Fishery Data Series No. 16-54

Chinook Salmon Creel Survey and Inriver Gillnetting Study, Lower Kenai River, Alaska, 2014

by

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and

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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

FISHERY DATA SERIES NO. 16-54

CHINOOK SALMON CREEL SURVEY AND INRIVER GILLNETTING STUDY, LOWER KENAI RIVER, ALASKA, 2014

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ABSTRACT

Sport-angler effort, catch, and harvest of late-run Chinook salmon (*Oncorhynchus tshawytscha*) were estimated from a creel survey conducted on the lower Kenai River in 2014. The Chinook salmon sport fishery was closed to fishing during the entire early run (1 May–30 June) and the last 6 days of the late run (26–31 July). During the late run, anglers caught 1,465 (SE 160) and harvested 539 (SE 98) Chinook salmon with 32,063 (SE 2,779) angler-hours of effort. Guided anglers accounted for 69% of effort and 79% of harvest. The age composition of harvested late-run Chinook salmon was 10.0% age-1.1 fish, 26.7% age-1.2 fish, 30.0% age-1.3 fish, and 33.3% age-1.4 fish. A standardized gillnetting program estimated catch rates and species composition at the RM 8.6 Chinook salmon sonar site within the midriver (insonified) and nearshore (not insonified) areas, 16 May–15 August 2014. During the early run, midriver gillnets caught 134 Chinook salmon and 3,082 sockeye salmon, and nearshore gillnets caught 38 Chinook salmon and 1,267 sockeye salmon. During the late run, midriver gillnets caught 289 Chinook salmon and 4,430 sockeye salmon, and nearshore gillnets caught 54 Chinook salmon and 4,274 sockeye salmon. The estimated age composition of early-run midriver Chinook salmon was 9.4% age-1.1 fish, 41.0% age-1.2 fish, 39.3% age-1.3 fish, 9.4% age-1.4 fish, and 0.9% age-1.5 fish. The estimated age composition of late-run midriver Chinook salmon was 2.5% age-1.1 fish, 20.5% age-1.2 fish, 35.6% age-1.3 fish, 39.3% age-1.4 fish, and 2.1% age-1.5 fish. In 2014, there was no significant difference between length distributions of radiotagged Chinook salmon tracked above the tributary weirs and those sampled at the tributary weirs.

Key words: Kenai River, *Oncorhynchus tshawytscha*, Chinook salmon, creel survey, effort, harvest, gillnet, CPUE, age composition, length distribution, radio tag

INTRODUCTION

The Kenai River (Figure 1) supports the largest freshwater sport fishery in Alaska (Jennings et al. 2015). Anglers fish for Chinook salmon (*Oncorhynchus tshawytscha*), coho salmon (*O. kisutch*), sockeye salmon (*O. nerka*), pink salmon (*O. gorbuscha*), Dolly Varden (*Salvelinus malma*), and rainbow or steelhead trout (*O. mykiss*). The Chinook salmon fishery is one of most intensively managed sport fisheries in Alaska. The Kenai River Chinook salmon creel survey between the Warren Ames Bridge (river mile [RM] 5.2) and Soldotna Bridge (RM 21.1), and a standardized inriver gillnetting study at RM 8.6 are the subjects of this report (Figure 2).

Chinook salmon returning to the Kenai River exhibit 2 distinct run-timing patterns: an early run and a late run. Telemetry studies have shown Chinook salmon that spawn in tributaries of the Kenai River (early run) enter the river from late April through early July, whereas Chinook salmon that spawn in the Kenai River mainstem (late run) enter the river from mid-June through mid-August (Bendock and Alexandersdottir 1992; Burger et al. 1985; Reimer 2013). For management purposes, the early run is composed of all Chinook salmon that enter the river before 1 July and the late run is composed of all fish entering on or after 1 July. Sport anglers value fish from both runs because of their large size relative to other Chinook salmon stocks (Roni and Quinn 1995). The world record sport-caught Chinook salmon (44.1 kg; 97 lb 4 oz) was harvested from the Kenai River in May 1985.

The inriver gillnetting study and creel survey are critical for inseason management of Kenai River Chinook salmon runs. The inriver gillnetting study provides salmon species length information necessary for the RM 8.6 sonar to estimate the number of Chinook salmon passing the sonar. Daily sonar passage estimates of abundance in conjunction with creel estimates of daily harvest provide fishery managers with inseason estimates of escapement. In addition to inseason management, these projects provide data used postseason to develop management plans and escapement goals for Kenai River Chinook salmon.

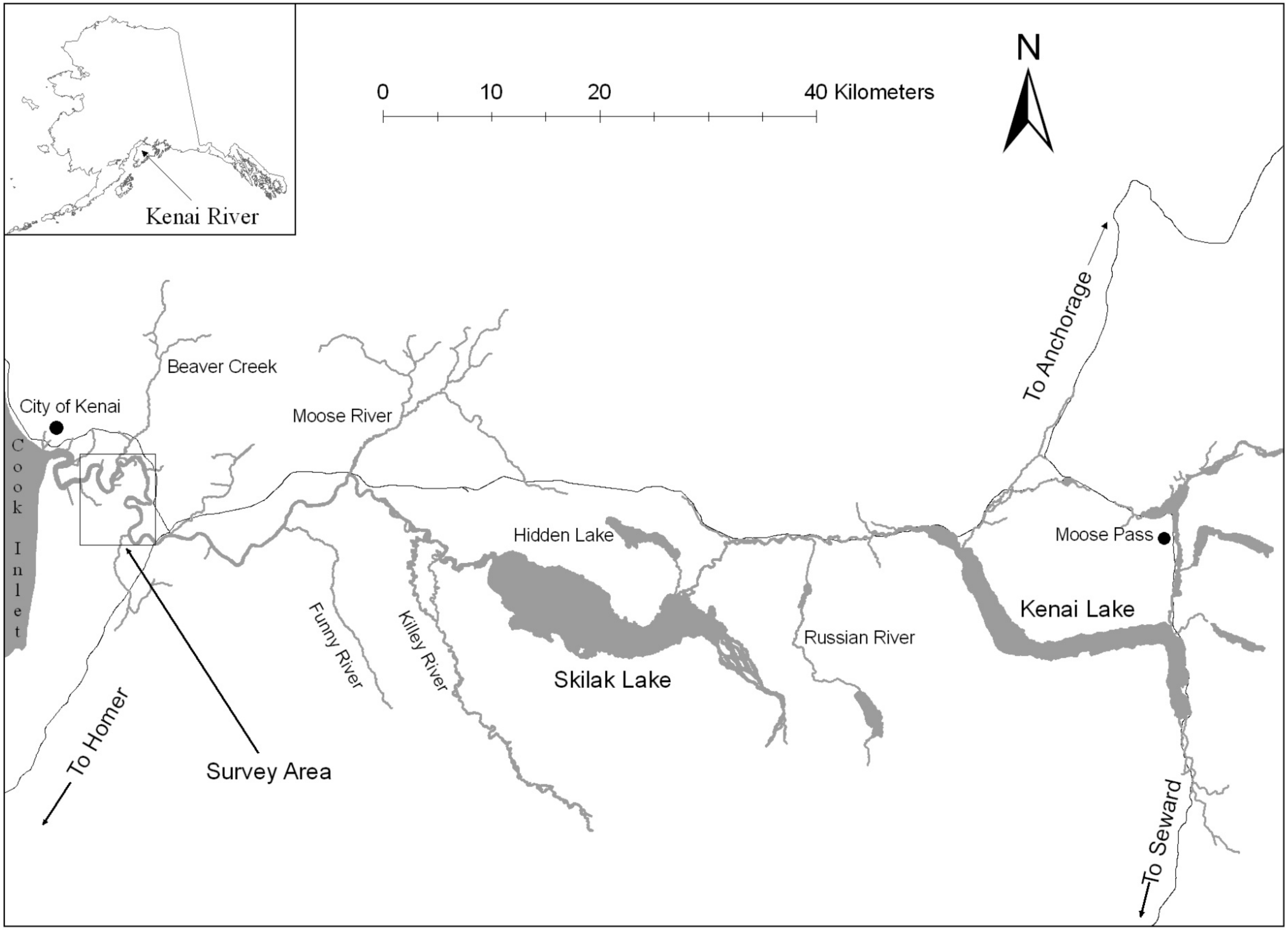

Figure 1.–Kenai River drainage on the Kenai Peninsula in Southcentral Alaska.

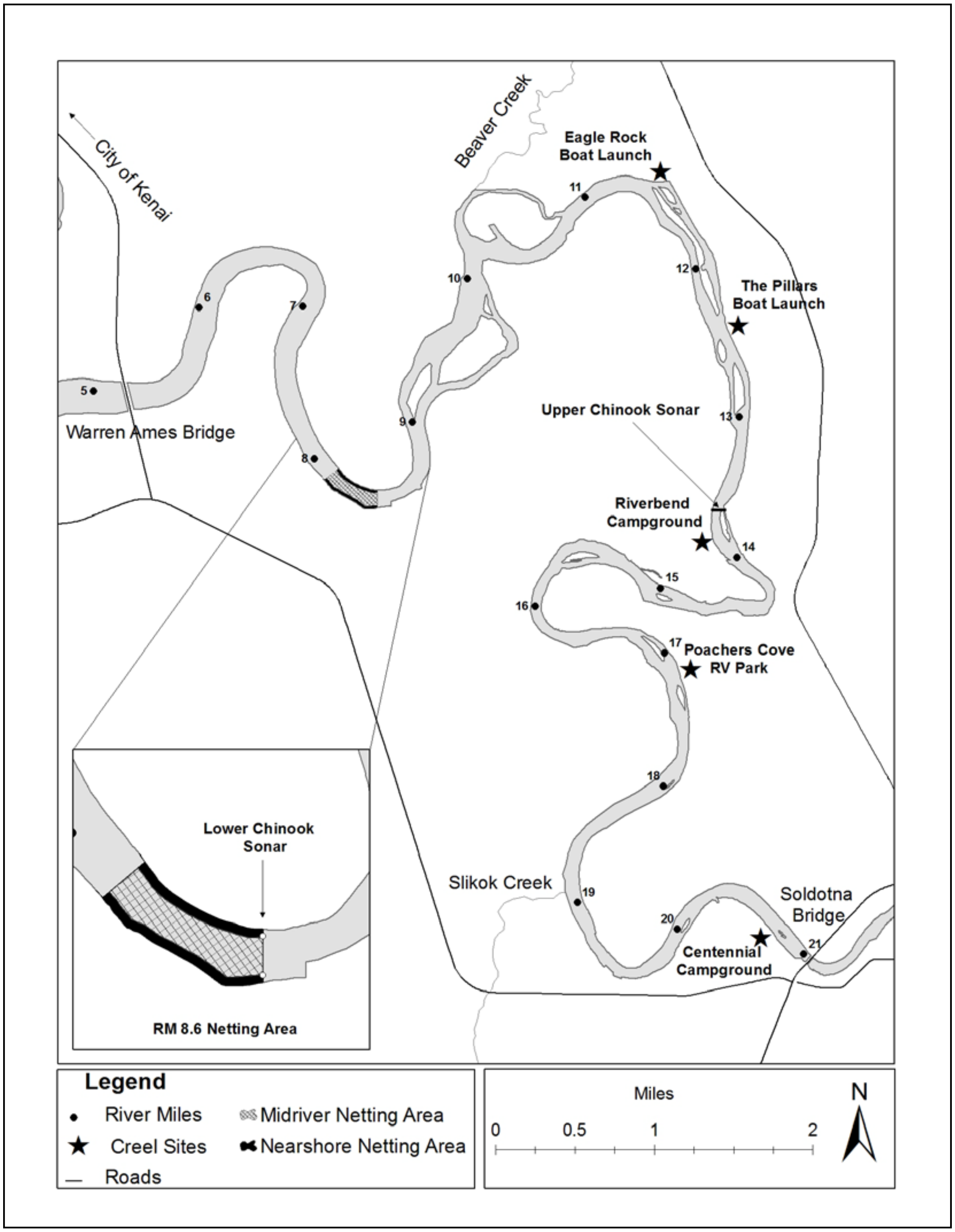

Figure 2.–Lower Kenai River from Warren Ames Bridge (RM 5.2) to Soldotna Bridge (RM 21.1).

CREEL SURVEY

The Alaska Department of Fish and Game (ADF&G) implemented a creel survey in 1974 in response to an increase in the number of boat anglers targeting Chinook salmon and to monitor the age, sex, and length (ASL) composition of harvested Chinook salmon. The inriver creel survey estimates sport harvest and catch of Chinook salmon, and sport angler effort, between the Warren Ames Bridge and the Soldotna Bridge. The late-run sport fishery is more popular than the early-run sport fishery, but angler effort and harvest for both runs have declined significantly since 2007 due to low Chinook salmon runs and fishery restrictions. The majority of the Chinook salmon sport harvest occurs downstream of the Soldotna Bridge (Jennings et al. 2015) where the creel survey is currently conducted.

INRIVER GILLNETTING

Beginning in the mid-1980s, mark–recapture studies using gillnets for the marking phase were used to estimate the inriver run of Chinook salmon (Hammarstrom and Larson 1984). Various capture techniques for adult Chinook salmon have been evaluated and the use of drift gillnets was found to be the most effective to date. The ADF&G Division of Sport Fish (SF) began using sonar in 1987 to estimate the inriver run of Chinook salmon and the inriver gillnetting program provided age-sex-length (ASL) compositions of the inriver run. The gillnetting program was standardized in 1998 to include catch rates (CPUE) and further standardized in 2002 to include species composition of fish passing through the insonified (midriver) area of the RM 8.6 Chinook salmon sonar site (Reimer 2004b). During 2002–2012, the inriver gillnetting program remained relatively unchanged and was conducted exclusively within the midriver area insonified by the RM 8.6 sonar. Although the netting program has provided an estimate of the ASL composition of fish passing through the midriver insonified area, recent studies suggest the ASL composition estimate may not always be representative of the Chinook salmon runs. Data collected by Miller et al. (2014) found significant numbers of Chinook salmon migrated shoreward of the transducers during high tide, and Chinook salmon captured shoreward of the transducers were found to be shorter in length than those captured midriver (Perschbacher 2015). These findings were consistent with weirs operated by the United States Fish and Wildlife Service (USFWS) on the Killey River (Gates and Boersma 2013) and the Funny River (Boersma and Gates 2013) that sampled relatively larger numbers of small Chinook salmon than the sonar and gillnetting program could account for.

As a result of the 2011–2013 studies, several modifications were made to the 2014 netting study in order to capture a more representative sample of returning Chinook salmon. Netting effort was doubled (from 6 to 12 hours per day) and divided equally between insonified and noninsonifed areas, throughout all tide stages. Netting shoreline to shoreline also corresponds to the future RM 13.7 sonar that will insonify the entire river, shoreline to shoreline, beginning in 2015 (Miller et al. 2016). In addition to the modifications to the traditional netting study at RM 8.6, a separate pilot study investigated the use of a tangle net and netting at an alternative site (RM 12) that is upstream of major tidal influence and closer to the future RM 13.7 sonar site.

MANAGEMENT PLANS

The Alaska Board of Fisheries (BOF) has adopted separate management plans for the early and late Kenai River Chinook salmon runs. Management within these plans utilizes inseason estimates of inriver run and harvest. Estimates of inriver run are obtained with sonar (Key et al. 2016a), whereas estimates of harvest are obtained from creel surveys (Perschbacher 2015).

The early run is managed to attain an optimal escapement goal (OEG) of 5,300 to 9,000 Chinook salmon. If the spawning escapement is projected to exceed 9,000 fish, the fishery may be liberalized to allow bait. If the spawning escapement is projected to be less than 5,300 fish, ADF&G may close the fishery or implement more conservative regulations (adopted by BOF) that restrict harvest of Chinook salmon less than 55 inches total length (TL). In 2002, BOF introduced a slot limit (harvest restricted between minimum and maximum sizes) into the *Kenai River and Kasilof River Early-Run King Salmon Conservation Management Plan* (Alaska Administrative Code 5 AAC 56.070). Under the current slot limit, anglers must release Chinook salmon measuring 42–55 inches TL until 1 July from the Kenai River mouth upstream to 300 yards below Slikok Creek (approximately RM 18.7), and until 15 July from RM 13.7 to Skilak Lake (RM 50). The slot limit regulation was implemented to protect early-run Chinook salmon that spend 5 winters in salt water.

Management of the late-run Chinook salmon sport fishery is more complex because multiple fisheries harvest Chinook salmon prior to the inriver sport fishery. The inriver late-run Chinook salmon sport fishery is managed under the *Kenai River Late-Run King Salmon Management Plan* (5 AAC 21.359), which mandates the late run be managed to achieve a sustainable escapement goal (SEG) of 15,000 to 30,000 Chinook salmon. The current management plan adopted by the BOF allows the use of bait during the late run beginning 1 July from the Kenai River mouth upstream to the outlet of Skilak Lake. If the spawning escapement is projected to exceed 30,000 fish, the fishery may be liberalized to allow harvest of Chinook salmon through the first week of August. If the spawning escapement is projected to be less than 15,000 fish, ADF&G may close the inriver fishery or implement more conservative regulations (adopted by BOF) such as restricting the use of bait, allowing catch-and-release fishing only, or reducing the amount of river open to Chinook salmon fishing. If the inriver fishery is restricted, other Cook Inlet sport fisheries, personal use fisheries, and Cook Inlet commercial fisheries are also restricted.

OBJECTIVES

PRIMARY OBJECTIVES

Objectives for the 2014 study were as follows:

1) Estimate catch and harvest of Chinook salmon[1] by the sport fishery in the mainstem Kenai River between the Warren Ames and Soldotna bridges from 16 May through 30 June (early run), and from 1 July through 31 July (late run) such that the estimates for each run are within 20%, or 1,000 fish, of the true values 95% of the time[2].

2) Estimate the proportion by age of Chinook salmon passing through the insonified zone (midriver) at RM 8.6 for the early and late runs such that all age-proportion estimates for each run are within 10 percentage points of the true values 95% of the time[3].

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1 Harvest is the number of fish caught and retained whereas catch is the total number of fish caught (including those intentionally released).

2 High precision is neither possible nor necessary when the harvest is small; meeting the absolute precision goal is sufficient in this case.

3 Within d of the true value A% of the time implies: $P(p_i - d \le \hat{p}_i \le p_i + d) = A/100$ for all i, where p_i denotes population age proportion for age class i.

3) Estimate the proportion by age of Chinook salmon harvested by the sport fishery in the mainstem Kenai River between the Warren Ames and Soldotna bridges such that all age-proportion estimates for each run are within 20 percentage points of the true values 80% of the time.

4) Using a Kolmogorov-Smirnov (K-S) test with Type I error probability $\alpha = 0.05$, test the hypothesis that the length distribution of early-run Chinook salmon is equal for a) fish caught by gillnet and radiotagged at RM 8.6 that migrate above the Funny and Killey river weirs and b) all fish that pass the Funny and Killey river weirs. A finding of different size compositions (null hypothesis [H_0] rejected) would be interpreted as evidence that the gillnet sample is not representative of early-run Chinook salmon passing RM 8.6.

SECONDARY OBJECTIVES

Secondary objectives can be accomplished without driving study design or sample size.

1) Estimate total sport angler effort in angler-hours by run. Precision of the effort estimates is driven by that of the catch and harvest estimates (Objective 1).

2) Estimate catch per unit effort (CPUE) and harvest per unit effort (HPUE) between the Warren Ames and Soldotna bridges of sport anglers for days surveyed where effort is measured in angler-hours.

3) Estimate daily CPUEs (where effort is measured in drift-minutes) of Chinook salmon and sockeye salmon captured in midriver gillnets at RM 8.6 to index run strength and run timing for fisheries managers.

4) Insert esophageal radio transmitters into Chinook salmon captured in inriver gillnets between 16 May and 15 August in conjunction with the *Kenai River Chinook Salmon Abundance and Migratory Timing* study (Reimer 2014).

5) Collect tissue samples for genetic analysis from Kenai River Chinook salmon sampled from inriver gillnets and the sport fish harvest.

6) Collect Secchi disk and water temperature readings midchannel at RM 15.3 during creel survey sampling days, and collect daily Secchi disk readings and tidal conditions at RM 8.6.

7) Examine Chinook salmon sampled from the sport harvest and the inriver drift gillnets for external sexual characteristics, absence of an adipose fin, and presence of a radio tag.

8) Estimate CPUE of Chinook salmon captured in drift gillnets in relation to tide stage at RM 8.6.

9) Determine the age, sex, and length compositions of Chinook salmon captured nearshore in drift gillnets at RM 8.6.

10) During the early run, investigate the feasibility of sampling Chinook salmon with drift gillnets (4.5-inch, 5.0-inch, and 7.5-inch mesh sizes) upstream of major tidal influence near RM 12.

METHODS

CREEL SURVEY

A stratified, 2-stage roving-access creel survey (Bernard et al. 1998) was conducted to estimate sport fishing effort, catch, and harvest of Chinook salmon from the Warren Ames Bridge (RM 5.2) to the Soldotna Bridge (RM 21.1) (Figure 2). Although the 2014 creel survey was scheduled for 16 May–31 July, fishery closures restricted the creel survey to 1–25 July. First-stage sampling units were days. The unguided angler-day was assumed to be 20 h long (4:00 AM to 12:00 AM), whereas the guided angler-day was 12 h long (6:00 AM–6:00 PM) by regulation. Daily catch and harvest were estimated as the product of effort (angler-hours) and CPUE or HPUE. Second-stage units for estimating angler effort, catch, and harvest were periodic angler counts and angler trips. Angler trips were sampled by interviewing anglers at the end of their fishing trips.

Stratification was used to account for the geographical, temporal, and regulatory factors affecting the fishery (Table 1). Because unknown harvest occurring downstream or upstream of a sonar site would affect inriver run or escapement estimation, angler counts were geographically stratified into the following 3 areas: 1) between the Warren Ames Bridge and the lower Chinook salmon sonar site (RM 8.6), 2) between the lower Chinook salmon sonar site (RM 8.6) and the upper Chinook salmon sonar site (RM 13.7), and 3) between the upper Chinook salmon sonar site (RM 13.7) and the Soldotna Bridge.

The current Chinook salmon sonar site at RM 8.6 has been the location for estimating Chinook salmon runs since 1987, and the new Chinook salmon sonar site at RM 13.7 will be used for estimating and managing the Chinook salmon runs beginning in 2015. Angler counts upstream and downstream of RM 8.6 were used to meet project objectives for sport angler effort, catch, and harvest estimation. Angler counts between RM 8.6 and RM 13.7 were used to provide preliminary estimates of sport angler effort, catch, and harvest occurring between the 2 sonar sites. Angler counts between the RM 8.6 site and the RM 13.7 site were used for preliminary estimation of sport angler effort, catch, and harvest between sonar sites. Only counts upstream and downstream of RM 8.6 were required to meet project objectives.

Although angler counts had 3 geographic strata, angler interviews did not because past attempts to estimate catch and harvest downstream of RM 8.6 using geographically stratified angler interviews were ineffective due to small sample size (Marsh 2000). Therefore, catch and harvest downstream of RM 8.6 were based on estimated effort downstream of the sonar site, and CPUE and HPUE were assumed constant throughout the entire study area.

Table 1.–Sampling strata used for conducting Kenai River Chinook salmon angler counts and estimating creel statistics, 2014.

Type	Number of strata	Description
Geographic [a]	3	Warren Ames Bridge (RM 5.1) to lower Chinook salmon sonar site (RM 8.6)
		Lower Chinook salmon sonar site (RM 8.6) to upper Chinook salmon sonar site (RM 13.7)
		Upper Chinook salmon sonar site (RM 13.7) to Soldotna Bridge (RM 21.1)
Temporal [b]	4	Late run: 1–6 July, 8–13 July, 15–20 July, 22–25 July
Day type [c]	3	Weekdays
		Weekends or holidays
		Late-run Mondays
Angler type	2	Guided
		Unguided

[a] Used for angler counts only.

[b] The early-run sport fishery was closed to all Chinook salmon fishing from 1 May to 30 June. The use of bait was prohibited in the late-run sport fishery from 1 to 31 July, and the fishery was closed to harvest of Chinook salmon from 19 to 25 July and closed to all Chinook salmon fishing from 26 to 31 July.

[c] Creel statistics for Mondays were not sampled but were estimated using an index during the late run.

Because harvest and catch rates can differ by time and angler type, the creel survey was stratified temporally by week and day type (weekdays or weekends and holidays), and by angler type (guided or unguided). Two of 4 available weekdays and both weekend days were sampled each week the fishery was open to Chinook salmon fishing. Due to budgetary constraints, nonholiday Mondays ("late-run Mondays") were assessed with an "index" angler count and an ad hoc procedure to generate effort, catch, and harvest estimates[4].

Angler Counts

Four angler counts were conducted during each sampled day. The first count began at the start of a randomly chosen hour between 4:00 AM and 8:00 AM with the remaining counts occurring every 5 hours thereafter. This schedule ensured that at least 2 angler counts were conducted while guided anglers were fishing (between 6:00 AM and 6:00 PM) each day.

Counts were conducted from a survey boat between the Soldotna Bridge and the Warren Ames Bridge, a distance of 15.9 mi. To maximize interview time, the direction (upstream or downstream) traveled to conduct angler counts was preselected to minimize total distance traveled and time spent conducting the count. Anglers were counted while driving the survey boat through the survey area, and counts were typically completed in less than 1 hour. Angler counts were treated as instantaneous counts; they reflect fishing effort at the time the count began. Anglers were counted if they were fishing or rigging their lines when observed during an angler count. Boats were counted as fishing if the boat contained at least 1 angler. Hand-held counters were used to sum the following categories for each geographic stratum: 1) unguided power boats, 2) unguided drift boats, 3) guided power boats, 4) guided drift boats, 5) unguided

[4] See "Angler Effort, Catch, and Harvest on Mondays" in the Data Analysis section for an explanation of Monday angler counts.

anglers in power boats, 6) unguided anglers in drift boats, 7) guided anglers in power boats (excluding the guide), 8) guided anglers in drift boats (excluding the guide), 9) active boats[5], and 10) non-active boats[6]. Only categories 5–8 were required for this project; categories 1–4, and 9–10 were supplementary information for management purposes.

