Regional Operational Plan No. ROP.SF.2A.2022.02

Operational Plan: Upper Cook Inlet Commercial Eastside Set Gillnet Chinook Salmon Harvest Composition Study, 2021–2023

by

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and

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January 2022

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

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Weights and measures (metric)

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

Weights and measures (English)

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

Time and temperature

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

Physics and chemistry

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

General

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

Mathematics, statistics

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

REGIONAL OPERATIONAL PLAN NO. ROP.SF.2A.2022.02

OPERATIONAL PLAN: UPPER COOK INLET COMMERCIAL EASTSIDE SET GILLNET CHINOOK SALMON HARVEST COMPOSITION STUDY, 2021–2023

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SIGNATURE PAGE

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ABSTRACT

Age, sex, and length composition information will be collected from harvested Chinook salmon in the Upper Cook Inlet Eastside set gillnet (ESSN) commercial fishery in 2021–2023. Genetic tissues from the harvest will also be collected and archived for potential future mixed stock analysis. The primary goal of the study is to estimate the age, sex, and length composition of the Chinook salmon harvest and to estimate the harvest of large (≥75 cm METF) Kenai River Chinook salmon in the ESSN fishery for each season (2021–2023). Age, sex, and length composition will be estimated for each temporal and geographic stratum and for each season. The harvest of large Kenai River Chinook salmon will be estimated using historical (2010–2020) large fish stock compositions relative to the total large fish harvest for each temporal and geographic stratum and summed to the total for each season.

Key words: Chinook salmon, *Oncorhynchus tshawytscha*, Kenai River, eastside set gillnet, commercial fishery, ESSN, upper Cook Inlet, MSA, stock-specific harvest

INTRODUCTION

PURPOSE

Harvest estimates by age, sex, and length of Kenai River Chinook salmon in the Eastside set gillnet (ESSN) commercial fishery are needed for effective management, improved understanding of stock productivity, brood table development, and for setting and attaining escapement goals. This project will collect and analyze age, sex, and length (ASL) compositions of Chinook salmon harvested in the ESSN commercial fishery. The harvest of large (75 cm mid eye to tail fork and longer) Kenai River Chinook salmon will be estimated each year for each temporal and geographic stratum using the range and average stock composition estimates generated from genetic mixed stock analysis for 2010, 2011, and 2013–2020 (Table 1); for each year, these stratum estimates of harvest will be summed to estimate the total Kenai River large Chinook salmon harvest during 2021–2023.

The Alaska Department of Fish and Game (ADF&G) Division of Sport Fish (SF) will be responsible for the collection of ASL data as well as genetic tissue samples to be used in a mixed stock analysis (MSA), though funding is not currently available to do so. Tissue samples will be archived at the Division of Commercial Fisheries (CF) Gene Conservation Lab (GCL), which will be responsible for the mixed stock analysis (MSA) if funding becomes available.

BACKGROUND

All 5 species of Pacific salmon are harvested by the commercial fisheries in Upper Cook Inlet (UCI). Sockeye salmon (*Oncorhynchus nerka*) compose the majority of the harvest (Marston and Frothingham 2019) but Chinook salmon (*O. tshawytscha*) are also harvested. 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 (Marston and Frothingham 2019). Most of the UCI commercial Chinook salmon harvest occurs 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 and 2). On average since 2011 (recent 10-year average), the ESSN fishery has accounted for 57.0% of all Chinook salmon harvested in UCI commercial fisheries (Shields and Frothingham 2018; Marston and Frothingham 2019).

