Fishery Data Series No. 18-22

Upper Cook Inlet Sockeye Salmon Escapement Studies, 2015

by

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and

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

Symbols and Abbreviations

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Weights and measures (metric)

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

Weights and measures (English)

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

Time and temperature

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

Physics and chemistry

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

General

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

Mathematics, statistics

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

FISHERY DATA SERIES NO. 18-22

UPPER COOK INLET SOCKEYE SALMON ESCAPEMENT STUDIES, 2015

by
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TABLE OF CONTENTS

Page

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

ABSTRACT

In 2015, the Alaska Department of Fish and Game (ADF&G) used dual frequency identification sonars to estimate an escapement of 1,709,051 (95% CI: 1,708,905–1,709,197) sockeye salmon (*Oncorhynchus* nerka) into the Kenai River, and 470,677 (95% CI: 469,545–471,808) sockeye salmon into the Kasilof River. Fish wheel sampling determined that predominant age classes for sockeye salmon in the Kenai River were 1.2 (18.6%), 1.3 (47.5%), 2.2 (6.7%), and 2.3 (26.2%); Kasilof River 1.2 (21.0%), 1.3 (34.7%), and 2.2 (35.1%); Yentna River 1.2 (18.9%), 1.3 (62.3%), and 2.3 (9.5%). Length and sex ratio information were also collected for sockeye salmon at each river. Results of escapement projects conducted by other agencies and organizations are also briefly mentioned in this report.

Key words: sockeye salmon, *Oncorhynchus nerka*, age, sex, length (ASL), sonar, DIDSON, escapement, salmon migration, fish passage, fish wheel, side-looking sonar, fish wheel coefficient, gillnet, apportionment, test fishery, Kenai River, Kasilof River, Yentna River, Susitna River, Upper Cook Inlet

INTRODUCTION

In Upper Cook Inlet (UCI) Alaska, sonar technology has been used to estimate hourly and daily Pacific salmon (*Oncorhynchus* spp.) run sizes in the Kenai and Kasilof rivers since the late 1970s (Figure 1; Waltemyer et al. 1980; King and Tarbox 1988). The species composition of each escapement has been estimated from daily fish wheel catches in each river. In this report, “escapement” refers to estimates of the number of salmon, by species, migrating upstream to spawn past a fixed point on the river. When any number of salmon are harvested upstream of the enumeration point, such as in sport fishing, the number of fish that survive to spawn will be less than the escapement referred to in this report.

Optimal escapement goals (OEG), which consider both biological and allocative issues, were revised in 2011 by the Alaska Board of Fisheries for late-run sockeye salmon (*Oncorhynchus nerka*) in the Kenai and Kasilof rivers (Shields and Dupuis 2012). In 2015, the OEG for sockeye salmon into the Kenai River was 700,000–1,400,000. More specifically, the Alaska Department of Fish and Game (ADF&G) manages for a Kenai River inriver escapement goal dependent upon forecasts and daily inseason evaluations of run strength. If the sockeye salmon run forecast is less than 2,300,000, the inriver escapement goal is 900,000–1,100,000; for a run of 2,300,000–4,600,000, the goal is 1,000,000–1,200,000; and for a run greater than 4,600,000, the goal is 1,100,000–1,350,000 fish. The OEG for sockeye salmon into the Kasilof River is 160,000–390,000. In 2009, the sustainable escapement goal (SEG) for Yentna River sockeye salmon was eliminated because of uncertainties in the Yentna sonar/fish wheel escapement estimates, so use of escapement data for inseason management was curtailed. Instead of using sonar generated escapement estimates from the Yentna River sonar study site to estimate Susitna River drainage sockeye salmon escapement, SEGs for Susitna River sockeye salmon were established for weirs at Judd (25,000–55,000), Chelatna (20,000–65,000), and Larson (15,000–50,000) lakes (Figure 2; Fair et al. 2009, 2013).

SONAR DEVELOPMENT IN UPPER COOK INLET

Prior to 1968, sockeye salmon escapement estimates in UCI were based on surveys of clear water spawning areas and provided no information about the distribution or number of sockeye salmon in glacially occluded waters (King et al. 1989). Commercial and recreational fishery management efforts were further hampered by a lack of daily and cumulative estimates of escapement. The development of side-looking (once referred to as side-scan) sonar techniques by the Bendix Corporation[1] made it possible to estimate sockeye salmon in certain glacial tributaries of UCI.

The use of sonar to estimate the inriver salmon migration began on the Kenai and Kasilof rivers in 1968 with the use of multiple transducer systems (MTS), transducers arrayed linearly in up-looking positions (Namvedt et al. 1977; Davis 1971). Side-looking sonar aimed horizontally atop an artificial substrate were tested on the Kenai River north bank between 12 July and 3 August 1977 using a 1977 model transducer (escapement counts in 1977 were derived from an MTS array). Side-looking sonar proved to be more practical and was implemented on both banks of the Kenai River in 1978. A similar unit was deployed for the first time on the north bank of the Kasilof river in 1977 (south bank counts also used an MTS array), and by 1979 both banks of the Kasilof River were utilizing side-looking sonar. In the Susitna River, an attempt to utilize MTS equipment failed in 1976, leading to use of side-looking sonar, which began with limited success in 1978.

Initially, all side-looking transducer systems were mounted on 20 cm (8 in) by 18.3 m (60 ft) diameter aluminum tubing (artificial substrate) and positioned on the bottom of the river, perpendicular to the bank. This arrangement forced fish to move across the artificial substrate and through the sonar beam. A transition to substrateless counters began in the late 1980s to eliminate the effects that artificial substrates had on fish behavior and the constant maintenance and safety problems with tree and brush entanglements. Substrateless counters began operation in the Kenai River in 1987 (north bank) and 1993 (south bank); and in the Kasilof River in 2003 (both banks).

Prior to the early 1980s, sonar operations were conducted at different sites on the Kasilof River. In 1983, the Kasilof River site was relocated from the outlet area of Tustumena Lake (about 3 km below the lake) to river kilometer 12.1 (mile 7.5), near the Sterling Highway Bridge and closer to Cook Inlet (King and Tarbox 1984; Figure 1). The Kenai River sonar site has been located at river kilometer (RKM) 30.9 (mile 19.2) since the 1960s.

Dual-frequency identification sonar (DIDSON; Belcher et al. 2001, 2002) was used for the first time to estimate escapement on the south bank of the Kenai River in 2007, on the north bank in 2008; and for the first time on both banks of the Kasilof River in 2010. DIDSON was used in the Yentna River from 2009 to 2014 (Westerman and Willette 2010a-b).

FISH WHEELS AND APPORTIONMENT

Fish wheels are used at each sonar site to collect representative samples of each run for the purpose of apportioning sonar counts by species (when necessary) and to collect morphological information such as age, sex, and length (ASL) data from sockeye salmon. Fish wheels were once deployed along both banks of the Kenai and Kasilof rivers but beginning in the mid-1980s were reduced to 1 fish wheel on the north bank of each river because species composition was similar between banks. The Susitna River site, near the confluence with Yentna, was abandoned in 1985 when recurrent flooding rendered the site untenable. The site was relocated to the Yentna River in 1986, about 9.2 km (6 mi) upstream of the confluence with the Susitna River and about 53 (river) km from Cook Inlet (King and Tarbox 1988). The Yentna River has always required 2

1 Product names used in this report are included for scientific completeness but do not constitute a product endorsement.

fish wheels, 1 on each bank, because of differences in species composition and variability of run timings.

Prior to 1999, a minimum fish wheel catch of 150 fish was required to apportion sonar counts in the Kenai River. However, during periods of low passage rates, it would take several days to attain an adequate sample size. In 1999 the apportionment guideline changed so that apportionment would not begin until salmon species other than sockeye exceeded 5% of the total fish wheel catch and the catch of other salmon was in an upward trend. The same criteria were also applied to the Kasilof River. An unpublished biometric analysis determined that altering the method by which sonar counts were apportioned to species did not significantly change the final sockeye salmon estimates ($p < 0.05$) and was more defensible[2].