A single boat count was completed between 10:00 AM and 2:00 PM for each Monday of the late run (restricted to unguided drift boats) to generate index estimates of effort, catch, and harvest.

Angler Interviews

Anglers who completed fishing were interviewed at the following boat launch sites (Figure 2):

1) Eagle Rock Campground
2) Pillars Boat Launch
3) Riverbend Campground
4) Poacher's Cove
5) Centennial Campground

For each day sampled, the first randomly scheduled boat count of the day was completed prior to conducting interviews (5:00–9:00 AM). There were 4 time intervals per day during which interviews could be conducted: 3 intervals between consecutive angler counts and 1 interval after the last angler count. There was a smaller probability of being sampled the first 1–4 hours of the angler day than other times of day; however, the chance of introducing length-of-stay bias (Bernard et al. 1998) was small based on similar CPUE and HPUE rates observed among the 4 interview time intervals (Reimer 2003). Interview location was chosen with replacement from the locations available. Time and boat launch were paired randomly.

The following information was recorded for each interviewed angler: 1) time of interview, 2) boat type (power or drift), 3) angler type (guided or unguided angler), 4) number of hours spent actively fishing downstream of the Soldotna Bridge[7], 5) whether the angler fished exclusively upstream or exclusively downstream of the upper sonar site (RM 13.7), or fished both upstream and downstream of RM 13.7, 6) number and location of Chinook salmon harvested downstream of the Soldotna Bridge[8], and 7) number of Chinook salmon released downstream of the Soldotna Bridge.

Age, Sex, and Length of the Sport Harvest

Harvested Chinook salmon were sampled for ASL during angler interviews. Sex was identified from external morphological characteristics (i.e., protruding ovipositor on females or a developing kype on males). Lengths from mid eye to tail fork (METF) were measured to the nearest half-centimeter. Three scales were removed from the right side of the fish approximately 3 rows above the lateral line along the posterior insertion of the dorsal fin to the anterior insertion of the anal fin and placed on an adhesive coated card. Acetate impressions of the scales were aged using a microfiche reader.

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[5] Boats were counted as active boats if there were no anglers actively fishing from the boat but the boat and motor were in operation.

[6] Boats were counted as non-active boats if there were no anglers actively fishing from the boat and the motor was not in operation, but it was obvious the motor had been run during the day.

[7] Hours fishing were rounded to the nearest 0.25 hour and included when an angler's line was in the water or being rigged but did not include travel time or time after an angler had harvested a fish.

[8] Location of harvested Chinook salmon was recorded as 1) upstream of upper sonar site, 2) between upper sonar and lower sonar sites, or 3) below lower sonar site.

All harvested fish were inspected for an adipose fin. A missing adipose fin indicated the fish was either missing the fin naturally or received a coded wire tag as a juvenile. Presence of a coded wire tag may identify a hatchery-produced Chinook salmon stray or a wild Chinook salmon tagged in another river system that strayed to the Kenai River. If a fish without an adipose fin was found, and permission was granted from the angler, the fish's head was removed and examined postseason for a coded wire tag.

Additionally, all harvested Chinook salmon sampled in the creel survey were examined for the presence of an esophageal radio transmitter. If a fish with a radio transmitter was found, the transmitter was collected, and the date and location (RM) the angler caught the Chinook salmon were recorded.

INRIVER GILLNETTING

In 2014, inriver gillnetting was conducted each day from 16 May through 20 August. The inriver netting area was approximately 0.3 RM in length, located immediately downstream of RM 8.6 (Figure 2). As a result of size-selective sampling observed during the 2013 nearshore netting study and recent USFWS tributary weir data, several modifications were done in 2014 to the former netting protocol (see Perschbacher 2015) in an attempt to capture a more representative sample of the Chinook salmon runs by size and age. The modifications were as follows:

1) Gillnetting effort was doubled with 2 crews scheduled to net in succession regardless of tide stage from 7:00 AM to 7:00 PM. A morning crew netted 6 hours (7:00 AM–1:00 PM) followed by 6 consecutive hours of netting by an afternoon crew (1:00 PM–7:00 PM).
2) Each crew was scheduled to net nearshore and midriver areas equally[9].
3) Gillnets were constructed of alternating 5.0-inch and 7.5-inch mesh panels within the same net and are referred to as "panel nets" hereafter.
4) A 30 ft deep panel net was used for netting the midriver area, and a 15 ft deep panel net was used for netting the shallow nearshore area.

The biggest modification to the netting protocol (standardized since 2002; Perschbacher 2015), was the addition of nearshore netting to the standard midriver netting protocol. Netting both nearshore and midriver, shoreline to shoreline, allows for a better correspondence with the future RM 13.7 Chinook salmon sonar site, which will insonify the river channel shoreline to shoreline. The netting schedule was also changed to set times of day rather than set by tidal stage, and was designed to examine the effects of tide stage on catch rates in order to determine optimal netting times that would produce the largest catch rates and unbiased length composition estimates of the inriver runs.

In 2014, use of single mesh nets (5.0-inch or 7.5-inch mesh) was modified to a panel net system that included both 5.0-inch and 7.5-inch mesh within each net. This modification was designed to reduce the number of nets in a boat from 4 single-mesh nets to 2 panel nets. Of the 2 panel nets required, a deep panel net (60 ft long by 30 ft deep) was used midriver, and a shallow panel net (60 ft long by 15 ft deep) was used nearshore. Depths of nets were determined based on river bottom profiles of the RM 8.6 sonar area conducted by ADF&G during 2013 (Jim Miller, Fishery Biologist, ADF&G, Anchorage, personal communication). Panel nets were constructed

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[9] During May, low tides that occurred during seasonal low water levels didn't allow for insonification or netting of nearshore areas.

by mending four 15 ft long panels (alternating 5.0-inch and 7.5-inch mesh panels) together. The panel nets were hung at a 2:1 hang ratio (length of stretched mesh to length of cork line). The mesh material used in the panel nets was the same as has been used since 2002:

1) 5.0-inch (stretched mesh) multifilament (80-meshes deep for midriver net, 40-meshes deep for nearshore net), R44 color, MS73 (14 strand) twine
2) 7.5-inch (stretched mesh) multifilament (52-meshes deep for midriver net, 26-meshes deep for nearshore net), R44 color, MS93 (18 strand) twine

Each panel net had a 5.0-inch mesh panel on one end and a 7.5-inch mesh panel on the other. To avoid having the same mesh size always drifted closest to the shoreline, the mesh size deployed towards shoreline was alternated. One sampling "replicate" consisted of 8 drifts; the first drift for each day was alternated by location (nearshore or midriver), mesh size deployed towards shoreline (5.0 inch or 7.5 inch), and direction of deployment (oriented facing left bank or right bank) such that each of the 8 possibilities was completed before beginning the pattern again. The location of the drifts within the study area was critical to ensure 2014 data would be comparable to data collected in prior years (Objectives 2 and 4). Midriver sets were designed to capture fish that pass through the insonified area of the river channel whereas nearshore sets were designed to capture fish that pass outside of the insonified area (behind the sonar transducers). The insonified area began 3 m offshore of each transducer, which was the dividing line between nearshore and midriver sets. Rangefinders were used to ensure nets remained within the specified area (insonified or not insonified).

Tide stages affect the direction and speed of the current (including no current) and therefore a maximum time per drift was set at 10 minutes to prevent overfishing any one tide stage. Drifts were terminated if any of the following occurred: 1) the net became snagged on the bottom or was not fishing properly, 2) the net was not fishing within the designated area (midriver or nearshore), 3) the downstream end of the study area was reached, 4) the maximum drift time was reached, 5) the net was determined to be saturated with sockeye or pink salmon (usually 5 or more fish), or 6) it was determined a Chinook salmon was caught. For each set, the first deployed mesh size (5.0 inch or 7.5 inch), netting location (nearshore or midriver), river bank (left or right), direction of tidal flow (upstream, downstream, or slack), start time, and stop time were recorded on a handheld computer.

Age, Sex, and Length of the Inriver Run

Each captured Chinook salmon was removed from the net and a cotton "tail tie" was secured around the caudal peduncle with the other end affixed to the boat gunwale so the tethered fish remained in the water while other fish were released from the net. In order to track the capture of Chinook salmon by mesh size, tail ties were color coded by the mesh size from which each was captured. Tethered Chinook salmon were placed in a padded restraint cradle (Larson 1995) hung from the side of the boat with the fish partially submerged in the water. The methods used to collect ASL data were similar to those described for sport harvested Chinook salmon during angler interviews. Samples were stratified into 2 approximately 3-week strata during each run, with a sample-size goal of 149 fish for each stratum. The early-run strata were 16 May–9 June and 10–30 June; the late-run strata were 1–20 July and 21 July–15 August.

To prevent resampling, a quarter-inch hole was punched in the dorsal lobe of the caudal fin on every Chinook salmon handled. Because Chinook salmon were also sampled upstream at RM 12 (see section below on RM 12 gillnetting feasibility and mesh-size investigations) and those fish were given a ventral caudal hole punch, each captured Chinook salmon was examined for a hole punch on both lobes of the caudal fin prior to sampling. Chinook salmon missing an adipose fin were sacrificed and the head was removed and examined postseason for a coded wire tag. Injuries sustained by Chinook salmon during the capture and handling process were also recorded.

Other Species

All other captured species were counted and recorded. Every rainbow trout (or steelhead) and Dolly Varden was measured for METF length because few are typically captured. Sockeye salmon, pink salmon, and coho salmon were sampled every third day for METF length measurements because many more of these are captured. The length distribution of captured salmon was used as a variable in a mixture model to evaluate species composition passing through the sonar transducers (Key et al. 2016b).

Radio Transmitter Deployment

The inriver gillnetting study served as the marking event for a separate *Kenai River Chinook Salmon Abundance and Migratory Timing* study (Reimer 2014). In previous seasons, Chinook salmon less than 550 mm METF length were not tagged because of higher mortality rates experienced by smaller Chinook salmon (Reimer 2013). To mitigate mortality concerns, Chinook salmon less than or equal to 600 mm METF length were tagged with model F1835B[10] esophageal implant radio transmitters and Chinook salmon greater than 600 mm METF length were tagged model F1845B[11] esophageal implant radio transmitters. Between 16 May and 30 June, all Chinook salmon sampled for ASL that were considered healthy received a radio transmitter. Between 1 July and 15 August, approximately every third Chinook salmon sampled was tagged to ensure enough radio transmitters were available through 15 August.

RM 12 Gillnetting Feasibility and Mesh-size Investigations

Due to a low preseason forecast for early-run Kenai River Chinook salmon, the Kenai River Chinook salmon sport fishery was closed to all fishing by emergency order (Emergency Order No. 2-KS-1-04-14, effective 12:01 AM, Thursday, 1 May 2014). This provided an opportunity to investigate the feasibility of drifting gillnets in an area upstream of major tidal influence, closer to the RM 13.7 sonar, without sport fishery interference. The experimental area extended from the existing late-run sport fish “Drift Fishing Only” regulatory sign at RM 12 downstream to just below Eagle Rock (RM 11.5). Three mesh sizes were used for 2 types of RM 12 gillnets: a 4.5-inch single mesh net, and the 5.0-inch and 7.5-inch mesh panel nets. The 4.5-inch mesh gillnets were hung loosely at a 4:1 ratio (mesh to cork line) in an attempt to “entangle” the majority of fish sizes. Gillnets were 30 ft in length and 15 ft deep. Sampling occurred 3 days each week from 16 May to 30 June. The 5.0-inch and 7.5-inch mesh panel nets were the same as those used in the RM 8.6 netting study. Mesh size was alternated at the beginning of each day, and every 2 sets throughout the day. For each set, the mesh size deployed towards shoreline (4.5 inch, 5.0 inch, or 7.5 inch), netting location (nearshore or midriver), river bank (left or right), start and stop times, and number of fish captured by species were recorded on a handheld computer. Fish handling, ASL and genetic sampling, and data recording were the same as gillnet operations at RM 8.6, but

[10] ATS 1835B radio tags are 17 mm diameter and 48 mm long, and weigh 16 grams.
[11] ATS 1845B radio tags are 19 mm diameter and 56 mm long, and weigh 26 grams.

Chinook salmon were given a ventral caudal hole punch. Other salmon species were not measured for length, and no radio transmitters were deployed in Chinook salmon.

GENETICS SAMPLING

In the creel survey, tissue samples from tips of the axillary process were taken from harvested Chinook salmon for genetic analysis. In the inriver gillnetting study, tissue samples from dorsal fins were collected instead because the axillary process, on the ventral side of the fish, is difficult to remove from Chinook salmon held in sampling cradles suspended in the water. Axillary process and dorsal finclip samples consisted of a half-inch piece of tissue placed in a 2 ml plastic vial and completely covered with a buffered 95% alcohol solution such that the liquid to tissue ratio was approximately 3:1. Plastic vials were sequentially numbered for each project and stored at ADF&G for future analysis.

ENVIRONMENTAL VARIABLES

Several variables were measured to monitor river conditions that may affect catch rates. At RM 8.6, the netting crews recorded drift direction for the deployed net (upstream, downstream, or slack) to record tidal influence for each set. In addition, water clarity was measured midchannel with a Secchi disk (nearest 0.05 m) 6 times daily (beginning, middle, and end of each crew shift). At the RM 12 gillnetting feasibility study site, water clarity was measured midchannel at the beginning of the drift area to the nearest 0.05 m, twice daily (beginning and end of each shift). During creel survey sampling days, water temperature (nearest 0.1°F) and water clarity were measured at RM 15.3 twice daily (during the 1st and 3rd angler counts). Daily discharge estimates for the 2014 field season (16 May through 20 August) were recorded by the United States Geological Survey (USGS) at RM 20, and were downloaded postseason from the USGS website.

DATA ANALYSIS

Creel Survey

Effort, catch, and harvest were estimated separately for guided and unguided anglers using the following procedures.

Angler Effort

The mean number of anglers on day *i* in stratum *h* was estimated as follows:

$$\bar{x}_{hi} = \frac{\sum_{g=1}^{r_{hi}} x_{hig}}{r_{hi}}, \tag{1}$$

where

x_{hig} = the number of anglers observed in the *g*th count of day *i* in stratum *h*, and

r_{hi} = the number of counts on day *i* in stratum *h*.

Angler counts were conducted systematically within each sample day. The variance of the mean angler count was estimated as follows:

$$\hat{V}(\bar{x}_{hi}) = \frac{\sum_{g=2}^{r_{hi}} \left(x_{hig} - x_{hi(g-1)}\right)^2}{2r_{hi}\left(r_{hi} - 1\right)}. \tag{2}$$

Effort (angler-hours) during day *i* in stratum *h* was estimated by

$$\hat{E}_{hi} = L_{hi}\bar{x}_{hi}, \tag{3}$$

where

L_{hi} = length of the sample day (20 hours for unguided anglers, 12 hours for guided anglers).

The within-day variance (effort) was estimated as follows:

$$\hat{V}\left(\hat{E}_{hi}\right) = L_{hi}^2 \hat{V}(\bar{x}_{hi}). \tag{4}$$

The mean effort for stratum *h* was estimated by

$$\bar{E}_h = \frac{\sum_{i=1}^{d_h} \hat{E}_{hi}}{d_h}, \tag{5}$$

where

d_h = number of days sampled in stratum *h*.

The sample variance of daily effort for stratum *h* was estimated as follows:

$$S^2(E)_h = \frac{\sum_{i=1}^{d_h} \left(\hat{E}_{hi} - \bar{E}_h\right)^2}{\left(d_h - 1\right)}. \tag{6}$$

Total effort for stratum *h* was estimated by

$$\hat{E}_h = D_h \bar{E}_h, \tag{7}$$

where

D_h = total number of days the fishery was open in stratum *h*.

The variance of total effort for each stratum in a 2-stage design, omitting the finite population correction factor for the second stage, was estimated by Bernard et al. (1988) as follows:

$$\hat{V}\left(\hat{E}_h\right) = (1 - f)D_h^2 \frac{S^2(E)_h}{d_h} + fD_h^2 \frac{\sum_{i=1}^{d_h} \hat{V}\left(\hat{E}_{hi}\right)}{d_h^2}, \tag{8}$$

where

f = fraction of days sampled (= d_h / D_h).

Catch and Harvest

Catch and harvest per unit (hour) of effort for day *i* was estimated from angler interviews using the jackknife method to minimize the bias of these ratio estimators (Efron 1982). The jackknife estimate of CPUE (similarly HPUE) for angler *j* was as follows:

$$CPUE^{*}_{hij} = \frac{\sum_{\substack{a=1 \\ a \neq j}}^{m_{hi}} c_{hia}}{\sum_{\substack{a=1 \\ a \neq j}}^{m_{hi}} e_{hia}}, \tag{9}$$

where

c_{hia} = catch of angler *a* interviewed on day *i* in stratum *h*,

e_{hia} = effort (hours fished) by angler *a* interviewed on day *i* in stratum *h*, and

m_{hi} = number of anglers interviewed on day *i* in stratum *h*.

The jackknife estimate of mean CPUE for day *i* was the mean of the angler estimates:

$$\overline{CPUE}^{*}_{hi} = \frac{\sum_{j=1}^{m_{hi}} CPUE^{*}_{hij}}{m_{hi}}, \tag{10}$$

and the bias corrected mean was

$$\overline{CPUE}^{**}_{hi} = m_{hi}\left(\overline{CPUE}_{hi} - \overline{CPUE}^{*}_{hi}\right) + \overline{CPUE}^{*}_{hi}, \tag{11}$$

where

$$\overline{CPUE}_{hi} = \frac{\sum_{j=1}^{m_{hi}} c_{hij}}{\sum_{j=1}^{m_{hi}} e_{hij}}. \tag{12}$$

The variance of the jackknife estimate of CPUE was estimated as follows:

$$\hat{V}\left(\overline{CPUE}^{**}_{hi}\right) = \frac{m_{hi}-1}{m_{hi}} \sum_{j=1}^{m_{hi}} \left(CPUE^{*}_{hij} - \overline{CPUE}^{*}_{hi}\right)^{2}. \tag{13}$$

Catch during each sample day was estimated as the product of effort and CPUE by

$$\hat{C}_{hi} = \hat{E}_{hi}\,\overline{CPUE}^{**}_{hi} \tag{14}$$

and the variance was estimated as follows (Goodman 1960):

$$\hat{V}\left(\hat{C}_{hi}\right) = \hat{V}\left(\hat{E}_{hi}\right)\left(\overline{CPUE}^{**}_{hi}\right)^{2} + \hat{V}\left(\overline{CPUE}^{**}_{hi}\right)\hat{E}^{2}_{hi} - \hat{V}\left(\hat{E}_{hi}\right)\hat{V}\left(\overline{CPUE}^{**}_{hi}\right). \tag{15}$$

HPUE was estimated by substituting angler harvest for angler catch in Equations 9–13. Harvest during sample day i was estimated by substituting the appropriate $HPUE_{hi}$ statistics into Equations 14 and 15. Total catch and harvest during stratum h was estimated using Equations 5–8, substituting estimated catch ($\hat{C}_{hi}$) and harvest ($\hat{H}_{hi}$) during sample day i for the estimated effort ($\hat{E}_{hi}$) during day i.

When no interviews from a particular angler type were obtained during a particular day, there were no CPUE and HPUE estimates to pair with angler counts. For these days, pooled estimates of CPUE and HPUE calculated from interviews obtained during the remaining days within the stratum, or similar strata, were imputed. A bootstrap procedure was used to estimate the variance introduced by use of imputed values.

Total effort, catch, and harvest estimates, and their respective variances, were summed across strata within each run. Technically, estimates of catch and harvest by geographic location and angler type were not statistically independent because HPUE and CPUE were estimated from the same interviews for both geographic strata, and estimates were poststratified by angler type. This lack of independence between strata could underestimate variances; however, the bias in variance estimates is small.

Angler Effort, Catch, and Harvest on Mondays

Regulations allow only unguided fishing from drift boats or from shore on Mondays. Due to budgetary constraints, the creel survey was not conducted on Mondays for the years 2001–2008 and 2011–2014; rather, "index" angler counts were conducted each late-run Monday between 10:00 AM and 2:00 PM. The index count was used in the following ad hoc procedure to estimate effort, catch, and harvest on drift-boat Mondays:

1) The relationship between index counts and mean angler counts on Mondays for 2009–2010 angler count data was used to estimate the relationship between index counts and mean angler counts on Mondays for 2014. The mean number of anglers was approximately 52% of the number of anglers counted during the "index" period.
2) To estimate angler-hours of effort E, the estimated mean count was multiplied by the length of the unguided angler-day (20 hours).
3) To estimate CPUE and HPUE on Mondays without angler interviews, we exploited the tendency for angler success to exhibit an autocorrelated time trend. CPUE and HPUE were plotted versus time for days sampled with angler interviews, and then we imputed CPUE and HPUE values for each Monday.
4) Catch and harvest were estimated as the product of the imputed values of CPUE and HPUE and the estimate of E derived from the index count.

Inriver Gillnetting

CPUE of Inriver Gillnetting

A midriver drift and a nearshore drift, originating from each side (k) of the river, were conducted with 1 mesh size deployed from the boat; the sequence was then repeated with the other mesh size deployed from the boat. A repetition j consisted of a complete set of 8 drifts (4 midriver and 4 nearshore). Daily CPUE r of species s in mesh size m for day i was estimated as follows:

$$\hat{r}_{smi} = \frac{\sum_{j=1}^{J_i}\sum_{k=1}^{2} c_{smijk}}{\sum_{j=1}^{J_i}\sum_{k=1}^{2} e_{mijk}}, \tag{16}$$

with variance

$$\hat{V}(\hat{r}_{smi}) = \frac{\sum_{j=1}^{J_i}\left(c_{smij\cdot} - \hat{r}_{smi} e_{mij\cdot}\right)^2}{\bar{e}_{mi}^{\,2} J_i (J_i - 1)}, \tag{17}$$

where c_{smijk} is the catch of species s in mesh m during a drift originating from bank k during repetition j on day i, e_{mijk} is the effort (soak time in minutes) for that drift, J_i is the number of repetitions completed on day i, c_{smij} is the catch of species i in mesh m summed across drifts on both banks conducted during repetition j of day i, $e_{mij.}$ is the effort for mesh m summed across drifts on both banks conducted during repetition j of day i, and $\bar{e}_{mi}$ is the mean of e_{mij} across all repetitions j for mesh m on day i. The variance follows Cochran (1977: 66).

Proportion Chinook Salmon

The proportion of species s passing through the insonified zone of the river channel (midriver sets only) on day i was estimated as follows:

$$\hat{p}_{si} = \frac{\sum_{j}^{J_i} \hat{r}_{sij}}{\sum_{s}\sum_{j}^{J_i} \hat{r}_{sij}}, \tag{18}$$

with variance

$$\hat{V}\left(\hat{p}_{si}\right) = \frac{\sum_{j=1}^{J_i}\left(\hat{r}_{sij} - \hat{p}_{si}\hat{r}_{\cdot ij}\right)^2}{\bar{r}_i^{\,2} J_i (J_i - 1)}, \tag{19}$$

where CPUE r of species s during repetition j of day i was estimated as the mean of the CPUEs, pooled across bank, for each mesh size:

$$\hat{r}_{sij} = \frac{1}{2}\sum_{m=1}^{2} \frac{\sum_{k=1}^{2} c_{smijk}}{\sum_{k=1}^{2} e_{mijk}}, \tag{20}$$

and where

$$\hat{r}_{\cdot ij} = \sum_{s} \hat{r}_{sij} \tag{21}$$

is the CPUE summed across all species caught during repetition j of day i, and

$$\bar{r}_i = \frac{\sum_{j=1}^{J_i} \hat{r}_{.ij}}{J_i} \tag{22}$$

is the mean CPUE of salmon (all species) caught across all drifts *k* during day *i*.

Age and Sex Composition of Sport Harvest and Inriver Netting

Age and sex compositions of the Chinook salmon harvest, and RM 8.6 midriver and nearshore netting were estimated for each run by time stratum *t*. The proportion of Chinook salmon in age or sex group *b* in time stratum *t* was estimated as follows:

$$\hat{p}_{bt} = \frac{n_{bt}}{n_t}, \tag{23}$$

where

n_{bt} = the number of Chinook salmon of age or sex group *b* sampled during stratum *t*, and

n_t = the number of successfully aged Chinook salmon sampled during stratum *t*.

The variance of $\hat{p}_{bt}$ was approximated[12] as follows (Cochran 1977):

$$V(\hat{p}_{bt}) = \frac{\hat{p}_{bt}(1-\hat{p}_{bt})}{(n_t - 1)}. \tag{24}$$

Contingency tables and chi-square tests were used to determine if age or sex composition differed significantly ($P < 0.05$) among strata (for sport harvest and RM 8.6 midriver and nearshore netting). If not, the proportion of Chinook salmon in age or sex group *b* during an entire run, and its variance, were estimated by pooling data across strata (Equations 23–24 without stratum subscripts *t*).

To determine if the time of day or time of tidal stage when nets were deployed had an effect on the age composition of the inriver run, contingency tables and chi-square tests were used to determine if age compositions differed significantly ($P < 0.05$) among Chinook salmon captured during the morning shift (7:00 AM–1:00 PM), the afternoon shift (1:00 PM–7:00 PM), and hypothetical netting schedules based on tidal stages: 3 hours before low tide to 3 hours after low tide (2002–2006 sampling schedule), and 5 hours before low tide to 1 hour after low tide (2007–2013 sampling schedule).