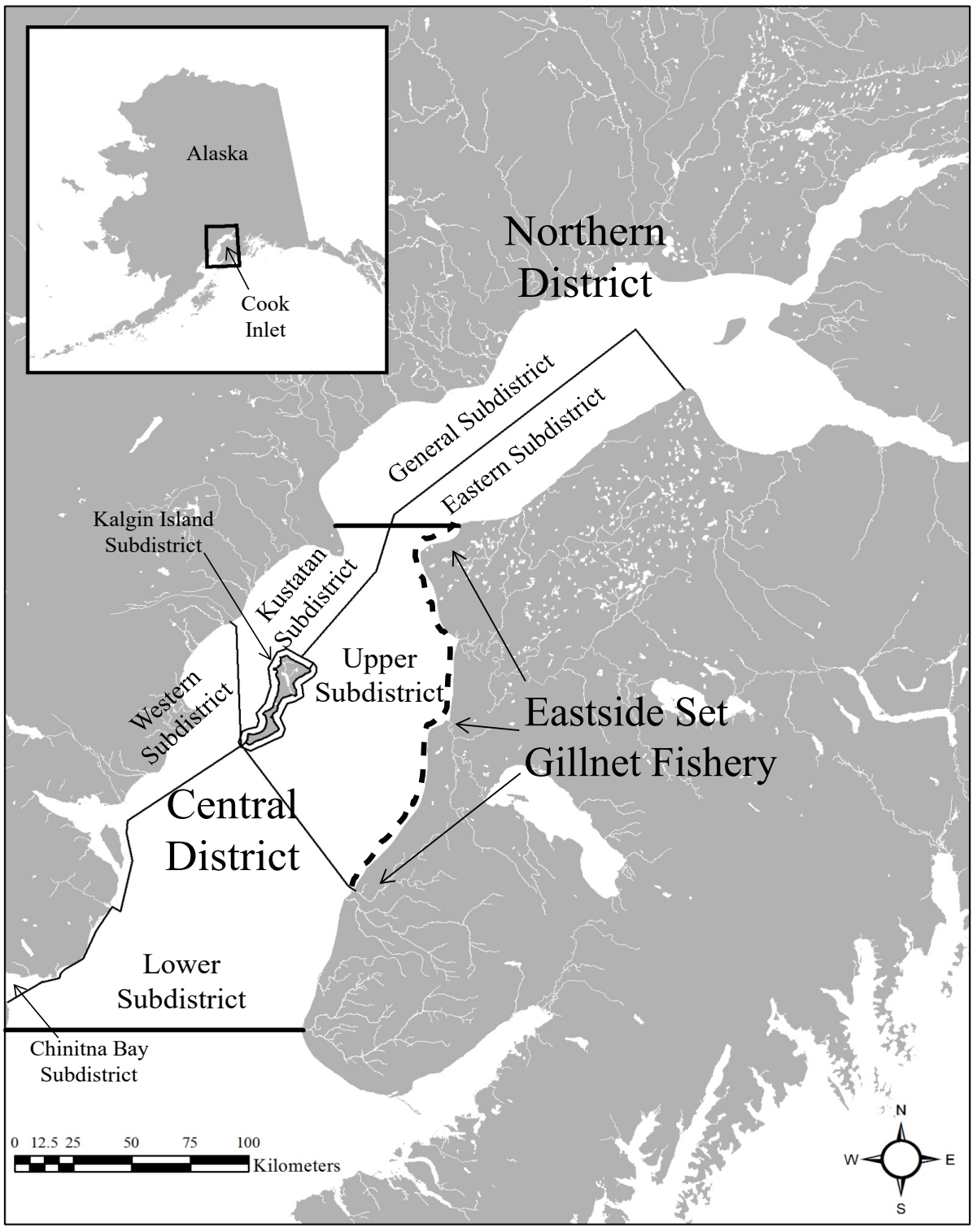

Figure 1.–Map of Upper Cook Inlet commercial fishing districts and subdistricts.

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.