OBJECTIVES

The 3 main objectives for UCI salmon escapement projects in 2015 were to estimate as follows:

1. The daily and cumulative escapement and run timing of sockeye salmon into the Kenai and Kasilof rivers such that the season total estimate is within 10% of the true value 95% of the time;
2. Age, length, and sex compositions for sockeye salmon escapements in the Kenai, Kasilof and Yentna Rivers such that the estimates are within 5% of the true value 90% of the time; and,
3. Collect Yentna River sockeye salmon tissue samples for genetic mark–recapture study.

Secondary objectives were as follows:

1. Determine counting differences among individual observers for DIDSON subsample image files during the season; and,
2. Conduct stream surveys to estimate salmon escapement in Quartz and Ptarmigan Creeks in the upper Kenai River watershed.

METHODS

SONAR SITES

The Kenai River is a glacial river approximately 120 m wide (at the sonar site) when the water level peaks in early August. River bottom profiles have remained relatively the same since the 1960s when sonar was first tested in the river (Figure 3). Historically, bottom profiles have been determined by the use of measuring rods and depth finders, but in recent years DIDSON has been used to construct river bottom profiles. The Kenai River north bank transducer was located on the inside of a gentle curve in the river that slopes gradually (about 1 m drop in 30 m) toward the opposite bank causing fish to be more dispersed during low water. The south bank slope is steeper (dropping about 1.5 m within the first 10 m, 2.2 m/25 m) and deeper with swifter current than the north bank, forcing most fish to stay within 2–10 m of shore throughout the run. The river bottom consists mostly of rocks 10–30 cm in diameter along both banks with a few bigger rocks (about 50 cm) scattered along the south bank.

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[2] Data on file with the Central Region Research Group, ADF&G Division of Commercial Fisheries, Soldotna.

The Kasilof River is a glacial river about 60 m wide at the sonar site when discharge peaks in early August. The north bank transducer site slopes downward 0.6 m within the first 3 m from shore then flattens to a slope of about 0.25 m in 30 m. The south bank slope is relatively constant, dropping slightly more than 1 m in 40 m. The river bottom consists mostly of rocks 20–60 mm in diameter along both banks, although larger rocks and boulders exceeding 1 m^3 are common along the north bank.

The Yentna River is very turbid, 3–5 cm (Secchi disc depth) at the surface, about 250–300 m wide at the fish wheel site and rising and falling up to 0.2 m daily. The river profile at each fish wheel was relatively steep, dropping 3 m (depth) within 20 m distance on the north bank and over 3 m in the first 10 m on the south before flattening in the next 15 m of range. The substrate consists of rounded rocks on the north bank and angular or blocky rocks on the south, averaging 10–30 cm in diameter along both banks. Sonars were not operated at the Yentna River site in 2015.

DIDSON OPERATIONS

For both rivers, the DIDSON alternated between 1 of 2 frequencies, 1 of 1.8 MHz with an acoustic beam consisting of 96, 0.3° x 14° beams and a range limit of 10 m, and the other of 1.1 MHz with an acoustic beam consisting of 48, 0.4° x 14° beams and a range limit of 30 m. The range limit was extended on the north bank of the Kenai River by installing a unique lens on the DIDSON unit. The river channels, bank to bank, were not completely ensonified with these range limits, but encompassed the expected traveling path of sockeye salmon for each river. The nearshore files, set at high frequency, usually recorded at 8 frames per second whereas the offshore files (low frequency) recorded at 6 frames per second. The pulse length of the DIDSON makes it difficult to field-test target strengths (TS); however, a 38.1 mm calibration sphere was clearly seen in DIDSON images from early field tests (Maxwell and Gove 2007). The TS of the sphere is theoretically between -38 dB and -39 dB for each frequency at a water temperature of 9°C.

DIDSON transducers were mounted on aluminum H-shaped stands for each river in approximately 0.6 m of water and about 15 cm above the bottom in a horizontal side-looking position on both river banks. For DIDSON units which did not come with an internal attitude sensor, an Applied Geomechanics Inc. digital analog clinometer was mounted externally to the DIDSON transducer, which was mounted to a HTI brand rotator operated by a control box located in a shed. The DIDSON transducer was placed 1–1.5 m from the offshore end and immediately upstream of a short weir, which extended approximately 3–6 m into the river.

An automated rotator coupled with an attitude sensor assured proper aim once the transducer was deployed. The aiming protocol of Maxwell and Smith (2007) was used as a guideline to determine the best aim for each river. The DIDSON position, the nominal beam angle, and the range were used to calculate and graph the sonar beam over each river profile (Figure 4). The height of the transducer was adjusted above the river bottom to determine “best fit” or beam angle for the desired range of the beam. At the start, the angle of the rotator/transducer was set and adjusted by an attitude sensor and seldom adjusted unless the transducer moved. The same beam angles were used in 2015 as in previous years because the DIDSON transducer was placed in the same location, at the same height, and aimed the same direction horizontally. To verify the aim, an artificial target or float was moved along the river bottom about 2 m in front of the transducer and through the acoustic beam. Once a proper aim was established, pitch and roll data from the attitude sensor was collected to maintain that aim, particularly when the DIDSON had to be moved or cleaned. Continual silt buildup behind the DIDSON lens predicated that lenses were cleaned once a week or more as needed on the Kenai and Kasilof rivers to maintain signal strength integrity and visual acuity.

Unlike echogram based technologies which produce still frame pictures of fish targets on a paper print out or computer screen, DIDSON produces black and white sonogram-like video images of swimming fish. In these videos, fish are seen as moving or, "swimming" across a predominantly static background or river substrate. To date, trial auto-counting methods for enumerating moving fish images have not been very accurate; therefore, the video-like DIDSON images of individual fish were manually counted with a tally whacker from a computer screen (Faulkner and Maxwell 2015). DIDSON units operated on both river banks of each river 24 hours per day and once each hour, DIDSON programing recorded two 10 minute image files of fish passage within ranges of 1–10 m, 10–20 m, or 10–30 m from shore depending on offshore fish distribution. Laptop computers collected data in a DIDSON video file and backed it up on 1 TB external hard drives. Technicians played back each image file containing a video recording, and counted all migrating fish observed with 2 tally whackers, 1 for fish swimming upstream and 1 for fish swimming downstream. Counts were entered into a Microsoft Excel spreadsheet, which automatically calculated hourly and daily totals. Resident fish species or holding salmon were ignored because only migrating salmon were enumerated for escapement purposes. Fish images which were substantially larger than average salmonid images and which were outside the immediate migration pattern were deemed as Chinook salmon and were not included in the daily count. In general, Chinook salmon are observed from mid-July to the end of the season at a rate of 1–10 fish per day.

To process and count the raw images as quickly and accurately as possible, a DIDSON background subtraction algorithm was often used to view the images of fish against a black background. For counting purposes, an intensity setting of 40 dB and threshold of 4–5 dB produced the best contrast that ensured counting ease and accuracy. Playback frame rates often varied between 8 and 30 frames per second, depending on fish densities and the ability to accurately differentiate fish images by individual observers. Intensity and threshold levels used by technicians were relatively constant with small variations between individuals for personal preference. Hourly fish counts from image files were continuously compiled and frequently relayed to ADF&G management biologists for inseason and timely commercial fishery applications. In addition to these escapement estimates, management biologists use inseason commercial fishery data to determine fishery openings and closings in UCI.