The harvest of each age or sex group by time stratum *t* and geographic stratum *g* (above and below the sonar), was estimated by

$$\hat{H}_{gbt} = \hat{H}_{gt}\hat{p}_{bt}, \tag{25}$$

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[12] Variance estimates for species proportions assume that each fish sampled is an independent observation (i.e., that simple random sampling, SRS, was employed). In reality, the sport harvest is sampled with a multistage design (creel survey) and the inriver run with a cluster design (netting), and technically, the age proportion variances should be estimated in the context of those designs. However, age composition changes very slowly over time, and in the past we have assumed that variability between sampling stages and among clusters is negligible. To verify this, we reanalyzed the 2006 netting data, calculated the age proportions using a modified version of Equations 7 and 8, and compared them to the SRS estimates in Equations 23 and 24. The point estimates and their standard errors were essentially equivalent. Based on this evidence, we continue to use the SRS equations for convenience.

with variance (Goodman 1960)

$$V\left(\hat{H}_{gbt}\right) = \hat{H}_{gt}^2 \hat{V}\left(\hat{p}_{bt}\right) + \hat{p}_{bt}^2 \hat{V}\left(\hat{H}_{gt}\right) - \hat{V}\left(\hat{p}_{bt}\right)\hat{V}\left(\hat{H}_{gt}\right), \tag{26}$$

where

$\hat{H}_{gt}$ = estimated harvest in geographic stratum g during temporal stratum t and

$\hat{V}\left(\hat{H}_{gt}\right)$ = variance of estimated harvest in geographic stratum g during temporal stratum t.

If age or sex composition differed ($P < 0.05$) among strata, a weighted proportion and its variance were calculated as follows:

$$\hat{p}_{gb} = \frac{\sum_t \hat{H}_{gt}\hat{p}_{bt}}{\sum_t \hat{H}_{gt}}, \text{ and} \tag{27}$$

$$\hat{V}(\hat{p}_{gb}) = \frac{1}{\hat{H}_g^2}\left[\frac{\hat{v}(\hat{H}_{g1})\left[\hat{p}_{b1}\hat{H}_{g2} - \hat{H}_{gb2}\right]^2}{\hat{H}_g^2} + \frac{v(\hat{H}_{g2})\left[\hat{p}_{b2}\hat{H}_{g1} - \hat{H}_{gb1}\right]^2}{\hat{H}_g^2} + \hat{v}(\hat{p}_{b1})\hat{H}_{g1}^2 + \hat{v}(\hat{p}_{b2})\hat{H}_{g2}^2\right]. \tag{28}$$

The number of Chinook salmon passing the RM 8.6 sonar N was apportioned by age and sex similarly (midriver sets only), using Equations 23–28, ignoring geographic stratum subscript g, substituting N for H, and using the net-captured Chinook salmon to estimate p. The midriver run R of age or sex group b was estimated as the sum of the age- or sex-specific sonar passage N_b and harvest below the sonar H_{2b} as follows:

$$\hat{R}_b = \hat{N}_b + \hat{H}_{2b}. \tag{29}$$

Chinook Salmon Length Comparisons

Nonparametric K-S tests were used to test for differences between length distributions of Chinook salmon captured in inriver gillnets by location (nearshore vs. midriver), and between fish captured in inriver gillnets (RM 8.6 or RM 12) and those sampled at Kenai River tributary weirs. Tributary weirs were operated by the USFWS on the Killey River (Gates and Boersma 2014b) and Funny River (Gates and Boersma 2014a) in 2014. Lengths of Chinook salmon sampled at the tributary weirs were provided by the USFWS and used in the K-S tests. The D statistics and the associated P-value were reported for the following K-S test comparisons:

1) The cumulative length distribution of Chinook salmon captured in nearshore gillnets vs. midriver gillnets at RM 8.6 for the early run and the late run.
2) The cumulative length distribution of Chinook salmon radiotagged at RM 8.6 that migrated past the Killey River weir vs. the cumulative length distribution of Chinook salmon sampled at the Killey River weir.
3) The cumulative length distribution of Chinook salmon radiotagged at RM 8.6 that migrated past the Funny River weir vs. the cumulative length distribution of Chinook salmon sampled at the Funny River weir.
4) The cumulative length distribution of early-run Chinook salmon sampled in gillnets at RM 8.6 vs. the cumulative length distribution of Killey River weir and Funny River weir

combined (Funny River and Killey River distributions were weighted by relative abundance).

5) The cumulative length distribution of early-run Chinook salmon sampled in gillnets at RM 12 (Eagle Rock feasibility study) vs. the cumulative length distribution of Killey River weir and Funny River weir combined (Funny River and Killey River distributions were weighted by relative abundance).

A 2-sample K-S test was used to compare cumulative length distributions of 2 samples (Tests 1–3), whereas the 1-sample K-S test (Tests 4 and 5) was used to compare the cumulative length distribution of a sample with a reference distribution (the Killey River weir and Funny River weir combined length distribution weighted by abundance). The samples in Tests 4 and 5 were the length distributions of all Chinook salmon sampled at either location (RM 8.6 or RM 12). The Killey River and Funny River account for a majority of spawning early-run Chinook salmon (Reimer 2013), and in the 1-sample K-S tests we assumed the Killey River weir and Funny River weir combined length distribution was an adequate representation of Kenai River early-run Chinook salmon.

RESULTS

CREEL SURVEY

Inseason Management Actions

To achieve escapement goals during 2014, several inseason management actions restricted the Kenai River Chinook salmon early- and late-run sport fisheries. The early-run sport fishery was closed drainagewide from 1 May through 30 June by emergency order (EO 2-KS-1-04-14) because the preseason forecast for early-run Chinook salmon was less than the lower end of the OEG. The following management actions occurred during the late-run sport fishery: 1) the Kenai River was closed to harvest upstream of the Slikok Creek closure area (RM 18.9) and the use of bait was prohibited (EO 2-KS-1-26-14) from 1 to 18 July, 2) harvest was restricted to no retention of Chinook salmon (catch-and-release fishing only) using unbaited, barbless, single-hooks only (EO 2-KS-1-40-14) from 19 to 25 July, and lastly, 3) the remainder of the late-run fishery was closed drainagewide to all Chinook salmon fishing (EO 2-KS-1-42-14).

Effort, Catch, and Harvest

The creel survey, conducted during the late-run Chinook salmon fishery from 1 to 25 July, sampled 58% (11/19) of the days the fishery was open to guided anglers and 64% (14/22) of the days the fishery was open to unguided anglers (Table 2). A total of 435 angler interviews were conducted during the late run. Index estimates of catch, harvest, and effort on the 3 late-run Mondays are not included in the unguided angler subtotals and season totals presented herein.

During the 2014 late run, anglers caught 1,465 (SE 160) and harvested 539 (SE 98) Chinook salmon with 32,063 (SE 2,779) angler-hours of effort (Table 2). Approximately 63% of the Chinook salmon catch was released. Angler effort and harvest were the second lowest on record dating back to 1981, and catch was second lowest on record dating back to 1994 (Figure 3). The absolute precision for total late-run harvest (±192) and catch (±314) was within 20%, or 1,000 fish, of the true value 95% of the time and satisfied Objective 1.

Table 2.–Estimated late-run Kenai River Chinook salmon sport fishery effort, catch, and harvest between Soldotna Bridge and Warren Ames Bridge, 1–25 July 2014.

				Effort		Chinook salmon			
						Catch [b]		Harvest [c]	
Fishing periods [a]	Days open to fishing from powerboats	Sampling days	Number of inter-views	Hours fished	SE	No. fish	SE	No. fish	SE
1–6 July									
Guided WD	4	2	66	6,224	2,042	155	72	138	61
Guided WE	1	1	24	666	150	10	8	10	8
Unguided WD	4	2	24	1,750	795	9	10	9	10
Unguided WE	2	2	21	735	118	22	13	22	13
7–13 July									
Monday [d]	0	1	0	73	NA	1	NA	1	NA
Guided WD	4	2	55	4,592	708	29	17	29	17
Guided WE	1	1	12	468	12	10	11	10	11
Unguided WD	4	2	13	1,110	130	0	0	0	0
Unguided WE	2	2	31	665	215	16	12	11	9
14–20 July									
Monday [d]	0	1	0	166	NA	7	NA	5	NA
Guided WD	4	2	74	6,616	1,042	266	63	236	58
Guided WE	1	1	5	564	248	120	57	0	0
Unguided WD	4	2	22	3,100	871	144	69	73	42
Unguided WE	2	2	28	875	160	99	30	0	0
21–25 July									
Monday [d]	0	1	0	31	NA	4	NA	0	NA
Guided WD	4	2	49	3,128	575	346	71	0	0
Unguided WD	4	2	11	1,570	238	238	41	0	0
Day type subtotals									
Monday [d]	0	3	0	270	NA	12	NA	6	NA
Guided WD	16	8	244	20,560	2,467	796	120	403	86
Guided WE	3	3	41	1,698	290	140	59	21	13
Unguided WD	16	8	70	7,530	1,210	391	81	82	43
Unguided WE	6	6	80	2,275	293	137	35	33	16
Angler type subtotals									
Guided	19	11	285	22,258	2,484	937	134	424	87
% Guided			66%	69%		64%		79%	
Unguided [e]	22	14	150	9,805	1,245	528	88	116	46
% Unguided			34%	31%		36%		21%	
Late-run total [e]	41	25	435	32,063	2,779	1,465	160	539	98

Note: WD is weekday and WE is weekend. NA means no data are available.

[a] Emergency order prohibited use of bait 1–31 July. The sport fishery was closed to harvest of Chinook salmon 19–25 July, and closed to all Chinook salmon fishing 26–31 July.

[b] "Catch" is the number of fish harvested plus fish released; catch estimates may not sum to total due to rounding.

[c] "Harvest" is the number of fish kept; harvest estimates may not sum to total due to rounding.

[d] Mondays were days when unguided drift boat fishing only was allowed. Estimates of effort, catch, and harvest were based on an index (see Methods).

[e] Unguided angler totals do not include Monday index estimates.

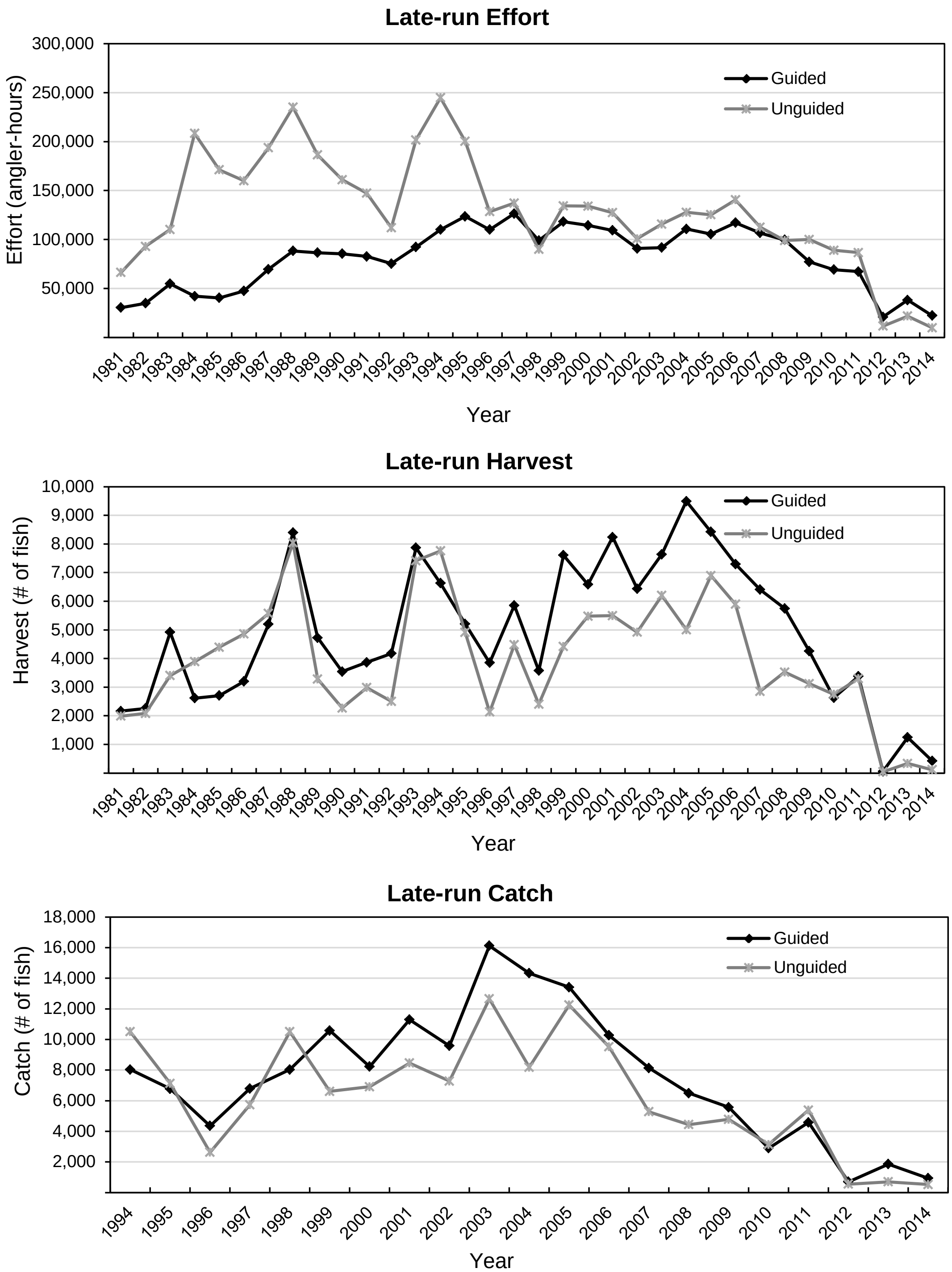


Figure 3.–Guided and unguided sport angler effort (top), harvest (middle), and catch (bottom) from ADF&G creel surveys for the late-run Kenai River Chinook salmon fishery between Soldotna Bridge and Warren Ames Bridge, 1981–2014.

Source: Hammarstrom and Larson (1982-1984, 1986); Hammarstrom et al. (1985); Conrad and Hammarstrom (1987); Hammarstrom (1988-1994); Schwager-King (1995); King (1996-1997); Marsh (1999, 2000); Reimer et al. (2002); Reimer (2003, 2004a, 2004b, 2007); Eskelin (2007, 2009-2010); and Perschbacher (2012a, 2012b, 2012c, 2012d, 2014, 2015).

The average count for unguided anglers was 21.6 and the maximum count of 81 occurred on 18 July during the evening (8:00 PM–11:59 PM) time stratum (Appendices A1–A3). The average count for guided anglers was 87.6 and the maximum count of 210 occurred on 18 July during the morning (4:00 AM–8:59 AM) time stratum.

Daily CPUE for unguided anglers was the highest (0.153 fish per hour) on 23 July and averaged 0.052 fish per hour (Appendix B1). Daily HPUE for unguided anglers was the highest (0.042 fish per hour) on 16 July and averaged 0.010 fish per hour. Daily CPUE for guided anglers was the highest (0.212 fish per hour) on 19 July and averaged 0.052 fish per hour (Appendix B2). Daily HPUE for guided anglers was the highest (0.0363 fish per hour) on 16 July and averaged 0.015 fish per hour (Appendix B2). CPUE during 2014 was higher for unguided than guided anglers, while HPUE was higher for guided than unguided anglers (Figure 4). CPUE and HPUE for guided and unguided anglers have been below average since 2012.

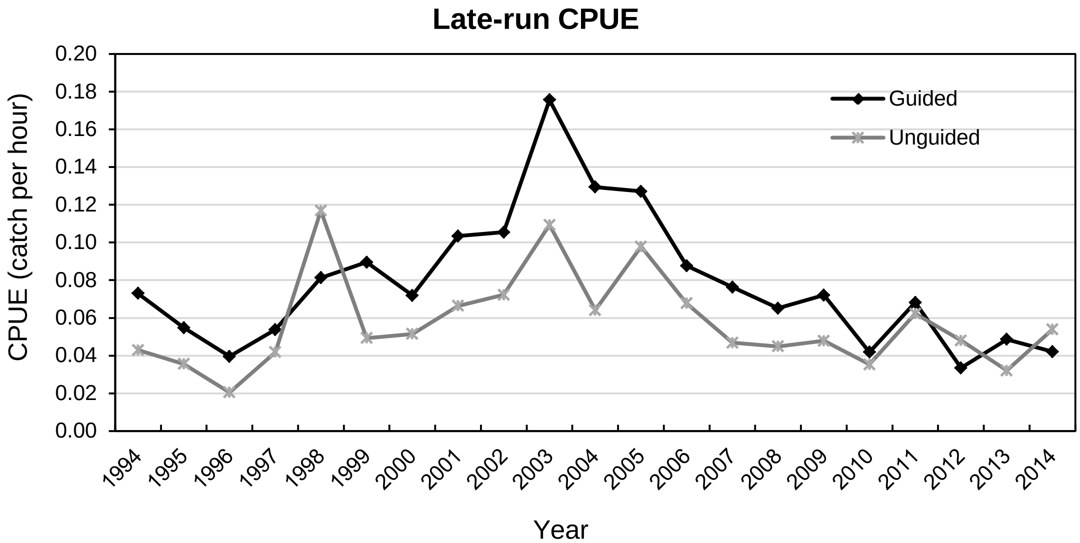
Creel Survey Estimates Downstream of RM 8.6 and RM 13.7 Chinook Salmon Sonars

Downstream of the RM 8.6 sonar site, anglers caught 8 (SE 4) and harvested 4 (SE 2) Chinook salmon with 176 (SE 70) angler-hours of effort (Appendix C1). Less than 1% of late-run effort, catch, and harvest occurred downstream of RM 8.6. Downstream of the RM 13.7 sonar site, anglers caught 767 (SE 104) and harvested 246 (SE 47) Chinook salmon with 15,366 (SE 1,394) angler-hours of effort (Appendix C2). Approximately 48% of angler effort, 52% of catch, and 46% of harvest occurred downstream of the RM 13.7 Chinook salmon sonar site. Because the late-run fishery in 2014 did not open upstream of the lower end of the Slikok Creek regulatory boundary at RM 18.8 (EO 2-KS-1-04-14), upstream harvest, catch, and effort estimates were between RM 13.7–18.8.

In preparation for the sonar transitioning from RM 8.6 to RM 13.7, CPUE and HPUE in relation to the RM 13.7 sonar was examined during 2012–2014. Anglers were asked if they fished exclusively above the RM 13.7 sonar, exclusively below the RM 13.7 sonar, or if they fished in both areas. Results show both CPUE and HPUE estimates were variable. In 2012 and 2013, HPUE estimates were highest for anglers that fished exclusively upstream of RM 13.7, whereas in 2014, HPUE estimates were highest for anglers that fished exclusively downstream of RM 13.7 (Figure 5). In all years (2012–2014), HPUE estimates were lowest for anglers that fished both areas. CPUE estimates were also variable and generally lowest for anglers that fished both areas.

Late-run Monday Index Estimates

It was estimated that unguided drift-boat anglers caught 12 and harvested 6 Chinook salmon with 270 angler-hours of effort during late-run Mondays (Table 2). Harvest of Chinook salmon on drift-boat Mondays was 1.1% of the total late-run harvest in 2014, and has been less than 4% (approximately 400 fish) of the total late-run harvest since 2009 (Perschbacher 2015).



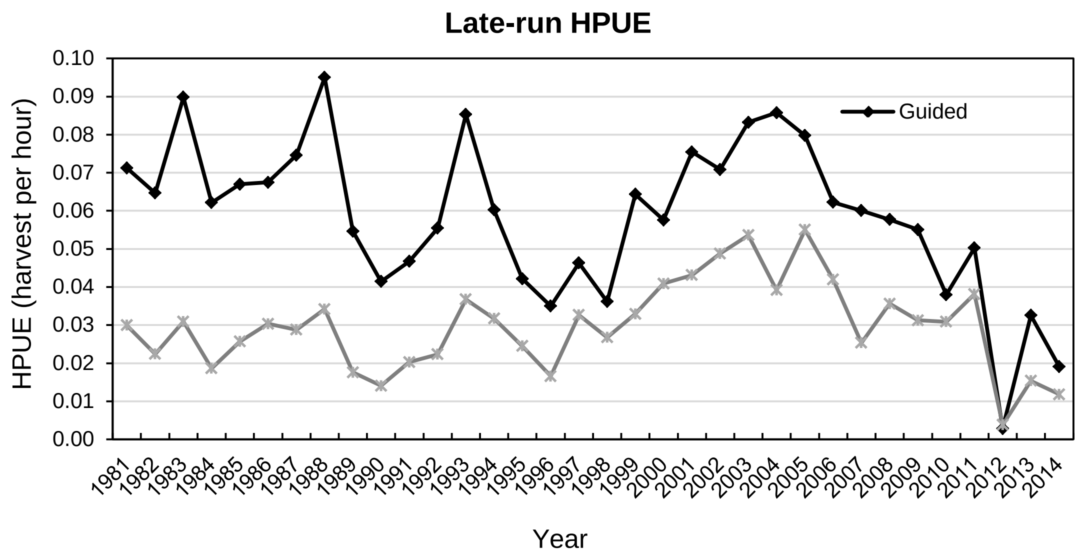


Figure 4.–Guided and unguided CPUE (top) and HPUE (bottom) from ADF&G creel surveys for the late-run Kenai River Chinook salmon fishery between Soldotna Bridge and Warren Ames Bridge, 1981–2014.

*Source:*Hammarstrom and Larson (1982-1984, 1986); Hammarstrom et al. (1985); Conrad and Hammarstrom (1987); Hammarstrom (1988-1994); Schwager-King (1995); King (1996-1997); Marsh (1999, 2000); Reimer et al. (2002); Reimer (2003, 2004a, 2004b, 2007); Eskelin (2007, 2009-2010); and Perschbacher (2012a, 2012b, 2012c, 2012d, 2014, 2015).

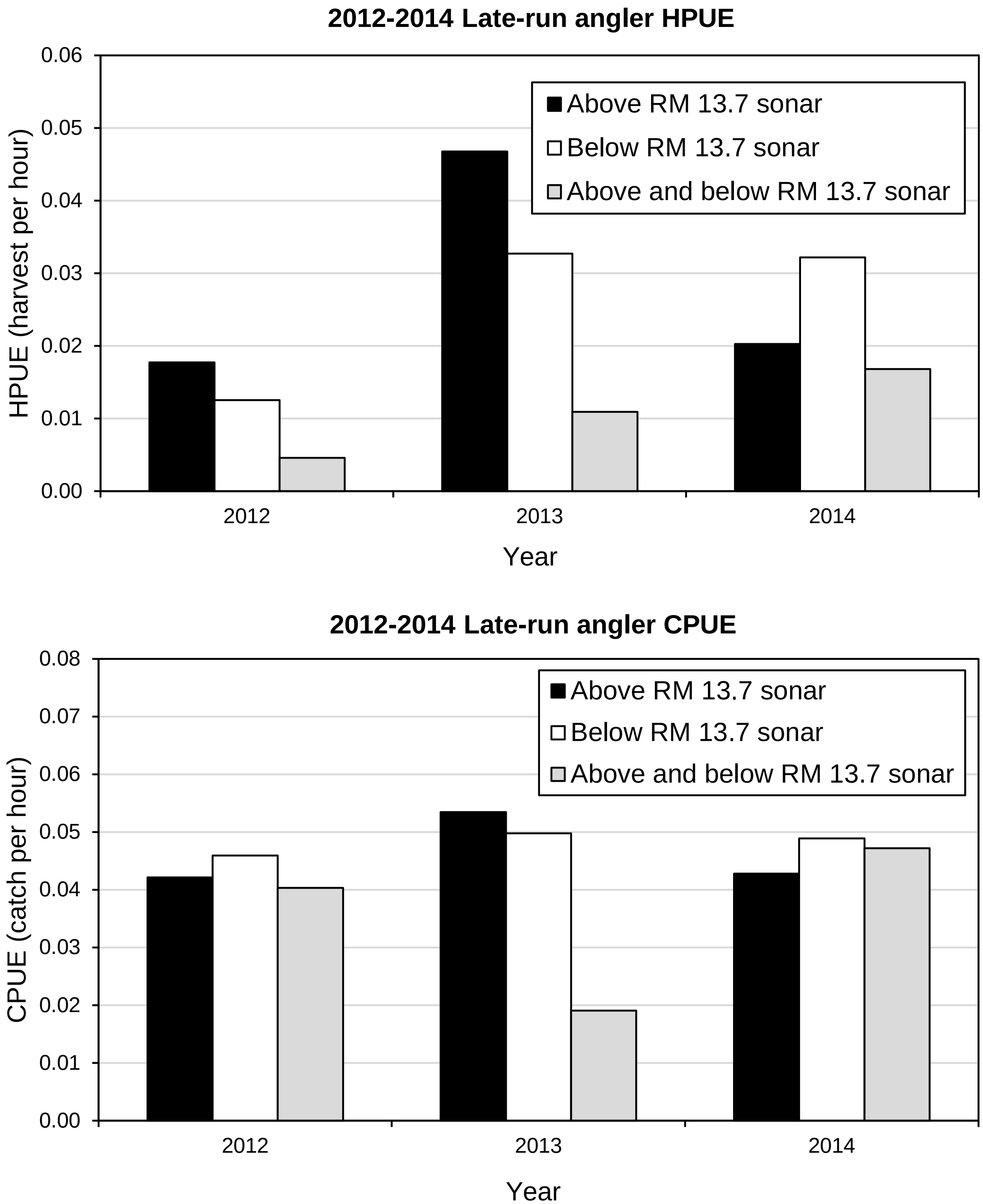


Figure 5.–HPUE (top) and CPUE (bottom) for Kenai River Chinook salmon anglers that fished exclusively above RM 13.7, below RM 13.7, or both above and below RM 13.7 during the late-run, 2012–2014.

Source: Perschbacher (2014, 2015)

INRIVER GILLNETTING AT RM 8.6

During the early run, midriver nets caught 134 Chinook salmon, 3,082 sockeye salmon, and 5 Dolly Varden, while nearshore nets caught 38 Chinook salmon, 1,267 sockeye salmon, and 4 Dolly Varden (Appendix D1). Of all the early-run Chinook salmon sampled, 78% were in midriver sets, while 22% were in nearshore sets. Approximately 57% of early-run netting effort occurred midriver and 43% of netting effort occurred nearshore. Daily midriver Chinook salmon CPUE (measured as catch per minute) was the highest (0.077) on 9 June and averaged 0.017, while daily midriver sockeye salmon CPUE was the highest (1.094) on 26 June and averaged 0.383 (Appendix D2). The daily proportion of Chinook salmon to total number of fish captured averaged 0.045 for midriver sets and 0.022 for nearshore sets.