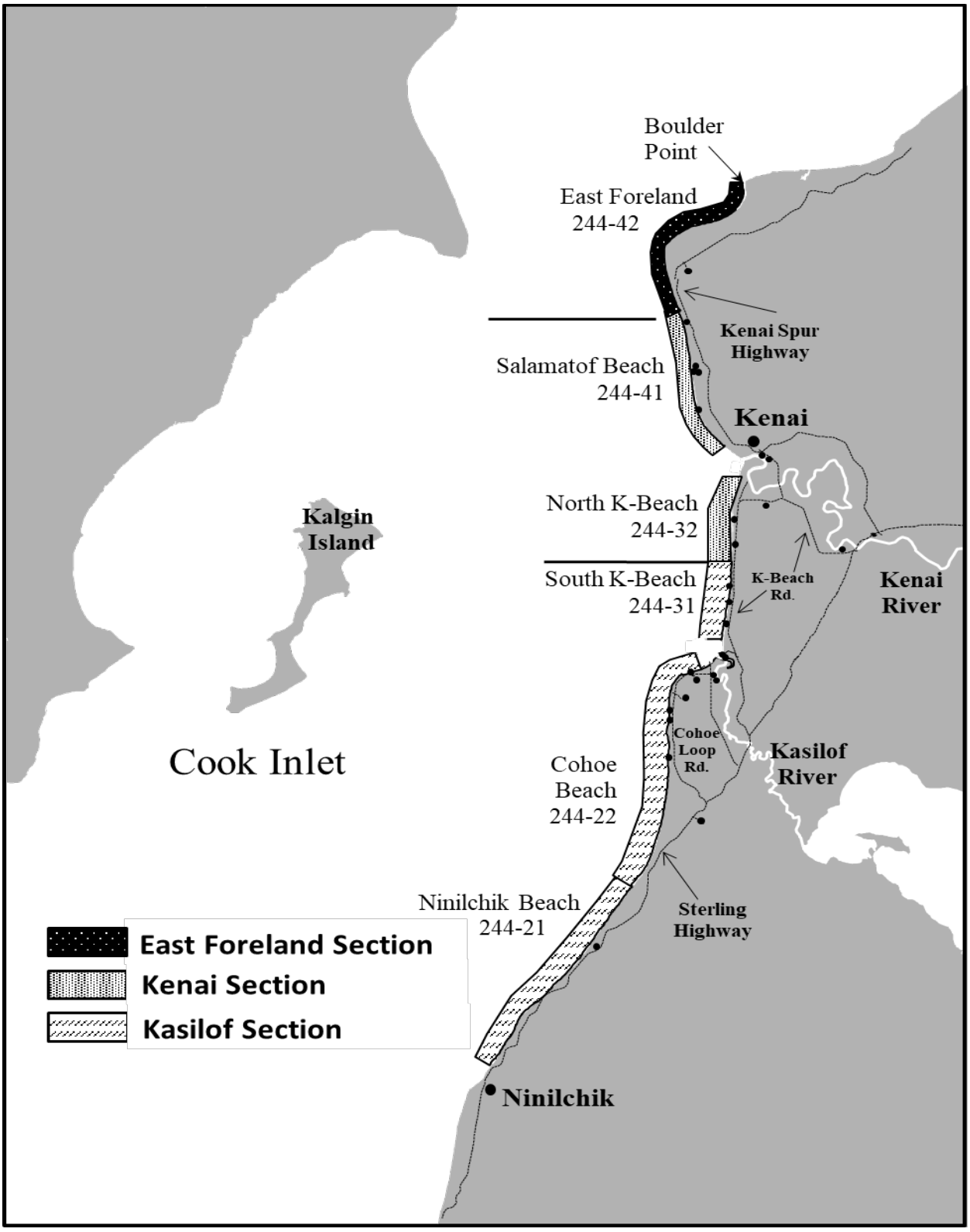

Figure 2.–Map of Upper Cook Inlet Eastside set gillnet commercial fishing statistical areas.

Note: Small circles represent approximate locations of processing plants or receiving sites.

Table 1.–Total large (≥75 cm METF) fish harvest, large Kenai River mainstem fish harvest, and proportion Kenai River mainstem by temporal and geographic stratum and year in the Eastside set gillnet fishery, Upper Cook Inlet, Alaska, 2010, 2011, and 2013–2020.

	Kasilof Section "Early"			Kasilof Section "Late"			Kenai/EF sections "Late"		
Year	Total large fish harvest	Kenai River mainstem large fish harvest	Proportion Kenai River mainstem	Total large fish harvest	Kenai River mainstem large fish harvest	Proportion Kenai River mainstem	Total large fish harvest	Kenai River mainstem large fish harvest	Proportion Kenai River mainstem
2010	149	98	0.66	1,683	574	0.34	1,133	1,084	0.96
2011	640	463	0.72	1,755	835	0.48	871	869	1.00
2013	83	65	0.78	233	170	0.73	418	385	0.92
2014	51	38	0.73	217	117	0.54	167	162	0.97
2015	184	90	0.49	720	401	0.56	1,575	1,545	0.98
2016	429	267	0.62	1,046	467	0.45	1,952	1,836	0.94
2017	473	338	0.71	1,072	672	0.63	1,719	1,636	0.95
2018[a]	139	107	0.77	353	220	0.62	230	229	0.99
2019	68	38	0.56	503	184	0.37	453	391	0.86
2020	79	36	0.46	66	36	0.54	100	94	0.94
Average	230	154	0.65	765	368	0.52	862	823	0.95
Minimum	51	36	0.46	66	36	0.34	100	94	0.86
Maximum	640	463	0.78	1,755	835	0.73	1,952	1,836	1.00

Source: Eskelin and Barclay (*In prep*)

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 the 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. The East Foreland Section comprises East Foreland Beach and has historically been fished concurrently with the Kenai Section. Chinook salmon harvest from East Foreland Beach is low; consequently, for this study, harvest from the East Foreland Section will be combined with the Kenai Section.

The Kasilof Section opens by regulation on the first Monday or Thursday on or after 25 June; however, if ADF&G estimates that 30,000 sockeye salmon are in the Kasilof River on or after 20 June but before 25 June, the ADF&G Commissioner shall open the fishery by emergency order (EO). The Kenai and East Foreland sections open by regulation on the first Monday or Thursday on or after 8 July (5 AAC 21.310). However, the North K-beach statistical area can open as early as July 1 but must be restricted to within 600 ft of the mean high tide mark prior to 9 July. Openings restricted to within 600 ft of the mean high tide mark are also possible for beaches restricted to normal opening dates for each section. KRSHA can be opened separately at any time to concentrate harvest of Kasilof River sockeye salmon while minimizing harvest of other stocks. The ESSN fishery closes on 15 August. Marston and Frothingham (*In prep*) will give specific details regarding management of the ESSN fishery.