ESTIMATING FISH PASSAGE

For each bank separately, all fish images on a computer screen were counted with a tally whacker for each nearshore (n) and offshore (o) 10 minute file, differentiating upstream (n_u) from downstream (n_d) swimming fish. Counts were entered into MS Excel spreadsheets where the number of salmon migrating upstream on bank (b) in hour (h) was estimated by:

$$N_{bh} = 60\frac{(n_{u(n)} - n_{d(n)}) + (n_{u(o)} - n_{d(o)})}{10} \quad . \qquad (1)$$

All 24 hourly estimates for a calendar day were summed to estimate daily fish passage (N_{bd}) for each bank (b), i.e.

$$N_{bd} = \sum_{h=1}^{24} N_{bh} \ , \tag{2}$$

Then, the fish passage estimates for both banks were summed to estimate the total daily fish passage (N_d).

Estimating Missing Data

When temporary equipment failure or intentional shutdowns for maintenance resulted in missing data for a given bank, hourly fish passage for any given hour ($\bar{x}_y$) was estimated by averaging valid counts for the same bank in adjoining hours, usually 1 hour before and 1 hour after $\bar{x}_y$.

$$\bar{x}_y = \frac{\sum s_{(xz)}}{n_{(xz)}} \ , \tag{3}$$

where:

$\sum s_{(xz)}$ = sum of all valid counts in adjoining hours of $\bar{x}_y$, (xz), and

$n_{(xz)}$ = number of valid adjoining hours of $\bar{x}_y$, (xz).

If a sonar unit did not operate for more than a day due to electronic problems or high water, a ratio of fish passage estimates between banks was used to estimate missing daily data. For example, if the daily estimate for bank 1 was unobtainable, daily fish passage was estimated from the ratio of the fish passage between banks for the previous 3 days and the fish passage on the opposite bank, i.e.

$$N_d = \left(\frac{\sum_{d=1}^{3} N_{1d}}{\sum_{d=1}^{3} N_{2d}} \right) \cdot N_{2d} \ . \tag{4}$$

Species Apportionment

Fish wheels were operated on the north banks of the Kenai and Kasilof rivers to catch fish for apportionment purposes and/or to collect ASL information from sockeye salmon (Figure 5). Fish wheels were operated on both banks of the Yentna River to collect ASL information and tissue samples from sockeye salmon for genetic analysis. All fish wheels were of similar design consisting of framework that supports aluminum or foam-filled plastic floats, an axle, and a livebox. Partitioned, custom-made aluminum floats prevented the fish wheel from sinking should a float develop a leak. Two baskets and 2 paddles were mounted to the axle at 90° angles to each other that rotated in the river. As the axle rotates in the current, the baskets scoop fish from the river, dropping them in a livebox mounted to the outside of the fish wheel frame. The baskets were fitted with 2–2.5 in (5–6 cm) tarred netting and a slide, which funneled the fish toward an opening in the basket netting and into the livebox. The livebox was mostly submerged in the river, where a constant flow of freshwater kept fish alive and vigorous. All fish wheels were anchored to shore using a boom (either a wooden or steel 4 x 4) to station the wheel in current deep and fast enough to allow the axle to turn. The baskets rotated as close to the bottom as possible where most fish migrate. Cables or rope secured the front end to shore and kept the fish wheel parallel to the current. Depending on current, spinning speed of the fish wheel ranged between 2 and 5 revolutions per minute (rpm) with optimum speed at 3–4 rpm (any slower or faster reduced its effectiveness). A short weir, 3–6 m wide (depending on river) with pickets spaced no more than 7–8 cm apart, extended from shore diverting nearshore fish toward the spinning baskets. These weirs were either aligned with or just downstream of the axle or immediately below the fish wheel (nearshore) float. At some sites it was practical to extend the weir immediately below the wheel, past the inshore float, to prevent fish from passing under the fish wheel float and avoiding the catch zone.

In 2015, the Kasilof River fish wheel, located 75 yards downriver of the DIDSON on the north bank, was positioned under the Sterling Highway Bridge for the first 2 weeks of operations, then relocated 30–40 m upriver when the water level was higher. The wheel fished more effectively from start to finish when fished in these locations.

The primary objective of the Kenai and Kasilof rivers projects are to estimate sockeye salmon escapement, but escapement estimates will also be reported for coho (*O. kisutch*), pink (*O.gorbuscha*) and chum salmon (*O. keta*) without variances. Kenai or Kasilof river sonar counts are not apportioned until the daily species composition of the fish wheel catch is at least 5% pink and/or coho salmon and the evidence of a trend is obvious. This guideline was developed to accommodate situations when run timing of sockeye and pink salmon (and sometimes coho salmon) overlap, usually during even-numbered years.

At the Kenai and Kasilof rivers, the daily escapement of each salmon species (N_{sd},) was determined by multiplying the total daily fish passage estimate (N_d) by the proportion of each species captured in the fish wheels (p_s), i.e.,

$$N_{sd} = N_d \cdot p_s \ . \tag{5}$$

When the fish wheel catch was low (less than 20 fish) or did not operate during a 24 hour period, the catches from the 2 previous days were combined with the low catch to estimate (p_s). The abundance of non-salmon in fish wheel catches, such as rainbow trout (*O. mykiss*) and whitefish (*Coregonus* spp.), are typically small (less than 1%) therefore these fish are not apportioned from the total sonar count.

A simple method for observing relative abundance and catch efficiency of any given fish species and gear type was determined by calculating catch per unit effort (CPUE).

$$CPUE = \frac{c}{e}, \tag{6}$$

where:

c = total number of fish caught, and

e = total number of hours each fish wheel was fished.

Variance of Sockeye Salmon Passage Estimates

The variance of the sockeye salmon passage estimate on bank (b) and day (d), due to systematic sampling in time and adjustments for missing data, was approximated using Wolter's (1985) successive difference method, i.e.

$$\hat{V}\left[\hat{N}_{bd}\right] \cong (1-\frac{1}{j}) \cdot \left(\frac{1}{m}\right) \cdot \left(\frac{1}{3.5(m-4)}\right) \cdot \sum_{h=5}^{m} (\frac{N_{bh}}{2} - N_{bh-1} + N_{bh-2} - N_{bh-3} + \frac{N_{bh-4}}{2})^2 \ , \tag{7}$$

where m was the number of hourly counts in a day (usually 24), j was the hourly sampling expansion factor (usually 60 minutes/10 minutes = 6). If sonar count data were missing in a day, the sample size (m) was adjusted accordingly. The total variance on day (d) was estimated by summing the variances from the 2 banks.

When daily fish passage total estimates were apportioned to species using fish wheel catches, the daily variance was estimated as:

$$V[N_{sd}] = N_d^2 \cdot V(p_s) + p_s^2 \cdot V(N_d) - V(p_s) \cdot V(N_d), \tag{8}$$

(Goodman 1960). The variance of the sockeye salmon passage estimate for the season was estimated by summing the daily variances. The 95% confidence intervals on the total sockeye salmon passage estimate were estimated as described by Zar (1984).

GENETICS, AGE, SEX, AND LENGTH COMPOSITION

Sample sizes for estimating ASL compositions were 0.1% of the previous day's sockeye salmon escapement estimate on the Kenai River and 0.2% on the Kasilof River. A single scale from sockeye salmon for age analysis was collected from a preferred area on the left side of each fish, on a line between the posterior edge of the dorsal fin and anterior portion of the anal fin about 2 or 3 scale rows above the lateral line. If the preferred area was scarred or void of scales, the scale was either taken in front of the preferred area or from the same spot on the right side of the fish. Lengths were measured from mideye to tail fork (METF). ASL information and genetic samples were collected from every sockeye salmon captured by the Yentna River north bank fish wheel (three 2 hour sampling periods) and from every other sockeye salmon captured by the south bank fish wheel during each of the three 1 hour sampling periods.