During the late run, midriver nets caught 289 Chinook salmon, 4,430 sockeye salmon, 226 coho salmon, 4,076 pink salmon, and 11 Dolly Varden, whereas nearshore nets caught 54 Chinook salmon, 4,274 sockeye salmon, 68 coho salmon, 3,308 pink salmon, and 7 Dolly Varden (Appendix D3–D4). Of all the late-run Chinook salmon sampled, 84% (289/343) were in midriver sets, while 16% (54/343) were in nearshore sets. Approximately 67% (6,481/9,602 drift-minutes) of late-run netting effort occurred midriver and 33% (3,121/9,602 drift-minutes) of netting effort occurred nearshore. Daily midriver Chinook salmon CPUE was highest (0.169) on 19 July and averaged 0.053, while daily midriver sockeye salmon CPUE highest (2.623) on 12 July and averaged 0.790 (Appendix D5). The daily proportion of Chinook salmon to total number of fish captured averaged 0.040 for midriver sets and 0.010 for nearshore sets.

During the 2014 early run, the cumulative CPUE for Chinook salmon was slightly below the 5-year average and substantially below the 10-year average, whereas sockeye salmon CPUE was substantially higher than both the 5- and 10-year averages (Figure 6). Similar results were observed during the 2014 late run, with a below-average cumulative CPUE of Chinook salmon and an above-average (5- and 10-year) cumulative CPUE of sockeye salmon (Figure 7).

Gillnetting Chinook Salmon Catch by Tide Stage

Chinook salmon catch (midriver and nearshore) was estimated for each tidal stage (low, rising, high, and falling tidal stages) for both the early and late run. A complete tide cycle of approximately 13 hours consisted of 2.5 hours of low tide, 4 hours of rising tide, 2.5 hours of high tide, and 4 hours of falling tide (Figure 8).

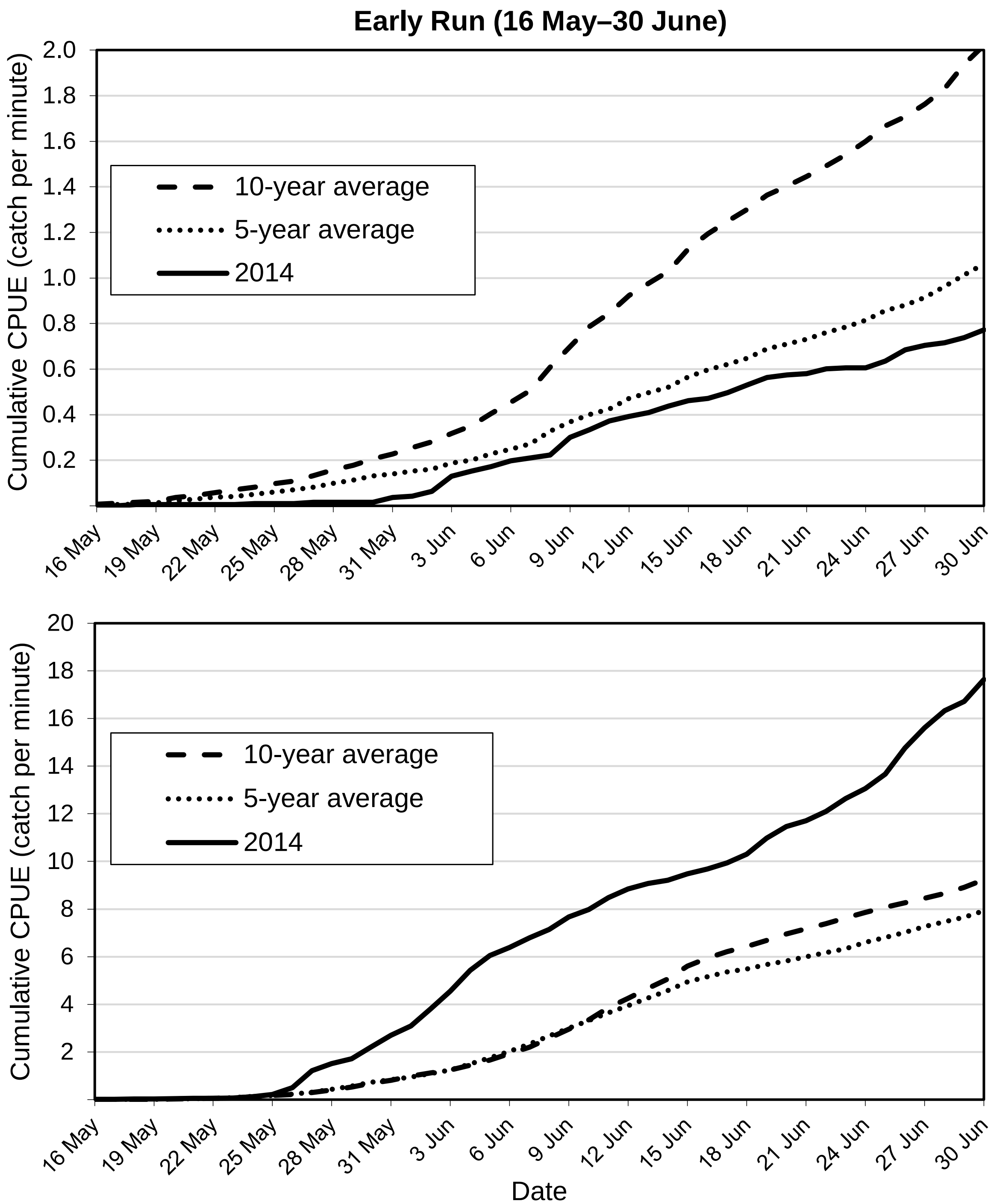


Figure 6.–Cumulative CPUE at RM 8.6 for early-run Kenai River Chinook salmon (top) and sockeye salmon (bottom) midriver gillnet 5-year and 10-year averages, and 2014.

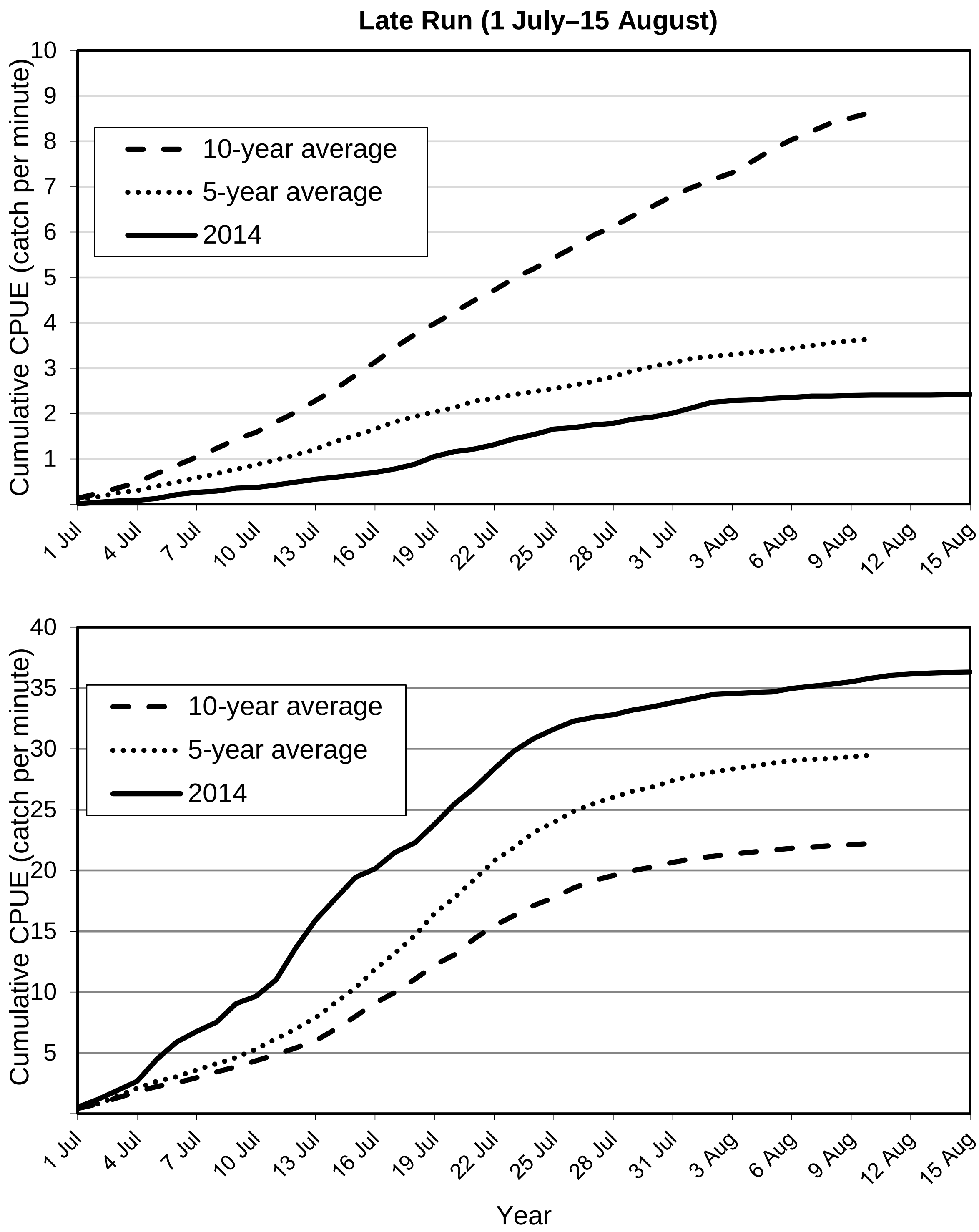


Figure 7.–Cumulative CPUE at RM 8.6 for late-run Kenai River Chinook salmon (top) and sockeye salmon (bottom) midriver gillnet 5-year and 10-year averages, and 2014.

Note: Late-run inriver netting was conducted through 10 August during 2002–2011, 17 August during 2013, and 15 August during 2012 and 2014.

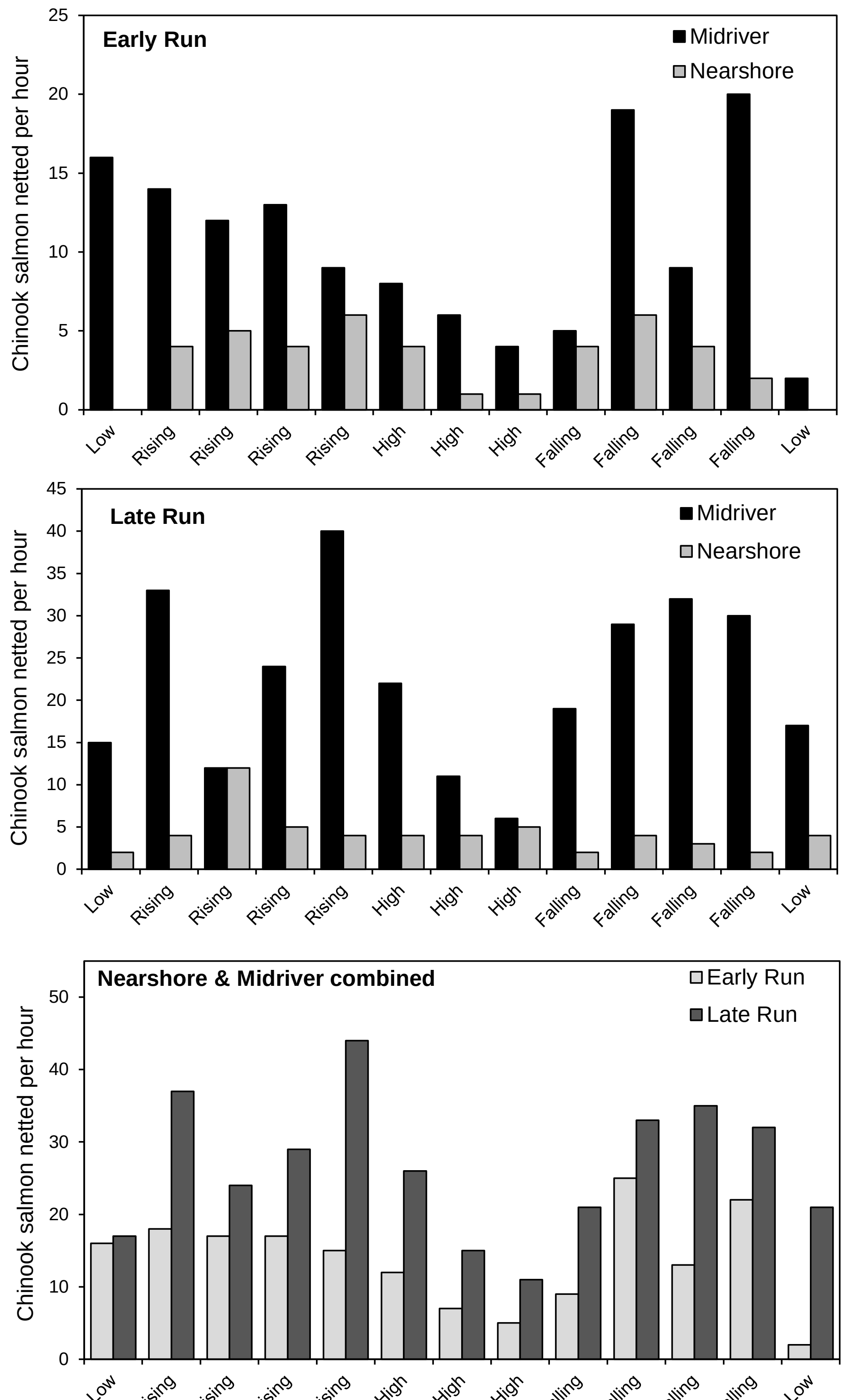


Figure 8.–Number of Chinook salmon captured by run and daily tide stages in nearshore and midriver nets, 2014.

Note: Time of catch recorded by the netting crew was related to stage of tide from the 2014 Kenai City Pier Tide Table.

Gillnetting catch of Chinook salmon at RM 8.6 varied by stage of tide during 2014. During the early run, higher midriver catches occurred during the falling and rising tides compared to high tide (Figure 8). Early-run nearshore catches were the lowest during high tide with approximately equal catches for all other tide stages. Low catch rates observed during the low tide stage were due to seasonal water levels being too shallow to gillnet or insonify. During the late run, the midriver set had the lowest catch at high tide and the highest catches during the rising and falling tides. Overall, catch was lowest around high tide, but otherwise no clear pattern of increasing or decreasing catch through the tide cycle was apparent.

Sockeye and Chinook Salmon CPUE by Morning and Afternoon Shifts

Netting effort at RM 8.6 was doubled from 6 hours per day during 2007–2013 to 12 hours per day in 2014. Catch rates were examined for each shift (morning and afternoon) to determine if any differences existed and if any modifications should be done to the netting schedule in subsequent years. Overall, the cumulative CPUEs for Chinook salmon and sockeye salmon were higher in the morning shift than the afternoon shift, especially during the late run (Figure 9).

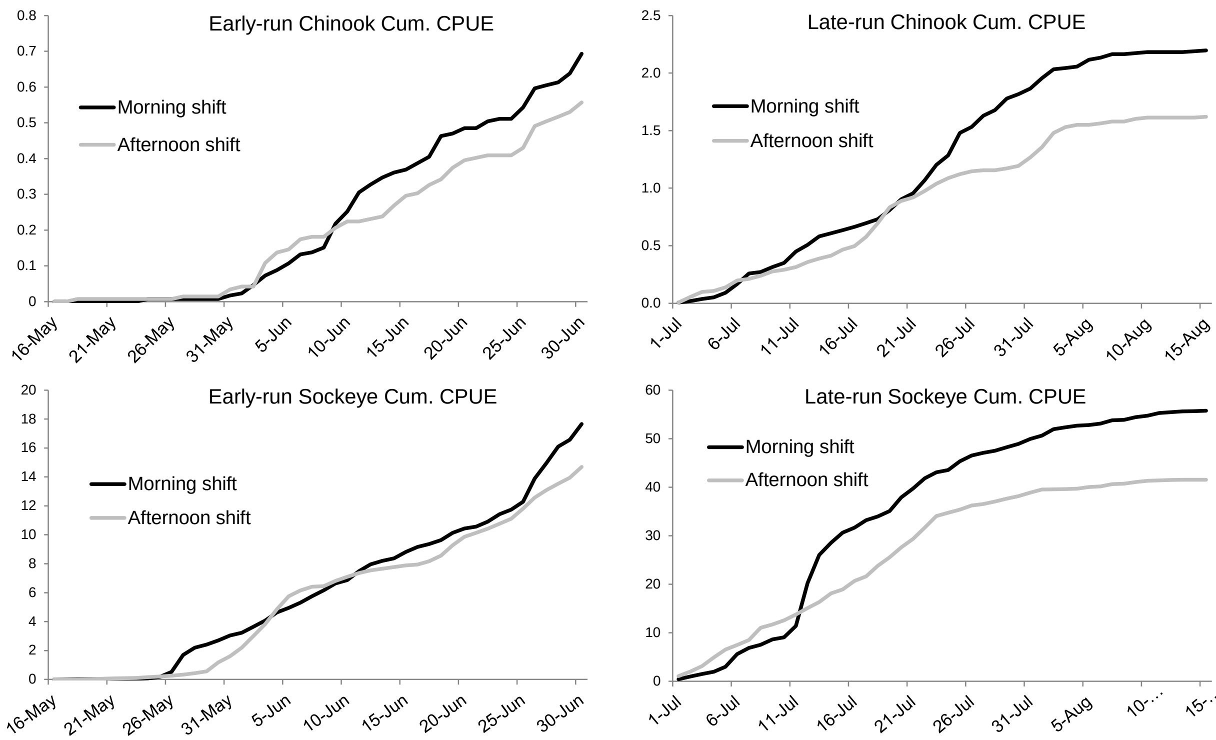


Figure 9.–Cumulative CPUE for early- and late-run Chinook (top) and sockeye salmon (bottom) captured during the morning netting shift (7:00 AM–1:00 PM) and afternoon shift (1:00 PM–7:00 PM), 2014.

Note: The y-axis CPUEs range between 0–2.5 for Chinook salmon and 0–60 for sockeye salmon. Effort is measured in drift-minutes.

AGE, SEX, AND LENGTH

Creel Survey

The 30 valid age samples collected in the late-run sport fishery met the sample size goal of 19 readable scales (Table 3). The age composition was composed of 10.0% (SE 5.6%) age-1.1 fish, 26.7% (SE 8.2%) age-1.2 fish, 30.0% (SE 8.5%) age-1.3 fish, and 33.3% (SE 8.8%) age-1.4 fish. Harvest of age-1.1 and age-1.2 Chinook salmon were some of the highest on record dating back to 1986 (Figure 10). Overall, 73.3% of the harvested late-run Chinook salmon were males; the remaining 26.7% were females. The average lengths of age-1.3 and -1.4 females were slightly larger than the average lengths of age-1.3 and 1.4 males (Table 4). The average length of all samples was 790 mm, with a range of 380 mm to 1,110 mm.

Table 3.–Age composition and estimated harvest by age class and geographic strata for late-run Kenai River Chinook salmon sport harvest between Soldotna Bridge and Warren Ames Bridge, 1–25 July 2014.

		Age				
Sex	Parameter [a]	1.1	1.2	1.3	1.4	Total
Female						
	Sample size			4	4	8
	% Sample			13.3%	13.3%	26.7%
	SE % sample			6.3%	6.3%	8.2%
	Downstream harvest			1	1	1
	SE downstream harvest			0	0	1
	Upstream harvest			71	71	143
	SE upstream harvest			36	36	50
	Total harvest			72	72	144
	SE total harvest			36	36	51
Male						
	Sample size	3	8	5	6	22
	% Sample	10.0%	26.7%	16.7%	20.0%	73.3%
	SE % sample	5.6%	8.2%	6.9%	7.4%	8.2%
	Downstream harvest	0	1	1	1	3
	SE downstream harvest	0	1	0	1	2
	Upstream harvest	53	143	89	107	392
	SE upstream harvest	31	50	40	44	84
	Total harvest	54	144	90	108	396
	SE total harvest	31	51	40	44	84
Both						
	Sample size	3	8	9	10	30
	% Sample	10.0%	26.7%	30.0%	33.3%	100.0%
	SE % sample	5.6%	8.2%	8.5%	8.8%	0.0%
	Downstream harvest	0	1	1	1	4
	SE downstream harvest	0	1	1	1	2
	Upstream harvest	53	143	160	178	535
	SE upstream harvest	31	50	54	56	98
	Total harvest	54	144	162	180	539
	SE total harvest	31	51	54	57	98

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

[a] "Downstream" is the Kenai River reach between Warren Ames Bridge and the RM 8.6 Chinook salmon sonar site; "upstream" is the Kenai River reach between the RM 8.6 Chinook salmon sonar site and Soldotna Bridge.

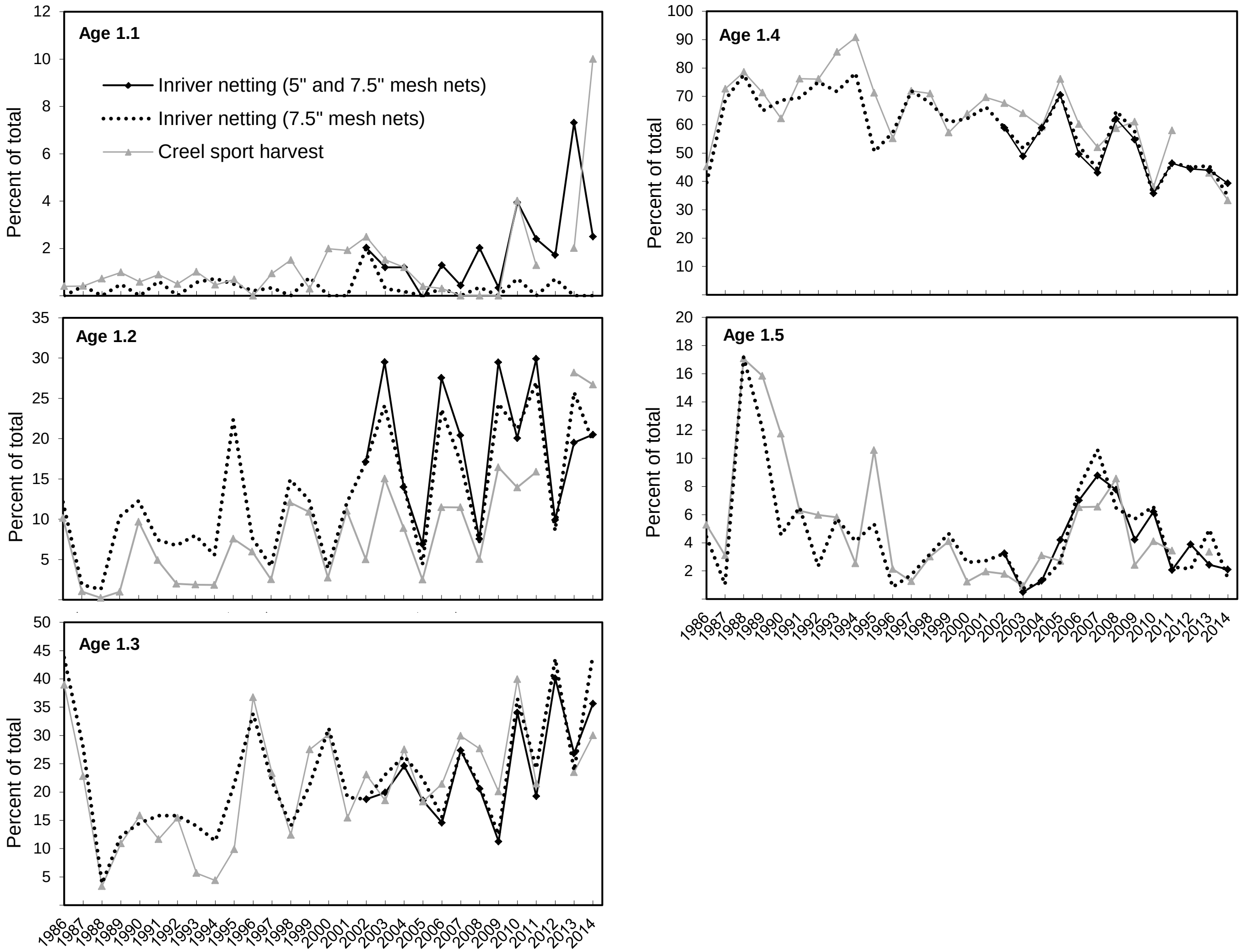


Figure 10.–Age composition of late-run harvest versus inriver netting for age-1.1 (top left), age-1.2 (middle left), age-1.3 (bottom left), age-1.4 (top right), and age-1.5 (bottom right) Chinook salmon, Kenai River, 1986–2015.

Note: Late-run age compositions were derived from midriver netting samples in 2002–2014 using 5.0-inch and 7.5-inch mesh nets (only 7.5-inch mesh nets were used in 1986–2001). Age compositions of the 2012 sport fishery were unreported because the sample size goal (19 aged scales) was not met. There was no reported harvest of age-1.5 Chinook salmon during 2014.

Table 4.–Late-run Kenai River Chinook salmon lengths by sex and age from creel survey samples, 1–25 July 2014.

		Age				
Sex	Parameter	1.1	1.2	1.3	1.4	Combined
Females						
	Sample size			4	4	8
	Mean length (SE)			883 (12)	1,014 (31)	948 (29)
	Min-max lengths			850–905	925–1,070	850–1,070
Males						
	Sample size	3	8	5	6	22
	Mean length (SE)	390 (10)	633 (21)	763 (37)	1,010 (26)	732 (46)
	Min-max lengths	380–410	515–700	700–900	950–1,110	380–1,110
Both						
	Sample size	3	8	9	10	30
	Mean length (SE)	390 (10)	633 (21)	816 (29)	1,012 (19)	790 (39)
	Min-max lengths	380–410	515–700	700–905	925–1,110	380–1,110

Note: All lengths were measured (mm) from mid eye to tail fork.