Research History

Age, sex, and length (ASL) samples have been collected from Chinook salmon harvested in the ESSN fishery since 1983 (Tobias and Willette 2002). Beginning in 2010, tissue samples were also collected from the ESSN fishery for mixed-stock analysis (MSA) using a UCI Chinook salmon genetic baseline first developed in 2012 by Barclay et al. (2012) including 30 populations and 38 genetically variant single nucleotide polymorphism (SNP) loci and since augmented to include 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 used for the ESSN mixed stock analysis only includes 54 of the 55 populations reported in Barclay and Habicht (2015).

Collection of ESSN tissue samples for mixed-stock analysis (MSA) has continued, and increased funding since 2013 has amplified the sampling rate and provided for better coverage of the fishery. Stock compositions and stock-specific harvest estimates have been produced for each year since 2010, except 2012 due to an inadequate number of samples for conducting an MSA (Eskelin and Barclay 2016, 2017, 2018, 2019, 2020; Eskelin and Barclay 2015). 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). Reporting groups were

chosen based on 1 or more of the following criteria: 1) genetic similarity among populations, 2) the expectation that proportional harvest would be greater than 5%, or 3) ability to answer fishery management questions.

In the meantime, management of Kenai River Chinook salmon has transitioned to assessment and management based on sonar estimates of Chinook salmon that are 75 cm from mid eye to tail fork (METF) and longer, hereafter referred to as "large" fish, and those less than 75 cm METF referred to as "small fish." This modification to the management plan to manage for "large fish" escapement was finalized at the 2017 UCI Alaska Board of Fisheries (BOF) meeting and updated at the 2020 UCI BOF meeting. To support the new management regime and to provide as much pertinent information as possible, methods were developed to estimate stock compositions and stock-specific harvest of ESSN Chinook salmon stratified by size (i.e., large and small fish as defined above). Time, area, and size-stratified estimates were produced for all years since 2010 except for 2012 (Eskelin and Barclay 2016, 2017, 2018, 2019, 2020; Eskelin and Barclay 2015; Eskelin and Barclay *In prep*).

Currently, due to budgetary constraints, there is no funding available for the analysis of tissues to produce stock compositions and stock specific harvest estimates using MSA, so the harvest of large Kenai River Chinook salmon will be estimated using the historical (2010, 2011, 2013–2020) average and range of large fish stock compositions relative to the total large fish harvest. If funding becomes available to conduct MSA, methods will be the same as used recently (Eskelin and Barclay 2020).

OBJECTIVES

PRIMARY OBJECTIVES

1) 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) Estimate the harvest of large Kenai River Chinook salmon harvested in the ESSN fishery.
2) Sample 30% of the Chinook salmon harvested in the ESSN fishery for tissue, scales, sex, and METF length.
3) Estimate the age, sex, and length composition of the Chinook salmon harvest.

METHODS

STUDY DESIGN

Reported Chinook Salmon Harvest

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*). Along with the number of fish harvested, the ticket includes information on the date and location of the harvest. Fish ticket information will be entered into the ADF&G fish ticket database by ADF&G commercial fisheries staff and reported to the project biologist the day after

each fishery opening. Final harvest information from the ESSN fishery will be retrieved from this database and used for postseason analyses.

Sampling Strategy

During and after fishery openings, 3 ADF&G personnel will travel to the receiving sites for fish processing plants after each tide and sample harvested Chinook salmon for genetic tissue, scales, sex, and length. All Chinook salmon at each receiving site will be sampled if possible. If the technician is not able to sample all Chinook salmon at a receiving site due to time constraints, Chinook salmon will be sampled for tissue and ASL composition randomly. Generally, as many Chinook salmon as possible will be sampled, but some areas may be visited and sampled more frequently than other areas. Based on past studies, it has been more difficult to collect sufficient tissue samples from the Ninilchik Beach and South K-Beach statistical areas to meet sample size requirements, so more time may be spent sampling in those areas. North K-Beach sampling locations may also be sampled more frequently if sample size is low. Salamatof Beach may be sampled less often than other statistical areas because MSA results have consistently showed nearly all of the harvest has been composed of *Kenai River mainstem* fish, and sample size goals for that area have been easily attained in previous years. Although in recent years, the number of openings in the entire Kenai and East Forelands sections has been low and all openings have been sampled.

