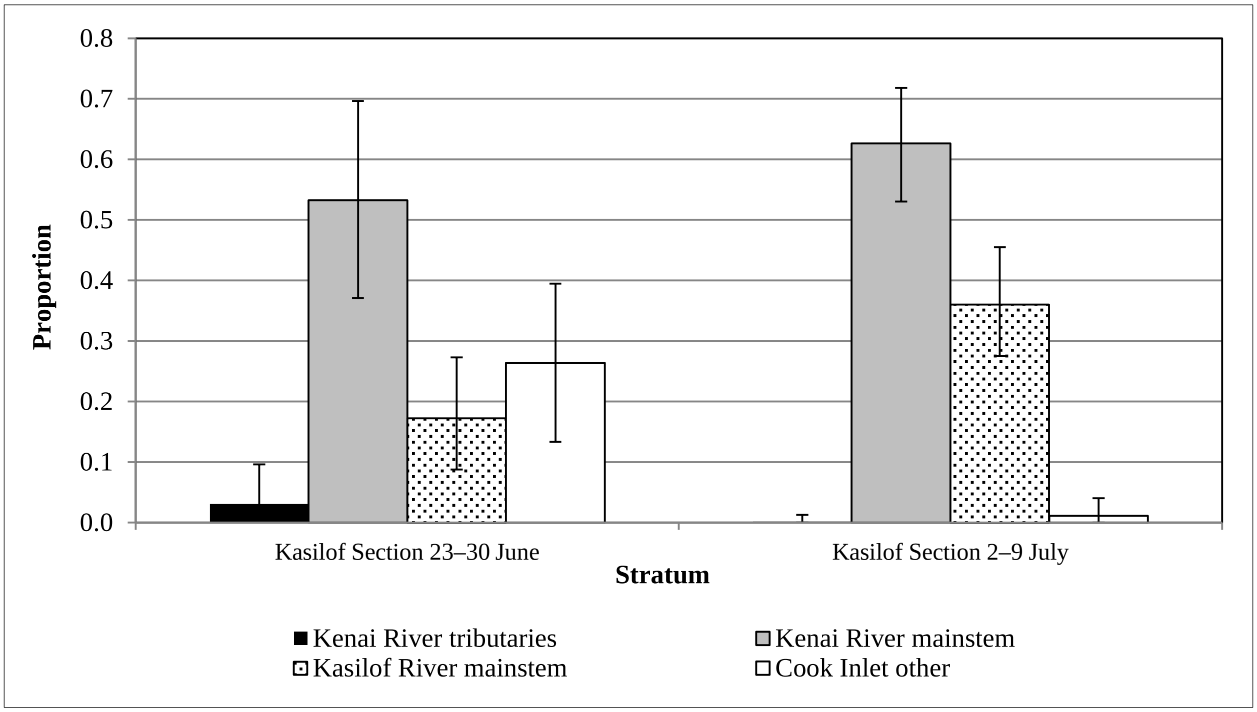

Figure 6.–Stock composition estimates and 90% credibility intervals of Chinook salmon harvested in the Kasilof Section of the Eastside set gillnet fishery for 23–30 June and 2–9 July strata, 2016.

Note: Due to uncertainty in estimates with stock composition proportions less than 0.050, these estimates are not reported in the text and caution should be used in their interpretation.

Kasilof Section "Early", 23 June–9 July

The stock composition and stock-specific harvest estimates were greatest for *Kenai River mainstem* (0.625, 714 fish, respectively) followed by *Kasilof River mainstem* (0.291, 332 fish, respectively), and *Cook Inlet other* (0.076, 87 fish, respectively) (Figure 5, Table 5).

Kasilof Section "Late", 11–28 July

The stock composition and stock-specific harvest estimates were greatest for *Kasilof River mainstem* (0.524, 881 fish, respectively) followed by *Kenai River mainstem* (0.471, 791 fish, respectively) (Figure 5, Table 5).

Kenai and East Foreland sections “Late”, 11–28 July

The stock composition and stock-specific harvest estimates were greatest for *Kenai River mainstem* (0.938, 3,061 fish, respectively) followed by *Kasilof River mainstem* (0.060, 195 fish, respectively) (Figure 5, Table 5).

Overall Stock Compositions and Stock-specific Harvest

The stock composition and stock-specific harvest estimates were greatest for *Kenai River mainstem* (0.736, 4,972 fish, respectively) followed by *Kasilof River mainstem* (0.247, 1,667 fish, respectively) (Table 5). All other reporting groups had stock composition estimates less than 0.05 and harvest estimates with lower 90% CIs less than 1 fish.

2013–2016 COMPARISON OF STOCK COMPOSITION ESTIMATES STRATIFIED BY SIMILAR TIME PERIODS AND AREAS

Stock composition and stock-specific harvest estimates have been geographically and temporally stratified since 2013. Stratification for the MSA for the ESSN fishery has differed among years depending on how the commercial fishery was prosecuted (i.e., stratification has differed by fishery date, time, and area openings), limitations due to insufficient number of samples collected by each time and area, and budgetary constraints (Eskelin et al. 2013; Eskelin and Barclay. 2015). However, there were 3 strata that were similar enough that comparisons could be made for 2013–2016: the Kasilof Section “Early” stratum, the Kasilof Section “Late” stratum, and the Kenai and East Foreland sections “Late” Stratum.

The time period for the Kasilof Section “Early” stratum has varied little among years since 2013. The time period for the Kasilof Section “Late” and Kenai and East Foreland sections “Late” strata have varied up to 7 days from 2013 to 2016. Although the harvest dates have varied from 2013 to 2016, they still represent similar enough time periods for comparing stock composition and stock-specific harvest estimates among years.

2013–2016 Kasilof Section “Early” Stratum Comparison

Since 2013, contributions of *Kenai River mainstem* fish in the Kasilof section “Early” stratum have averaged 0.666 of the harvest (range: 0.551–0.769), whereas contributions of *Kasilof River mainstem* fish have averaged 0.214 of the harvest (range: 0.140–0.291) (Table 6, Figure 7). Contributions of *Cook Inlet other* fish have averaged 0.117 of the harvest (range: 0.007–0.246). Lastly, contributions of *Kenai River tributaries* fish have been low in all years (2013–2016).

On average, an estimated 453 *Kenai River mainstem* fish have been harvested in the Kasilof Section “Early” stratum since 2013 (range: 290–714 fish). Estimated harvests of *Kasilof River mainstem* fish have averaged 164 fish (range: 57–332 fish) (Table 6). Estimated harvests of *Cook Inlet Other* fish have averaged 87 fish (range: 3–200 fish). Estimated harvests of *Kenai River tributary* fish have been low in all years.

2013–2016 Kasilof Section “Late” Stratum Comparison,

In the Kasilof section “Late” stratum, *Kenai River mainstem* fish have averaged 0.610 of the harvest (range: 0.504–0.733) whereas contributions of *Kasilof River mainstem* fish have averaged 0.426 of the harvest (range: 0.265–0.524) (Table 7, Figure 7).

On average, an estimated 640 *Kenai River mainstem* fish have been harvested in the Kasilof section “Late" stratum since 2013 (range: 283–791 fish) (Table 7). Estimated harvests of *Kasilof*

River mainstem fish have averaged 516 fish (range: 231–881 fish). Estimated harvests of *Kenai River tributaries* and *Cook Inlet other* fish have been low in all years (2013–2016).

2013–2016 Kenai and East Foreland sections "Late" Comparison

In the Kenai and East Foreland sections "Late" stratum, *Kenai River mainstem* fish have averaged 0.958 of the harvest (range: 0.938–0.976) (Table 8). Contribution of *Kasilof River* mainstem fish only exceeded 0.050 (5%) during one year (2013).

On average, an estimated 2,038 *Kenai River mainstem* fish have been harvested in the Kenai and East Foreland sections "Late" stratum since 2013 (range: 417–3,398) (Table 8). Very few fish from other stocks have been harvested in this stratum since 2013.

Table 6.–Stock composition and stock-specific harvest estimates, including mean and 90% credibility intervals (CI) of Chinook salmon harvested in the Eastside set gillnet fishery, Kasilof Section "Early" stratum (prior to Kenai and East Foreland sections opening), 2013–2016.

			Stock composition			Stock-specific harvest		
				90% CI			90% CI	
Reporting group	Year	Dates	Mean	5%	95%	Harvest	5%	95%
Kenai R. tributaries	2013	27 Jun–6 Jul	0.003	0.000	0.010	1	0	4
	2014	23 Jun–7 Jul	0.001	0.000	0.001	0	0	0
	2015	22 Jun–6 Jul	0.003	0.000	0.016	3	0	13
	2016	23 Jun–9 Jul	0.007	0.000	0.027	8	0	31
		Average	0.004			3		
Kenai R. mainstem	2013	27 Jun–6 Jul	0.718	0.610	0.820	290	246	336
	2014	23 Jun–7 Jul	0.769	0.637	0.887	360	298	415
	2015	22 Jun–6 Jul	0.551	0.395	0.712	448	321	579
	2016	23 Jun–9 Jul	0.625	0.540	0.700	714	616	799
		Average	0.666			453		
Kasilof R. mainstem	2013	27 Jun–6 Jul	0.140	0.066	0.225	57	27	91
	2014	23 Jun–7 Jul	0.224	0.108	0.352	105	51	165
	2015	22 Jun–6 Jul	0.200	0.094	0.313	162	77	255
	2016	23 Jun–9 Jul	0.291	0.230	0.360	332	262	411
		Average	0.214			164		
Cook Inlet other	2013	27 Jun–6 Jul	0.139	0.072	0.216	56	29	87
	2014	23 Jun–7 Jul	0.007	0.000	0.037	3	0	17
	2015	22 Jun–6 Jul	0.246	0.132	0.371	200	107	302
	2016	23 Jun–9 Jul	0.076	0.034	0.126	87	38	144
		Average	0.117			87		

Source for prior years: Eskelin et al. (2013); Eskelin and Barclay (2015, 2016).

Note: Due to uncertainty in estimates with stock composition proportions less than 0.050 and stock-specific harvest estimates with the lower end of the 90% CI less than 1 fish, these estimates are not reported in the text and caution should be used in their interpretation.