Inriver Gillnetting at RM 8.6

The 117 age samples collected in early-run midriver gillnetting did not meet the sample size goal of 127 valid scale ages (Table 5). The midriver age composition (5.0-inch and 7.5-inch mesh nets) was 9.4% age-1.1 fish, 41.0% age-1.2 fish, 39.3% age-1.3 fish, 9.4% age 1.4-fish, and 0.9% age-1.5 fish. The percentage of age-1.2 fish was the highest on record by a large margin (Figure 11). Age-1.1 fish have been caught in higher proportions since adding the 5.0-inch mesh nets to the inriver gillnetting study in 2002. The proportion of age-1.2 fish was the highest on record, and the proportion of age-1.4 fish was the lowest on record.

In early-run nearshore gillnetting, the age composition of the 29 sampled Chinook salmon was 27.6% age-1.1 fish, 34.5% age-1.2 fish, 34.5% age-1.3 fish, and 3.4% age-1.4 fish (Table 5). A much higher percentage of jacks (age-1.1 fish) were caught nearshore (27.6%) than midriver (9.4%). The composite early-run age composition estimate of the inriver run (nearshore and midriver combined) was 13.0% age-1.1 fish, 39.7% age-1.2 fish, 38.4% age-1.3 fish, 8.2% age-1.4 fish, and 0.7% age-1.5 fish.

Approximately 86.2% and 74.4% of early-run Chinook salmon captured nearshore and midriver, respectively, were male; the remaining 13.8% and 25.6%, respectively, were females (Table 5). Overall, 76.7% of early-run Chinook salmon (midriver and nearshore combined) were males; the remaining 23.3% were females.

Late-run midriver gillnets collected 239 valid age samples and met the sample size goal of 127 valid scale ages (Table 6). The midriver age composition was 2.5% age-1.1 fish, 20.5% age-1.2 fish, 35.6% age-1.3 fish, 39.3% age 1.4-fish, and 2.1% age-1.5 fish. As in the early run, age-1.1 fish have been caught in higher proportions during the late run since adding the 5.0-inch mesh nets to the inriver gillnetting study in 2002 (Figure 10).

Late-run nearshore gillnets collected 44 valid age samples (Table 6). The nearshore age composition was 20.5% age-1.1 fish, 36.4% age-1.2 fish, 29.5% age-1.3 fish, and 13.6% age-1.4 fish. Similar to the early run, a much higher percentage of jacks (age-1.1 fish) were caught nearshore (20.5%) than midriver (2.5%). Conversely, a much lower percentage of age-1.4 fish were caught nearshore (13.6%) than midriver (39.3%). The composite late-run age composition estimate of the inriver run (nearshore and midriver combined) was 5.3% age-1.1 fish, 23.0% age-1.2 fish, 34.6% age-1.3 fish, 35.3% age-1.4 fish, and 1.8% age-1.5 fish.

Approximately 77.3% and 56.1% of late-run Chinook salmon captured nearshore and midriver, respectively, were male; the remaining 22.7% and 43.9%, respectively, were females (Table 6). Overall, 59.4% of late-run Chinook salmon (midriver and nearshore combined) were males; the remaining 40.6% were females.

Table 5.–Early-run Kenai River Chinook salmon age compositions from midriver, nearshore, and combined gillnet samples, 16 May–30 June 2014.

			Age					
Source	Sex	Parameter	1.1	1.2	1.3	1.4	1.5	Total
Midriver								
	Female							
		Sample size		4	20	6		30
		% Midriver run		3.4%	17.1%	5.1%		25.6%
		SE % midriver run		1.7%	3.5%	2.0%		4.1%
	Male							
		Sample size	11	44	26	5	1	87
		% Midriver run	9.4%	37.6%	22.2%	4.3%	0.9%	74.4%
		SE % midriver run	2.7%	4.5%	3.9%	1.9%	0.9%	4.1%
	Both							
		Sample size	11	48	46	11	1	117
		% Midriver run	9.4%	41.0%	39.3%	9.4%	0.9%	100.0%
		SE % midriver run	2.7%	4.6%	4.5%	2.7%	0.9%	0.0%
Nearshore								
	Female							
		Sample size			4			4
		% Nearshore run			13.8%			13.8%
		SE % nearshore run			6.5%			6.5%
	Male							
		Sample size	8	10	6	1		25
		% Nearshore run	27.6%	34.5%	20.7%	3.4%		86.2%
		SE % nearshore run	8.4%	9.0%	7.7%	3.4%		6.5%
	Both							
		Sample size	8	10	10	1		29
		% Nearshore run	27.6%	34.5%	34.5%	3.4%		100.0%
		SE % nearshore run	8.4%	9.0%	9.0%	3.4%		0.0%
Combined								
	Female							
		Summed sample size		4	24	6		34
		% Inriver run		2.7%	16.4%	4.1%		23.3%
		SE % inriver run		1.4%	3.1%	1.6%		3.5%
	Male							
		Summed sample size	19	54	32	6	1	112
		% Inriver run	13.0%	37.0%	21.9%	4.1%	0.7%	76.7%
		SE % inriver run	2.8%	4.0%	3.4%	1.6%	0.7%	3.5%
	Both							
		Summed sample size	19	58	56	12	1	146
		% Inriver run	13.0%	39.7%	38.4%	8.2%	0.7%	100.0%
		SE % inriver run	2.8%	4.1%	4.0%	2.3%	0.7%	0.0%

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

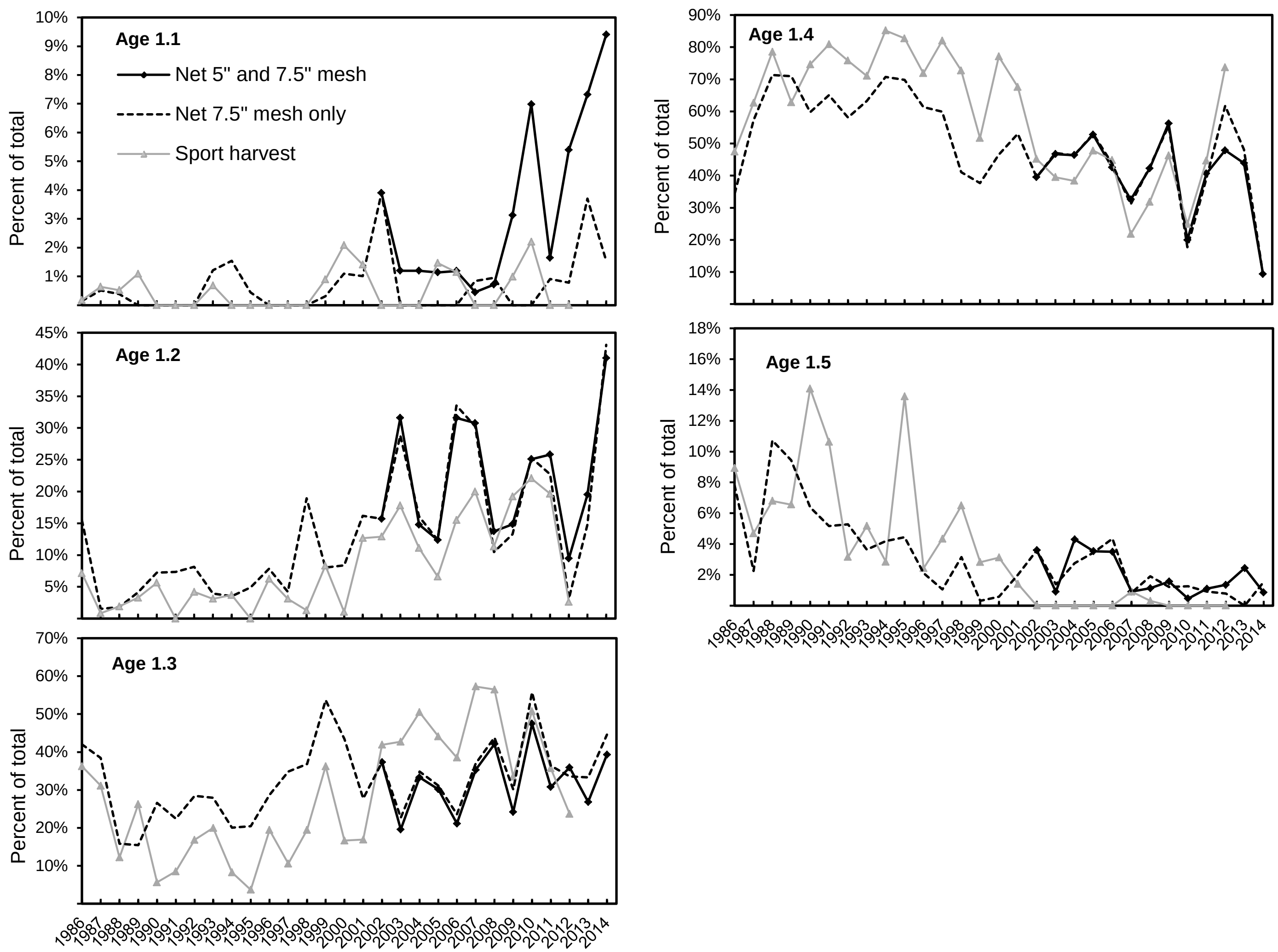


Figure 11.–Age composition of early-run harvest versus inriver netting for age-1.1 (top left), age-1.2 (middle left), age-1.3 (bottom left), age-1.4 (top right), and age-1.5 (bottom right) of Kenai River Chinook salmon, 1986–2014.

Note: The 2015 early-run sport fishery was closed to all Chinook salmon fishing 1 May–30 June. Inriver run age compositions are derived from 2002–2014 midriver netting samples using 5.0-inch and 7.5-inch mesh nets (only 7.5-inch mesh nets were used in 1986–2001). There was a Chinook salmon sport fishery slot limit of 44 inches–55 inches total length during 2003–2007, 46 inches–55 inches total length during 2008–2013, and 42 inches–55 inches during 2015.

Table 6.–Late-run Kenai River Chinook salmon age compositions from midriver, nearshore, and combined gillnet samples, 1 July–15 August 2014.

			Age					
Source	Sex	Parameter	1.1	1.2	1.3	1.4	1.5	Total
Midriver								
	Female							
		Sample size		2	28	72	3	105
		% Midriver run		0.8%	11.7%	30.1%	1.3%	43.9%
		SE % midriver run		0.6%	2.1%	3.0%	0.7%	3.2%
	Male							
		Sample size	6	47	57	22	2	134
		% Midriver run	2.5%	19.7%	23.8%	9.2%	0.8%	56.1%
		SE % midriver run	1.0%	2.6%	2.8%	1.9%	0.6%	3.2%
	Both							
		Sample size	6	49	85	94	5	239
		% Midriver run	2.5%	20.5%	35.6%	39.3%	2.1%	100.0%
		SE % midriver run	1.0%	2.6%	3.1%	3.2%	0.9%	0.0%
Nearshore								
	Female							
		Sample size			6	4		10
		% Nearshore run			13.6%	9.1%		22.7%
		SE % nearshore run			5.2%	4.4%		6.4%
	Male							
		Sample size	9	16	7	2		34
		% Nearshore run	20.5%	36.4%	15.9%	4.5%		77.3%
		SE % nearshore run	6.2%	7.3%	5.6%	3.2%		6.4%
	Both							
		Sample size	9	16	13	6		44
		% Nearshore run	20.5%	36.4%	29.5%	13.6%		100.0%
		SE % nearshore run	6.2%	7.3%	7.0%	5.2%		0.0%
Combined								
	Female							
		Summed sample size		2	34	76	3	115
		% Inriver run		0.7%	12.0%	26.9%	1.1%	40.6%
		SE % inriver run		0.5%	1.9%	2.6%	0.6%	2.9%
	Male							
		Summed sample size	15	63	64	24	2	168
		% Inriver run	5.3%	22.3%	22.6%	8.5%	0.7%	59.4%
		SE % inriver run	1.3%	2.5%	2.5%	1.7%	0.5%	2.9%
	Both							
		Summed sample size	15	65	98	100	5	283
		% Inriver run	5.3%	23.0%	34.6%	35.3%	1.8%	100.0%
		SE % inriver run	1.3%	2.5%	2.8%	2.8%	0.8%	0.0%

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

Chinook salmon captured in the inriver gillnetting project were on average smaller during the early run (684 mm) than the late run (809 mm) (Tables 7 and 8). Chinook salmon captured in late-run inriver gillnetting (809 mm) were larger on average than those sampled in the late-run creel survey (790 mm) (Tables 4 and 8). On average, males were similar or larger in length than females of comparable age classes aside from age-1.3 Chinook salmon, where females were larger than males of the same age class (Tables 4, 7, and 8).

Table 7.–Early-run Kenai River Chinook salmon lengths by sex and age from midriver, nearshore, and combined gillnet samples, 16 May–30 June 2014.

			Age					
Source	Sex	Parameter	1.1	1.2	1.3	1.4	1.5	Combined
Midriver								
	Females							
		Sample size		4	20	6		30
		Mean length (SE)		585 (16)	812 (9)	938 (22)		807 (20)
		Min-max lengths		545–610	750–885	880–995		545–995
	Males							
		Sample size	11	44	26	5	1	87
		Mean length (SE)	418 (10)	609 (8)	773 (11)	986 (21)	1,170	662 (17)
		Min-max lengths	380–495	505–705	690–865	930–1,050	1,170	380–1,170
	Both							
		Sample size	11	48	46	11	1	117
		Mean length (SE)	418 (10)	607 (8)	790 (8)	960 (17)	1,170	699 (15)
		Min-max lengths	380–495	505–705	690–885	880–1,050		380–1,050
Nearshore								
	Females							
		Sample size			4			4
		Mean length (SE)			799 (20)			799 (20)
		Min-max lengths			755–850			755–850
	Males							
		Sample size	8	10	6	1		25
		Mean length (SE)	406 (8)	606 (18)	774 (27)	1,010		598 (34)
		Min-max lengths	380–455	540–695	680–860			380–1,010
	Both							
		Sample size	8	10	10	1		29
		Mean length (SE)	406 (8)	606 (18)	784 (18)	1,010		626 (32)
		Min-max lengths	380–455	540–695	680–860	1,010		380–1,010
Combined								
	Females							
		Summed sample size		4	24	6		34
		Mean length (SE)		585 (16)	810 (9)	938 (22)		806 (20)
		Min-max lengths		545–610	750–885	880–995		545–995
	Males							
		Summed sample size	19	54	32	6	1	112
		Mean length (SE)	413 (10)	608 (8)	773 (11)	990 (21)	1,170	648 (17)
		Min-max lengths	380–494	505–705	680–865	930–1,050	1,170	380–1,170
	Both							
		Summed sample size	19	58	56	12	1	146
		Mean length (SE)	413 (10)	607 (8)	789 (8)	964 (17)	1,170	684 (15)
		Min-max lengths	380–495	505–705	680–885	880–1,050	1,170	380–1,170

Note: All lengths were measured (mm) from mid eye to tail fork (METF).

Table 8.–Late-run Kenai River Chinook salmon lengths by sex and age from midriver, nearshore, and combined gillnet samples, 1 July–15 August 2014.

			Age					
Source	Sex	Parameter	1.1	1.2	1.3	1.4	1.5	Combined
Midriver								
	Females							
		Sample size		2	28	72	3	105
		Mean length (SE)		625 (15)	860 (9)	965 (7)	1,110 (21)	935 (9)
		Min-max lengths		610–640	710–915	880–1,140	1,080–1,150	610–1,150
	Males							
		Sample size	6	47	57	22	2	134
		Mean length (SE)	422 (17)	642 (8)	772 (8)	977 (11)	1,075	749 (13)
		Min-max lengths	380–500	505–710	670–920	900–1,090	1,075	380–1,090
	Both							
		Sample size	6	49	85	94	5	239
		Mean length (SE)	422 (17)	641 (7)	801 (7)	968 (6)	1,096 (14)	830 (10)
		Min-max lengths	380–500	505–710	670–920	880–1,140	1,075–1,150	380–1,150
Nearshore								
	Females							
		Sample size			6	4		10
		Mean length (SE)			845 (35)	991 (31)		904 (33)
		Min-max lengths			675–900	940–1,065		675–1065
	Males							
		Sample size	9	16	7	2		34
		Mean length (SE)	431 (6)	635 (16)	784 (30)	1,028 (18)		635 (29)
		Min-max lengths	395–455	495–710	695–875	1,010–1,045		395–1,045
	Both							
		Sample size	9	16	13	6		44
		Mean length (SE)	431 (6)	635 (16)	812 (24)	1,003 (22)		696 (29)
		Min-max lengths	395–455	495–710	675–900	940–1,065		395–1,065
Combined								
	Females							
		Summed sample size		2	34	76	3	115
		Mean length (SE)		625 (15)	858 (9)	966 (7)	1,110 (21)	932 (9)
		Min-max lengths		610–640	675–915	880–1,140	1,080–1,150	610–1,150
	Males							
		Summed sample size	15	63	64	24	2	168
		Mean length (SE)	427 (17)	640 (8)	773 (8)	981 (11)	1,075	726 (13)
		Min-max lengths	380–500	495–710	670–920	900–1,090	1,075	380–1,090
	Both							
		Summed sample size	15	65	98	100	5	283
		Mean length (SE)	427 (17)	640 (7)	802 (7)	970 (6)	1,096 (14)	809 (10)
		Min-max lengths	380–500	495–710	670–920	880–1,140	1,075–1,150	380–1,150

Note: All lengths were measured (mm) from mid eye to tail fork (METF).

Inriver Gillnetting Age Compositions: Time of Day vs. Tidal Stage

The ages of all Chinook salmon sampled in 2014 at RM 8.6 were analyzed to see if there were differences in the age compositions of Chinook salmon captured during different times of day or tidal stage. Age compositions were compared for 2 times of day: the 7:00 AM–1:00 PM schedule and the 1:00 PM–7:00 PM schedule. Age compositions were compared for 2 tide stages: 6 hours centered on low tide (the schedule implemented in 2002–2006) and 6 hours of the falling tide (the schedule implemented in 2007–2013) (Figure 12). Although there were slight differences, overall, the age compositions of fish captured around low tide or falling tide were similar to the age composition of fish captured during a set time of day (7:00 AM–1:00 PM or 1:00 PM–7:00 PM). Age compositions between the 4 schedules did not differ significantly during the early run (χ^2 = 2.58, df = 9, P = 0.87) or late run (χ^2 = 2.35, df = 9, P = 0.95) with age-1.1,-1.2, -1.3, and -1.4 fish considered.

Because catch rates differed between shifts in the 2014 inriver gillnetting study (Figure 9), the age composition of the morning shift (7:00 AM–1:00 PM) was compared to the age composition of the afternoon shift (1:00 PM–7:00 PM) (Figure 12). Age compositions did not differ significantly during the early run (χ^2 = 3.15, df = 3, P = 0.37) or late run (χ^2 = 0.82, df = 3, P = 0.84) with age-1.1,-1.2, -1.3, and -1.4 fish considered.

Chinook Salmon Age Composition Comparisons

The age compositions of Chinook salmon captured midriver were significantly different (χ^2 = 36.82, df = 2, P < 0.001) between the early and late runs with age-1.2, -1.3, and -1.4 fish considered. Age-1.2 fish made up the highest proportion of the early run (41.0%, SE 4.6%) and age-1.4 fish made up the highest proportion of the late run (39.3%, SE 3.2%), (Tables 5 and 6).

The age composition of fish captured nearshore for the early and late runs did not differ significantly (χ^2 = 0.13, df = 1, P = 0.7) with only age-1.2, and -1.3 fish considered. Age-1.2 Chinook salmon made up the highest proportion of the early run (34.5%, SE 9.0%) and late run (36.4%, SE 7.3%) (Tables 5 and 6).

The age composition of the late-run sport harvest did not differ significantly with either the late-run midriver gillnetting (χ^2 = 0.92, df = 2, P = 0.63) or nearshore gillnetting (χ^2 = 3.42, df = 2, P = 0.18) age compositions, with age-1.2, -1.3, and -1.4 fish considered (Tables 4 and 6).

Chinook Salmon Length Comparisons

Midriver vs. Nearshore Gillnetting Length Compositions

During the early run, the length distribution of 35 Chinook salmon captured in nearshore nets was compared to the length distribution of 130 Chinook salmon captured midriver (Figure 13). Although the average length of early-run Chinook salmon captured nearshore (626 mm) was slightly smaller than those captured midriver (699 mm) (Table 7), there was no significant difference between the 2 length distributions (D = 0.16, P = 0.47) (Figure 14).

During the late run, the length distribution of 50 Chinook salmon captured in nearshore nets was compared to the length distribution of 273 Chinook salmon captured midriver (Figure 13). The average length of late-run Chinook salmon captured nearshore (696 mm) was smaller than those captured midriver (830 mm) (Table 8), and a significant difference (D = 0.35, P < 0.001) between the 2 length distributions was observed (Figure 14). Table 9 summarizes the results of all the K-S tests.

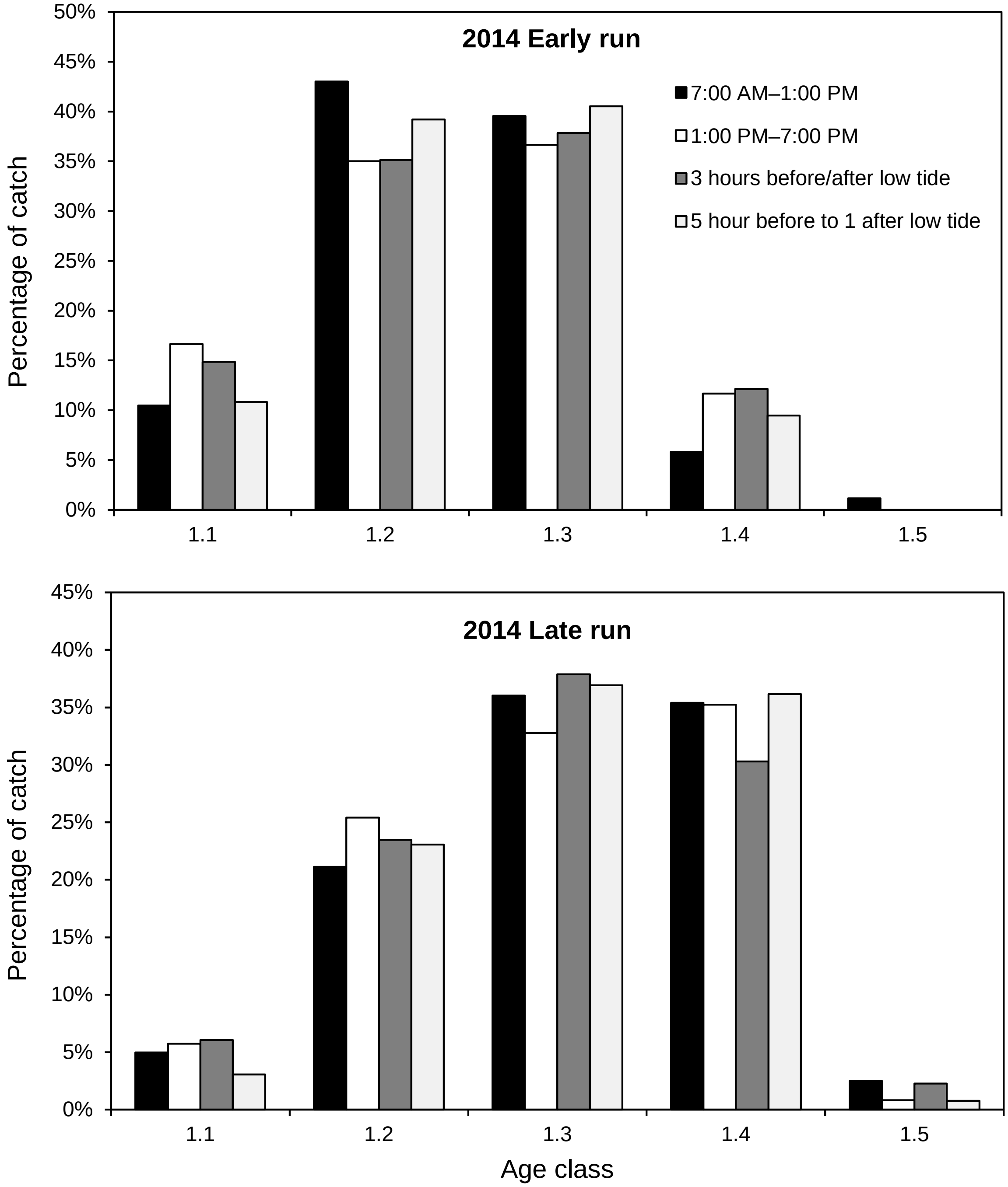


Figure 12.–Percentage of all Kenai River Chinook salmon captured during 2 times of day and 2 tide stages in the early run (top) and late run (bottom), 2014.

Note: The 2 times of day were 7:00 AM–1:00 PM (morning shift of 2014 sampling schedule) and 1:00 PM–7:00 PM (afternoon shift of 2014 sampling schedule). The 2 tide stages were 3 before low tide to 3 hours after low tide (2002–2006 gillnet sampling schedule) and 5 hours before low tide to 1 hour after low tide (2007–2013 gillnet sampling schedule).