OBSERVER VARIABILITY

Counting variability among observers at the Kenai and Kasilof river sites was examined in 2015 to evaluate sources of error in fish passage estimates and help train sonar staff. One source of error arises from counting moving fish from a video in a timely manner for inseason management. Previous studies by Westerman and Willette (2011) indicated that differences among observers increased for rivers with higher densities, especially for the Kenai River. Observers recounted 24 (Kasilof) or 35 (Kenai), 10-minute DIDSON subsample files recorded during or near the peaks of the Kenai or Kasilof river runs. The Kenai and Kasilof crews primarily counted files from 2012 to 2014 so observers could familiarize themselves with counting in preparation for 2015. Rather than use a single observer as a benchmark with which to compare other observers, average crew counts were used as the benchmark for each of the subsamples compared. Counts were primarily done from nearshore (1–10 m) subsample recordings (both banks) where fish abundance and the likelihood of error were greater than less abundant offshore subsamples. The number of fish per subsample in all Kenai River files ranged between 40 and 1,500 fish; Kasilof River counting files ranged between 20 and 600 fish. Observer counts were stratified for every 100 fish based on averages (Equation 9) of each sample (100–199, 200–299, etc.), then averages determined from these strata were compared against those of each observer.

For each river, the number of fish counted by each observer per subsample was compared against the crew average for that subsample:

$$\bar{f}_i = \frac{\sum f_i}{n_i}, \tag{9}$$

where:

$\bar{f}_i$ = average number of fish for a given subsample (i),

$\sum f_i$ = sum of fish counts of all observers for a given subsample, and

n_i = number of observers for a given subsample.

The number of observers in each crew (x) was 3 for Kasilof and 5 for Kenai. The observer average of all subsample counts (24, in the case of Kasilof) was also compared to the crew average of all subsamples (24_x):

$$\overline{F}_o = \frac{\sum f_o}{24x}, \tag{10}$$

where:

$\overline{F}_o$ = average of all observers, and

$\sum f_o$ = sum of all subsample counts for all observers.

The standard deviation (SD) provided a measure of error between observers, and correlation (R^2) values indicated the relationship between an individual's subsample count and the average of the crew for that same subsample. These values were compared against the averages for each sample and for all samples ($n = 24$).

CESSATION CRITERIA

Sonar operations end on the Kenai and Kasilof rivers when daily escapements meet cessation criteria of ≤1% of the total cumulative estimates of sockeye salmon for 3 consecutive days. Fish wheel operations on the Yentna River end when sockeye salmon catches from fish wheels reach ≤1% for 3 consecutive days. The cessation criteria for the Kenai and Kasilof River sonar enumeration projects are not applied until after the closure of commercial fishing within the Kenai, Kasilof, and East Forelands sections. Exceptions to this criterion have may be made if budgetary constraints and/or environmental factors such as high water put equipment or personnel at risk and the run was near the historical end dates as well as close to the 1% cessation criteria.

STREAM SURVEYS

When seasonal ADF&G staff are available and weather conditions are favorable, stream surveys are scheduled during the historical sockeye salmon peak escapement periods for Quartz and Ptarmigan creeks. Quartz Creek peak run periods occur in mid to late August and Ptarmigan Creek peak runs occur in the first part of September. A stream survey consists of walking in or along the water way counting live and dead fish with hand held tally whackers. These counts provide an index of abundance. Because there is not enough staff and time to conduct frequent surveys during the course of the sockeye salmon escapement, there is no statistical analysis completed for index counts which occur in a single counting survey.

Climatological Data

Water and air temperatures, water depth (staff gauge), and general weather conditions were recorded at each of the sonar sites. Turbidity or water clarity (Secchi disc) is measured in the Kenai River, but not in the Yentna or Kasilof rivers due to their low clarity.

RESULTS AND DISCUSSION

Objective 1 regarding escapement enumeration was met due to conditions being adequate for use of sonar to estimate salmon escapement in each of 2 river systems in UCI because 1) most sockeye salmon migrate nearshore (less than 10 m) within range of a transducer beam and near the bottom; 2) salmon densities were challenging but not overwhelming in the Kenai and Kasilof rivers; 3) processing of DIDSON files were completed in a timely and reasonably accurate manner; and 4) the acoustic size of migrating fish and TS were within detection thresholds of DIDSON as demonstrated by Maxwell and Gove 2007; Tarbox and King 1991, where target strengths of (tracked) salmon averaged -32.2 dB in the Copper River and between -32.0 and -32.4 dB in the Yentna River. These TSs were well above the minimum thresholds for DIDSON, which have detected calibration spheres of -38.1 dB and -43 dB. Objective 2 was also met. Fish wheels operated in a sufficient manner to adequately catch sockeye salmon for ASL compositions and estimates.

Kenai River

The largest documented sockeye salmon counts occurred in the Kenai River in 1987 (the Glacier Bay oil spill, 2.2 million fish) and 1989 (the Exxon Valdez oil spill, 2.3 million fish), when commercial fishing was restricted for part or all the fishing season. In comparison, the Kenai River sockeye salmon escapement in 2015 was estimated at 1,709,051 (95% CI: 1,708,905–1,709,197) with a relative error of 0.009%. A small CI range was due to non-apportionment of other salmon species from the count. The 2015 escapement was the sixth highest estimate since 1979, exceeding the inriver goal of 1.0–1.2 million sockeye salmon, a goal based on a Kenai River run of 3.6 million fish[3] (Tables 1 and 2).

Most of the escapement (about 80%) occurred within a 37 day period, beginning 14 July. The midpoint of the escapement was 30 July, which was 8 days later than the historical average since 1979 and 8 days later than the 2000–2014 average (Table 3). Commensurate with the average run peak, daily escapements peaked on 23 July when about 75,000 sockeye salmon passed the sonar site. However, salmon escapement protracted well into late August, making 2015 the third longest counting season since 1979 (Figure 6). Salmon migration was in decline and the 3 consecutive day cessation criteria nearly achieved, when, for budgetary reasons, the counting season ended just short of the prescribed cessation criteria.

Kenai River sockeye salmon escapement frequently comes in several peak (pulses) periods throughout the run, commonly observed as late July or early August escapement peaks. Late season peaks occur at a time when commercial fishing effort is declining and other salmonid

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[3] Additional information regarding the determination of inriver goals located at: http://www.adfg.alaska.gov/static/applications/dcfnewsrelease/505539253.pdf

runs are prevalent. Early August is historically the time when species apportionment begins, however, there was no apportionment of species in 2015 because run size and/or timing of pink and coho salmon didn't justify apportioning. The high percentage of sockeye salmon was typical, because pink salmon usually do not appear in the river during odd numbered years. Estimates of pink and coho salmon are typically not indicative of run size because the project operational period does not coincide very well with the complete run timing of these species. Tarbox et al. (1983) identified difficulties enumerating these species with sonar and apportionment related to the sonar site's specific location. Observations using sonar and sampling techniques historically indicate that late season coho and pink salmon apparently have spatially broader migration patterns than sockeye salmon, and that Chinook salmon (*O. tshawytscha*) tend to migrate further from shore. Additionally, Chinook and pink salmon spawn within the locations of the sonar and fish wheel placement increasing enumeration difficulties. Since the use of DIDSON, stationary or spawning salmon are visually identified and ignored during counting procedures. The fish wheels function only to catch migrating fish for apportionment and ASL sampling and don't target resident or spawning fish during sampling.

Run timing was average for both banks with a slightly higher percentage (51%) of fish migrating along the north bank (Table 4; Appendices A1–A2). However, fish distribution from shore differed by bank because of differences in depth and bottom profile (Table 5). During the first week of July, less than 80% of the fish migrated within 0–10 m of the north bank transducer compared to greater than 90% within 0–10 m of the south bank transducer. During the second week of July water levels peaked for the season and fish migrated closer to shore along the south bank where greater than 96% were passing within 10 m of the transducer throughout the remainder of the salmon run. In contrast, the north bank fluctuated between 75% and 90% through July and August as water levels decreased. By 9 August, when coho salmon densities typically increase, a few more salmon are usually observed moving beyond 10 m along the north bank and occasionally along the south bank. However, in 2015 near shore orientation was sustained during the later portion of the run as water levels decreased. Subsample counts for the entire season indicated that about 86% of the north bank fish and about 98% of the south bank fish migrated within 10 m of each transducer.