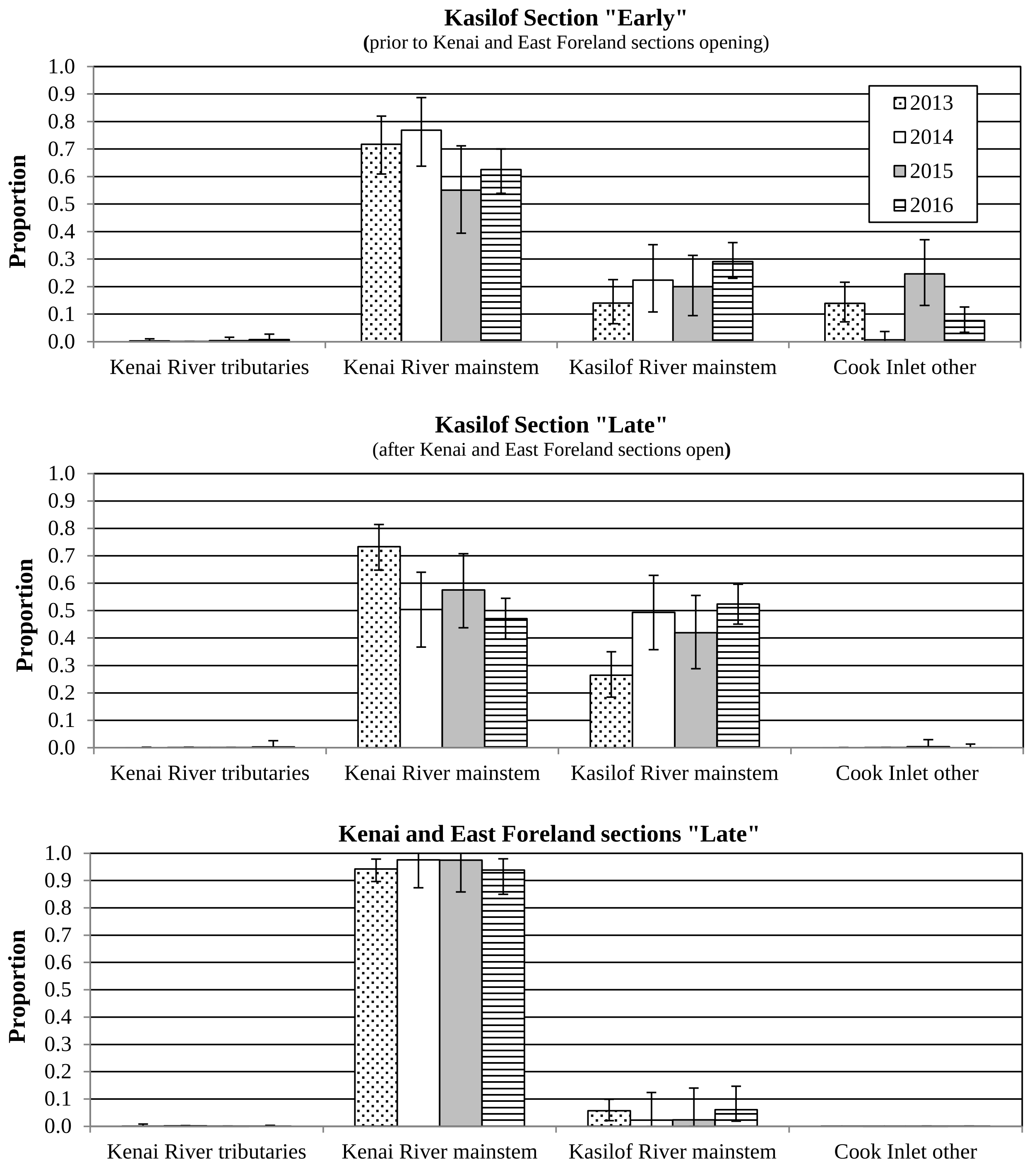

Figure 7.–Stock composition estimates and 90% credibility intervals of Chinook salmon harvested in the Eastside set gillnet fishery by similar geographic and temporal strata, 2013–2016.

Source for prior years: Eskelin et al. (2013); Eskelin and Barclay (2015, 2016).

Note: Due to uncertainty in estimates with stock composition proportions less than 0.050, these estimates are not reported in the text and caution should be used in their interpretation.

Table 7.–Stock composition and stock-specific harvest estimates, including mean and 90% credibility intervals (CI) of Chinook salmon harvested in the ESSN fishery, Kasilof Section "Late" stratum (after Kenai and East Foreland sections open), 2013–2016.

			Stock composition			Stock-specific harvest		
				90% CI			90% CI	
Reporting group	Year	Dates	Mean	5%	95%	Harvest	5%	95%
Kenai R. tributaries	2013	8–23 Jul	0.001	0.000	0.002	1	0	1
	2014	9–23 Jul	0.001	0.000	0.002	1	0	1
	2015	9–30 Jul	0.001	0.000	0.001	2	0	1
	2016	11–28 Jul	0.003	0.000	0.026	5	0	43
		Average	0.002			2		
Kenai R. mainstem	2013	8–23 Jul	0.733	0.648	0.814	639	564	709
	2014	9–23 Jul	0.504	0.368	0.640	283	206	359
	2015	9–30 Jul	0.575	0.437	0.708	925	703	1,139
	2016	11–28 Jul	0.471	0.397	0.545	791	667	916
		Average	0.571			640		
Kasilof R. mainstem	2013	8–23 Jul	0.265	0.185	0.350	231	161	305
	2014	9–23 Jul	0.493	0.358	0.629	277	201	353
	2015	9–30 Jul	0.420	0.288	0.556	675	463	893
	2016	11–28 Jul	0.524	0.451	0.597	881	759	1,003
		Average	0.426			516		
Cook Inlet other	2013	8–23 Jul	0.001	0.000	0.001	1	0	1
	2014	9–23 Jul	0.001	0.000	0.001	1	0	1
	2015	9–30 Jul	0.004	0.000	0.030	7	0	48
	2016	11–28 Jul	0.002	0.000	0.013	3	0	22
		Average	0.002			3		

Source for prior years: Eskelin et al. (2013); Eskelin and Barclay (2015, 2016).

Note: Due to uncertainty in estimates with stock composition proportions less than 0.050 and stock-specific harvest estimates with the lower end of the 90% CI less than 1 fish, these estimates are not reported in the text and caution should be used in their interpretation.

Table 8.–Stock composition and stock-specific harvest estimates, including mean and 90% credibility intervals (CI) of Chinook salmon harvested in the ESSN fishery, Kenai and East Foreland sections "Late" stratum, 2013–2016.

			Stock composition			Stock-specific harvest		
				90% CI			90% CI	
Reporting group	Year	Dates	Mean	5%	95%	Harvest	5%	95%
Kenai R. tributaries	2013	8–23 Jul	0.002	0.000	0.008	1	0	1
	2014	9–23 Jul	0.001	0.000	0.002	1	0	1
	2015	9–30 Jul	0.001	0.000	0.001	3	0	3
	2016	11–28 Jul	0.001	0.000	0.003	5	0	43
		Average	0.001			2		
Kenai R. mainstem	2013	8–23 Jul	0.941	0.896	0.978	1,276	1,214	1,325
	2014	9–23 Jul	0.976	0.874	1.000	417	373	427
	2015	9–30 Jul	0.975	0.858	1.000	3,398	2,992	3,485
	2016	11–28 Jul	0.938	0.850	0.980	3,061	2,773	3,197
		Average	0.958			2,038		
Kasilof R. mainstem	2013	8–23 Jul	0.057	0.021	0.099	77	29	135
	2014	9–23 Jul	0.023	0.000	0.124	10	0	53
	2015	9–30 Jul	0.023	0.000	0.014	82	0	487
	2016	11–28 Jul	0.060	0.019	0.147	195	62	478
		Average	0.040			91		
Cook Inlet other	2013	8–23 Jul	0.000	0.000	0.000	0	0	0
	2014	9–23 Jul	0.000	0.000	0.000	0	0	0
	2015	9–30 Jul	0.000	0.000	0.000	2	0	1
	2016	11–28 Jul	0.000	0.000	0.001	1	0	3
		Average	0.000			0		

Source for prior years: Eskelin et al. (2013); Eskelin and Barclay (2015, 2016).

Note: Due to uncertainty in estimates with stock composition proportions less than 0.050 and stock-specific harvest estimates with the lower end of the 90% CI less than 1 fish, these estimates are not reported in the text and caution should be used in their interpretation.

COMPARISON OF ANNUAL STOCK COMPOSITION AND STOCK-SPECIFIC HARVEST ESTIMATES BY YEAR

Kenai River mainstem fish have composed the majority of the ESSN Chinook salmon harvest in MSAs since 2010, averaging 0.698 of the harvest and ranging from 0.770 in 2015 to 0.609 in 2014 (Figure 8, Table 9). Estimated harvest of *Kenai River mainstem* fish has averaged 4,053 fish, ranging from 1,401 fish harvested in 2014 to 5,988 fish harvested in 2015 (Table 9). *Kasilof River mainstem* fish have composed nearly all of the remainder of the harvest, averaging 0.284 of the harvest and ranging from 0.201 in 2015 to 0.387 in 2014. Estimated harvest of *Kasilof River mainstem* fish has averaged 1,600 fish, ranging from 673 fish in 2013 to 2,538 fish in 2011. *Kenai River tributaries* and *Cook Inlet other* fish have composed a very small fraction of the harvest. The harvest estimate of *Kenai River tributaries* fish was highest at 75 fish (90% CI 4–220) in 2010. The harvest estimate of *Cook Inlet other* fish was highest at 211 fish (90% CI 112–327) in 2015 and has averaged 88 fish since 2010.