Each technician will be assigned a specific area to sample; however, there will be overlap in sampling areas among technicians and modifications to assigned areas may occur in season. Inseason analyses of the number of samples collected and the sampling rate by statistical area will be conducted by the project biologist and modifications will be made to the sampling strategy as necessary to meet sample size requirements for each proposed stratum.

Technicians will begin sampling most often at the southern end of their sampling area after the first round of deliveries to each buying station. Sampling at the southern end first and moving northward usually follows the fish deliveries as they occur and will maximize the number of samples collected. This sampling strategy should not introduce bias. If technicians always started at the northern end and moved southerly, they would probably collect fewer samples due to the generally later timing of deliveries from the northern end of the fishery, but it will be up to the technicians and project biologist to determine the best sampling strategy for each day. Technicians will sample during each opening at the receiving sites before harvested fish are transported to processing plants. The day following each fishing period, additional Chinook salmon samples may be collected at the fish processing plants, if deemed necessary by the project biologist.

There will probably be 20 or more receiving sites in total, spread throughout each statistical area where Chinook salmon are delivered. The number and location of receiving sites can change from year to year so prior to each field season, the project biologist will develop a list with processor contact information and a map showing possible locations to sample, which will be distributed to each technician. There will be no set schedule for times to sample at each location. Sampling times will depend on tides and the times of fishing periods. Technicians will gauge when and where they need to be to maximize sample collections, yet still sample representatively.

Tissue Sampling for MSA

A 1⅓ cm (half-inch) piece of the axillary process will be removed from each fish and placed on a Whatman paper card in its own grid space and then stapled in place. Whatman cards with tissue

samples will be placed in an airtight case with desiccant beads to preserve the tissue for DNA extraction. Tissue sampling instructions are detailed in Appendix A1. Tissues will be archived at the ADF&G Gene Conservation Laboratory in Anchorage.

Scale, Sex, and Length Sampling

Three scales will be removed from the preferred area of each fish and placed on an adhesive-coated card (Clutter and Whitesel 1956; Welander 1940). Acetate impressions will be made of the scales on the card using a 25,000 psi press, and the scale growth patterns will be viewed with a 40× microfiche reader to determine freshwater and marine residence times. Sex will generally be identified from external morphometric characteristics (i.e., protruding ovipositor on females or a developing kype on males). METF length will be measured to the nearest half-centimeter. Fish less than 75 cm METF may be, at the discretion of the technician and by approval from the receiving site attendee, examined internally to positively confirm sex by cutting a small slit in the anal opening using a plastic gut hook.

Sample Selection

Subsampling of collections is required after the season is over to ensure analyses accurately represent the harvest by time, area, size, sex, and age. The goal will be to sample at least 30% of the reported harvest. However, sampling goals will not drive the study design because the number of samples that are collected and the sampling rate is largely dependent on harvest. Samples from the same fish that are selected for and used to estimate ASL compositions will also be selected for genetic tissue and any MSA that is conducted. Strata to be used in the analysis will depend on the number of representative samples collected within each possible stratum.

Once the number of required samples for each day and statistical area is determined, samples will be selected by length and sex from all available samples on that date and statistical area. To do this, samples will be sorted by length and sex and selected systematically in line to ensure the selected sample accurately represents the samples collected by length and sex. When insufficient samples are collected, to select samples in proportion to harvest by statistical area for a given day, excess samples from the same statistical area and from the next closest day will be used to represent the harvest, but only if samples were collected within 3 days of each other and are within the same stratum. By systematically sampling by length and sex, the length and sex distribution of fish selected for analysis will be approximately equivalent to the length and sex distribution of all sampled fish within each stratum.

The goal will be to select and use a total of 100 ASL samples for each stratum, which will also satisfy sample size goals for tissue selection and MSA if funding becomes available; the MSA will be conducted using methods described in Eskelin and Barclay (2020).

Stratification of Harvest

Harvest samples will be stratified temporally, spatially (geographically), and by size (large and small; Table 2). The level of temporal and spatial stratification will be dependent on several factors: how the ESSN fishery is prosecuted; the number of representative samples of the harvest that are collected by date, area, time period, and size; the ability to provide new information; and the ability to provide comparative information from past studies. Stratification will be conducted with the assumption that MSA of tissues will be conducted eventually, so judicious effort will be made to stratify the harvest to maximize potential new information from this fishery, yet still provide comparative estimates for similar strata from previous years. In all previous years,

estimates have been produced for 3 strata: 1) Kasilof Section "Early" prior to the Kenai and East Foreland sections open for the season, 2) Kasilof Section "Late" in July after the Kenai and East Foreland sections open for the season, and 3) Kenai and East Foreland sections "Late" in July. Depending on how the fishery is prosecuted, there may be more strata added if sample sizes are met. In past studies there have been strata for August, Kasilof River Special Harvest area, and analyses by beach.