After mid-July, approximately 129 fish observed on the south bank were Chinook salmon, based on their size and swimming behavior observed in DIDSON images. A few Chinook salmon were also observed beyond 20 m of the north bank, but were usually intermixed with other salmon.

Average hourly passage trends were relatively similar between the north and south bank (Figure 7; Appendices A3–A4). Salmon passage rates met or exceeded a constant or average daily rate of 4.2% (the average percent hourly passage rate for a 24 hour period) from late morning through late evening hours along both banks. Fish passages were lowest throughout the early morning hours along both banks.

The Kenai River fish wheel caught 4,852 salmon, and in correspondence with odd-numbered year catch averages, was comprised of 0.9% pink, 0.7% coho, 0.2% Chinook, and sockeye salmon (98.2%) was the predominant species (Table 6). Estimates for species other than sockeye salmon have limited value as indices of total passage, because (1) their run continues beyond the operational time frame of the project, and (2) fish wheel avoidance (e.g., Chinook salmon) often affect results. Most Chinook salmon do not migrate near shore and are frequently observed in the outer ranges (10–30 m) of DIDSON. Total CPUE for sockeye salmon (8.1 fish per hour) was slightly more than the historical average for an odd year (Table 7). Likewise, total CPUE for all species was above average for an odd year.

Predominant age[4] components of the sockeye salmon escapement in the Kenai River were 1.3 (47.5%), followed by 2.3 (26.2%), 1.2 (18.6%), and 2.2 (6.7%) based on a sample of 1,409 fish (Table 8). Weighted samples of age-1.3 fish averaged 544 mm, -2.3 fish averaged 543 mm and -1.2 fish averaged 454 mm, which was below average for each age class (Table 9). The average length for all age classes combined was 520 mm, which was within the historical range of 488–576 mm. The male to female ratio (0.7:1) was consistent with the average historical ratio.

The biggest challenge for any observer counting fish in Kenai River image files, more so than any other sonar escapement project in UCI, was an ability to detect individual fish within high densities of fish. High densities of swimming fish created acoustic shadowing effects that often masked fish passing side by side and made it difficult to keep track of moving images. The closer to the transducer high densities of fish passed, the more profound the problem. Observers were able to counter this problem by adjusting the frame rate (playback speed) and intensity on the computer to detectable levels. In practice, the playback speed could be slowed down when high densities of fish were being observed, allowing the technician to count more accurately. This was a big concern on the south bank, where many fish were often tightly packed within 2–5 m of the DIDSON transducer throughout the peak of the run, creating these shadowing effects. On the north bank, fish were more evenly distributed throughout the detection range of the DIDSON, posing a different problem; that is, “mentally” tracking fish and remembering which fish were counted as they were observed moving across the computer screen. Masking and distribution problems were not always exclusive to 1 bank or the other; many times these problems were prevalent on both sides of the river. The lower image quality on the north bank due to the long range requirement and capabilities of the particular DIDSON unit was mitigated by viewing images with a slower frame rate. Efforts to lessen these high density effects included lengthening the weir 1–2 m to push fish farther away from the transducer and re-aiming the DIDSON unit to provide a better viewing angle.

Realized inseason nearshore hourly (10 minutes per hour) subsample counts of fish averaged 92 on the north bank and 98 on the south bank. North bank nearshore subsample counts were below 300, 97.1% of the time. Similarly, south bank nearshore subsample counts were below 300, 94.7% of the time. Less than 1% of north bank and 2% of south bank nearshore counts exceeded 400 (Table 10). Offshore counts were substantially lower; averaging 15 counts per subsample on the north bank and 3 counts on the south bank.

The water level in the Kenai River, a glacially fed river, was 0.5 m higher early in the sonar season compared to the end of the season (Table 11; Figure 8). This is the opposite of the normal pattern (i.e., lowest in early July and peaking in August). Consequently, water clarity was slightly above average with a Secchi depth of 97 cm. Air temperature was average for the period 1987–2014. Fish distribution from shore was not affected by diminishing water levels to the point where fish dispersed throughout the sonar range and farther from shore on the north bank.

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[4] European aging system indicated by freshwater years, followed by years in ocean.

KASILOF RIVER

The Kasilof River sockeye salmon escapement estimate in 2015 was 470,677 (95% CI: 469,545–471,808) with a relative error of 0.2% (Table 12). The 2015 escapement into the Kasilof River was the fourth highest documented escapement since 1983, exceeding the upper limit of the OEG (160,000–390,000). Of the highest documented escapements into the Kasilof River, 9 have occurred in the last 13 years and the highest historical estimated escapement was in 2004 when about 524,000 sockeye salmon passed the Kasilof River sonar counters. Kasilof River sonar counts are usually not apportioned because of a low percentage (less than 2%) of other species in daily fish wheel catches. Nominal pink salmon runs occasionally occur in mid-July, but do not usually return in numbers warranting apportioning counts. However, during a brief period in mid-July, sonar counts were apportioned for 5 days when pink salmon numbers were high.

Fish migration was slightly early in 2015. The midpoint of the escapement occurred on 13 July, 2 days earlier than the historical average (1979–2014) and the majority of the escapement (80%) passed the counting site in 45 days (Table 13). Like the Kenai River, this demonstrated a protracted counting season, 8 days longer than the historical average (1979–2014). The run did not exhibit a single peak day, but instead fluctuated throughout most of the season. Several escapement peaks occurred between 20 June and 24 June when daily escapements ranged from 7,000 to 17,000 fish, followed by a single daily peak of 16,000 fish on 6 July. During a subsequent period from 14–27 July daily escapements peaked at up to 12,000 fish, which primarily migrated along the north bank (Figure 6). In 2015, approximately 65% of the fish were estimated to have migrated along the north bank, which was higher than the historical average of 58% for all years since 1979 (Table 4; Appendices B1 and B2). For unknown reasons, the trend from 2005 to 2011 saw an increasing percentage of fish pass along the north bank, and has since then maintained a prevailing fish passage rate. Prior to 2005, fish were either predominantly south bank oriented or evenly split between the banks.

A moderate percentage of fish migrated between 10 m and 30 m from shore in late June on both banks, but with higher water, fish became more shore oriented (less than 10 m) by early July and August (Table 5). By 6 July, about 96% of the fish passed within 10 m of the transducer along the north bank and 93% along the south bank. By 19 July, about 99% of the fish were within 10 m of the transducer on both banks. For the season, 96.4% of the fish passed within 10 m of the north bank transducer and 89.1% were within 10 m of the south bank transducer.

The daily run timing along the south bank was different than on the north bank, with a slightly greater portion of the run occurring in late morning and late evening hours, then slightly declining during early morning and mid-afternoon hours. The north bank tended to increase from mid-day and throughout evening hours, and declined substantially after midnight (Figure 7; Appendices B3 and B4). Differences in hourly escapement patterns between banks may indicate crossing over behavior somewhere downstream of the sonar site or tidal influences upon entry into the river mouth, but actual causes are unknown.

The fish wheel operated for 518 hours and caught a total of 2,698 salmon for a CPUE of 5.2 fish per hour, higher than the historical average of 3.7 fish per hour (Tables 14 and 15). Due to rising water levels the fish wheel was moved upstream 25 June. No significant change in catch rates were observed following this move. The percentage of sockeye salmon in the catch (about 98%) was slightly above the historical average (97%) for the project (1983–present) and was typical of an odd-numbered year.

The fish were more susceptible to capture during the evening and night hours, which may be due to abundance or run timing along the north bank and/or environmental factors. Compared to other glacial rivers, the Kasilof fish wheel CPUE is characteristically less than Kenai River and much less than Yentna River.