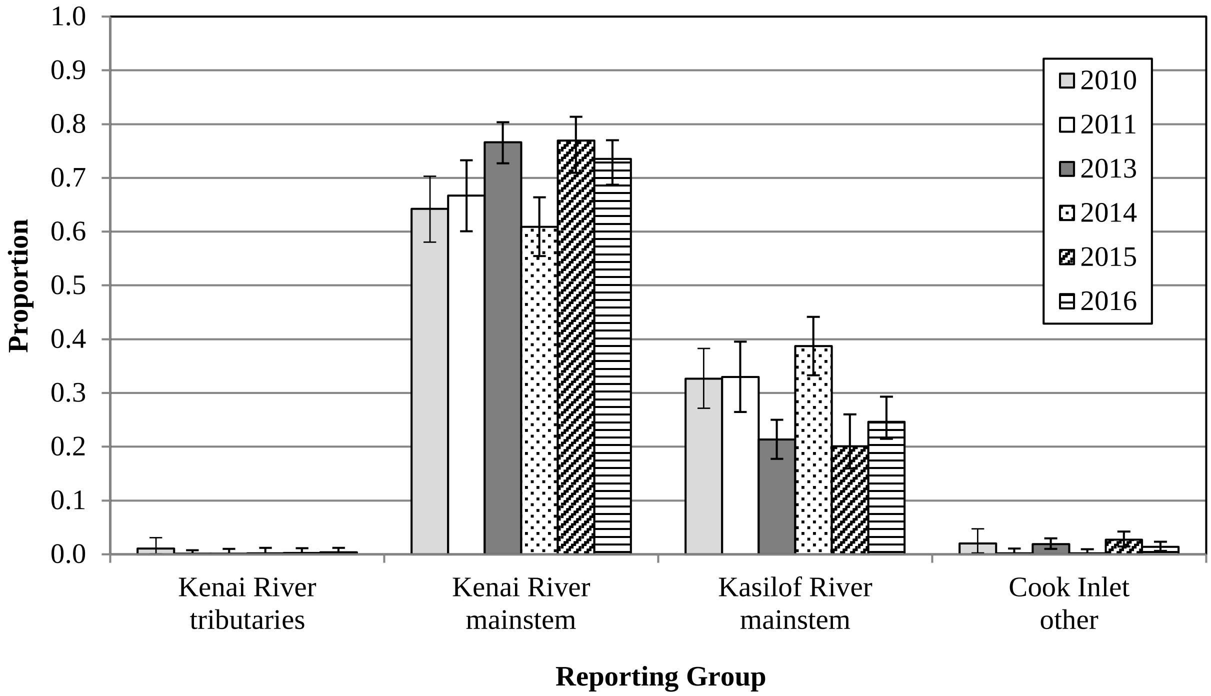

Figure 8.–Stock composition estimates and 90% credibility intervals of Chinook salmon harvested in the Eastside set gillnet fishery by year for 2010, 2011, and 2013–2016.

Source for prior years: Eskelin et al. (2013); Eskelin and Barclay (2015, 2016).

Table 9.–Stock composition and stock-specific harvest estimates, including mean and 90% credibility intervals (CI) for Chinook salmon harvested in the Eastside set gillnet fishery, Upper Cook Inlet, Alaska, 2010, 2011, 2013–2016.

		Stock composition			Stock-specific harvest		
			90% CI			90% CI	
Reporting group	Year	Mean	5%	95%	Harvest	5%	95%
Kenai River tributaries	2010	0.011	0.001	0.031	75	4	220
	2011	0.001	0.000	0.008	9	0	59
	2013	0.001	0.000	0.010	4	0	30
	2014	0.002	0.000	0.012	4	0	28
	2015	0.002	0.000	0.011	19	0	86
	2016	0.004	0.000	0.012	24	0	81
	Average	0.003			23		
Kenai River mainstem	2010	0.643	0.581	0.703	4,536	4,100	4,963
	2011	0.667	0.601	0.733	5,135	4,624	5,641
	2013	0.766	0.727	0.804	2,289	2,173	2,401
	2014	0.609	0.555	0.664	1,401	1,276	1,527
	2015	0.770	0.709	0.814	5,988	5,519	6,330
	2016	0.736	0.687	0.770	4,972	4,645	5,205
	Average	0.698			4,053		
Kasilof River mainstem	2010	0.326	0.271	0.383	2,305	1,915	2,701
	2011	0.330	0.265	0.395	2,538	2,038	3,042
	2013	0.213	0.178	0.250	637	530	748
	2014	0.387	0.333	0.441	891	766	1,015
	2015	0.201	0.160	0.260	1,564	1,242	2,025
	2016	0.247	0.215	0.293	1,667	1,451	1,982
	Average	0.284			1,600		
Cook Inlet other	2010	0.020	0.003	0.047	144	19	334
	2011	0.002	0.000	0.011	14	0	84
	2013	0.019	0.010	0.030	57	29	89
	2014	0.002	0.000	0.010	4	0	22
	2015	0.027	0.014	0.042	211	112	327
	2016	0.014	0.007	0.024	96	44	160
	Average	0.014			88		

Source for prior years: Eskelin et al. (2013); Eskelin and Barclay (2015, 2016).

Note: Due to uncertainty in estimates with stock composition proportions less than 0.050 and stock-specific harvest estimates with the lower end of the 90% CI less than 1 fish, these estimates are not reported in the text and caution should be used in their interpretation.

LARGE FISH STOCK COMPOSITIONS AND STOCK-SPECIFIC HARVEST ESTIMATES

Mixed-stock analyses with stock compositions and stock-specific harvest estimates stratified by size, section, and date are reported in Table 10 for 2015 and in Table 11 for 2016. Annual stock composition and stock-specific harvest estimates are also provided in each table. The 2016 MSA with estimates stratified by size, beach, and date are reported in Appendix A1. The 2015 MSA was not stratified by beach.

2015

The estimated stock composition and harvest of large *Kenai River mainstem* fish in each stratum were as follows: Kasilof section “Early” 22 June–6 July, 0.111 (90 fish); Kasilof Section “Late” 9–30 July, 0.249 (401 fish); Kenai and East Foreland sections “Late” 9–30 July, 0.443 (1,545 fish); KRSHA 7 July–August 2, 0.143 (61 fish); Kasilof Section openings restricted to within 600 ft of the mean high tide line 15–31 July, 0.155 (32 fish); Kasilof Section 1–10 August, 0.345 (115 fish); Kenai and East Foreland sections 1–12 August, 0.621 (562 fish) (Table 10). Harvest of large *Kenai River tributaries* fish was low.

Large *Kenai River mainstem* fish were harvested primarily in the Kenai and East Foreland sections, where 55% (1,545 fish) of all large *Kenai River mainstem* fish were harvested during 9–30 July and 20% (562 fish) of all large *Kenai River mainstem* fish were harvested during 1–12 August. Kasilof section harvested 23% (638 fish) of large *Kenai River mainstem* fish of which 3% (90 fish) were harvested during 22 June–6 July, 14% (401 fish) during 9–30 July, 4% (115 fish) during 1–10 August, and 1% (32 fish) during 15–31 July openings restricted to within 600 ft of the mean high tide line. The remaining 2% (61 fish) of large *Kenai River mainstem* fish was harvested in KRSHA (Table 10).

Overall, the stock composition estimate of large *Kenai River mainstem* fish was 0.361 (90% CI 0.312–0.408) and the harvest estimate was 2,808 fish (90% CI 2,424–3,171 fish) (Table 10). Of *Kenai River mainstem* fish in the 2015 ESSN harvest, 47% (2,808 out of 5,221 fish) were classified as large. Overall harvest of large *Kenai River tributaries* fish was low. All stock compositions and stock-specific harvest estimates for all strata and the 2015 season overall are listed in Table 10 as well as 90% CIs for all estimates.

2016

In 2016, large *Kenai River mainstem* fish were harvested in each major stratum as follows: Kasilof Section “Early” 23–9 July, 0.234 (267 fish); Kasilof Section “Late” 11–28 July, 0.278 (467 fish); Kenai and East Foreland sections “Late” 11–28 July, 0.563 (1,836 fish); “All Areas” 1–9 August, 0.501 (338 fish) (Table 11). Harvest of large *Kenai River tributaries* fish was low in all strata (Table 11).

The percentage of the harvest of large *Kenai River mainstem* fish by stratum was as follows: 63% were harvested from Kenai and East Foreland sections “Late” (1,836 fish), 16% from Kasilof Section “Late (467 fish), 9% from Kasilof Section “Early” (267 fish), and 12% from “All Areas” 1–9 August (338 fish).

Overall, the stock composition of large *Kenai River mainstem* fish was 0.430 (90% CI 0.386–0.472) and harvest was 2,906 fish (90% CI 2,606–3,189 fish) (Table 11). Of *Kenai River mainstem* fish in the 2016 ESSN harvest, 58% (2,906 out of 4,972 fish) were classified as large. Overall harvest of large *Kenai River tributaries* fish was low. Stock compositions and stock-specific harvest estimates for all strata and the 2016 season overall are listed in Table 11 as well as 90% CIs for all estimates. Appendix A1 provides stock compositions and stock-specific harvest estimates stratified by size and beach for 2016.

Table 10.–Stock composition and stock-specific harvest estimates of Chinook salmon harvested in the Eastside set gillnet fishery, including mean and 90% credibility intervals (CI), stratified by size (large and small) overall, and by size for each temporal and geographic stratum, Upper Cook Inlet, Alaska, 2015.

Stratum				Stock composition			Stock-specific harvest		
					90% CI			90% CI	
Area	Period	Size	Reporting group	Mean	5%	95%	Harvest	5%	95%
Annual estimates stratified by size									
All	All season	Large	Kenai R. tributaries	0.001	0.000	0.005	8	0	36
			Kenai R. mainstem	0.361	0.312	0.408	2,808	2,424	3,171
			Kasilof R. mainstem	0.098	0.074	0.127	764	577	985
			Cook Inlet other	0.006	0.002	0.012	48	13	94
		Small	Kenai R. tributaries	0.002	0.000	0.008	12	0	60
			Kenai R. mainstem	0.410	0.359	0.463	3,187	2,797	3,603
			Kasilof R. mainstem	0.102	0.076	0.137	790	590	1,064
			Cook Inlet other	0.021	0.011	0.033	164	85	259
Date, area, and size stratified estimates									
Kasilof Section	22 Jun–6 Jul	Large	Kenai R. tributaries	0.001	0.000	0.003	1	0	2
			Kenai R. mainstem	0.111	0.051	0.181	90	41	148
			Kasilof R. mainstem	0.060	0.016	0.120	49	13	98
			Cook Inlet other	0.054	0.014	0.105	44	12	86
		Small	Kenai R. tributaries	0.003	0.000	0.011	3	0	9
			Kenai R. mainstem	0.435	0.306	0.567	354	249	461
			Kasilof R. mainstem	0.141	0.060	0.237	115	48	192
			Cook Inlet other	0.194	0.101	0.298	158	82	242
Kasilof Section	9–30 Jul	Large	Kenai R. tributaries	0.001	0.000	0.000	1	0	0
			Kenai R. mainstem	0.249	0.162	0.345	401	260	554
			Kasilof R. mainstem	0.197	0.112	0.293	316	180	471
			Cook Inlet other	0.001	0.000	0.007	2	0	12
		Small	Kenai R. tributaries	0.001	0.000	0.000	1	0	0
			Kenai R. mainstem	0.325	0.225	0.431	523	361	693
			Kasilof R. mainstem	0.224	0.133	0.323	360	214	519
			Cook Inlet other	0.002	0.000	0.009	3	0	15
Kenai and E. Foreland sections	9–30 Jul	Large	Kenai R. tributaries	0.000	0.000	0.000	1	0	0
			Kenai R. mainstem	0.443	0.348	0.540	1,545	1,212	1,881
			Kasilof R. mainstem	0.008	0.000	0.057	27	0	199
			Cook Inlet other	0.000	0.000	0.000	1	0	0
		Small	Kenai R. tributaries	0.000	0.000	0.000	1	0	0
			Kenai R. mainstem	0.536	0.436	0.634	1,870	1,520	2,211
			Kasilof R. mainstem	0.011	0.000	0.071	38	0	249
			Cook Inlet other	0.000	0.000	0.000	1	0	0

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Table 10.–Page 2 of 2.