Table 2.–Summary of strata that have been used in analyses in the Eastside set gillnet Chinook salmon fishery, Upper Cook Inlet, Alaska, 2010–2020.

Time period	Geographic area	Size	Years with MSA
Early [a]	Kasilof Section	Large/Small	2010–2020 [d]
Late [b]	Kasilof Section	Large/Small	2010–2020 [d]
Late [b]	Kenai–East Foreland sections	Large/Small	2010–2020 [d]
All	Kasilof River Special Harvest Area	Large/Small	2013–2015
All	Kasilof 600 ft [c]	Large/Small	2015
August	Kasilof Section	Large/Small	2015, 2017
August	Kenai–E.F. sections	Large/Small	2014, 2015, 2017
Entire Season	All areas	Large/Small	2010–2020 [d]

[q] "Early" describes the portion of the fishery prior to the Kenai and East Foreland sections opening for the season.

[b] "Late" describes the portion of the fishery in July after the Kenai and East Foreland sections open for the season, except in 2019 which also includes early August.

[c] Kasilof Section openings restricted to within 600 feet of the mean high tide mark.

[d] No stratified analyses were conducted in 2012.

Age, Sex, and Length Sample Size and Compositions

The objective criterion (± 0.10 with 95% confidence level) for estimating the overall age composition of Chinook salmon harvested in the ESSN fishery should be achieved with approximately 170 scale samples. To arrive at this sample size, we assumed a worst-case scenario of 25% scale regeneration rate with multinomial proportions of equality among ages (Thompson 1987). We plan to collect and analyze substantially more than 170 samples every year, so we are likely to achieve much higher precision for the age composition estimates than the objective states.

DATA COLLECTION

Scale, Sex, and Length Collection

All scales, sex, and length information will be recorded on data sheets and handheld computers, including positive sex identification of small fish (Appendix B1). Data will be kept in the Soldotna ADF&G office.

Tissue Collection

Axillary processes from up to 10 fish will be stapled to each Whatman card. Each Whatman card will have a unique barcode and a numbered grid. Card barcodes (5-digit) and grid position numbers (1–10) will be recorded on data sheets for each sample (Appendix B1) and will also be entered into field computers. All Whatman cards will be stored at the Soldotna office until the end of the season then sent to the GCL for archiving and future analysis.

DATA REDUCTION

Technicians will return their scale cards, genetic cards, field data sheets, and field computers to the Soldotna office daily and will be responsible for ensuring the recorded data are legible and accurate. The project biologist will ensure all data are returned, legible, and entered correctly and will also download files from the field computer to the office computer. Age data will be entered upon scale reading analysis.

DATA ANALYSIS

Age Composition

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

$$\hat{p}_i^{(z)} = \frac{n_i^{(z)}}{n_i} \tag{1}$$

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

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

$$\mathrm{var}\left[\hat{p}_i^{(z)}\right] = \left(1 - \frac{n_i}{H_i}\right)\frac{\hat{p}_i^{(z)}\left(1-\hat{p}_i^{(z)}\right)}{n_i - 1} \tag{2}$$

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

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

$$\hat{H}_i^{(z)} = H_i \hat{p}_i^{(z)} \tag{3}$$

with variance

$$\mathrm{var}\left[\hat{H}_i^{(z)}\right] = H_i^2 \,\mathrm{var}\left[\hat{p}_i^{(z)}\right] \tag{4}$$

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

$$\hat{H}^{(z)} = \sum_{i=1}^{S} \hat{H}_i^{(z)} \tag{5}$$

and

$$\mathrm{var}\left[\hat{H}^{(z)}\right] = \sum_{i=1}^{S} \mathrm{var}\left[\hat{H}_i^{(z)}\right] \tag{6}$$

where S equals the number of sampling strata.

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

$$\hat{p}^{(z)} = \frac{\hat{H}^{(z)}}{H} \tag{7}$$

and

$$\mathrm{var}\left[\hat{p}^{(z)}\right] = \frac{\mathrm{var}\left[\hat{H}^{(z)}\right]}{H^2} \tag{8}$$

where H is the total reported Chinook salmon harvest for each year.

Sex Composition

Sex composition will be estimated using the same Equations 1–8 used to estimate age composition.