Kasilof River sockeye salmon escapement age composition was mainly age-1.2 (21.0%), -1.3 (34.7%) and -2.2 (35.1%) based on a sample of 1,122 fish (Table 16). Average lengths were 467 mm for age-1.2, 474 mm for -2.2 and 519 mm for -1.3 sockeye salmon (Table 17). Average length for all age classes was 489 mm. The male to female ratio (0.7:1) was about average for this river.

Inseason nearshore hourly (10 minutes per hour) subsample counts of fish averaged 34 on the north bank and 17 on the south bank. North bank nearshore subsample counts were below 100, 94.8% of the time. Similarly, south bank nearshore subsample counts were below 100, 98.9% of the time. Less than 1% of north bank subsample counts exceeded 200 and less than 2% of south bank subsample counts exceeded 100 (Table 10). Offshore subsample counts were significantly lower; averaging 1–2 fish counts per subsample.

The average 2015 water temperature was close to the historical mean and water level rose 0.8 m during the run, which was slightly below average for the Kasilof River (Table 11; Figure 8). Environmental factors did not appear to influence salmon run timing, although water level influenced fish distribution and fish wheel operations. As water level rose, water velocity increased, so fish took the path of least resistance near the banks. High water and faster current makes operating the fish wheel more difficult and lowers catch efficiency.

YENTNA RIVER

Factors influencing the accuracy of escapement estimates for pink, coho, chum, and Chinook salmon in the Yentna River have been discussed by Tarbox et al. (1981, 1983). Prior to 2015, escapement range estimates for sockeye salmon were probably a conservative indicator of run strength because of biases in sonar estimates of total salmon abundance and fish wheel selectivity (Maxwell et al. 2013).

The reliability of using fish wheels on the Yentna River to apportion sonar estimates because of possible species selectivity has been a concern in recent years. A study by Meehan (1961) on the Taku River found that fish wheels were more efficient at capturing smaller Chinook (approximately sockeye salmon size) and pink salmon and less efficient at capturing coho and larger Chinook salmon (larger than sockeye salmon). In 1981 and 1982, ADF&G (1983) found that fish wheels on the Susitna River at Talkeetna and Curry Stations were more selective for pink salmon and less for chum and Chinook salmon with no apparent selectivity for coho or sockeye salmon. A problem with the use of fish wheels is that species selectivity may be dependent on specific site conditions (depth, flow, profile, etc.) where some sites are more conducive to the capture of certain species than others (i.e., eddies might improve capture probabilities of pink salmon over other species). This may be the case with Yentna River fish wheels where environmental factors such as an eddy on the north bank and constantly fluctuating water levels influence species selectivity.

Beginning in 2009, fish wheel selectivity coefficients derived from studies on the Susitna (ADF&G 1983) and Taku rivers (Meehan 1961), and Flathorn Station (Susitna River) were factored into daily (total) fish wheel catches to determine a minimum-maximum escapement range for Yentna River sockeye, pink, chum and coho salmon. Consequentially, Yentna River sockeye salmon escapement estimates ceased being used inseason for management purposes. In addition, test fishing by drifting gillnets within the ensonified zone of the DIDSON was conducted from 2012 to 2014 to determine if species apportionment using gillnets would provide more accurate estimates of sockeye salmon escapement. The method was similar to that used on the Nushagak River with some modifications (Brazil and Buck 2010).

Westerman and Willette (2013) initially discovered differences between the 2 catch methods, indicating gillnet apportionment of sonar counts provided a more consistent estimate of sockeye salmon escapement. However, disparity in results and year to year inconsistency forestalled drawing conclusions. The ratio between gillnet and fish wheel counts in 2012 was 3.8:1; in 2013, 2.8:1; and in 2014, 1.2:1. Another year or more of comparison studies were needed before any conclusions could be made about the feasibility of this method, but budgetary restraints completed sonar and escapement studies on the Yentna River in 2014.

The Bendix based Yentna sockeye salmon SEG was replaced with 3 weir SEGs for Chelatna, Judd, and Larson lakes, 3 of the major sockeye salmon rearing lakes within the Susitna River drainage in 2009 (Fair et al. 2009; Yanusz et al. 2011). Cook Inlet Aquaculture Association (CIAA) operated the weirs on these lakes from 2009 to 2012, and since then the weirs were operated by ADF&G (CIAA 2012, 2013; Weber 2012a-b, 2013a-b). In 2015, sockeye salmon weir counts exceeded the SEG range of 20,000 to 65,000 at Chelatna Lake (69,897), achieved the range of 15,000 to 50,000 at Larson lake (23,185), and were well within the SEG range of 25,000 to 55,000 (47,934) at Judd Lake (Table 18).

Following suspension of sonar studies, fish wheel operations continued in 2015 for the purpose of collecting physiological characteristics of sockeye salmon, including ages (scales), lengths and sexes. Sockeye salmon tissue samples (n = 1,601) for genetic analysis were collected, fulfilling UCI salmon escapement project Objective 3. The north bank fish wheel caught about 23 salmon per hour and catches consisted mostly of sockeye (13.8%), pink (58.6%), chum (17.4%) and coho salmon (10.0%) (Table 19). The catch percentage for sockeye salmon was near the historical average for the north bank, whereas pink salmon catches were below average (Table 20). The south bank fish wheel CPUE was nearly double its historical average, and was much greater than the north bank, which has been typical for the Yentna River since fish wheels were first used on the river in 1982 (Table 21). The south bank fish wheel averaged 39 salmon per hour and catches consisted mostly of sockeye (36.4%), pink (43.6%), chum (10.5%), and coho salmon (9.4%). Sockeye salmon catch was 37% higher than its historical average, whereas pink salmon catch was 17% less (Table 22). The percentage of chum salmon on the north bank was double (17.4%) the average (8.8%), and slightly above (10.5%) the historical average (7.7%) on the south bank. Coho salmon catches were slightly higher (10.0%) than average (8.9%) on the north bank and slightly below (9.4%) average (13.0%) on the south bank. The midpoint of sockeye salmon catches occurred between 25 July and 2 August on both banks, which is consistent with peak historical sonar escapement estimates (Tables 20 and 22). Pink salmon catches peaked between 26 July and 29 July, chum salmon on 25 July and 6 August and coho salmon on 27 July and 7 August.

The age composition of Yentna River sockeye salmon consisted mostly of age-1.3 (62.3%), -2.3 (9.5%), and -1.2 (18.9%) and was based on a larger than usual sample of 1,212 fish (Table 23). Age-1.3 sockeye salmon percentages were well above historical averages, but the -1.2 and -2.2 sockeye salmon were below average. Average lengths for these age classes ranged between 466 mm and 541 mm. These were among the shortest lengths recorded since 1983 for the age-1.3, -2.2 and -2.3 sockeye salmon. The male to female ratio was average at 0.9:1 (Table 24).

OBSERVER VARIABILITY

DIDSON image files primarily from 2012–2014 (n = 35) were recounted by each Kenai River crew member to estimate count variability among observers using average counts as a comparison baseline. Files ranged between 50 and 1,500 fish/file averaging 644 fish (SD = 12). These same files when originally counted, averaged 633 fish per file. Most files selected for this comparison analysis (about 66%) ranged between 200 and 900 fish/h (11% <200 fish and 23% >900 fish). The overall average for each observer (35 samples combined) correlated closely with the average range for the entire crew (R^2 = 0.979–0.993; Table 25). Variability among observers increased as fish densities increased (SD = 6.3, <299 fish counted; SD = 20.1, 300–599 fish counted; SD = 24.0, 600–899 fish counted; SD = 23.6 >900 fish counted) and were less consistent as sample densities exceeded 500 fish (Figure 9). Correlations among observer counts typically diminish as subsample counts increase. In 2015, contrary to this trend, subsample counts greater than 900 fish had an R^2 of 0.909. Counts for 300–600 had an R^2 of 0.587; however, this low R^2 value was attributed to 1 comparison file that was inaccurately transcribed from the original count (Figure 10). The original estimates (R^2 = 0.976) were lower than all of the 2015 averages. The trend up to 900 counts was similar in 2014 when observer differences were more variable at higher densities.