Stratum				Stock composition			Stock-specific harvest		
					90% CI			90% CI	
Area	Period	Size	Reporting group	Mean	5%	95%	Harvest	5%	95%
KRSHA[a]	7 Jul– 2 Aug	Large	Kenai R. tributaries	0.008	0.000	0.051	3	0	22
			Kenai R. mainstem	0.143	0.063	0.232	61	27	99
			Kasilof R. mainstem	0.305	0.207	0.406	130	88	173
			Cook Inlet other	0.001	0.000	0.000	0	0	0
		Small	Kenai R. tributaries	0.013	0.000	0.090	6	0	38
			Kenai R. mainstem	0.174	0.083	0.270	74	35	115
			Kasilof R. mainstem	0.357	0.253	0.459	152	108	195
			Cook Inlet other	0.001	0.000	0.000	0	0	0
Kasilof Section within 600 ft.[b]	15–31 Jul	Large	Kenai R. tributaries	0.002	0.000	0.012	0	0	2
			Kenai R. mainstem	0.155	0.072	0.254	32	15	53
			Kasilof R. mainstem	0.269	0.165	0.374	56	34	78
			Cook Inlet other	0.003	0.000	0.026	1	0	5
		Small	Kenai R. tributaries	0.004	0.000	0.022	1	0	5
			Kenai R. mainstem	0.225	0.119	0.342	47	25	71
			Kasilof R. mainstem	0.337	0.224	0.463	70	47	97
			Cook Inlet other	0.005	0.000	0.044	1	0	9
Kasilof Section	1–10 Aug	Large	Kenai R. tributaries	0.002	0.000	0.012	1	0	4
			Kenai R. mainstem	0.345	0.223	0.468	115	75	157
			Kasilof R. mainstem	0.463	0.347	0.583	155	116	195
			Cook Inlet other	0.000	0.000	0.000	0	0	0
		Small	Kenai R. tributaries	0.001	0.000	0.007	0	0	2
			Kenai R. mainstem	0.091	0.041	0.154	30	14	52
			Kasilof R. mainstem	0.097	0.043	0.163	32	14	55
			Cook Inlet other	0.000	0.000	0.000	0	0	0
Kenai and E. Foreland sections	1–12 Aug	Large	Kenai R. tributaries	0.000	0.000	0.000	0	0	0
			Kenai R. mainstem	0.621	0.495	0.730	562	448	661
			Kasilof R. mainstem	0.034	0.000	0.127	31	0	115
			Cook Inlet other	0.000	0.000	0.000	0	0	0
		Small	Kenai R. tributaries	0.000	0.000	0.000	0	0	0
			Kenai R. mainstem	0.319	0.222	0.423	289	201	383
			Kasilof R. mainstem	0.024	0.000	0.091	22	0	83
			Cook Inlet other	0.000	0.000	0.000	0	0	0

Note: Due to uncertainty in estimates with stock composition proportions less than 0.050 and stock-specific harvest estimates with the lower end of the 90% CI less than 1 fish, these estimates are not reported in the text and caution should be used in their interpretation.

Note: Large fish are 75 cm METF and longer; small fish are less than 75 cm METF. These estimates were summarized from the thinned *BAYES* posterior output (1,000 iterations), and the original estimates reported in Eskelin and Barclay (2016) were summarized from the full *BAYES* posterior output (100,000 iterations); therefore, overall estimates by reporting group derived from summing large and small fish may differ slightly from those reported in Eskelin and Barclay (2016).

[a] Kasilof River Special Harvest Area.

[b] Kasilof Section openings restricted to within 600 ft of the mean high tide line.

Table 11.–Stock composition and stock-specific harvest estimates of Chinook salmon harvested in the ESSN fishery, including mean and 90% credibility intervals (CI), stratified by size (large and small) overall, and by size for each temporal and geographic stratum, Upper Cook Inlet, Alaska, 2016.

Stratum				Stock composition			Stock-specific harvest		
					90% CI			90% CI	
Area	Period	Size	Reporting group	Mean	5%	95%	Harvest	5%	95%
Annual estimates stratified by size									
All	23 Jun–9 Aug	Large	Kenai R. tributaries	0.002	0.000	0.007	14	0	49
			Kenai R. mainstem	0.430	0.386	0.472	2,906	2,606	3,189
			Kasilof R. mainstem	0.154	0.130	0.188	1,039	876	1,271
			Cook Inlet other	0.005	0.001	0.010	34	10	68
		Small	Kenai R. tributaries	0.002	0.000	0.006	11	0	42
			Kenai R. mainstem	0.306	0.266	0.346	2,065	1,796	2,337
			Kasilof R. mainstem	0.093	0.075	0.114	628	507	771
			Cook Inlet other	0.009	0.004	0.016	62	24	106
Date, area, and size stratified estimates									
Kasilof Section	23 Jun–9 Jul	Large	Kenai R. tributaries	0.003	0.000	0.014	4	0	16
			Kenai R. mainstem	0.234	0.184	0.283	267	210	323
			Kasilof R. mainstem	0.114	0.081	0.152	130	92	173
			Cook Inlet other	0.024	0.007	0.047	28	8	54
		Small	Kenai R. tributaries	0.004	0.000	0.016	4	0	18
			Kenai R. mainstem	0.391	0.323	0.453	447	369	517
			Kasilof R. mainstem	0.177	0.130	0.231	202	149	263
			Cook Inlet other	0.052	0.018	0.090	59	21	103
Kasilof Section	11–28 Jul	Large	Kenai R. tributaries	0.002	0.000	0.014	3	0	24
			Kenai R. mainstem	0.278	0.221	0.336	467	371	565
			Kasilof R. mainstem	0.341	0.283	0.399	574	476	671
			Cook Inlet other	0.001	0.000	0.010	2	0	17
		Small	Kenai R. tributaries	0.001	0.000	0.012	2	0	19
			Kenai R. mainstem	0.193	0.148	0.241	324	249	406
			Kasilof R. mainstem	0.183	0.139	0.227	307	233	381
			Cook Inlet other	0.000	0.000	0.003	1	0	4
Kenai and E. Foreland sections	11–28 Jul	Large	Kenai R. tributaries	0.001	0.000	0.002	3	0	7
			Kenai R. mainstem	0.563	0.483	0.639	1,836	1,576	2,086
			Kasilof R. mainstem	0.034	0.008	0.088	112	26	288
			Cook Inlet other	0.000	0.000	0.000	1	0	1
		Small	Kenai R. tributaries	0.001	0.000	0.001	2	0	4
			Kenai R. mainstem	0.375	0.304	0.445	1,224	991	1,450
			Kasilof R. mainstem	0.026	0.006	0.066	84	20	216
			Cook Inlet other	0.000	0.000	0.000	0	0	1
All	1–9 Aug	Large	Kenai R. tributaries	0.007	0.000	0.036	5	0	24
			Kenai R. mainstem	0.501	0.386	0.620	338	260	419
			Kasilof R. mainstem	0.325	0.220	0.436	220	149	294
			Cook Inlet other	0.004	0.000	0.024	3	0	17
		Small	Kenai R. tributaries	0.003	0.000	0.012	2	0	8
			Kenai R. mainstem	0.099	0.050	0.156	67	34	105
			Kasilof R. mainstem	0.058	0.021	0.105	39	15	71
			Cook Inlet other	0.002	0.000	0.012	2	0	8

Note: Due to uncertainty in estimates with stock composition proportions less than 0.050 and stock-specific harvest estimates with the lower end of the 90% CI less than 1 fish, caution should be used in the interpretation of these estimates.

Note: Large fish are 75 cm METF and longer; small fish are less than 75 cm METF.

AGE, SEX, AND LENGTH COMPOSITION

Age Composition

The overall age composition of 2016 ESSN Chinook salmon harvest was estimated as 6.7% age-1.1 fish, 28.5% age-1.2 fish, 36.2% age-1.3 fish, 26.7% age-1.4 fish, and 1.9% age-1.5 fish (Table 12). Age compositions of the 4 major strata, Kasilof Section “Early,” Kasilof Section “Late,” Kenai and East Foreland sections “Late,” and “All Areas” August are each listed in Tables 13–16 and depicted in Figure 9. The stratified estimates were summed to produce the overall age composition estimates. The Kasilof Section “Early” stratum was composed of 14% age-1.1 fish, 45% age-1.2 fish, 24% age-1.3 fish, and 18% age-1.4 fish (Table 13). The Kasilof Section “Late” stratum was composed of 8% age-1.1 fish, 26% age-1.2 fish, 34% age-1.3 fish, 30% age-1.4 fish, and 2% age-1.5 fish (Table 14). The Kenai and East Foreland sections “Late” stratum was composed of 5% age-1.1 fish, 28% age-1.2 fish, 40% age-1.3 fish, 25% age-1.4 fish, and 2% age-1.5 fish (Table 15). The “All Areas” August stratum was composed of 1% age-1.1 fish, 9% age-1.2 fish, 42% age-1.3 fish, 46% age-1.4 fish, and 2% age-1.5 fish (Table 16). Standard errors are listed within each age, sex, and length composition table for each stratum (Tables 13–16). Table 17 show the historical age composition of ESSN Chinook salmon sampled since 1987. A depiction of age composition by year for each age is presented in Figure 10.

Sex Composition

Overall sex composition in 2016 was 33% females and 67% males (Table 12). The sex composition was fairly consistent among all strata throughout the season for each of the major strata (Tables 13–16). The “All Areas” 1–9 August stratum had the highest percentage (41%) of females of any stratum (Table 16).

Length Composition

The smallest average METF length over all ages within a stratum (695 mm) was observed in the earliest stratum (Kasilof Section “Early”; Table 13). The largest average METF length over all ages within a stratum (883 mm) was from the latest stratum (“All Areas” 1–9 August; Table 16). Mean lengths by age of harvest samples and standard errors for ASL composition are also presented in Table 12 for the 2016 season overall and for each of the 4 major strata in Tables 13–16. A summary of average MEFT length by age during 1987–2016 is provided in Table 18.

Table 12.–Age, sex, and length composition of Chinook salmon harvested in the Eastside set gillnet fishery, 23 June–9 August, Upper Cook Inlet, Alaska, 2016.