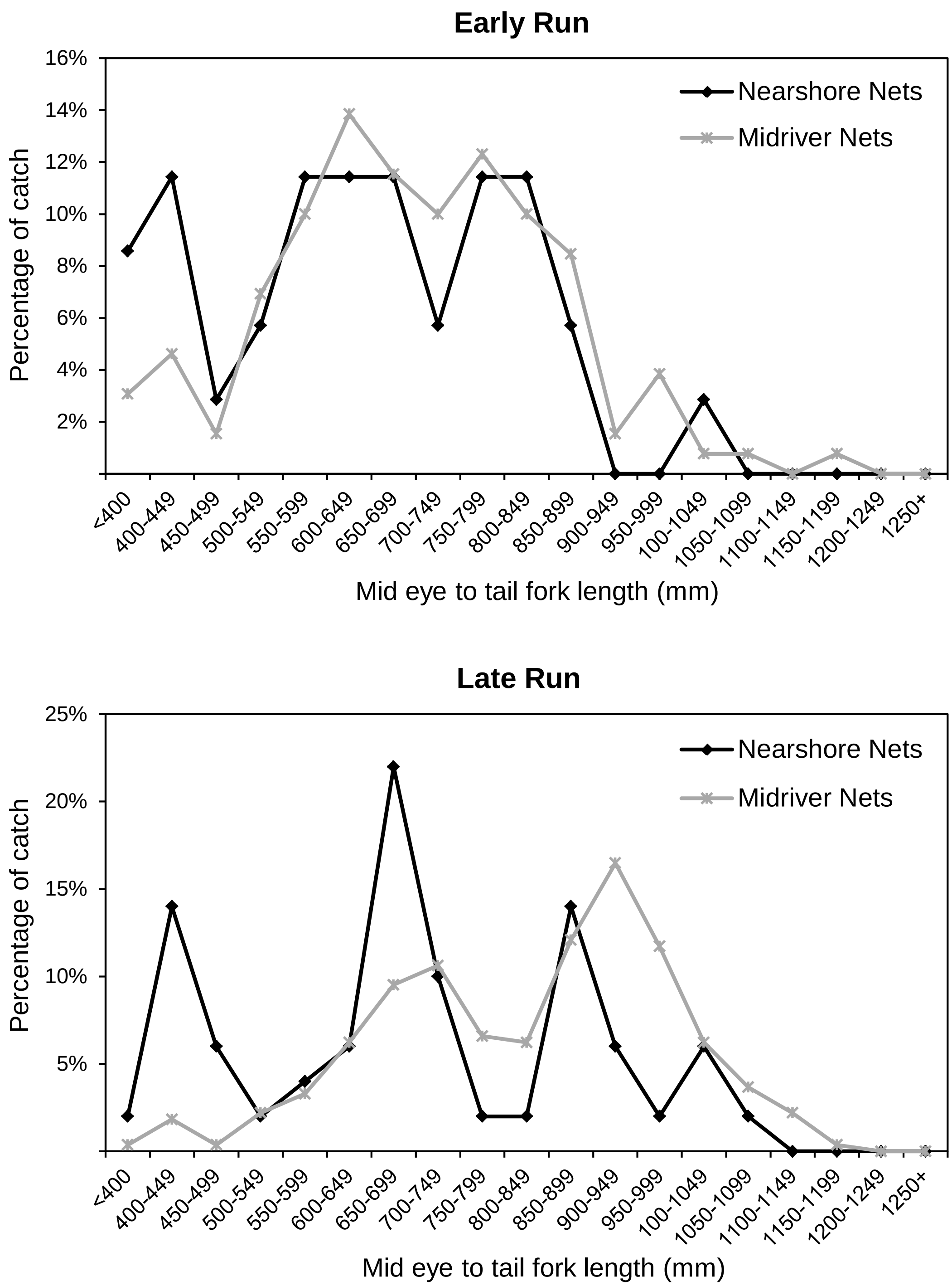


Figure 13.–Length composition of early- and late-run Chinook salmon caught in midriver and nearshore nets at RM 8.6, 2014.

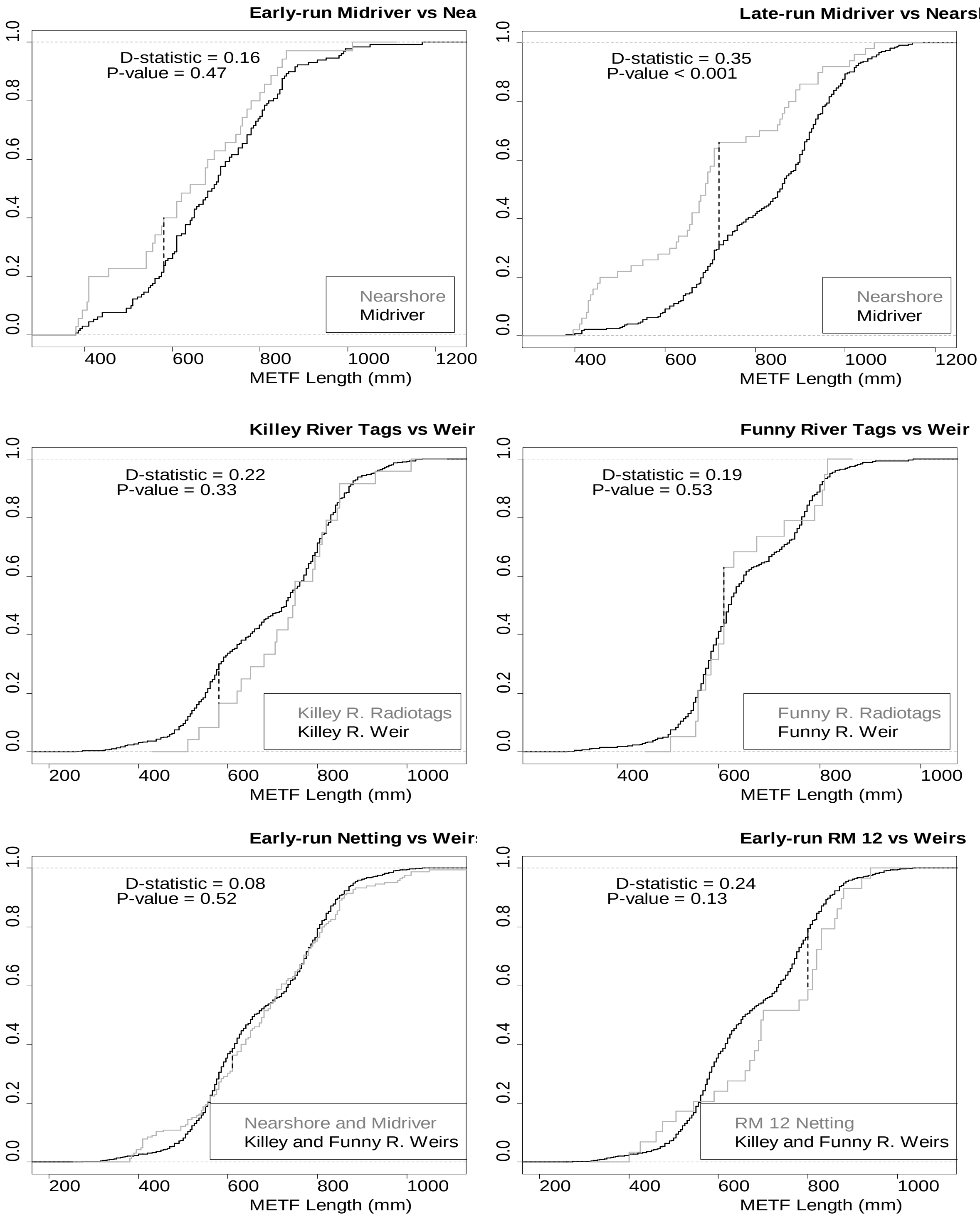


Figure 14.–Cumulative distributions and K-S test results for Chinook salmon sampled in early-run nearshore vs. midriver netting (top left), Kiley River tagged fish vs. Killey River weir (middle left), early-run netting vs. Funny and Killey river weirs (bottom left), late-run nearshore vs. midriver netting (top right), Funny River tagged fish vs. Funny River weir (middle right), and early-run RM 12 netting vs. Funny and Killey river weirs (bottom right), 2014.

Table 9.–Kolmogorov-Smirnov tests between length distributions of Chinook salmon captured in inriver nets, radiotagged, and sampled at the Killey and Funny River Weirs, 2014.

Variables	Run	D-statistic	*P*-value
Midriver (n = 130) vs. nearshore (n = 35)	Early	0.16	0.47
Midriver (n = 273) vs nearshore (n = 50)	Late	0.35	**< 0.001**
Midriver and nearshore (n = 165) vs. weirs (n = 937)	Early	0.08	0.52
Midriver (n = 130) vs. weirs (n = 937)	Early	0.08	0.36
Killey R. tags (n = 24) vs. Killey R. weir (n = 556)	Early	0.22	0.33
Funny R. tags (n = 19) vs. Funny R. weir (n = 381)	Early	0.19	0.53
RM 12 netting (n = 29) vs. weirs (n = 937)	Early	0.24	0.13

Note: The *P*-value less than 0.05 in bold indicates a significant difference between the 2 length distributions.

RM 8.6 and RM 12 Gillnetting vs. Tributary Weir Passage Length Compositions

Overall, the length distributions of early-run Chinook salmon sampled at either RM 8.6 or RM 12 were similar to the length distributions of Chinook salmon sampled by the USFWS at the Killey River and Funny River tributary weirs (Table 9 and Figure 14).

The length distribution of 24 radiotagged Chinook salmon that migrated above the Killey River weir was similar (D = 0.22, P = 0.33) to the length distribution of 556 Chinook salmon sampled at the Killey River weir. Although the length distribution of 19 radiotagged Chinook salmon that migrated above the Funny River weir was similar (D = 0.19, P = 0.53) to the length distribution of 381 Chinook salmon sampled at the Funny River weir, the sample size of Funny River radiotagged fish may be too small to detect a significant difference.

The length distribution of all early-run Chinook salmon sampled in both nearshore and midriver nets at RM 8.6 (165) was compared to the length distribution (weighted by abundance) of 937 Chinook salmon sampled at the Killey River and Funny River weirs (Table 9 and Figure 14). There was no significant difference (D = 0.08, P = 0.52) between these 2 length distributions, suggesting a representative sample of early-run Chinook salmon were caught with combined nearshore and midriver nets at RM 8.6.

The length distribution of early-run Chinook salmon captured with 5.0-inch and 7.5-inch mesh gillnets (nearshore and midriver) during the RM 12 feasibility gillnetting study (29 fish) was compared to the length distribution (weighted by abundance) of 937 Chinook salmon sampled at the Killey and Funny River weirs (Table 9 and Figure 14). There was no significant difference (D = 0.24, P = 0.13) between these 2 length distributions, suggesting a representative sample of early-run Chinook salmon were caught with inriver nets at RM 12.

ENVIRONMENTAL VARIABLES

Secchi disk measurements at the RM 8.6 Chinook salmon sonar site ranged between 0.3 m and 1.1 m with an average (0.6 m) that was near the historical (1998–2013) average (Figure 15). Secchi disc measurements in the sport fishery at RM 15.3 were below average during 2–15 July and above average during 20–25 July.

The 2014 Kenai River average discharge, measured by USGS at the Soldotna Bridge (9,875 ft^3/s), was below the historical (1965–2013) average (10,331 ft^3/s). There was a large increase in discharge during 12–20 July with a peak of 16,200 ft^3/s on 14 July, but otherwise discharge was generally below the historical average.

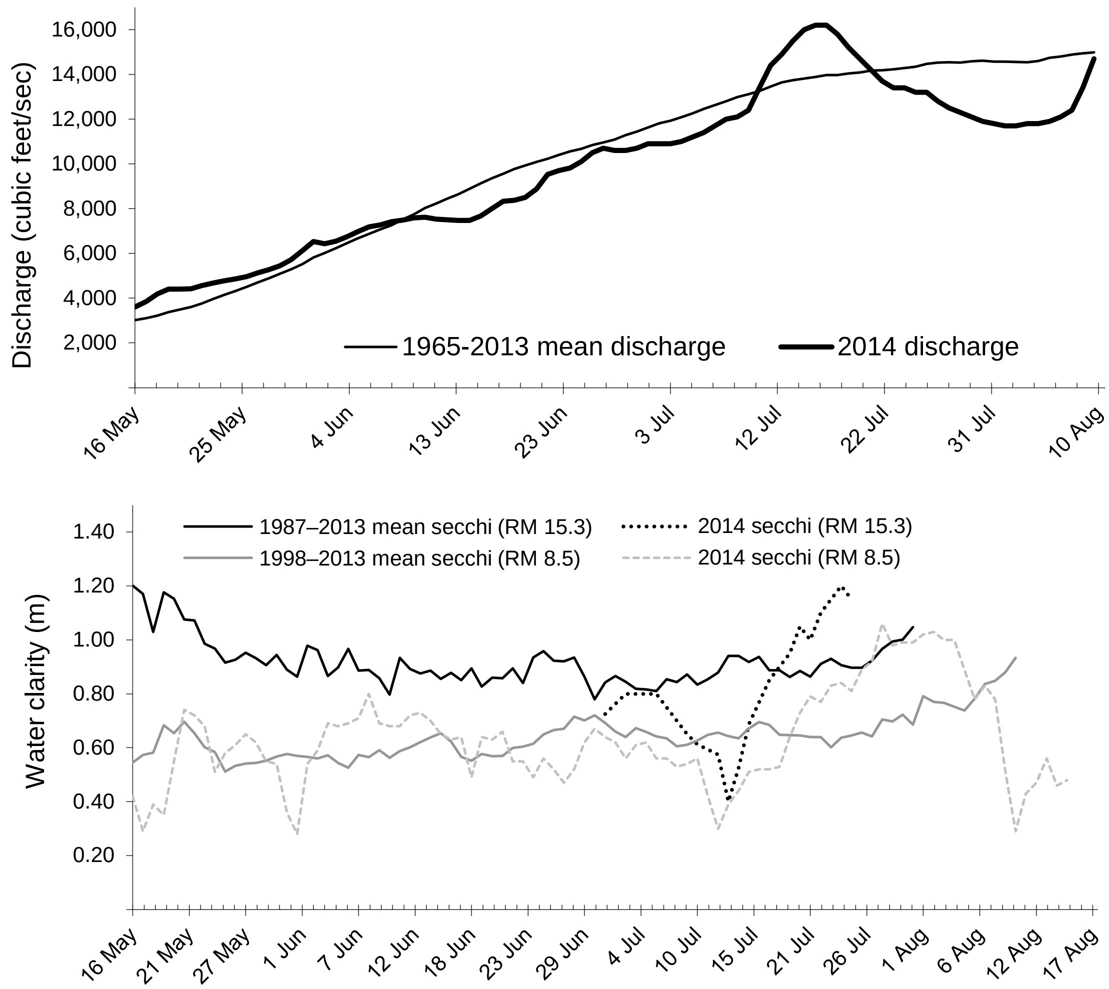


Figure 15.–Kenai River discharge (top) and water clarity (bottom), 16 May–17 August 2014.

Note: Discharge data downloaded from USGS 15266300 KENAI RIVER AT SOLDOTNA AK 2014-09-26 10:10 EST http://waterdata.usgs.gov/ak/nwis/dv.

OTHER RESULTS

Prior to the closure of the late-run sport fishery to Chinook salmon harvest on 19 July, approximately 63% of Chinook salmon caught in the sport fishery were released (calculated from Appendices B1–B2). Guided anglers reported releasing 54% of their catch, while unguided anglers reported releasing 78% of their catch. The size of Chinook salmon released wasn't recorded during angler interviews but conversations with anglers revealed that released Chinook salmon were generally smaller, younger age-class fish. This observation agrees with empirical measurements of abundant smaller and younger Chinook salmon captured in inriver gillnets.

Genetic tissue samples were collected from 488 Chinook salmon sampled from inriver gillnets at RM 8.6 (165 early run, 323 late run), 48 samples from inriver gillnets at RM 12 (early run only) and 32 samples from the creel survey sport harvest (late run only).

Esophageal implant radio transmitters were deployed in 277 Chinook salmon captured in inriver gillnets at RM 8.6 (159 early run, 118 late run). No radio transmitters were recovered from harvested Chinook salmon during creel survey sampling.

There was no reported harvest of Chinook salmon 55 inches TL or greater, and no Chinook salmon were observed by the inriver gillnetting crew or the creel survey crew that had a missing adipose fin.

DISCUSSION AND RECOMMENDATIONS

CREEL SURVEY

To achieve early- and late-run escapement goals during 2014, inseason management actions were imposed to restrict harvest of Kenai River Chinook salmon monitored by the creel survey. The early run has been closed since 2013 and the late run has been restricted or closed for at least a portion of the fishery during 2011–2014.

During times of low abundance and fishing restrictions, unguided anglers expend less effort and account for a smaller proportion of the harvest than guided anglers. During 2014, guided anglers accounted for 69% of late-run effort and 79% of the late-run harvest, both historical highs. In addition, Chinook salmon abundance and fishery restrictions not only affect the quantity of sport angler effort and harvest, but also the location where effort and harvest occurs. During times of high abundance (2006), approximately 25% of the late-run harvest occurred below the RM 8.6 sonar site; in contrast, less than 1% occurred below the RM 8.6 sonar site during the historically low run in 2014. During times of low abundance, fishermen tend to target upstream areas where fish are more concentrated and fishing without bait is more effective due to clearer water.

In 2015, ADF&G will discontinue the RM 8.6 sonar site and management of the Chinook salmon runs will be based on RM 13.7 sonar passage estimates. The RM 13.7 sonar site is advantageous because the entire water column can be insonified and the site is upstream of tidal influence. However, a large portion of the sport fishery occurs downstream of RM 13.7, requiring accurate geographically stratified creel survey estimates for effective management. Historically, sport harvest and catch estimates above and below the RM 8.6 sonar were the product of non-stratified CPUE and HPUE estimates derived from angler interviews (Warren Ames Bridge to Soldotna Bridge) and stratified estimates of effort from angler counts (Warren Ames Bridge to RM 8.6 and RM 8.6 to Soldotna Bridge). Prior attempts to stratify CPUE and HPUE in relation to RM 8.6 were unsuccessful due to the limited number of interviews of anglers that fished below RM 8.6. Because a majority of anglers reported spending a portion of their trip fishing below RM 13.7 during 2012–2014, a sufficient number of interviews may be available to accurately stratify CPUE and HPUE rates that are related to the RM 13.7 sonar site in future years.

Recommendations for Creel Survey

During 2015, it is recommended that to estimate angler effort (from angler boat counts) in addition to CPUE and HPUE (from angler interviews), the analysis should be geographically stratified above and below the RM 13.7 Chinook salmon sonar site. For better estimates of effort, catch, and harvest related to the RM 13.7 sonar site, we recommend the following information be recorded from each angler interviewed in 2015 and beyond:

1) total hours (to the quarter-hour) actively fished downstream of the RM 13.7 sonar
2) total hours (to the quarter-hour) actively fished upstream of the RM 13.7 sonar
3) the location and number of Chinook salmon harvested within each area (downstream or upstream of the RM 13.7)
4) the location and number of Chinook salmon released within each area (downstream or upstream of the RM 13.7)

Late-run drift-boat Mondays are monitored using an index rather than being included into the regular creel survey sampling schedule. This portion of the fishery grew in popularity since its inception in 2002 until 2008 (Perschbacher 2012d). Late-run Monday index estimates of unguided angler effort and harvest were less than 5% of total late-run effort and harvest during 2009–2014, but it is anticipated that as Chinook salmon runs rebound, so will angler effort and harvest on Mondays. This unique portion of the fishery should continue to be monitored annually, and estimates incorporated into season totals of effort, catch, and harvest. Periodic calibration of the index estimation method will also be necessary to ensure accuracy.

INRIVER GILLNETTING

During 2014, several changes were incorporated into the inriver gillnetting study at RM 8.6. Netting effort was doubled, the river was fished rigorously from bank to bank for the first time, panel nets were instituted, and the schedule was based on a set time of day rather than tidal stage. These changes were incorporated to examine size discrepancies of Chinook salmon captured midriver and nearshore to those sampled at tributary weirs, to examine whether it is possible to net RM 8.6 shoreline to shoreline with equal effort, and to examine tidal effects on catch rates and size of Chinook salmon captured in inriver gillnets. In addition, a feasibility study (early run only) investigated a netting site upstream of major tidal influence that was closer to the RM 13.7 Chinook salmon sonar site.

During the 2014 inriver gillnetting study at RM 8.6, the midriver gillnets were able to be deployed at all possible tide stages during both the early and late runs. Nearshore nets could not be deployed during extreme low tides when seasonal flows were at minimum, mostly during the beginning of the early run. The addition of nearshore netting was more complicated for the boat driver, and netting nearshore was more hazardous than netting midriver because nearshore netting was constricted at low tide and shorter drifts were required to avoid submerged trees from eroded banks, especially along the left bank. Despite these challenges, the time spent netting nearshore was only slightly less (10–14% less) than the time spent netting midriver.

Chinook salmon catch rates, related to tidal stage and time of day, differed significantly during both the early and late runs. Higher catch rates occurred during rising and falling tides compared to other tide stages. Higher catch rates were also observed during the morning shift compared to the afternoon shift. Although catch rates varied, length compositions of Chinook salmon were similar regardless of the tide stage or time of day they were captured.

In 2014, a representative sample of early-run Chinook salmon was captured in the RM 8.6 netting program. This conclusion is based on the similar sizes of Chinook salmon radiotagged by the RM 8.6 netting program that migrated past tributary weirs compared to other Chinook salmon sampled at the tributary weirs. In addition, the length distribution of all early-run Chinook salmon captured at RM 8.6 was similar to the Killey River weir and Funny River weir combined length distribution. This comparison may not always be repeatable because we know from telemetry studies that early-run Chinook salmon captured in the netting program spawn below tributary weirs, in other tributaries, and in the mainstem Kenai River (Reimer 2013). Despite capturing a representative sample with nearshore and midriver sets combined, the midriver sets alone captured a representative sample in 2014. In 2013, midriver sets alone did not capture a representative sample of early-run Chinook salmon; however, there was a much larger proportion of small Chinook salmon captured nearshore in 2013 than in 2014. During the 2014 late run, length distributions of Chinook salmon captured midriver and nearshore differed, but were similar during the 2013 late run. Although there is no separate source (like tributary weirs for early-run Chinook salmon) to validate length compositions of late-run Chinook salmon captured at RM 8.6, sample sizes were large enough in 2014 to have confidence in the detection of a significant difference between fish captured nearshore and midriver.

Differing results in 2013 and 2014, with respect to length distributions of Chinook salmon captured nearshore and midriver, suggest that geographic strata may be important in some years and not in others. Although results of differences in length distributions of nearshore and midriver fish contrasted between 2013 and 2014, Chinook salmon captured nearshore were on average smaller than midriver fish for both runs in 2013 and 2014. While midriver netting has at times captured a representative sample of returning Chinook salmon, incorporating nearshore sets into the netting study is warranted because the RM 13.7 sonar will insonify the entire water column from shoreline to shoreline.

Ideally, the netting program would operate just downstream of the RM 13.7 sonar. Unfortunately, it is not possible to conduct the netting program at RM 13.7 without significantly affecting the sport fishery in the area. In 2014, the early-run sport fishery was closed and it provided an opportunity for us to test a potential future netting site at RM 12. The area around RM 12 was considerably easier to net and had obvious advantages over the RM 8.6 location, including lower tidal fluctuations, minimal snags, and a narrower river channel, and it is closer to the RM 13.7 sonar site. Disadvantages of this location include the presence of drifting algae that catches on the nets and possibly causes net avoidance issues in the clearer water and the popularity of the area as a sport fishing location. Although we were able to net this area when the early-run Chinook salmon fishery was closed, there would have been negative interactions with anglers and boat traffic if this location had been open to sport fishing. In summary, unless the RM 12 netting area is regulated as closed to sport fishing, or regulated as a no-wake zone, it will probably not be a good place for an intensive inriver gillnetting study due to social issues and heavy boat traffic.

During the 2014 RM 12 pilot study, we also tested a 4.5-inch mesh net hung loosely in an attempt to entangle fish rather than gill them. Unfortunately, the 4.5-inch mesh net did not work well. Captured salmon sometimes took longer to remove from the loosely hung net due to the greater amount of mesh to untangle. The large amount of mesh might also have contributed to net avoidance. Compared to the RM 8.6 site, the water at the RM 12 netting location was clearer and slower, making the nets much more visible in the water. The 4.5-inch mesh nets were effective at capturing jack Chinook salmon and sockeye salmon, but these fish were mostly gilled and mortality rates were probably higher. Using a tangle net at RM 8.6 that has a smaller mesh size and shorter hang ratio may help reduce net avoidance, handling time, and mortality.

Recommendations for Inriver Gillnetting

A better alternative to the historical (2002–2013) netting schedules that were based on a fixed tide stage is a netting schedule based on a fixed time of day. Preferably, netting should be conducted during the morning hours (7:00 AM–1:00 PM) because catch rates were higher compared to the afternoon hours (1:00 PM–7:00 PM). Similar age compositions of fish captured during different times of day and at different tide stages suggest that any tide stage may be acceptable to collect a representative sample of the inriver runs (low catch rates during the low and high tide stages aside). Although the intensified netting study of 2014 occurred during historically low runs of early- and late-run Chinook salmon, and the abundance of returning Chinook salmon fluctuates year-by-year, a fixed time-of-day netting schedule allows for detection of any tidal effects that may influence when different-sized Chinook salmon migrate upstream.

The 4-panel net system worked well to reduce the number of nets required in the boat, and they were effectively fished nearshore and midriver, but sockeye salmon were difficult to remove specifically where the 5.0- and 7.5-inch panels were seamed together. Smaller fish (mainly sockeye salmon) captured in the 5.0-inch mesh net had a tendency to be caught in the 7.5-inch mesh at the same time. Fish captured in multiple mesh sizes required increased handling time, which increased mortalities. A 2-panel net (a 30 ft 5.0-inch mesh panel seamed to a 30 ft 7.5-inch mesh panel) would reduce the number of seams, mortalities, and time spent handling fish.

Continued analysis of length and age compositions of Chinook salmon captured midriver and nearshore are required because RM 8.6 midriver catch information has been used to establish current escapement goals, and both nearshore and midriver catch data will be used to establish future (shoreline to shoreline) escapement goals concurrent with RM 13.7 Chinook salmon sonar passage estimates.

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APPENDIX A: BOAT ANGLER COUNTS DURING THE KENAI RIVER CHINOOK SALMON FISHERY, 2014

Appendix A1.–Guided and unguided downstream boat angler counts by geographic strata during the late-run Kenai River Chinook salmon fishery, 1–25 July 2014.