For comparison and preseason training purposes, historical DIDSON image files were recounted by each Kasilof River crew member to estimate count variability among observers using average counts as a comparison baseline. A nearly 1:1 relationship (R^2 = 0.997, SD = 4.6) existed between observers when counting identical image files (Table 25). Samples averaged 158 fish per file with one-third containing between 100 and 200 fish. Variability between observers was minimal because of low fish densities, but like the Kenai, crew differences increased with higher fish densities (Figures 9 and 10). In general, overall average observer counts of subsamples containing 200 fish or more are most variable, and those subsamples containing less than 200 fish are least variable. Concurring with this observation, observer counts in 2015 were less variable for files containing less than 100 fish (n = 12; SD = 0.5) compared to those containing 100–199 fish (n = 7; SD = 3.2) and files containing greater than 200 fish (n = 5; SD = 17.5) were most variable across the average observer count. Average observer counts were within 1 to 5 fish of the counts made in the original files, a good correlation (R^2 = 0.996–0.999) among all observers. Unlike the Kenai River, spatial distribution and acoustic shadowing effects were not a problem for the Kasilof River crew because of lower fish densities. A counting standard of ≤5% of the crew average was set to allow for some degree of error, and the Kasilof crew met that standard in 2015.

STREAM SURVEYS AND WEIR COUNTS

Stream surveys and weir counts were important indicators of run strengths in UCI in 2015. A foot stream survey was conducted on Quartz Creek by ADF&G, Division of Commercial Fisheries during the historical peak of sockeye salmon spawning activity (late August) to assess tributary escapements in the upper Kenai River drainage. All observed fish, living and dead sockeye salmon and other species of fish, were counted and evidence of predation noted. The Quartz Creek survey covered the lower 7.5 km of the creek starting at the Matanuska Electric Association substation on the Sterling Highway and ending at Kenai Lake. Other indicators of run strength in the upper Kenai River drainage (weir counts on the Russian River) were provided by the Division of Sport Fish and CIAA (weir counts from Hidden Creek). ADF&G, Division of Commercial Fisheries also operated weirs at Judd, Chelatna, and Larson lakes within the Susitna River watershed. The Division of Sport Fish in Palmer operated a weir on Fish Creek and stream surveys (aerial and ground) on a number of Northern District streams and lakes (Table 18).

Late run Russian River and Hidden Creek weir counts and a stream survey on Quartz creek provided an upper Kenai River index of 81,103 sockeye salmon, about 4.7% of the estimated sockeye salmon migration past river kilometer (RKM) 31 sonar site (Table 26). Ptarmigan creek was not surveyed due to budget constraints and a late counting season on the Kenai River which reduced availability of staff. The Quartz Creek stream survey counts were conservative, because 1) unknown quantities of fish were observed in Kenai lake at the mouth of Quartz Creek at the time of the survey, 2) any fish in water greater than 1.5 m deep were difficult or impossible to see, 3) early (or late) spawners were not counted because only 1 survey was conducted (sockeye salmon are often observed spawning in Quartz Creek as late as mid-October), and 4) many dead fish were observed, probably an indication that the survey did not include a complete observation of the run. Quartz Creek counts were well below the 20 year average. A later survey was not conducted because of budget constraints and staff availability. The total late run Russian River weir and stream survey count was 46,223 and 11,172 sockeye salmon, and the Hidden Lake weir count was 18,777. The late run Russian River escapement of sockeye salmon fell within the SEG for this stock (30,000–110,000) but was less than the 45-year average dating back to 1969. Correlations between combined survey/weir counts and sonar estimates ($R^2 < 0.25$) have never been strong (Westerman and Willette 2010a).

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TABLES AND FIGURES

Table 1.–Sockeye salmon escapement estimates (Bendix and DIDSON) for the Kenai, Kasilof, and Yentna rivers 1978–2015.

	Kenai R.[a]		Kasilof R.[b]		Yentna R.[c]	
Year	Bendix	DIDSON	Bendix	DIDSON	Bendix	DIDSON
1978	398,900	ND	116,600	ND	ND	ND
1979	285,020	412,978	152,179	ND	ND	ND
1980	464,038	667,474	184,260	ND	ND	ND
1981	407,639	575,848	256,625	ND	139,401	236,218
1982	619,831	809,173	180,239	ND	113,847	192,916
1983	630,340	866,455	210,271	215,731	104,414	176,932
1984	344,571	481,473	231,685	238,413	149,375	253,119
1985	502,820	680,897	505,049	512,827	107,124	181,524
1986	501,157	645,906	275,963	283,054	92,076	156,025
1987	1,596,871	2,245,615	249,250	256,707	66,054	111,930
1988	1,021,469	1,356,958	204,000[d]	204,336	52,330	88,674
1989	1,599,959	2,295,576	158,206	164,952	96,269	163,130
1990	659,520	950,358	144,136	147,663	140,290	237,725
1991	647,597	954,843	238,269	233,646	109,632	185,774
1992	994,798	1,429,864	184,178	188,819	66,074	111,964
1993	813,617	1,134,922	149,939	151,801	141,694	240,104
1994	1,003,446	1,412,047	205,117	218,826	128,032	216,953
1995	630,447	884,922	204,935	202,428	121,220	205,410
1996	797,847	1,129,274	249,944	264,511	90,660	153,625
1997	1,064,818	1,512,733	266,025	263,780	157,822	267,433
1998	767,558	1,084,996	273,213	259,045	119,623	202,704
1999	803,379	1,137,001	312,587	312,481	99,029	167,807
2000	624,578	900,700	256,053	263,631	133,094	225,531
2001	650,036	906,333	307,570	318,735	83,532	141,547
2002	957,924	1,339,682	226,682	235,731	78,591	133,174
2003	1,181,309	1,656,026	359,633	353,526	180,813	306,392
2004	1,385,981	1,945,383	577,581	523,653	71,281	120,787
2005	1,376,452	1,908,821	348,012	360,065	36,921	62,563
2006	1,499,692	2,064,728	368,092	389,645	92,896	157,414
2007	867,572	1,229,945	336,866	365,184	79,901	135,394
2008	614,946	917,139	301,469	327,018	90,146	152,754
2009	745,170	1,090,055	297,125	326,285	ND	43,972–153,910
2010	970,662	1,294,884	267,013	295,265	ND	59,399–145,139
2011	ND	1,599,217	ND	245,721	ND	62,231–140,445
2012	ND	1,581,555	ND	374,523	ND	30,462–89,957
2013	ND	1,359,893	ND	489,654	ND	70,781–212,705
2014	ND	1,520,340[e]	ND	440,192	ND	55,759–137,256
2015	ND	1,709,051	ND	470,677	ND	ND

Note: Bendix counts were converted to DIDSON estimates (equivalents) for Kenai (1979–2006) and Kasilof Rivers (1983–2007). Estimates after these dates are actual DIDSON generated estimates.

[a] Counting began 22 June, 1978–1987, and 1 July (1988–present).

[b] Includes counts or estimates prior to 15 June (1978–1988) and post enumeration estimates (1981–1986).

[c] The escapement range (2009–2012) based on DIDSON estimates and 1 of 7 possible fish wheel catch scenarios.

[d] Combined counts from weirs on Bear and Glacier Flat Creeks and surveys of remaining spawning streams.

[e] Reflects a postseason adjustment related to apportionments.

Table 2.–Daily salmon escapement estimates in the Kenai River, 1 July–26 August 2015.