		Age class					
Sex	Parameter	1.1	1.2	1.3	1.4	1.5	All ages
Females							
	Harvest by age		116	1,136	969	22	2,243
	SE (harvest by age)		20	157	152	31	138
	Samples by age		22	135	126	3	286
	Age composition		1.7%	16.8%	14.3%	0.3%	33.2%
	SE (age composition)		0.3%	2.3%	2.2%	0.5%	2.0%
	Mean length (mm METF)		664	857	953	1,085	889
Males							
	Harvest by age	459	1,828	1,334	852	44	4,516
	SE (harvest by age)	78	158	174	155	43	140
	Samples by age	67	230	130	88	6	521
	Age composition	6.8%	27.0%	19.7%	12.6%	0.7%	66.8%
	SE (age composition)	1.2%	2.3%	2.6%	2.3%	0.6%	2.1%
	Mean length (mm METF)	447	623	830	972	1,087	704
Both Sexes							
	Harvest by age	459	1,944	2,469	1,821	66	6,759
	SE (harvest by age)	74	141	154	136	20	
	Samples by age	67	252	265	214	9	807
	Age composition	6.8%	28.8%	36.5%	26.9%	1.0%	100.0%
	SE (age composition)	1.1%	2.1%	2.3%	2.0%	0.3%	
	Mean length (mm METF)	447	625	843	962	1,086	788

Note: Values given by age and sex may not sum to totals due to rounding.

Table 13.–Age, sex, and length composition of Chinook salmon harvested in the Eastside set gillnet fishery, Kasilof Section "Early," 23 June–9 July, Upper Cook Inlet, Alaska, 2016.

		Age class				
Sex	Parameter	1.1	1.2	1.3	1.4	All ages
Females						
	Harvest by age		55	166	160	382
	SE (harvest by age)		9	15	14	28
	Samples by age		13	42	39	94
	Age composition		4.8%	14.6%	14.0%	33.4%
	SE (age composition)		0.8%	1.3%	1.2%	2.5%
	Mean length (mm METF)		658	839	951	848
Males						
	Harvest by age	155	461	102	41	759
	SE (harvest by age)	15	21	12	8	28
	Samples by age	38	115	25	11	189
	Age composition	13.6%	40.4%	9.0%	3.6%	66.6%
	SE (age composition)	1.3%	1.9%	1.0%	0.7%	2.5%
	Mean length (mm METF)	432	615	799	958	621
Both sexes						
	Harvest by age	155	516	268	201	1,141
	SE (harvest by age)	21	30	25	23	
	Samples by age	38	128	67	50	283
	Age composition	13.6%	45.2%	23.5%	17.7%	100.0%
	SE (age composition)	1.8%	2.6%	2.2%	2.0%	
	Mean length (mm METF)	432	620	824	953	695

Note: Values given by age and sex may not sum to totals due to rounding.

Table 14.–Age, sex, and length composition of Chinook salmon harvested in the Eastside set gillnet fishery, Kasilof Section "Late," 11–28 July, Upper Cook Inlet, Alaska, 2016.

		Age class					
Sex	Parameter	1.1	1.2	1.3	1.4	1.5	All ages
Females							
	Harvest by age		60	314	278	14	666
	SE (harvest by age)		18	37	35	9	40
	Samples by age		9	50	45	2	106
	Age composition		3.6%	18.7%	16.5%	0.8%	39.6%
	SE (age composition)		1.1%	2.2%	2.1%	0.5%	2.4%
	Mean length (mm METF)		670	855	955	1,083	885
Males							
	Harvest by age	135	379	263	218	21	1,015
	SE (harvest by age)	26	40	35	32	11	45
	Samples by age	22	60	40	33	3	158
	Age composition	8.0%	22.5%	15.6%	12.9%	1.2%	60.4%
	SE (age composition)	1.5%	2.4%	2.1%	1.9%	0.7%	2.7%
	Mean length (mm METF)	431	630	833	970	1,090	739
Both sexes							
	Harvest by age	135	439	577	496	35	1,681
	SE (harvest by age)	26	42	46	44	14	
	Samples by age	22	69	90	78	5	264
	Age composition	8.0%	26.1%	34.3%	29.5%	2.1%	100.0%
	SE (age composition)	1.5%	2.5%	2.7%	2.6%	0.8%	
	Mean length (mm METF)	431	635	845	962	1,087	797

Note: Values given by age and sex may not sum to totals due to rounding.

Table 15.–Age, sex, and length composition of Chinook salmon harvested in the Eastside set gillnet fishery, Kenai and East Foreland sections “Late,” 11–28 July, Upper Cook Inlet, Alaska, 2016.

		Age class					
Sex	Parameter	1.1	1.2	1.3	1.4	1.5	All ages
Females							
	Harvest by age			531	377	8	916
	SE (harvest by age)			107	90	8	128
	Samples by age			26	21	1	48
	Age composition			16.3%	11.6%	0.3%	28.1%
	SE (age composition)			3.3%	2.8%	0.2%	3.9%
	Mean length (mm METF)			865	949	1,090	900
Males							
	Harvest by age	162	930	807	438	8	2,346
	SE (harvest by age)	66	130	123	97	8	128
	Samples by age	6	47	43	23	1	120
	Age composition	5.0%	28.5%	24.7%	13.4%	0.3%	71.9%
	SE (age composition)	2.0%	4.0%	3.8%	3.0%	0.2%	3.9%
	Mean length (mm METF)	471	625	830	975	1,060	690
Both sexes							
	Harvest by age	162	930	1,338	816	17	3,262
	SE (harvest by age)	66	130	141	123	11	
	Samples by age	6	47	69	44	2	168
	Age composition	5.0%	28.5%	41.0%	25.0%	0.5%	100.0%
	SE (age composition)	2.0%	4.0%	4.3%	3.8%	0.3%	
	Mean length (mm METF)	471	625	844	963	1,075	742

Note: Values given by age and sex may not sum to totals due to rounding.

Table 16.–Age, sex, and length composition of Chinook salmon harvested in the Eastside set gillnet fishery "All Areas," 1–9 August, Upper Cook Inlet, Alaska 2016.

		Age Class					
Sex	Parameter	1.1	1.2	1.3	1.4	1.5	All ages
Females							
	Harvest by age			125	154		279
	SE (harvest by age)			107	116		32
	Samples by age			17	21		38
	Age composition			18.5%	22.8%		41.3%
	SE (age composition)			4.2%	4.6%		4.8%
	Mean length (mm METF)			856	963		915
Males							
	Harvest by age	7	59	161	154	15	396
	SE (harvest by age)	29	78	118	116	40	32
	Samples by age	1	8	22	21	2	54
	Age composition	1.1%	8.7%	23.9%	22.8%	2.2%	58.7%
	SE (age composition)	1.1%	3.1%	4.6%	4.6%	1.6%	4.8%
	Mean length (mm METF)	495	608	844	967	1,098	860
Both sexes							
	Harvest by age	7	59	286	308	15	675
	SE (harvest by age)	7	19	32	33	10	
	Samples by age	1	8	39	42	2	92
	Age composition	1.1%	8.7%	42.4%	45.7%	2.2%	100.0%
	SE (age composition)	1.0%	2.7%	4.8%	4.9%	1.4%	
	Mean length (mm METF)	495	608	849	965	1,098	883

Note: Values given by age and sex may not sum to totals due to rounding.

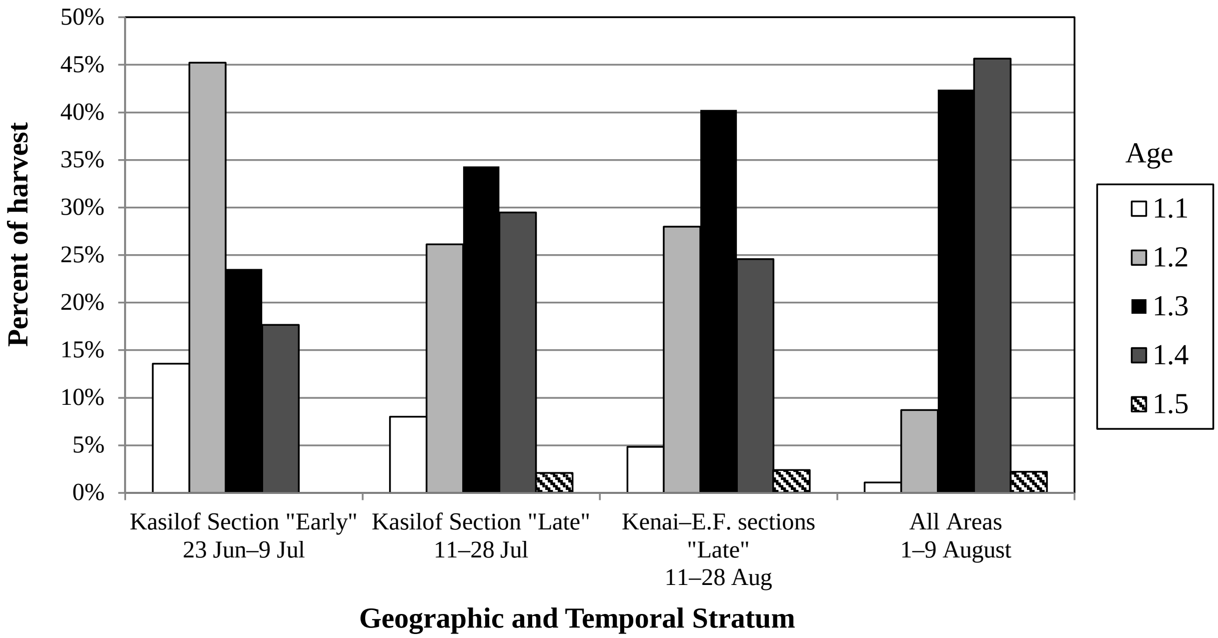

Figure 9.–Age composition estimates of Chinook salmon harvested in the Eastside set gillnet fishery by temporal and geographic stratum, Upper Cook Inlet, Alaska, 2016.

Note: Kenai–E.F. means Kenai and East Foreland sections. Ages are given in the European aging system: age 1.1 is a 3-year-old fish, age 1.2 is age 4, age 1.3 is age 5, age 1.4 is age 6, and age 1.5 is age 7.

Table 17.–Age composition of Chinook salmon harvested in the Eastside set gillnet fishery, Upper Cook Inlet, Alaska, 1987–2016.