Length Composition

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

$$\bar{l}_z = \frac{1}{n_z}\sum_{i=1}^{n_z} l_i \tag{14}$$

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 var ($\bar{l}_z$) of the mean length-at-age class z will be estimated as follows:

$$\mathrm{var}(\bar{l}_z) = \frac{1}{n_z}\frac{\sum_{i=1}^{n_z}(l_i - \bar{l}_z)^2}{n_z - 1} \tag{15}$$

Large Kenai River Chinook Salmon Harvest

Estimations of large Kenai River Chinook salmon harvests in the ESSN fishery for 2021–2023 will use historical data from MSAs conducted during 2010, 2011, and 2013–2020 (Eskelin and Barclay 2016, 2017, 2018, 2019, 2020; Eskelin and Barclay 2015; Eskelin and Barclay *In prep*). The overall (2010, 2011, 2013–2020) average and range by stratum of the proportion of large Kenai River mainstem fish relative to the total large fish in the ESSN harvest will be used with each year's total large fish harvest in that stratum to estimate the large Kenai River mainstem harvest by stratum; stratum estimates will then be summed to produce annual total harvest estimates of large Kenai River Chinook salmon. The total large fish harvest in each stratum will be estimated by the proportion of large fish in the sample collection by date and statistical area. MSA estimates from the 3 strata that have been analyzed annually since 2010 are provided in Table 1. If enough samples are collected to create additional strata, estimates from similar strata in Eskelin and Barclay (*In prep)* will be used to produce estimates and ranges for each additional stratum.

An example of the method described above follows: if it is estimated that 200 large Chinook salmon are harvested in the Kasilof Section "Early" stratum in a particular year, then the point and range estimate of large Kenai River Chinook salmon harvest for that stratum will be 130 fish (200 fish × 0.65; historical average proportion in Table 1) with a range of 91 (200 fish × 0.46; historical

minimum in Table 1) to 157 fish (200 fish × 0.78; historical maximum in Table 1). Stratified estimates and the range (minimum and maximum) of each stratum will be summed to produce an overall estimate and a minimum and maximum of large Kenai River Chinook salmon harvest by the ESSN fishery for the entire season.

SCHEDULE AND DELIVERABLES

Dates	Activity
Mid–late June	Hiring and preseason training (*Eskelin*)
Late-June–mid-August	ESSN Chinook salmon harvest sampling, collection of ASL data and genetic tissue (3 *FWT II*)
October	Data edited; tissue collection transferred to GCL (*Eskelin*)
December	Final harvest estimates by date and statistical area assembled (provided by *CF management staff*). Age, sex, and length subsamples selected for composition analysis (*Eskelin and Huang*).
January	Scales aged (*Eskelin*)
	Draft ASL composition estimates completed (*Eskelin and Huang*)
Based on need	Publication of final FDS report (*Eskelin and Barclay*)

RESPONSIBILITIES

Principal investigator: *Tony Eskelin, Project Leader, Fishery Biologist II*

Duties: As project leader, responsible for writing the operational plan. Serves as the project biologist, who is responsible hiring and training personnel, supervising data collection, collating data, and transferring tissue samples and associated data to Anchorage. Responsible for all scale aging, ensuring all data is in proper format, and archiving data with RTS at the completion of the field season. Serves as the primary author on any reporting.

Co-principal investigator: *Andy Barclay, Fishery Biologist III*

Duties: Represents the Gene Conservation Laboratory and is responsible for any analysis of tissue samples for MSA and providing estimates to the project biologist and biometrician if funding for genetic analysis becomes available. Serves as coauthor on FDS reports.

Consulting Biometrician: *Jiaqi Huang, Biometrician III*

Duties: Provides guidance on sampling design and data analysis, selects samples for analysis, and assisting with preparation and editing of the operational plan and any reports.

Sampling Crew:
Vacant*, Fish and Wildlife Technician II, 20 June–16 August*
Vacant, *Fish and Wildlife Technician II, 20 June–16 August*
Vacant, *Fish and Wildlife Technician II, 20 June–16 August*

Duties: Operates State of Alaska vehicles, adheres to sampling schedule, samples harvested Chinook salmon for ASL and tissue, records data accurately, enters data into a computerized database in a timely manner, and completes miscellaneous duties as assigned.

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APPENDIX A: INSTRUCTIONS FOR TISSUE SAMPLING

Adult Finfish Tissue Sampling for DNA Analysis

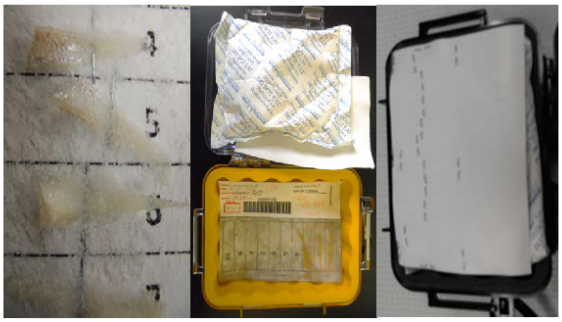
ADF&G Gene Conservation Lab, Anchorage

I. General Information

We use fin tissues as a source of DNA to genotype fish. Genotyped fish are used to determine the genetic characteristics of fish stocks or to determine stock compositions of fishery mixtures. The most important thing to remember in collecting samples is that **only quality tissue samples give quality results**. If sampling from carcasses: tissues need to be as "fresh" and as cold as possible.