		Downstream [b] angler counts									
		Unguided anglers [c]					Guided anglers [c]				
Date	Day type [a]	$\bar{x}$	A	B	C	D	$\bar{x}$	A	B	C	D
1 Jul	WD	0	0	0	0	0	2	0	4		
3 Jul	WD	0	0	0	0	0	0	0	0	0	
5 Jul	WE-H	2	2	0	0	4	1		2	0	
6 Jul	WE-H	1	2	0	0	0					
8 Jul	WD	0	0	0	0	0	0	0	0		
11 Jul	WD	0	0	0	0	0	0	0	0	0	
12 Jul	WE-H	0	0	0	0	0	0	0	0		
13 Jul	WE-H	0	0	0	0	0					
16 Jul	WD	1	0	0	2	0	0		0	0	
18 Jul	WD	0	0	0	0	0	1	0	0	4	
19 Jul	WE-H	0	0	0	0	0	0	0	0	0	
20 Jul	WE-H	0	0	0	0	0					
23 Jul	WD	0	0	0	0	0	1	0	3	0	
24 Jul	WD	0	0	0	0	0	0	0	0	0	
	Min (All A–D)			0.0					0.0		
	Average (All A–D)			0.2					0.5		
	Max (All A–D)			4.0					4.0		

Note: Blank space in data fields indicates that fishing was closed for guided anglers during the time of this count, therefore no data to present.

[a] WD is weekday and WE-H is weekend and holiday

[b] "Downstream" is the Kenai River reach from Warren Ames Bridge to the RM 8.6 Chinook salmon sonar site; "Upstream" is the Kenai River reach from the RM 8.6 Chinook salmon sonar site to Soldotna Bridge.

[c] Angler count times: A is 4:00 AM–8:59 AM; B is 9:00 AM–1:59 PM; C is 2:00 PM–7:59 PM; and D is 8:00 PM–11:59 PM; $\bar{x}$ is the average count of the 4 count times.

Appendix A2.–Guided and unguided upstream boat angler counts by geographic strata during the late-run Kenai River Chinook salmon fishery, 1–25 July 2014.

		Upstream [b] angler counts									
		Unguided anglers [c]					Guided anglers [c]				
Date	Day type [a]	$\bar{x}$	A	B	C	D	$\bar{x}$	A	B	C	D
1 Jul	WD	35	73	30	34	2	187	210	164		
3 Jul	WD	9	4	6	7	19	70	103	84	24	
5 Jul	WE-H	22	3	26	33	27	55		67	42	
6 Jul	WE-H	13	24	18	8	0					
8 Jul	WD	13	15	18	16	2	104	134	74		
11 Jul	WD	15	10	21	18	11	87	144	90	28	
12 Jul	WE-H	13	24	4	16	9	39	38	40		
13 Jul	WE-H	20	1	28	9	42					
16 Jul	WD	24	12	19	39	25	155		197	113	
18 Jul	WD	53	45	40	47	81	119	179	129	50	
19 Jul	WE-H	19	11	9	36	18	47	47	79	15	
20 Jul	WE-H	25	26	37	27	11					
23 Jul	WD	23	19	27	24	21	57	99	59	14	
24 Jul	WD	17	20	13	27	6	72	108	97	11	
	Min (All A–D)			0.0					11.0		
	Average (All A–D)			21.4					87.1		
	Max (All A–D)			81.0					210.0		

Note: Blank space in data fields indicates that fishing was closed for guided anglers during the time of this count, therefore no data to present.

[a] WD is weekday and WE-H is weekend and holiday

[b] "Downstream" is the Kenai River reach from Warren Ames Bridge to the RM 8.6 Chinook salmon sonar site; "Upstream" is the Kenai River reach from the RM 8.6 Chinook salmon sonar site to Soldotna Bridge.

[c] Angler count times: A is 4:00 AM–8:59 AM; B is 9:00 AM–1:59 PM; C is 2:00 PM–7:59 PM; and D is 8:00 PM–11:59 PM; $\bar{x}$ is the average count of the 4 count times.

Appendix A3.–Guided and unguided combined upstream and downstream boat angler counts by geographic strata during the late-run Kenai River Chinook salmon fishery, 1–25 July 2014.

		Combined strata [b]									
		Unguided anglers [c]					Guided anglers [c]				
Date	Day type [a]	$\bar{x}$	A	B	C	D	$\bar{x}$	A	B	C	D
1 Jul	WD	35	73	30	34	2	189	210	168		
3 Jul	WD	9	4	6	7	19	70	103	84	24	
5 Jul	WE-H	24	5	26	33	31	56		69	42	
6 Jul	WE-H	13	26	18	8	0					
8 Jul	WD	13	15	18	16	2	104	134	74		
11 Jul	WD	15	10	21	18	11	87	144	90	28	
12 Jul	WE-H	13	24	4	16	9	39	38	40		
13 Jul	WE-H	20	1	28	9	42					
16 Jul	WD	24	12	19	41	25	155		197	113	
18 Jul	WD	53	45	40	47	81	121	179	129	54	
19 Jul	WE-H	19	11	9	36	18	47	47	79	15	
20 Jul	WE-H	25	26	37	27	11					
23 Jul	WD	23	19	27	24	21	58	99	62	14	
24 Jul	WD	17	20	13	27	6	72	108	97	11	
	Min (All A–D)			0.0					11.0		
	Average (All A–D)			21.6					87.6		
	Max (All A–D)			81.0					210.0		

Note: Blank space in data fields indicates that fishing was closed for guided anglers during the time of this count, therefore no data to present.

[a] WD is weekday and WE-H is weekend and holiday

[b] "Combined strata" is the Kenai River reach from Warren Ames Bridge to the Soldotna Bridge.

[c] Angler count times: A is 4:00 AM–8:59 AM; B is 9:00 AM–1:59 PM; C is 2:00 PM–7:59 PM; and D is 8:00 PM–11:59 PM; $\bar{x}$ is the average count of the 4 count times.

APPENDIX B: EFFORT, CATCH, AND HARVEST ESTIMATES BY GEOGRAPHIC STRATA DURING THE KENAI RIVER CHINOOK SALMON FISHERY, 2014

Appendix B1.–Daily estimates of unguided boat angler CPUE, HPUE, angler effort, catch and harvest, by geographic strata, during the late-run Kenai River Chinook salmon fishery, 1–25 July 2014.

		Angler interview data [b]					Downstream [c] creel estimates						Upstream [c] creel estimates					
							Effort		Catch		Harvest		Effort		Catch		Harvest	
Date	Day type [a]	*n* [d]	CPUE	SE	HPUE	SE	Est.	SE	Est.	SE	Est.	SE	Est.	SE	Est.	SE	Est.	SE
1 Jul	WD	14	0.000	0.000	0.000	0.000	0	0	0	0	0	0	695	219	0	0	0	0
2 Jul	WD [e]		0.005		0.005		0		0		0		438		2		2	
3 Jul	WD	10	0.025	0.029	0.025	0.029	0	0	0	0	0	0	180	50	4	5	4	5
4 Jul	WD [e]		0.005		0.005		0		0		0		438		2		2	
5 Jul	WE-H	3	0.030	0.025	0.030	0.025	30	18	1	1	1	1	445	101	13	12	13	12
6 Jul	WE-H	18	0.031	0.024	0.031	0.024	10	8	0	0	0	0	250	58	8	6	8	6
7 Jul	M																	
8 Jul	WD	3	0.000	0.000	0.000	0.000	0	0	0	0	0	0	255	59	0	0	0	0
9 Jul	WD [e]		0.000		0.000		0		0		0		278		0		0	
10 Jul	WD [e]		0.000		0.000		0		0		0		278		0		0	
11 Jul	WD	10	0.000	0.000	0.000	0.000	0	0	0	0	0	0	300	55	0	0	0	0
12 Jul	WE-H	8	0.000	0.000	0.000	0.000	0	0	0	0	0	0	265	99	0	0	0	0
13 Jul	WE-H	23	0.040	0.023	0.027	0.019	0	0	0	0	0	0	400	191	16	12	11	9
14 Jul	M																	
15 Jul	WD [e]		0.046		0.024		5		0		0		770		36		18	
16 Jul	WD	7	0.042	0.048	0.042	0.048	10	12	0	1	0	1	475	104	20	23	20	23
17 Jul	WD [e]		0.046		0.024		5		0		0		770		36		18	
18 Jul	WD	15	0.049	0.026	0.015	0.017	0	0	0	0	0	0	1,065	143	52	29	17	18
19 Jul	WE-H	10	0.101	0.053	0.000	0.000	0	0	0	0	0	0	370	133	37	24	0	0
20 Jul	WE-H	18	0.122	0.029	0.000	0.000	0	0	0	0	0	0	505	89	62	18	0	0
21 Jul	M																	
22 Jul	WD [e]		0.152		0.000		0		0		0		393		60		0	
23 Jul	WD	11	0.153	0.021	0.000	0.000	0	0	0	0	0	0	455	37	69	11	0	0
24 Jul	WD	0	0.151	0.022	0.000	0.000	0	0	0	0	0	0	330	107	50	18	0	0
25 Jul	WD [e]		0.152		0.000		0		0		0		393		60		0	
	Min	0	0.000		0.000		0		0		0		180		0		0	
	Average	11	0.052		0.010		3		0		0		443		24		5	
	Max	23	0.153		0.042		30		1		1		1,065		69		20	

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Notes: "Catch" is fish harvested plus fish released; "Harvest" is fish kept; "Effort" is angler hours; "CPUE" is catch per unit effort (hours); "HPUE" is harvest per unit effort (hours).

[a] M is Monday index count (8:00 AM–1:59 PM), WD is weekday, and WE-H is weekend and holiday.

[b] Angler counts were geographically stratified; angler interviews were not.

[c] "Downstream" is the Kenai River reach from Warren Ames Bridge to the RM 8 Chinook salmon sonar site; "Upstream" is the Kenai River reach from the RM 8 Chinook salmon sonar site to the Soldotna Bridge.

[d] On days with less than 5 angler interviews, pooled estimates of CPUE and HPUE from other days in the stratum were used.

[e] Harvest, catch, and effort estimates for unsampled weekdays were the average harvest, catch, and effort estimates, respectively, of the sampled weekdays within the same stratum.

Appendix B2.–Daily estimates of guided boat angler CPUE, HPUE, angler effort, catch and harvest, by geographic strata, during the late-run Kenai River Chinook salmon fishery, 1–25 July 2014.

							Downstream [c] creel estimates						Upstream [c] creel estimates					
		Angler interview data [b]					Effort		Catch		Harvest		Effort		Catch		Harvest	
Date	Day type [a]	*n*	CPUE	SE	HPUE	SE	Est.	SE	Est.	SE	Est.	SE	Est.	SE	Est.	SE	Est.	SE
1 Jul	WD	47	0.027	0.010	0.023	0.009	24	24	1	1	1	1	2,244	276	60	23	52	21
2 Jul	WD[d]		0.025		0.022		12		0		0		1,544		39		34	
3 Jul	WD	19	0.020	0.015	0.020	0.015	0	0	0	0	0	0	844	218	17	14	17	14
4 Jul	WD[d]		0.025		0.022		12		0		0		1,544		39		34	
5 Jul	WE-H	24	0.016	0.011	0.016	0.011	12	12	0	0	0	0	654	150	10	8	10	8
8 Jul	WD	20	0.007	0.008	0.007	0.008	0	0	0	0	0	0	1,248	360	9	10	9	10
9 Jul	WD[d]		0.006		0.006		0		0		0		1,148		7		7	
10 Jul	WD[d]		0.006		0.006		0		0		0		1,148		7		7	
11 Jul	WD	35	0.005	0.005	0.005	0.005	0	0	0	0	0	0	1,048	285	5	6	5	6
12 Jul	WE-H	12	0.022	0.023	0.022	0.023	0	0	0	0	0	0	468	12	10	11	10	11
15 Jul	WD[d]		0.040		0.036		8		0		0		1,646		66		59	
16 Jul	WD	39	0.041	0.014	0.036	0.013	0	0	0	0	0	0	1,860	504	76	33	67	30
17 Jul	WD[d]		0.040		0.036		8		0		0		1,646		66		59	
18 Jul	WD	35	0.039	0.014	0.035	0.013	16	14	1	1	1	1	1,432	324	57	23	50	22
19 Jul	WE-H	5	0.212	0.039	0.000	0.000	0	0	0	0	0	0	564	248	120	57	0	0
22 Jul	WD[d]		0.111		0.000		6		1		0		776		86		0	
23 Jul	WD	24	0.136	0.026	0.000	0.000	12	15	2	2	0	0	688	209	94	34	0	0
24 Jul	WD	25	0.09	0.022	0.000	0.000	0	0	0	0	0	0	864	300	78	33	0	0
25 Jul	WD[d]		0.111		0.000		6		1		0		776		86		0	
	Min	5	0.005		0.000		0		0		0		468		5		0	
	Average	26	0.052		0.015		6		0		0		1,165		49		22	
	Max	47	0.212		0.036		24		2		1		2,244		120		67	

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Notes: "Catch" is fish harvested plus fish released; "Harvest" is fish kept; "Effort" is angler hours; "CPUE" is catch per unit effort (hours); "HPUE" is harvest per unit effort (hours).

[a] WD is weekday; WE-H is weekend and holiday.

[b] Angler counts were geographically stratified; angler interviews were not.

[c] "Downstream" is the Kenai River reach from Warren Ames Bridge to the RM 8 Chinook salmon sonar site; "Upstream" is the Kenai River reach from the RM 8 Chinook salmon sonar site to the Soldotna Bridge.

[d] Harvest, catch, and effort estimates for unsampled weekdays were the average harvest, catch, and effort estimates, respectively, of the sampled weekdays within the same stratum.

APPENDIX C: EFFORT, CATCH, AND HARVEST ESTIMATES BY TEMPORAL AND GEOGRAPHIC STRATA DURING THE KENAI RIVER CHINOOK SALMON FISHERY, 2014

Appendix C1.–Estimated effort, catch, and harvest above and below RM 8.6 during the late-run Kenai River Chinook salmon fishery, 1–25 July 2014.

	Downstream [b] creel estimates						Upstream [b] creel estimates								
			Chinook salmon						Chinook salmon						
	Effort		Catch		Harvest		Effort		Catch		Harvest		Downstream %		
Fishing periods [a]	Hours fished	SE	No. fish	SE	No. fish	SE	Hours fished	SE	No. fish	SE	No. fish	SE	Effort	Catch	Harvest
1–6 July															
Guided weekdays	48	48	1	1	1	1	6,176	2,041	154	72	137	61	1%	1%	1%
Guided weekends	12	12	0	0	0	0	654	150	10	8	10	8	2%	2%	2%
Unguided weekdays	0	0	0	0	0	0	1,750	795	9	10	9	10	0%	0%	0%
Unguided weekends	40	20	1	1	1	1	695	116	21	13	21	13	5%	5%	5%
8–13 July															
Guided weekdays	0	0	0	0	0	0	4,592	708	29	17	29	17	0%	0%	0%
Guided weekends	0	0	0	0	0	0	468	12	10	11	10	11	0%	0%	0%
Unguided weekdays	0	0	0	0	0	0	1,110	130	0	0	0	0	0%	NA	NA
Unguided weekends	0	0	0	0	0	0	665	215	16	12	11	9	0%	0%	0%
15–20 July															
Guided weekdays	32	30	1	1	1	1	6,584	1,041	265	63	235	58	0%	0%	0%
Guided weekends	0	0	0	0	0	0	564	248	120	57	0	0	0%	0%	NA
Unguided weekdays	20	22	1	1	1	1	3,080	871	143	69	73	42	1%	1%	1%
Unguided weekends	0	0	0	0	0	0	875	160	99	30	0	0	0%	0%	NA
22–25 July															
Guided weekdays	24	27	3	4	0	0	3,104	574	342	71	0	0	1%	1%	NA
Unguided weekdays	0	0	0	0	0	0	1,570	238	238	41	0	0	0%	0%	NA
Day type subtotals															
Guided weekdays	104	63	6	4	2	2	20,456	2,466	790	120	401	86	1%	1%	1%
Guided weekends	12	12	0	0	0	0	1,686	290	140	59	21	13	1%	0%	1%
Unguided weekdays	20	22	1	1	1	1	7,510	1,210	390	81	82	43	0%	0%	1%
Unguided weekends	40	20	1	1	1	1	2,235	292	136	35	32	16	2%	1%	4%
Angler type subtotals															
Guided	116	64	6	4	2	2	22,142	2,483	931	134	422	87	0.5%	0.6%	0.6%
% Guided	66%		75%		54%		69%		64%		79%				
Unguided	60	29	2	2	2	2	9,745	1,245	526	88	113	46	0.6%	0.4%	1.8%
% Unguided	34%		25%		46%		31%		36%		21%				
Late-run total	176	70	8	4	4	2	31,887	2,778	1,457	160	535	98	0.5%	0.5%	0.8%

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Note: NA means not applicable. Late-run Monday unguided drift-boat effort, catch, and harvest were not geographically stratified.

[a] Emergency order prohibited the use of bait 1–31 July. Sport fishery closed to harvest of Chinook salmon 19–25 July and closed to all Chinook salmon fishing 26–31 July.

[b] “Downstream” is the Kenai River reach from Warren Ames Bridge to the RM 8 Chinook salmon sonar site; “Upstream” is the Kenai River reach from the RM 8.6 Chinook salmon sonar site to Soldotna Bridge.

Appendix C2.–Estimated effort, catch, and harvest estimates above and below RM 13.7 during the late-run Kenai River Chinook salmon fishery, 1–25 July 2014.

	Downstream [b] creel estimates						Upstream [b] creel estimates								
			Chinook salmon						Chinook salmon						
	Effort		Catch		Harvest		Effort		Catch		Harvest		Downstream %		
Fishing periods [a]	Hours fished	SE	No. fish	SE	No. fish	SE	Hours fished	SE	No. fish	SE	No. fish	SE	Effort	Catch	Harvest
1–6 July															
Guided weekdays	2,480	724	61	27	55	23	3,744	1,375	94	46	83	39	40%	39%	40%
Guided weekends	384	120	6	5	6	5	282	42	4	3	4	3	58%	60%	60%
Unguided weekdays	1,050	472	6	6	6	6	700	331	3	4	3	4	60%	67%	67%
Unguided weekends	440	102	13	8	13	8	295	81	9	6	9	6	60%	59%	59%
8–13 July															
Guided weekdays	1,520	161	10	6	10	6	3,072	671	19	12	19	12	33%	34%	34%
Guided weekends	222	18	5	5	5	5	246	30	6	6	6	6	47%	45%	45%
Unguided weekdays	690	117	0	0	0	0	420	90	0	0	0	0	62%	N/A	N/A
Unguided weekends	380	135	11	8	7	6	285	107	5	4	3	3	57%	69%	70%
15–20 July															
Guided weekdays	2,908	633	117	32	104	30	3,708	645	149	38	133	35	44%	44%	44%
Guided weekends	332	270	70	59	0	0	232	52	49	14	0	0	59%	59%	N/A
Unguided weekdays	1,830	666	86	46	40	23	1,270	257	58	27	33	21	59%	60%	55%
Unguided weekends	500	66	57	15	0	0	375	105	42	16	0	0	57%	58%	N/A
22–25 July															
Guided weekdays	1,720	366	187	39	0	0	1,408	225	158	36	0	0	55%	54%	N/A
Unguided weekdays	910	239	138	38	0	0	660	98	100	16	0	0	58%	58%	N/A
Day type subtotals															
Guided weekdays	8,628	1,042	375	58	169	38	11,932	1,676	420	71	235	54	42%	47%	42%
Guided weekends	938	296	81	59	11	7	760	73	59	16	10	7	55%	58%	52%
Unguided weekdays	4,480	859	230	60	46	24	3,050	440	161	32	36	21	59%	59%	56%
Unguided weekends	1,320	182	81	19	20	10	955	170	56	18	12	7	58%	59%	63%
Angler type subtotals															
Guided	9,566	1,083	456	83	180	39	12,692	1,677	479	72	245	54	43%	49%	42%
% Guided	62%		59%		73%		76%		69%		84%				
Unguided	5,800	878	311	63	66	26	4,005	472	217	36	48	22	59%	59%	58%
% Unguided	38%		41%		27%		24%		31%		16%				
Late-run total	15,366	1,394	767	104	246	47	16,697	1,742	696	81	293	59	48%	52%	46%

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Note: NA means not applicable. Late-run Monday unguided drift-boat effort, catch, and harvest were not geographically stratified.

[a] Emergency order prohibited the use of bait 1–31 July. Sport fishery closed to harvest of Chinook salmon 19–25 July and closed to all Chinook salmon fishing 26–31 July.

[b] "Downstream" is the Kenai River reach from Warren Ames Bridge to the RM 8 Chinook salmon sonar site; "Upstream" is the Kenai River reach from the RM 8.6 Chinook salmon sonar site to Soldotna Bridge.

APPENDIX D: INRIVER GILLNETTING DAILY CATCH, CPUE, AND SPECIES PROPORTIONS DURING THE KENAI RIVER CHINOOK SALMON FISHERY, 2014

Appendix D1.–Number of early-run Kenai River Chinook, sockeye, coho, and pink salmon, and Dolly Varden caught in midriver and nearshore 5.0- and 7.5-inch mesh gillnets at RM 8.6, 16 May–30 June, 2014.

							Inriver drift gillnetting catch											
	No. of drifts			Drift minutes			Chinook salmon			Sockeye salmon			Dolly Varden			All species		
Date	Mid-river	Near shore	All	Mid-river	Near shore	All	Mid-river	Near shore	All	Mid-river	Near shore	All	Mid-river	Near shore	All	Mid-river	Near shore	All
16 May	23	20	43	155	81	236	0	0	0	2	1	3	0	0	0	2	1	3
17 May	24	18	42	156	78	234	0	0	0	0	1	1	0	0	0	0	1	1
18 May	25	20	45	193	128	322	1	0	1	2	1	3	0	1	1	3	2	5
19 May	26	23	49	196	139	335	0	0	0	1	1	2	0	0	0	1	1	2
20 May	31	16	47	282	112	394	0	0	0	3	0	3	0	0	0	3	0	3
21 May	26	12	38	254	86	340	0	0	0	3	1	4	0	0	0	3	1	4
22 May	27	13	40	227	89	317	0	0	0	1	1	2	0	0	0	1	1	2
23 May	24	13	37	228	99	327	0	0	0	2	3	5	0	0	0	2	3	5
24 May	20	12	32	208	116	323	1	0	1	11	2	13	0	0	0	12	2	14
25 May	31	10	41	237	86	322	0	0	0	23	2	25	0	0	0	23	2	25
26 May	32	10	42	224	76	300	0	0	0	63	10	73	0	0	0	63	10	73
27 May	26	7	33	200	61	261	1	0	1	144	4	148	0	0	0	145	4	149
28 May	30	14	44	208	83	292	0	0	0	61	28	89	0	0	0	61	28	89
29 May	30	12	42	232	71	303	0	0	0	48	6	54	0	0	0	48	6	54
30 May	22	13	35	159	72	230	0	0	0	79	22	101	0	0	0	79	22	101
31 May	24	10	34	188	62	249	4	0	4	92	6	98	0	0	0	96	6	102
1 Jun	26	24	50	175	121	295	1	1	2	69	39	108	0	0	0	70	40	110
2 Jun	21	20	41	141	119	260	3	1	4	99	44	143	0	0	0	102	45	147
3 Jun	18	18	36	137	100	237	9	1	10	103	35	138	0	0	0	112	36	148
4 Jun	24	22	46	169	128	296	4	2	6	148	63	211	0	0	0	152	65	217
5 Jun	21	22	43	154	120	274	3	1	4	95	59	154	2	0	2	100	60	160
6 Jun	21	18	39	157	107	265	4	3	7	53	45	98	0	0	0	57	48	105
7 Jun	22	22	44	160	137	297	2	0	2	64	42	106	1	0	1	67	42	109
8 Jun	22	20	42	154	109	263	2	0	2	54	14	68	0	0	0	56	14	70
9 Jun	21	24	45	156	139	295	12	1	13	83	40	123	0	0	0	95	41	136
10 Jun	32	18	50	231	112	343	8	1	9	71	16	87	0	0	0	79	17	96
11 Jun	35	16	51	242	106	348	9	0	9	123	28	151	0	0	0	132	28	160
12 Jun	26	14	40	194	96	290	4	0	4	70	23	93	0	0	0	74	23	97
13 Jun	24	22	46	184	115	300	3	1	4	42	13	55	0	0	0	45	14	59

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							Inriver drift gillnetting catch											
	No. of drifts			Drift minutes			Chinook salmon			Sockeye salmon			Dolly Varden			All species		
Date	Mid-river	Near shore	All	Mid-river	Near shore	All	Mid-river	Near shore	All	Mid-river	Near shore	All	Mid-river	Near shore	All	Mid-river	Near shore	All
14 Jun	26	24	50	172	101	273	5	1	6	23	17	40	0	0	0	28	18	46
15 Jun	22	22	44	170	107	276	4	1	5	46	29	75	0	0	0	50	30	80
16 Jun	30	24	54	201	112	312	2	2	4	42	23	65	0	0	0	44	25	69
17 Jun	30	24	54	200	94	294	5	1	6	50	11	61	0	0	0	55	12	67
18 Jun	27	22	49	202	82	284	7	4	11	73	19	92	1	0	1	81	23	104
19 Jun	23	22	45	155	120	275	5	0	5	105	60	165	0	0	0	110	60	170
20 Jun	24	22	46	176	101	277	2	3	5	86	40	126	0	0	0	88	43	131
21 Jun	26	28	54	178	141	319	1	0	1	43	18	61	0	0	0	44	18	62
22 Jun	30	28	58	195	112	307	4	0	4	77	20	97	0	0	0	81	20	101
23 Jun	29	30	59	188	127	315	1	0	1	102	31	133	0	0	0	103	31	134
24 Jun	30	28	58	207	122	329	0	0	0	86	24	110	0	0	0	86	24	110
25 Jun	27	28	55	171	93	264	5	2	7	105	60	165	0	0	0	110	62	172
26 Jun	27	26	53	162	82	244	8	6	14	177	105	282	0	0	0	185	111	296
27 Jun	23	24	47	155	107	262	3	0	3	131	62	193	0	2	2	134	64	198
28 Jun	24	21	45	174	97	271	2	1	3	124	80	204	0	0	0	126	81	207
29 Jun	28	28	56	180	96	276	4	1	5	71	50	121	1	0	1	76	51	127
30 Jun	22	21	43	144	74	218	5	4	9	132	68	200	0	1	1	137	73	210
Total	1,182	905	2,087	8,630	4,714	13,344	134	38	172	3,082	1,267	4,349	5	4	9	3,221	1,309	4,530
Min	18	7	32	137	61	218	0	0	0	0	0	1	0	0	0	0	0	1
Mean	26	20	45	188	102	290	3	1	4	67	28	95	0	0	0	70	28	98
Max	35	30	59	282	141	394	12	6	14	177	105	282	2	2	2	185	111	296

Note: Inriver gillnetting effort was doubled during 2014 with the first crew netting from 7:00 AM to 1:00 PM and the second crew netting from 1:00 PM to 7:00 PM.