		Percent composition by age class (%)				
Year	Sample size	Age 3 (1.1, 0.2)	Age 4 (1.2, 2.1, 0.3)	Age 5 (1.3, 2.2, 0.4)	Age 6 (1.4, 2.3)	Age 7 (1.5, 2.4)
1987	1,212	2.14	14.77	33.18	48.75	1.15
1988	870	3.22	10.81	14.83	68.62	2.52
1989	854	0.94	15.11	21.31	53.28	9.37
1990	437	1.36	30.62	29.91	33.09	5.02
1991	446	0.89	25.12	32.51	39.21	2.24
1992	688	2.46	14.97	28.20	50.44	3.93
1993	992	3.33	14.01	20.86	57.26	4.54
1994	1,502	3.53	12.36	14.92	61.73	7.40
1995	1,508	2.73	22.44	33.64	35.06	6.09
1996	2,186	3.25	15.89	35.02	43.89	1.95
1997	1,691	6.38	13.78	31.35	46.36	2.13
1998	911	12.21	23.74	22.73	38.92	2.43
1999	1,818	2.37	26.46	24.52	43.86	2.78
2000	991	9.15	13.15	38.98	37.88	0.85
2001	989	11.68	40.04	14.53	32.52	1.23
2002	1,224	10.60	29.32	36.68	22.57	0.83
2003	678	3.83	51.77	23.90	18.73	1.77
2004	1,409	3.54	19.90	48.22	27.68	0.67
2005	482	3.11	26.97	20.55	47.50	1.87
2006	560	12.86	35.35	22.14	27.14	2.50
2007	789	4.82	42.71	22.57	28.51	1.40
2008	380	10.27	19.73	27.64	40.78	1.59
2009	487	13.76	51.34	12.31	21.98	0.61
2010	743	18.27	24.62	36.06	20.22	0.82
2011	1,187	4.56	33.70	25.18	35.36	1.20
2012	167	9.59	17.98	36.64	35.79	0.00
2013	668	22.69	43.44	15.22	18.65	0.00
2014	459	17.57	32.25	29.12	20.93	0.13
2015	610	14.18	37.43	24.28	23.81	0.31
2016	807	6.79	28.76	36.54	26.94	0.98
Average 1987–2016	925	7.40	26.28	27.12	36.92	2.28

Source for prior years: 1987–2009, Shields and Dupuis (2013: Appendix A15); 2010–2013, Eskelin et al. (2013); and 2014–2015, Eskelin and Barclay (2015 and 2016).

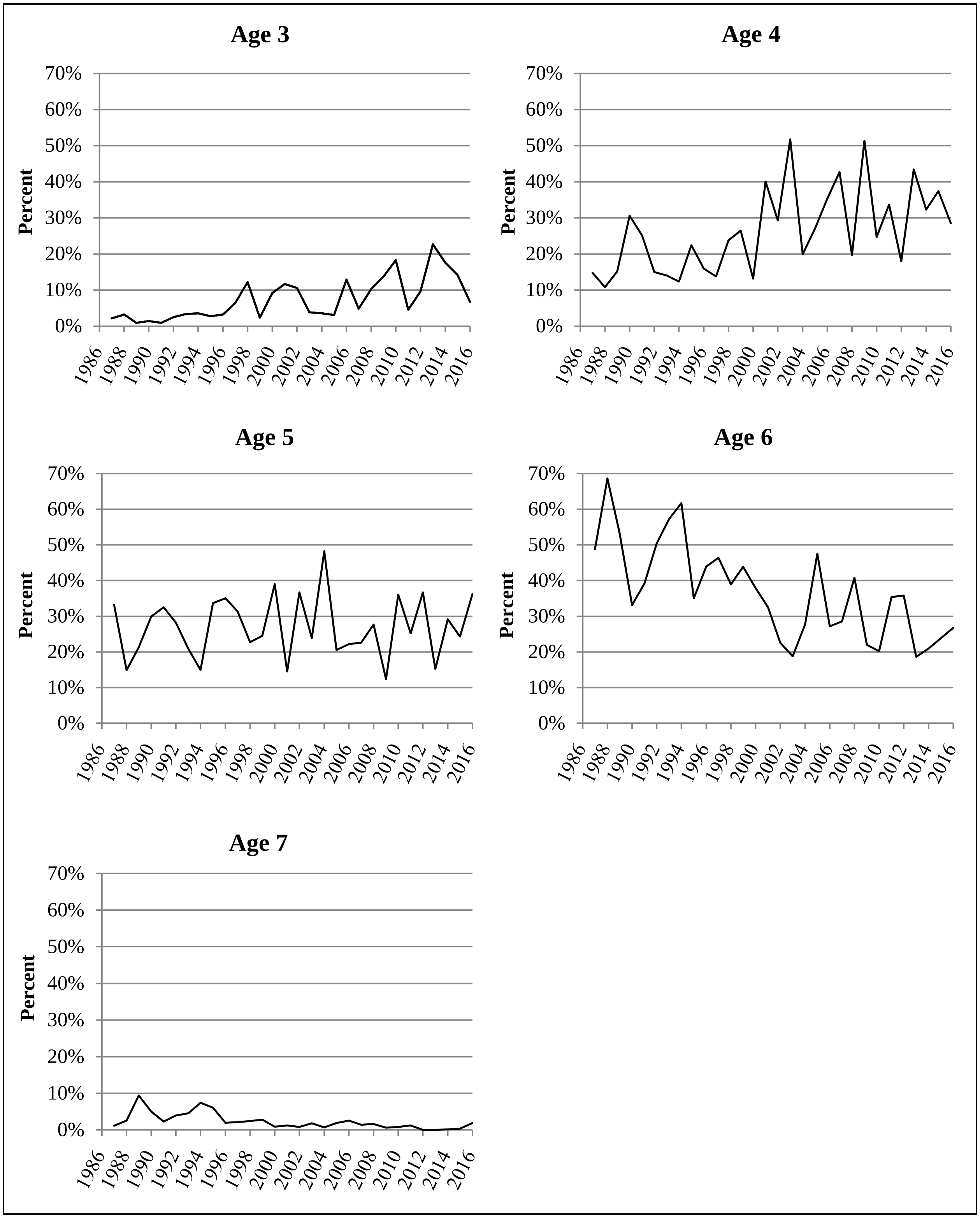

Figure 10.–Age composition estimates of Chinook salmon harvested in the Eastside set gillnet fishery, Upper Cook Inlet, Alaska, 1987–2016.

Source for prior years: Tobias and Willette (2010); Eskelin et al. (2013); and Eskelin and Barclay (2015 and 2016).

Table 18.–Average METF length by age of Chinook salmon sampled in the Eastside set gillnet fishery, Upper Cook Inlet, Alaska, 1987–2016.

	Average length by age class (mm METF)					Overall
Year	Age 1.1	Age 1.2	Age 1.3	Age 1.4	Age 1.5	average
1987	408	614	873	1,008	1,067	893
1988	399	647	820	992	957	909
1989	451	673	825	992	1,037	898
1990	560	611	773	979	979	798
1991	461	626	822	976	1,054	835
1992	442	613	784	974	1,052	855
1993	419	632	826	990	1,047	887
1994	420	662	866	898	1,088	934
1995	422	646	895	1,026	1,107	883
1996	410	625	871	1,018	1,098	883
1997	426	632	858	1,003	1,055	868
1998	443	644	838	994	1,045	806
1999	414	626	808	968	1,055	827
2000	413	631	846	989	1,064	832
2001	422	614	820	985	1,054	748
2002	422	640	871	989	1,057	784
2003	434	640	859	1,017	1,102	763
2004	428	645	866	1,010	1,093	848
2005	408	594	814	985	1,090	828
2006	440	581	806	978	1,102	733
2007	430	600	800	954	1,046	743
2008	424	593	825	982	1,097	806
2009	409	577	865	1,003	1,051	686
2010	430	611	850	984	1,102	743
2011	403	610	857	968	1,054	794
2012	399	560	870	1,006	[a]	818
2013	451	589	832	986	[a]	658
2014	431	626	795	954	1,240	712
2015	436	632	829	962	1,100	742
2016	447	625	843	962	1,086	788
Average 1987–2016	430	621	837	984	1,071	810

Source for prior years: 1987–2008, Tobias and Willette (2010: Table 54); 2009, Tobias and Willette (2012); 2010–2013, Eskelin et al. (2013); and 2014–2015, Eskelin and Barclay (2015 and 2016).

[a] No age 7 fish were sampled in 2012 and 2013.

CODED WIRE TAG (CWT) RECOVERY

A total of 13 sampled Chinook salmon were missing the adipose fin, and the heads of these fish were sacrificed and sent to the ADF&G Mark, Tag, and Age Laboratory in Juneau, Alaska for dissection and CWT recovery. Adipose finclipped fish were observed in the harvest during 23 June–7 July from Ninilchik Beach (9) and Cohoe Beach (4). Only 3 heads possessed CWTs, all of which originated from Crooked Creek in 2015, and all of which were age-1.1 “jacks” based on scale age. The other 9 samples that did not possess a CWT were age-1.1 (1 jack) and age-1.2 (8 fish).

DISCUSSION

MANAGEMENT OF THE EASTSIDE SET GILLNET FISHERY

The location and timing of ESSN commercial fishery openings in 2016 were not as complex as in recent years: once the Kenai and East Foreland sections opened for the 2016 season, all areas were fished the same days throughout the season. This management strategy allowed for more comparisons by area and time period than in previous ESSN Chinook salmon sampling projects when the timing of openings varied by area.

MIXED-STOCK ANALYSIS

Tissue Selection for MSA

We selected and analyzed more samples for MSA in 2016 than any previous year (*cf*. Eskelin et al. 2013; Eskelin and Barclay 2015, 2016). Of the 909 tissue samples that were selected for MSA, 887 were used in the MSA, which was 46% of all samples collected and 13% of the total reported harvest of ESSN Chinook salmon. We were able to stratify by beach and time periods for the first time due to how the fishery was prosecuted and the number of tissue samples that were collected.

Stock-Specific Harvest Patterns Across Study Years

There are now 6 years (2010, 2011, 2013–2016) of stock composition and stock-specific harvest estimates of the ESSN Chinook salmon harvest (Eskelin et al. 2013; Eskelin and Barclay 2015, 2016). Additionally, there are 4 years (2013–2016) of geographically and temporally stratified stock composition and stock-specific harvest estimates that allow for comparisons of similar strata among years. Over 4 study years, more *Kenai River mainstem* fish have been harvested in the Kenai and East Foreland sections than in the Kasilof Section (Tables 6–8). Stock compositions of the harvest in the Kenai and East Foreland sections have also been more consistent across years than stock compositions of the harvest in the Kasilof Section (Figure 7). The proportion of *Kenai River mainstem* fish in the Kenai and East Foreland sections “Late” stratum has averaged 0.958 across years ranging from 0.976 in 2014 to 0.938 in 2016 (Figure 8 and Table 8). The proportion of *Kenai River mainstem* fish during August has also averaged 0.958 during the 2 years the MSA results were geographically and temporally stratified with an August-only component, ranging from 0.945 in 2015 to 0.971 in 2014 (Eskelin and Barclay 2015, 2016).