Preservative used: Silica desiccant bead packet and salt dries and preserves tissues for later DNA extraction. Quality DNA preservation requires **Fast drying** (under 5 hours at 65°F); **Dry storage** (with 2 desiccant packs) in weathertight file box.

II. Sampling Method



III. Sampling Instructions

- **Every morning:** before sampling, rotate 3 desiccant packs (2-Pelican micro, 1-file box) into dehydrator @ **160^0 F** for 12 hrs. **(NOT SAMPLES)!**
- **Prior to sampling**: Set up work space, fill out required collection information (upper left hand corner only) and place Whatman genetics card (10WGC) flat for easy access; ready to sample.
- **Sampling:**
  - Wipe fin prior to sampling.
  - Briefly wipe or rinse clippers with water between samples to reduce cross contaminating.
  - Using clippers, cut one axillary fin per fish.
  - Place one clipped fin tissue onto appropriate grid space. Follow sampling order printed on card - do not deviate. If large tissue sample, center tissue diagonally on grid space.
  - **Only one fin clip per fish into each numbered grid space.**
  - Staple each sample to 10WGC (see photo).
  - Sampling complete, dust tissues with **1 tsp. non-iodized salt** to promote the preservation process.
  - Staple landscape cloth "rain fly" to paper edge (2 staples max).
- **Loading Pelican Case:**
  - 1st card: Remove blotter papers and desiccant packs from Pelican case. Place first card in Pelican case with tissues facing up. Next, place blotter paper directly over card and place one desiccant pack on top. Close and secure lid so drying begins.
  - Up to 4 cards can be added per case. Add them so **tissue samples always face the desiccant pack** through blotter paper: 2nd card facing down between desiccant packs; 3rd card facing up between desiccant packs; and 4th card facing down on top of second desiccant pack. Close and secure Pelican case after inserting each card.
  - All Whatman cards **remain in Pelican overnight** to dry flat.
- **Post-sampling storage:** Every morning, store dried tissue cards in weathertight file box at room temperature. Two desiccant packs are allocated for file box: every morning rotate 3 desiccant packs (2-Pelican, 1-file box) into dehydrator @ **160^0 F** for 12 hours. **(NOT SAMPLES)!**
- **Shipping at end of the season:** Pack 10 **dried cards** per plastic photo page, slide in manila envelope; pack inside priority mailing box. Tape box shut and tape return address on box.

IV. Supplies included in sampling kit:

1. Clippers - for cutting a portion of selected fin.
2. Whatman genetics card – holds 10 fish/card.
3. Pelican case - 1st stage of drying and holding card samples.
4. Non-iodized salt – distribute 1 tsp. non-iodized salt over each card.
5. Silica packs – desiccant removes moisture from samples.
6. Blotter paper – covers full sample card for drying; multiple use.
7. Watertight file box – dry storage prior to return shipment.
8. Plastic photo page – 10 cards per page for return shipment.
9. Manila envelope – pack dried cards in manila envelope.
10. Shipping box – put sealed manila envelope inside box.
11. Stapler – extra protection, secure sample to numbered grid.
12. Staples – only use staples provided, specific for stapler.
13. Dehydrator – oven-dry desiccant packs overnight (share w/CF).
14. Laminated "return address" labels.
15. Sampling instructions.
16. Pencil

V. Shipping: Address the sealed mailer box for return shipment to ADF&G Genetics lab.

Return to ADF&G Anchorage lab:	ADF&G – Genetics 333 Raspberry Road Anchorage, Alaska 99518	Lab staff: 907-267-2247 Judy Berger: 907-267-2175 **Freight code:** _____

APPENDIX B: SAMPLING FORMS

Appendix B1.–ESSN Chinook salmon harvest sampling form.

ESSN Chinook salmon sampling form

Date:__________ **Sampler(s):** ______________

Start Time: ________ **End Time:**_______

Scale		METF		Sex	Genetics		Sample	Stat	
Card#	**Scale#**	**Length**	**Sex**	**Verify?**	**Card#**	**Box#**	**Location**	**Area**	**CWT #**
	1								
	2								
	3								
	4								
	5								
	6								
	7								
	8								
	9								
	10								
	1								
	2								
	3								
	4								
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	9								
	10								
	1								
	2								
	3								
	4								
	5								
	6								
	7								
	8								
	9								
	10								

Sex: 1-male 2-female, verify sex for fish less than 750 cm METF (if granted permission).
Length: mid eye to fork-of-tail to nearest cm.