Appendix D2.–CPUE of early-run Kenai River Chinook and sockeye salmon, Dolly Varden, and proportion of Chinook salmon caught in midriver and nearshore 5.0- and 7.5-inch mesh gillnets at RM 8.6, 16 May–30 June 2014.

	CPUE [a]									Proportion Chinook [b]		
	Chinook salmon			Sockeye salmon			Dolly Varden					
Date	Mid-river	Near shore	All	Mid-river	Near shore	All	Mid-river	Near shore	All	Mid-river	Near shore	All
16 May	0.000	0.000	0.000	0.013	0.012	0.013	0.000	0.000	0.000	0.000	0.000	0.000
17 May	0.000	0.000	0.000	0.000	0.013	0.004	0.000	0.000	0.000	NA	0.000	NA
18 May	0.005	0.000	0.003	0.010	0.008	0.009	0.000	0.008	0.003	0.333	0.000	0.200
19 May	0.000	0.000	0.000	0.005	0.007	0.006	0.000	0.000	0.000	0.000	0.000	0.000
20 May	0.000	0.000	0.000	0.011	0.000	0.008	0.000	0.000	0.000	0.000	NA	0.000
21 May	0.000	0.000	0.000	0.012	0.012	0.012	0.000	0.000	0.000	0.000	0.000	0.000
22 May	0.000	0.000	0.000	0.004	0.011	0.006	0.000	0.000	0.000	0.000	0.000	0.000
23 May	0.000	0.000	0.000	0.009	0.030	0.015	0.000	0.000	0.000	0.000	0.000	0.000
24 May	0.005	0.000	0.003	0.053	0.017	0.040	0.000	0.000	0.000	0.083	0.000	0.071
25 May	0.000	0.000	0.000	0.097	0.023	0.078	0.000	0.000	0.000	0.000	0.000	0.000
26 May	0.000	0.000	0.000	0.281	0.132	0.243	0.000	0.000	0.000	0.000	0.000	0.000
27 May	0.005	0.000	0.004	0.720	0.066	0.568	0.000	0.000	0.000	0.007	0.000	0.007
28 May	0.000	0.000	0.000	0.293	0.336	0.305	0.000	0.000	0.000	0.000	0.000	0.000
29 May	0.000	0.000	0.000	0.207	0.084	0.178	0.000	0.000	0.000	0.000	0.000	0.000
30 May	0.000	0.000	0.000	0.497	0.307	0.438	0.000	0.000	0.000	0.000	0.000	0.000
31 May	0.021	0.000	0.016	0.491	0.097	0.393	0.000	0.000	0.000	0.042	0.000	0.039
1 Jun	0.006	0.008	0.007	0.395	0.323	0.366	0.000	0.000	0.000	0.014	0.025	0.018
2 Jun	0.021	0.008	0.015	0.703	0.369	0.550	0.000	0.000	0.000	0.029	0.022	0.027
3 Jun	0.066	0.010	0.042	0.754	0.349	0.583	0.000	0.000	0.000	0.080	0.028	0.068
4 Jun	0.024	0.016	0.020	0.877	0.493	0.712	0.000	0.000	0.000	0.026	0.031	0.028
5 Jun	0.020	0.008	0.015	0.618	0.491	0.562	0.013	0.000	0.007	0.030	0.017	0.025
6 Jun	0.025	0.028	0.026	0.337	0.419	0.370	0.000	0.000	0.000	0.070	0.063	0.067
7 Jun	0.012	0.000	0.007	0.399	0.308	0.357	0.006	0.000	0.003	0.030	0.000	0.018
8 Jun	0.013	0.000	0.008	0.351	0.128	0.258	0.000	0.000	0.000	0.036	0.000	0.029
9 Jun	0.077	0.007	0.044	0.533	0.288	0.418	0.000	0.000	0.000	0.126	0.024	0.096
10 Jun	0.035	0.009	0.026	0.307	0.143	0.254	0.000	0.000	0.000	0.101	0.059	0.094
11 Jun	0.037	0.000	0.026	0.507	0.265	0.434	0.000	0.000	0.000	0.068	0.000	0.056
12 Jun	0.021	0.000	0.014	0.360	0.241	0.321	0.000	0.000	0.000	0.054	0.000	0.041
13 Jun	0.016	0.009	0.013	0.228	0.113	0.184	0.000	0.000	0.000	0.067	0.071	0.068

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	CPUE [a]											
	Chinook salmon			Sockeye salmon			Dolly Varden			Proportion Chinook [b]		
Date	Mid-river	Near shore	All	Mid-river	Near shore	All	Mid-river	Near shore	All	Mid-river	Near shore	All
14 Jun	0.029	0.010	0.022	0.134	0.169	0.147	0.000	0.000	0.000	0.179	0.056	0.130
15 Jun	0.024	0.009	0.018	0.271	0.272	0.271	0.000	0.000	0.000	0.080	0.033	0.063
16 Jun	0.010	0.018	0.013	0.209	0.206	0.208	0.000	0.000	0.000	0.045	0.080	0.058
17 Jun	0.025	0.011	0.020	0.250	0.117	0.208	0.000	0.000	0.000	0.091	0.083	0.090
18 Jun	0.035	0.049	0.039	0.362	0.232	0.324	0.005	0.000	0.004	0.086	0.174	0.106
19 Jun	0.032	0.000	0.018	0.676	0.502	0.600	0.000	0.000	0.000	0.045	0.000	0.029
20 Jun	0.011	0.030	0.018	0.489	0.397	0.455	0.000	0.000	0.000	0.023	0.070	0.038
21 Jun	0.006	0.000	0.003	0.241	0.128	0.191	0.000	0.000	0.000	0.023	0.000	0.016
22 Jun	0.021	0.000	0.013	0.395	0.179	0.316	0.000	0.000	0.000	0.049	0.000	0.040
23 Jun	0.005	0.000	0.003	0.542	0.244	0.422	0.000	0.000	0.000	0.010	0.000	0.007
24 Jun	0.000	0.000	0.000	0.414	0.197	0.334	0.000	0.000	0.000	0.000	0.000	0.000
25 Jun	0.029	0.022	0.026	0.613	0.646	0.624	0.000	0.000	0.000	0.045	0.032	0.041
26 Jun	0.049	0.073	0.057	1.094	1.283	1.158	0.000	0.000	0.000	0.043	0.054	0.047
27 Jun	0.019	0.000	0.011	0.844	0.581	0.737	0.000	0.019	0.008	0.022	0.000	0.015
28 Jun	0.011	0.010	0.011	0.713	0.825	0.753	0.000	0.000	0.000	0.016	0.012	0.014
29 Jun	0.022	0.010	0.018	0.395	0.519	0.438	0.006	0.000	0.004	0.053	0.020	0.039
30 Jun	0.035	0.054	0.041	0.916	0.915	0.916	0.000	0.013	0.005	0.036	0.055	0.043
Min	0.000	0.000	0.000	0.000	0.000	0.004	0.000	0.000	0.000	0.000	0.000	0.000
Mean	0.017	0.009	0.014	0.383	0.272	0.343	0.001	0.001	0.001	0.045	0.022	0.038
Max	0.077	0.073	0.057	1.094	1.283	1.158	0.013	0.019	0.008	0.333	0.174	0.200

Note: Inriver gillnetting effort was doubled during 2014 with the first crew netting from 7:00 AM to 1:00 PM and the second crew netting from 1:00 PM to 7:00 PM. “NA” means not applicable.

[a] CPUE is catch per minute.

[b] “Proportion Chinook” is equal to Chinook salmon CPUE per combined total of all species CPUE.

Appendix D3.–Effort for midriver and nearshore 5.0- and 7.5-inch mesh gillnets at RM 8.6, 1 July–15 August 2014.

	No. of drifts			Drift minutes		
Date	Midriver	Near shore	All	Midriver	Near shore	All
1 Jul	29	30	59	189	135	324
2 Jul	27	24	51	191	90	280
3 Jul	18	20	38	135	82	217
4 Jul	24	21	45	168	108	277
5 Jul	20	21	41	122	96	218
6 Jul	20	16	36	121	56	177
7 Jul	26	28	54	146	96	243
8 Jul	31	28	59	192	104	296
9 Jul	20	22	42	116	87	203
10 Jul	27	26	53	157	88	245
11 Jul	16	17	33	75	63	138
12 Jul	18	18	36	90	59	149
13 Jul	21	22	43	97	68	165
14 Jul	27	26	53	123	76	199
15 Jul	24	24	48	118	70	188
16 Jul	28	24	52	148	85	233
17 Jul	22	24	46	114	86	200
18 Jul	19	18	37	101	67	167
19 Jul	19	20	39	101	75	176
20 Jul	24	22	46	105	64	170
21 Jul	26	28	54	108	68	176
22 Jul	26	26	52	106	73	179
23 Jul	26	26	52	123	71	194
24 Jul	26	26	52	122	77	198
25 Jul	20	20	40	97	73	170
26 Jul	26	26	52	133	81	214
27 Jul	24	28	52	115	86	202
28 Jul	26	28	54	194	88	283
29 Jul	26	28	54	136	102	237
30 Jul	30	27	57	144	88	232
31 Jul	31	30	61	135	64	199
1 Aug	24	24	48	115	44	159
2 Aug	20	23	43	89	38	126
3 Aug	24	23	47	90	42	132
4 Aug	23	24	47	84	40	124
5 Aug	29	20	49	100	33	133
6 Aug	42	10	52	165	33	198
7 Aug	36	16	52	198	29	227
8 Aug	38	11	49	202	43	245
9 Aug	36	16	52	192	40	232
10 Aug	40	12	52	184	35	218
11 Aug	35	16	51	225	39	264
12 Aug	26	10	36	141	33	174
13 Aug	41	20	61	240	51	291
14 Aug	36	12	48	218	49	267
15 Aug	31	12	43	217	47	264
Total	1,228	993	2,221	6,481	3,121	9,602
Min	16	10	33	75	29	124
Mean	27	22	48	141	68	209
Max	42	30	61	240	135	324

Appendix D4.–Number of late-run Kenai River Chinook, sockeye, coho, and pink salmon, and Dolly Varden caught in midriver and nearshore 5.0- and 7.5-inch mesh gillnets at RM 8.6, 1 July–15 August 2014.

	Inriver drift gillnetting catch																	
	Chinook salmon			Sockeye salmon			Coho salmon			Pink salmon			Dolly Varden			All species		
Date	Mid-river	Near shore	All	Mid-river	Near shore	All	Mid-river	Near shore	All	Mid-river	Near shore	All	Mid-river	Near shore	All	Mid-river	Near shore	All
1 Jul	2	0	2	100	40	140	0	0	0	0	0	0	0	0	0	102	40	142
2 Jul	7	1	8	120	43	163	0	0	0	0	0	0	0	0	0	127	44	171
3 Jul	3	4	7	102	60	162	0	0	0	0	0	0	0	0	0	105	64	169
4 Jul	3	0	3	129	75	204	0	0	0	0	0	0	0	0	0	132	75	207
5 Jul	5	3	8	221	79	300	0	0	0	0	0	0	2	0	2	228	82	310
6 Jul	10	2	12	169	209	378	0	0	0	0	0	0	0	0	0	179	211	390
7 Jul	8	3	11	127	132	259	0	0	0	0	0	0	2	0	2	137	135	272
8 Jul	5	1	6	146	96	242	0	0	0	0	0	0	2	0	2	153	97	250
9 Jul	7	1	8	180	200	380	0	0	0	0	0	0	0	0	0	187	201	388
10 Jul	3	3	6	95	48	143	0	0	0	0	0	0	0	0	0	98	51	149
11 Jul	4	3	7	101	91	192	0	0	0	0	0	0	0	0	0	105	94	199
12 Jul	6	1	7	235	203	438	0	0	0	0	0	0	0	0	0	241	204	445
13 Jul	6	1	7	220	184	404	0	0	0	0	0	0	0	0	0	226	185	411
14 Jul	5	0	5	216	123	339	0	0	0	0	0	0	0	0	0	221	123	344
15 Jul	7	1	8	208	154	362	0	0	0	2	1	3	0	0	0	217	156	373
16 Jul	7	0	7	102	102	204	0	0	0	3	2	5	0	0	0	112	104	216
17 Jul	9	3	12	155	178	333	0	0	0	3	2	5	0	0	0	167	183	350
18 Jul	11	1	12	79	65	144	0	0	0	4	1	5	0	1	1	94	68	162
19 Jul	17	2	19	155	132	287	0	0	0	4	1	5	0	1	1	176	136	312
20 Jul	11	1	12	175	193	368	0	0	0	6	14	20	0	0	0	192	208	400
21 Jul	6	1	7	144	202	346	0	0	0	3	12	15	1	3	4	154	218	372
22 Jul	11	2	13	167	162	329	1	1	2	13	13	26	0	0	0	192	178	370
23 Jul	15	3	18	180	184	364	0	0	0	13	18	31	0	0	0	208	205	413
24 Jul	11	2	13	125	164	289	0	0	0	19	22	41	0	0	0	155	188	343
25 Jul	12	3	15	73	102	175	0	0	0	29	24	53	0	0	0	114	129	243
26 Jul	5	3	8	89	100	189	0	0	0	38	65	103	0	0	0	132	168	300
27 Jul	6	3	9	37	114	151	0	1	1	40	122	162	0	0	0	83	240	323
28 Jul	7	1	8	41	61	102	0	0	0	46	76	122	0	0	0	94	138	232
29 Jul	13	1	14	52	99	151	0	0	0	72	110	182	1	1	2	138	211	349

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Appendix D4.–Page 2 of 2.

	Inriver drift gillnetting catch																	
	Chinook salmon			Sockeye salmon			Coho salmon			Pink salmon			Dolly Varden			All species		
Date	Mid-river	Near shore	All	Mid-river	Near shore	All	Mid-river	Near shore	All	Mid-river	Near shore	All	Mid-river	Near shore	All	Mid-river	Near shore	All
30 Jul	7	0	7	41	108	149	1	0	1	76	179	255	0	0	0	125	287	412
31 Jul	11	1	12	45	118	163	5	3	8	128	220	348	0	0	0	189	342	531
1 Aug	14	0	14	36	75	111	3	3	6	189	274	463	1	0	1	243	352	595
2 Aug	11	1	12	31	105	136	0	2	2	239	299	538	0	0	0	281	407	688
3 Aug	3	0	3	6	28	34	3	3	6	357	325	682	0	0	0	369	356	725
4 Aug	1	1	2	7	23	30	4	3	7	366	499	865	0	0	0	378	526	904
5 Aug	4	0	4	6	8	14	1	2	3	682	387	1,069	0	0	0	693	397	1,090
6 Aug	3	0	3	48	13	61	12	5	17	295	120	415	0	0	0	358	138	496
7 Aug	5	0	5	37	52	89	7	3	10	213	79	292	0	0	0	262	134	396
8 Aug	0	0	0	28	29	57	31	1	32	196	65	261	2	1	3	257	96	353
9 Aug	3	1	4	43	32	75	19	13	32	248	103	351	0	0	0	313	149	462
10 Aug	2	0	2	53	17	70	28	4	32	253	88	341	0	0	0	336	109	445
11 Aug	0	0	0	54	41	95	33	2	35	318	72	390	0	0	0	405	115	520
12 Aug	0	0	0	15	5	20	10	2	12	44	40	84	0	0	0	69	47	116
13 Aug	0	0	0	18	16	34	7	5	12	35	20	55	0	0	0	60	41	101
14 Aug	1	0	1	11	6	17	45	12	57	78	50	128	0	0	0	135	68	203
15 Aug	2	0	2	8	3	11	16	3	19	64	5	69	0	0	0	90	11	101
Total	289	54	343	4,430	4,274	8,704	226	68	294	4,076	3,308	7,384	11	7	18	9,032	7,711	16,743
Min	0	0	0	6	3	11	0	0	0	0	0	0	0	0	0	60	11	101
Mean	6	1	7	96	93	189	5	1	6	89	72	161	0	0	0	196	168	364
Max	17	4	19	235	209	438	45	13	57	682	499	1,069	2	3	4	693	526	1,090

Appendix D5.–CPUE of late-run Kenai River Chinook, sockeye, coho, and pink salmon, and Dolly Varden, and proportion of Chinook salmon caught in midriver and near shore in 5.0- and 7.5-inch mesh gillnets at RM 8.6, 1 July–15 August 2014.

	CPUE [a]																	
	Chinook salmon			Sockeye salmon			Coho salmon			Pink salmon			Dolly Varden			Proportion Chinook [b]		
Date	Mid-river	Near shore	All	Mid-river	Near shore	All	Mid-river	Near shore	All	Mid-river	Near shore	All	Mid-river	Near shore	All	Mid-river	Near shore	All
1 Jul	0.011	0.000	0.006	0.528	0.296	0.431	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.020	0.000	0.014
2 Jul	0.037	0.011	0.029	0.629	0.480	0.581	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.055	0.023	0.047
3 Jul	0.022	0.049	0.032	0.755	0.736	0.748	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.029	0.063	0.041
4 Jul	0.018	0.000	0.011	0.767	0.692	0.737	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.023	0.000	0.014
5 Jul	0.041	0.031	0.037	1.814	0.823	1.377	0.000	0.000	0.000	0.000	0.000	0.000	0.016	0.000	0.009	0.022	0.037	0.026
6 Jul	0.083	0.036	0.068	1.396	3.765	2.141	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.056	0.009	0.031
7 Jul	0.055	0.031	0.045	0.869	1.369	1.068	0.000	0.000	0.000	0.000	0.000	0.000	0.014	0.000	0.008	0.058	0.022	0.040
8 Jul	0.026	0.010	0.020	0.762	0.921	0.818	0.000	0.000	0.000	0.000	0.000	0.000	0.010	0.000	0.007	0.033	0.010	0.024
9 Jul	0.060	0.011	0.039	1.552	2.288	1.869	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.037	0.005	0.021
10 Jul	0.019	0.034	0.024	0.606	0.544	0.584	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.031	0.059	0.040
11 Jul	0.053	0.048	0.051	1.342	1.444	1.388	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.038	0.032	0.035
12 Jul	0.067	0.017	0.047	2.623	3.417	2.939	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.025	0.005	0.016
13 Jul	0.062	0.015	0.042	2.277	2.687	2.447	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.027	0.005	0.017
14 Jul	0.041	0.000	0.025	1.756	1.629	1.708	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.023	0.000	0.015
15 Jul	0.059	0.014	0.043	1.765	2.201	1.927	0.000	0.000	0.000	0.017	0.014	0.016	0.000	0.000	0.000	0.032	0.006	0.021
16 Jul	0.047	0.000	0.030	0.690	1.205	0.877	0.000	0.000	0.000	0.020	0.024	0.022	0.000	0.000	0.000	0.063	0.000	0.032
17 Jul	0.079	0.035	0.060	1.356	2.066	1.661	0.000	0.000	0.000	0.026	0.023	0.025	0.000	0.000	0.000	0.054	0.016	0.034
18 Jul	0.109	0.015	0.072	0.783	0.977	0.860	0.000	0.000	0.000	0.040	0.015	0.030	0.000	0.015	0.006	0.117	0.015	0.074
19 Jul	0.169	0.027	0.108	1.539	1.765	1.635	0.000	0.000	0.000	0.040	0.013	0.028	0.000	0.013	0.006	0.097	0.015	0.061
20 Jul	0.104	0.016	0.071	1.661	3.002	2.169	0.000	0.000	0.000	0.057	0.218	0.118	0.000	0.000	0.000	0.057	0.005	0.030
21 Jul	0.056	0.015	0.040	1.332	2.985	1.969	0.000	0.000	0.000	0.028	0.177	0.085	0.009	0.044	0.023	0.039	0.005	0.019
22 Jul	0.103	0.027	0.073	1.569	2.224	1.835	0.009	0.014	0.011	0.122	0.178	0.145	0.000	0.000	0.000	0.057	0.011	0.035
23 Jul	0.122	0.042	0.093	1.464	2.581	1.874	0.000	0.000	0.000	0.106	0.253	0.160	0.000	0.000	0.000	0.072	0.015	0.044
24 Jul	0.091	0.026	0.066	1.029	2.139	1.458	0.000	0.000	0.000	0.156	0.287	0.207	0.000	0.000	0.000	0.071	0.011	0.038
25 Jul	0.123	0.041	0.088	0.749	1.402	1.028	0.000	0.000	0.000	0.297	0.330	0.311	0.000	0.000	0.000	0.105	0.023	0.062
26 Jul	0.038	0.037	0.037	0.671	1.235	0.884	0.000	0.000	0.000	0.286	0.802	0.482	0.000	0.000	0.000	0.038	0.018	0.027
27 Jul	0.052	0.035	0.045	0.321	1.321	0.749	0.000	0.012	0.005	0.347	1.414	0.803	0.000	0.000	0.000	0.072	0.013	0.028
28 Jul	0.036	0.011	0.028	0.211	0.691	0.361	0.000	0.000	0.000	0.237	0.861	0.432	0.000	0.000	0.000	0.074	0.007	0.034
29 Jul	0.096	0.010	0.059	0.383	0.972	0.636	0.000	0.000	0.000	0.531	1.080	0.766	0.007	0.010	0.008	0.094	0.005	0.040

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Appendix D5.–Part 2 of 2.

	CPUE [a]																	
	Chinook salmon			Sockeye salmon			Coho salmon			Pink salmon			Dolly Varden			Proportion Chinook		
Date	Mid-river	Near shore	All	Mid-river	Near shore	All	Mid-river	Near shore	All	Mid-river	Near shore	All	Mid-river	Near shore	All	Mid-river	Near shore	All
30 Jul	0.049	0.000	0.030	0.284	1.234	0.643	0.007	0.000	0.004	0.527	2.045	1.100	0.000	0.000	0.000	0.056	0.000	0.017
31 Jul	0.081	0.016	0.060	0.333	1.851	0.819	0.037	0.047	0.040	0.946	3.451	1.749	0.000	0.000	0.000	0.058	0.003	0.023
1 Aug	0.122	0.000	0.088	0.313	1.718	0.700	0.026	0.069	0.038	1.645	6.275	2.921	0.009	0.000	0.006	0.058	0.000	0.024
2 Aug	0.124	0.027	0.095	0.349	2.788	1.076	0.000	0.053	0.016	2.692	7.938	4.255	0.000	0.000	0.000	0.039	0.002	0.017
3 Aug	0.033	0.000	0.023	0.067	0.672	0.258	0.033	0.072	0.046	3.972	7.803	5.185	0.000	0.000	0.000	0.008	0.000	0.004
4 Aug	0.012	0.025	0.016	0.083	0.574	0.241	0.048	0.075	0.056	4.348	12.459	6.963	0.000	0.000	0.000	0.003	0.002	0.002
5 Aug	0.040	0.000	0.030	0.060	0.240	0.105	0.010	0.060	0.023	6.825	11.633	8.026	0.000	0.000	0.000	0.006	0.000	0.004
6 Aug	0.018	0.000	0.015	0.291	0.389	0.308	0.073	0.150	0.086	1.789	3.595	2.093	0.000	0.000	0.000	0.008	0.000	0.006
7 Aug	0.025	0.000	0.022	0.187	1.780	0.392	0.035	0.103	0.044	1.077	2.704	1.287	0.000	0.000	0.000	0.019	0.000	0.013
8 Aug	0.000	0.000	0.000	0.138	0.670	0.232	0.153	0.023	0.130	0.969	1.502	1.063	0.010	0.023	0.012	0.000	0.000	0.000
9 Aug	0.016	0.025	0.017	0.224	0.794	0.323	0.099	0.322	0.138	1.293	2.555	1.512	0.000	0.000	0.000	0.010	0.007	0.009
10 Aug	0.011	0.000	0.009	0.289	0.492	0.321	0.152	0.116	0.147	1.378	2.545	1.563	0.000	0.000	0.000	0.006	0.000	0.004
11 Aug	0.000	0.000	0.000	0.240	1.054	0.361	0.147	0.051	0.133	1.416	1.850	1.480	0.000	0.000	0.000	0.000	0.000	0.000
12 Aug	0.000	0.000	0.000	0.106	0.152	0.115	0.071	0.061	0.069	0.312	1.214	0.483	0.000	0.000	0.000	0.000	0.000	0.000
13 Aug	0.000	0.000	0.000	0.075	0.312	0.117	0.029	0.097	0.041	0.146	0.390	0.189	0.000	0.000	0.000	0.000	0.000	0.000
14 Aug	0.005	0.000	0.004	0.051	0.121	0.064	0.207	0.243	0.213	0.358	1.012	0.479	0.000	0.000	0.000	0.007	0.000	0.005
15 Aug	0.009	0.000	0.008	0.037	0.064	0.042	0.074	0.064	0.072	0.295	0.107	0.262	0.000	0.000	0.000	0.022	0.000	0.020
Min	0.000	0.000	0.000	0.037	0.064	0.042	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Mean	0.053	0.016	0.039	0.790	1.364	0.976	0.026	0.035	0.029	0.702	1.625	0.962	0.002	0.002	0.002	0.040	0.010	0.024
Max	0.169	0.049	0.108	2.623	3.765	2.939	0.207	0.322	0.213	6.825	12.459	8.026	0.016	0.044	0.023	0.117	0.063	0.074

[a] CPUE is catch per minute.

[b] Proportion Chinook is equal to Chinook salmon CPUE per combined total of all species CPUE.