Stock-Specific Harvest Patterns by Beach

The 2016 estimates in this report represent the first ESSN Chinook salmon MSA estimates stratified by beach and time period. Prior to 2016, either sample size was too low to conduct MSA by beach (e.g., 2010–2014) or funding for genetic analysis was used to analyze other strata (e.g., KRSHA or Kasilof section openings restricted to within 600 ft of the mean high tide line in 2015; Eskelin and Barclay 2016). Unfortunately, due to low sampling rate (20%) and also low harvest (675 fish), the 138 tissue samples collected in August were too few to stratify by beach or section in the 2016 MSA.

Kasilof Section

In 2016, stock compositions varied considerably by beach and time period within the Kasilof Section. Harvest from Ninilchik Beach was composed of mostly *Kenai River mainstem* fish during both early (23 June–9 July) and late (11–28 July) time periods, whereas harvest from South K-Beach was composed of mostly *Kasilof River mainstem* fish during both early and late time periods. Harvest from Cohoe beach was composed of mostly *Kenai River mainstem* fish during the early time period and then was composed of mostly *Kasilof River mainstem* fish during the late time period. These results provide some insight into the migratory patterns of Chinook salmon within the Kasilof section, explained in the stock-specific harvest patterns section below.

Kenai and East Foreland Sections

Stock composition of the 2016 harvest from the Salamatof and East Foreland beaches combined was nearly all *Kenai River mainstem* fish (Figure 4). These results are consistent with MSA results from the entire Kenai and East Forelands sections during 2013–2015 (Figure 7). Harvest from North K-Beach was also predominately *Kenai River mainstem* fish but was also composed of some *Kasilof River mainstem* fish (Table 4), providing some insight into the migration patterns of the *Kasilof River mainstem* reporting group (see below).

Stock-Specific Harvest Patterns within Season

The high proportion of *Kasilof River mainstem* fish harvested from South K-beach that persisted from late June to late July indicates that many *Kasilof River mainstem* fish migrated north of the Kasilof River prior to entering their natal stream. This pattern was also observed with harvest of *Kasilof River mainstem* fish from North K-Beach during July. However, the MSA was not conducted by beach in August to determine stock compositions so a continuation of this pattern could not be determined. *Kenai River mainstem* fish were also observed to have a similar migratory pattern (moving north of the Kenai River prior to entering the Kenai River), based on harvests from the Salamatof and East Foreland beaches.

Stock composition estimates from the June-only stratum revealed that nearly all of the 2016 harvest of *Cook Inlet other* fish occurred in June (Table 5). This was expected because populations within the *Cook Inlet other* reporting group have earlier run timing than *Kenai River mainstem* and *Kasilof River mainstem* fish (e.g., Kerkvliet and Booz 2012; Ivey 2014; St. Saviour 2017). *Cook Inlet other* fish were observed in the harvest from Ninilchik Beach and South K-Beach during the early time period but were not observed in the harvest from Cohoe Beach during the same time period. If migratory movement northward of natal streams is consistent across stocks, this result could be due to populations from lower Kenai Peninsula streams (i.e., Ninilchik River, Deep Creek, and Anchor River) migrating north of their natal streams and being harvested from Ninilchik Beach and fish from the Crooked Creek population from the Kasilof River drainage migrating north of the Kasilof River prior to entering the Kasilof river. However, the *Cook Inlet other* reporting group includes populations from all over Cook Inlet (Figure 3), and the actual migration patterns of specific populations within the *Cook Inlet other* reporting group are unknown. Although this migration and subsequent harvest pattern is interesting, caution should be used when interpreting very low harvest estimates with wide credibility intervals. More years of harvest estimates by beach are needed to determine if this is a consistent harvest pattern.

Results from the 2016 MSA analysis indicated the harvest of *Kenai River tributaries* fish was low in June; this result is similar to previous studies (Eskelin et al. 2013; Eskelin and Barclay 2015, 2016) and indicates the earlier run timing of this stock prior to the ESSN fishery. The 2016 MSA was also the first analysis to stratify stock-compositions by the early July portion of the fishery. Results from this stratification indicated an increase in the harvest of *Kasilof River mainstem* fish from 23–30 June to 2–9 July (Figure 6 and Table 5) as this stock migrated toward the Kasilof River.

2013–2016 Comparison of Stock Composition Estimates Stratified by Similar Time Periods and Areas

When comparing the stock composition estimates for similar spatio-temporal strata among years (2013–2016), the most variability was observed in Kasilof Section strata (Figure 7) of which the Kasilof Section "Late" stratum had the most variable stock composition estimates. This variability is probably due to differences in the run timing and run size of *Kenai River mainstem* vs. *Kasilof River mainstem* fish, as well as the timing of fishery openings among years. For instance, the ESSN fishery ended on 23 July in 2013 and 2014, but ended on 30 July in 2016 and 31 July in 2015. Stock composition estimates in the Kasilof Section "Early" stratum also varied among years; however, 90% CIs of stock composition estimates generally overlapped, indicating that the estimates were not significantly different (Tables 6 and 7). In 3 of the 4 years, the Kasilof Section "Early" stratum was the only stratum with 90% CIs of stock composition and harvest estimates of *Cook Inlet other* fish that were 1 fish or greater (Table 6).

Large Fish Stock Compositions and Stock-specific Harvest Estimates

This report includes the first stock composition and stock-specific harvest estimates of ESSN Chinook salmon stratified by size to include large fish estimates (i.e., those fish 75 cm METF or longer). Estimates of large fish harvest provide useful information germane to management of large Kenai River Chinook salmon (Fleischman and Reimer 2017). Results from 2015 are included with results from 2016 in this report to provide information for the estimation of harvest and run size of large Kenai River Chinook salmon.

In both 2015 and 2016, a majority of the large *Kenai River mainstem* fish were harvested in the Kenai and East Foreland sections. In the "late" stratum, the Kenai and East Foreland sections accounted for 55% and 63% of all large *Kenai River mainstem* fish in 2015 and 2016, respectively. The August 2015 samples were geographically stratified and the Kenai and East Forelands accounted for 20% of the harvest of large *Kenai River mainstem* fish. This level of stratification was not possible for August 2016 due insufficient sample size of tissue collections.

In 2015, approximately 75% (55% in July and 20% in August) of the total large *Kenai River* mainstem fish harvest occurred in the Kenai and East Forelands sections. It is likely that percentage was similar in 2016; however, the MSA was not stratified in August so the exact percentage of large *Kenai River* mainstem fish harvest that occurred in the Kenai and East Forelands sections is unknown. Large *Kenai River* mainstem fish composed an average of 0.395 of the harvests for 2015 and 2016 combined. Although these results are informative, more years of data and MSA results stratified by size are needed to adequately characterize the variability of stock composition and stock-specific harvest estimates by size.

AGE, SEX, AND LENGTH COMPOSITION

Tissue and Age, Sex, and Length Sampling

In 2016, we sampled 28% of the harvest, which was near the goal of 30%, and we met the primary objectives and established precision criteria goals for estimating stock compositions, stock-specific harvests, and age composition. Having a dedicated sampling crew with knowledge of the intricacies of each buying station and the timing of when to arrive at each station helped to maximize the number of samples collected. The inseason adjustments made to increase the sampling rate from the beaches with the lowest number of collections allowed for a more representative sample to be collected. A record of the statistical area of harvest is required for each sample used in the MSA, and samplers were diligent in determining the statistical area of harvest; however, this can be difficult when receiving stations have fish that could have been harvested from more than 1 statistical area.

For tissue sampling, we used a different sampling protocol than was used in previous years, which worked seamlessly, and the new method was easier for crews to manage because the Whatman tissue collection cards were paired with the gum cards used for scale collections and both cards had 10 positions each. Additionally, all receiving stations and processors allowed crews to examine fish internally for positive sex identification of smaller fish, which was appreciated by ADF&G staff.

Age Composition

Similar to recent years (2013–2015), the earliest stratum in 2016 was composed of primarily younger fish (jacks and age-1.2 fish), and as the season progressed, the age composition shifted to older fish, with samples collected in August being primarily of age-1.3 and age-1.4 fish (Figure 9; Eskelin et al. 2013; Eskelin and Barclay 2015, 2016). Jacks composed 14% of the harvest in the Kasilof Section "Early" stratum (Table 13), which was higher than in any other stratum but not nearly as high as what was observed for the Kasilof Section "Early" stratum in past years when jacks composed 48%, 46%, and 39% of the Kasilof Section "Early" stratum harvest in 2013–2015, respectively (Eskelin et al. 2013; Eskelin and Barclay 2015, 2016). Age-1.2 fish composed 45% of the harvest in the Kasilof Section "Early" stratum in 2016 (Table 13), which was higher than the last 3 years when the Kasilof Section "Early" stratum was composed of 30%, 37%, and 38% age-1.2 fish in 2013–2015, respectively (Eskelin et al. 2013; Eskelin and Barclay 2015, 2016).

Historical data from ESSN Chinook salmon harvest sampling (Tobias and Willette 2010; Eskelin et al. 2013; Eskelin and Barclay 2015, 2016) indicates the percentage of jacks in the 2016 ESSN fishery was about average (1987–2016) at 7% of the total harvest but the lowest percentage observed since 2011 and second lowest observed since 2006 (Table 17 and Figure 10). The percentage of age-1.2 fish in the 2016 harvest was also about average at 29% but lower than the past 3 years when age-1.2 fish composed 43%, 32%, and 37% of harvests in 2013–2015, respectively (Table 17 and Figure 10). The combined total of jacks and age-1.2 fish in 2016 was 35%, also near the historical average, but not nearly as high as the past 3 years when jacks and age-1.2 fish combined composed 66%, 50%, and 52% of harvests in 2013–2015, respectively (calculated from Table 17). There was a slight increase in the percentage of age-1.4 fish in the harvest in 2016 (27%) compared to recent years (2013–2015), but that percentage was still well below the historical average of 37% and the 23rd lowest out of the past 30 years (Table 17). It is unclear whether the higher percentages of younger, smaller fish observed in the harvest during 2013–2015 reflect fundamental shifts in size and age at maturity, poor production from earlier years when low numbers of fish returned, good recent recruitments from favorable freshwater and marine conditions, or some combination of these factors. More years of data with complete brood year returns are needed to assess underlying mechanisms.

CODED WIRE TAG (CWT) RECOVERY

Only 3 of 13 fish observed without an adipose fin possessed a CWT, and those fish were hatchery releases into Crooked Creek, a Kasilof River tributary. It is likely that many of the 10 adipose finclipped fish that were sampled but did not have a CWT had been released into Crooked Creek or Ninilchik River as smolt because 9 of those 10 fish were age-1.2, which means they migrated to the ocean in 2014 when hatchery Chinook salmon without coded wire tags were released into Crooked Creek and Ninilchik River (Begich et al. 2017; Kerkvliet et al. 2016). The remaining adipose finclipped fish that did not possess a CWT was a jack and had therefore migrated to the ocean in 2015.

HARVEST KEPT FOR PERSONAL USE

By regulation, all salmon harvested in the ESSN fishery must be recorded on fish tickets, including those not sold but kept for personal use (Alaska Administrative Code 5 AAC 21.355 *Reporting requirements*). In most years dating back to 1993, fewer than 100 Chinook salmon in the ESSN harvest were reported as kept for personal use, but the reported harvest has been as high as 867 fish (2005; Table 19). In the last 2 years (2015 and 2016), 507 and 237 fish, respectively, were reported as kept for personal use (Table 19). We are not able to sample most fish kept for personal use because we collect samples at the receiving stations when they are sold to processors and many fish kept for personal use are not transferred to receiving sites. However, at current levels, the numbers of fish that are kept for personal use are not high enough to affect the collection of a representative sample of harvested Chinook salmon in this study.

RECOMMENDATIONS AND FUTURE STUDIES

The new tissue sampling protocol using Whatman cards instead of vials filled with ethanol worked seamlessly and will be used in future studies. In this study, we were also able to positively identify the sex of small fish by internal examination, which improved the accuracy of the sex composition estimates of small fish, so internal examination of small fish will also be retained in future studies. MSA results for 2016 were summarized for 15 geographical and temporal strata and 2 size strata, which are the most strata analyzed to date and the first time that estimates of harvest and stock compositions were stratified by beach and by size. If possible, depending on how the ESSN fishery is prosecuted and the number of tissue samples that are collected, future studies will conduct the MSA using similar strata to allow for time and area comparisons both within and among years. Information about stock compositions and harvest of "large" Chinook salmon is very beneficial to management of Kenai River Chinook salmon now that management is based primarily on "large" Kenai River Chinook salmon. The methods developed for stratifying MSA estimates by size in this study will be employed by future ESSN Chinook salmon MSA studies, including a retrospective MSA for previous years when harvest samples were collected, as time allows.

This project continues to provide useful information regarding the stock composition, stock-specific harvest, and the age, sex, and length composition of the ESSN Chinook salmon harvest. Results from this study will be used for Kenai River Chinook salmon run reconstruction, modification of escapement goals if necessary, and management decisions. ADF&G was awarded a grant from the Pacific States Marine Fisheries Commission that will continue this project in 2017. The goal for 2017 will be to collect as many representative tissue, age, sex, and length samples as possible and to stratify the MSA geographically, temporally, and by size in a manner similar to 2016.

Table 19.–Number of Chinook salmon harvested and reported as kept for personal use in the Eastside set gillnet fishery, Upper Cook Inlet, Alaska, 1993–2016.

Year	Chinook salmon harvest reported as kept for personal use (*n*)	Total reported Chinook salmon harvest (*N*)	Percent of total harvest reported as kept for personal use (%)
1993	110	14,079	0.8%
1994	13	15,575	0.1%
1995	36	12,068	0.3%
1996	43	11,564	0.4%
1997	44	11,325	0.4%
1998	48	5,087	0.9%
1999	73	9,463	0.8%
2000	33	3,684	0.9%
2001	105	6,009	1.7%
2002	14	9,478	0.1%
2003	48	14,810	0.3%
2004	255	21,684	1.2%
2005	867	21,597	4.0%
2006	38	9,956	0.4%
2007	38	12,292	0.3%
2008	26	7,573	0.3%
2009	56	5,588	1.0%
2010	40	7,059	0.6%
2011	97	7,697	1.3%
2012	39	705	5.5%
2013	122	2,988	4.1%
2014	177	2,301	7.7%
2015	507	7,781	6.5%
2016	237	6,759	3.5%

Source: ADF&G fish ticket database.

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APPENDIX A: STOCK COMPOSITION AND STOCK-SPECIFIC HARVEST ESTIMATES OF CHINOOK SALMON BY BEACH, DATE, AND SIZE (LARGE AND SMALL) IN THE EASTSIDE SET GILLNET FISHERY, UPPER COOK INLET, ALASKA, 2016

Appendix A1.–Stock composition and stock-specific harvest estimates, including mean and 90% credibility intervals of Chinook salmon by beach, date, and size (large and small) in the Eastside set gillnet fishery, Upper Cook Inlet, Alaska, 2016.

Stratum				Stock composition			Harvest		
					90% CI			90% CI	
Area	Period	Reporting Group	Size	Proportion	5%	95%	No.	5%	95%
Ninilchik	23 Jun–	Kenai R. tributaries	Large	0.002	0.000	0.016	1	0	7
Beach	9 Jul	Kenai R. mainstem	Large	0.350	0.255	0.449	163	119	209
		Kasilof R. mainstem	Large	0.033	0.000	0.085	15	0	40
		Cook Inlet other	Large	0.028	0.002	0.071	13	1	33
		Kenai R. tributaries	Small	0.005	0.000	0.025	2	0	12
		Kenai R. mainstem	Small	0.437	0.321	0.556	203	149	259
		Kasilof R. mainstem	Small	0.051	0.001	0.116	24	0	54
		Cook Inlet other	Small	0.094	0.019	0.180	44	9	84
Cohoe	23 Jun–	Kenai R. tributaries	Large	0.002	0.000	0.007	1	0	3
Beach	9 Jul	Kenai R. mainstem	Large	0.181	0.115	0.260	73	46	105
		Kasilof R. mainstem	Large	0.090	0.038	0.152	36	15	61
		Cook Inlet other	Large	0.004	0.000	0.021	2	0	8
		Kenai R. tributaries	Small	0.003	0.000	0.014	1	0	5
		Kenai R. mainstem	Small	0.535	0.423	0.652	215	170	262
		Kasilof R. mainstem	Small	0.179	0.085	0.283	72	34	114
		Cook Inlet other	Small	0.006	0.000	0.033	2	0	13
South	23 Jun–	Kenai R. tributaries	Large	0.013	0.000	0.055	4	0	15
K-Beach	9 Jul	Kenai R. mainstem	Large	0.104	0.026	0.196	28	7	54
		Kasilof R. mainstem	Large	0.288	0.198	0.391	79	54	107
		Cook Inlet other	Large	0.048	0.000	0.113	13	0	31
		Kenai R. tributaries	Small	0.010	0.000	0.041	3	0	11
		Kenai R. mainstem	Small	0.100	0.023	0.194	27	6	53
		Kasilof R. mainstem	Small	0.390	0.281	0.488	107	77	134
		Cook Inlet other	Small	0.049	0.000	0.111	13	0	30
Ninilchik	11–28 July	Kenai R. tributaries	Large	0.007	0.000	0.046	3	0	20
Beach		Kenai R. mainstem	Large	0.414	0.311	0.515	181	136	225
		Kasilof R. mainstem	Large	0.170	0.086	0.264	74	38	115
		Cook Inlet other	Large	0.007	0.000	0.046	3	0	20
		Kenai R. tributaries	Small	0.006	0.000	0.042	3	0	18
		Kenai R. mainstem	Small	0.289	0.198	0.381	126	87	167
		Kasilof R. mainstem	Small	0.104	0.043	0.179	46	19	78
		Cook Inlet other	Small	0.003	0.000	0.016	1	0	7

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Stratum				Stock composition			Harvest		
					90% CI			90% CI	
Area	Period	Reporting Group	Size	Proportion	5%	95%	No.	5%	95%
Cohoe Beach	11–28 July	Kenai R. tributaries	Large	0.002	0.000	0.007	1	0	5
		Kenai R. mainstem	Large	0.193	0.111	0.285	117	67	172
		Kasilof R. mainstem	Large	0.358	0.263	0.461	217	159	279
		Cook Inlet other	Large	0.001	0.000	0.007	1	0	4
		Kenai R. tributaries	Small	0.001	0.000	0.008	1	0	5
		Kenai R. mainstem	Small	0.204	0.129	0.287	124	78	174
		Kasilof R. mainstem	Small	0.238	0.158	0.326	144	96	197
		Cook Inlet other	Small	0.001	0.000	0.007	1	0	4
South K-Beach	11–28 July	Kenai R. tributaries	Large	0.002	0.000	0.010	1	0	6
		Kenai R. mainstem	Large	0.255	0.156	0.364	163	100	232
		Kasilof R. mainstem	Large	0.445	0.336	0.556	284	215	355
		Cook Inlet other	Large	0.002	0.000	0.009	1	0	6
		Kenai R. tributaries	Small	0.002	0.000	0.008	1	0	5
		Kenai R. mainstem	Small	0.111	0.056	0.178	71	36	114
		Kasilof R. mainstem	Small	0.182	0.112	0.259	116	71	165
		Cook Inlet other	Small	0.001	0.000	0.007	1	0	5
North K-Beach	11–28 July	Kenai R. tributaries	Large	0.002	0.000	0.009	1	0	6
		Kenai R. mainstem	Large	0.581	0.483	0.677	415	345	484
		Kasilof R. mainstem	Large	0.094	0.030	0.173	67	21	124
		Cook Inlet other	Large	0.002	0.000	0.008	1	0	6
		Kenai R. tributaries	Small	0.001	0.000	0.007	1	0	5
		Kenai R. mainstem	Small	0.243	0.164	0.323	174	118	231
		Kasilof R. mainstem	Small	0.076	0.022	0.141	54	16	101
		Cook Inlet other	Small	0.001	0.000	0.006	1	0	4
Salamatof/ E. Foreland beaches	11–28 July	Kenai R. tributaries	Large	0.002	0.000	0.009	6	0	24
		Kenai R. mainstem	Large	0.549	0.446	0.640	1,398	1,135	1,630
		Kasilof R. mainstem	Large	0.020	0.000	0.086	50	0	220
		Cook Inlet other	Large	0.001	0.000	0.007	3	0	17
		Kenai R. tributaries	Small	0.002	0.000	0.010	5	0	25
		Kenai R. mainstem	Small	0.412	0.327	0.502	1,050	833	1,278
		Kasilof R. mainstem	Small	0.012	0.000	0.058	31	0	146
		Cook Inlet other	Small	0.002	0.000	0.009	4	0	22

Note: Large fish are 75 cm METF and longer; small fish are less than 75 cm METF.

Note: Due to uncertainty in estimates with stock composition proportions less than 0.050 and stock-specific harvest estimates with the lower end of the 90% CI less than 1 fish, these estimates are not reported in the text and caution should be used in their interpretation.