	Sockeye		Pink		Coho		Chinook	
Date	Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum
1 Jul	4,880	4,880	0	0	0	0	0	0
2 Jul	5,850	10,730	0	0	0	0	0	0
3 Jul	7,658	18,387	0	0	0	0	0	0
4 Jul	7,398	25,785	0	0	0	0	0	0
5 Jul	8,592	34,377	0	0	0	0	0	0
6 Jul	11,294	45,671	0	0	0	0	0	0
7 Jul	13,287	58,959	0	0	0	0	0	0
8 Jul	12,840	71,799	0	0	0	0	0	0
9 Jul	22,770	94,569	0	0	0	0	0	0
10 Jul	15,587	110,156	0	0	0	0	0	0
11 Jul	12,135	122,291	0	0	0	0	0	0
12 Jul	12,373	134,664	0	0	0	0	0	0
13 Jul	20,172	154,836	0	0	0	0	0	0
14 Jul	24,744	179,580	0	0	0	0	0	0
15 Jul	15,148	194,728	0	0	0	0	0	0
16 Jul	18,114	212,842	0	0	0	0	0	0
17 Jul	17,529	230,371	0	0	0	0	0	0
18 Jul	20,009	250,380	0	0	0	0	0	0
19 Jul	49,158	299,538	0	0	0	0	0	0
20 Jul	53,600	353,137	0	0	0	0	0	0
21 Jul	32,547	385,684	0	0	0	0	0	0
22 Jul	27,262	412,946	0	0	0	0	0	0
23 Jul	75,150	488,096	0	0	0	0	0	0
24 Jul	57,280	545,376	0	0	0	0	0	0
25 Jul	72,100	617,476	0	0	0	0	0	0
26 Jul	66,442	683,918	0	0	0	0	0	0
27 Jul	49,749	733,667	0	0	0	0	0	0
28 Jul	58,985	792,652	0	0	0	0	0	0
29 Jul	41,620	834,273	0	0	0	0	0	0
30 Jul	34,791	869,063	0	0	0	0	0	0
31 Jul	21,565	890,628	0	0	0	0	0	0
1 Aug	42,730	933,358	0	0	0	0	0	0
2 Aug	35,975	969,333	0	0	0	0	0	0
3 Aug	24,064	993,397	0	0	0	0	0	0
4 Aug	21,743	1,015,140	0	0	0	0	0	0
5 Aug	48,318	1,063,458	0	0	0	0	0	0
6 Aug	43,038	1,106,496	0	0	0	0	0	0
7 Aug	43,429	1,149,925	0	0	0	0	0	0
8 Aug	46,631	1,196,556	0	0	0	0	0	0
9 Aug	28,866	1,225,422	0	0	0	0	0	0
10 Aug	23,899	1,249,321	0	0	0	0	0	0
11 Aug	36,822	1,286,143	0	0	0	0	0	0
12 Aug	32,700	1,318,843	0	0	0	0	0	0
13 Aug	30,411	1,349,254	0	0	0	0	0	0
14 Aug	35,817	1,385,071	0	0	0	0	0	0
15 Aug	34,401	1,419,472	0	0	0	0	0	0

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Table 2.–Page 2 of 2.

	Sockeye		Pink		Coho		Chinook	
Date	Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum
16 Aug	36,221	1,455,693	0	0	0	0	0	0
17 Aug	28,851	1,484,544	0	0	0	0	0	0
18 Aug	20,370	1,504,914	0	0	0	0	0	0
19 Aug	32,591	1,537,504	0	0	0	0	0	0
20 Aug	42,023	1,579,527	0	0	0	0	0	0
21 Aug	22,582	1,602,109	0	0	0	0	0	0
22 Aug	19,153	1,621,263	0	0	0	0	0	0
23 Aug	24,346	1,645,608	0	0	0	0	0	0
24 Aug	26,910	1,672,518	0	0	0	0	0	0
25 Aug	23,109	1,695,627	0	0	0	0	0	0
26 Aug	13,424	1,709,051	0	0	0	0	0	0

Sockeye salmon 95% CI 1,708,905–1,709,197

Note: There were no apportionments for pink, coho and Chinook salmon estimates in 2015.

Table 3.–Cumulative proportion by date of sockeye salmon escapement in the Kenai River, 2000–2015.

	Cumulative proportion															
Date	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
01 Jul	0.003	0.002	0.005	0.005	0.002	0.004	0.001	0.004	0.004	0.003	0.004	0.001	0.003	0.006	0.007	0.003
02 Jul	0.005	0.011	0.013	0.008	0.005	0.010	0.003	0.010	0.009	0.008	0.008	0.004	0.008	0.009	0.013	0.006
03 Jul	0.010	0.017	0.018	0.012	0.007	0.015	0.004	0.015	0.014	0.013	0.011	0.006	0.013	0.012	0.020	0.011
04 Jul	0.015	0.023	0.028	0.017	0.009	0.023	0.006	0.018	0.016	0.020	0.017	0.007	0.016	0.020	0.026	0.015
05 Jul	0.018	0.029	0.057	0.022	0.010	0.033	0.008	0.021	0.018	0.027	0.027	0.010	0.019	0.028	0.034	0.020
06 Jul	0.021	0.033	0.085	0.024	0.011	0.042	0.010	0.025	0.019	0.033	0.038	0.013	0.021	0.032	0.053	0.027
07 Jul	0.028	0.038	0.142	0.028	0.014	0.049	0.012	0.031	0.021	0.041	0.043	0.016	0.024	0.034	0.072	0.035
08 Jul	0.034	0.047	0.181	0.031	0.018	0.058	0.014	0.041	0.022	0.047	0.051	0.019	0.027	0.037	0.083	0.042
09 Jul	0.045	0.056	0.207	0.037	0.020	0.078	0.016	0.051	0.026	0.055	0.057	0.023	0.031	0.042	0.099	0.055
10 Jul	0.059	0.063	0.227	0.046	0.022	0.095	0.019	0.055	0.031	0.062	0.062	0.028	0.036	0.055	0.113	0.065
11 Jul	0.066	0.071	0.239	0.066	0.024	0.121	0.021	0.061	0.034	0.073	0.070	0.030	0.043	0.080	0.121	0.072
12 Jul	0.073	0.075	0.247	0.118	0.026	0.158	0.022	0.066	0.037	0.101	0.085	0.032	0.049	0.088	0.136	0.079
13 Jul	0.113	0.081	0.255	0.154	0.030	0.177	0.024	0.070	0.045	0.117	0.109	0.034	0.056	0.094	0.157	0.091
14 Jul	0.260	0.097	0.265	0.178	0.113	0.189	0.025	0.075	0.049	0.146	0.126	0.038	0.069	0.112	0.173	0.105
15 Jul	0.390	0.141	0.291	0.197	0.215	0.199	0.027	0.083	0.092	0.212	0.150	0.040	0.144	0.181	0.188	0.114
16 Jul	0.464	0.188	0.328	0.273	0.284	0.231	0.036	0.091	0.204	0.288	0.199	0.057	0.268	0.362	0.202	0.125
17 Jul	0.501	0.250	0.356	0.363	0.320	0.276	0.046	0.097	0.288	0.358	0.265	0.202	0.314	0.521	0.223	0.135
18 Jul	0.552	0.295	0.400	0.441	0.344	0.313	0.052	0.108	0.318	0.407	0.336	0.312	0.334	0.608	0.249	0.147
19 Jul	0.591	0.347	0.500	0.501	0.359	0.367	0.056	0.156	0.347	0.442	0.422	0.367	0.352	0.676	0.260	0.176
20 Jul	0.611	0.388	0.565	0.529	0.366	0.394	0.061	0.174	0.396	0.503	0.480	0.438	0.378	0.736	0.282	0.207
21 Jul	0.631	0.410	0.600	0.556	0.389	0.409	0.071	0.210	0.449	0.540	0.530	0.495	0.440	0.764	0.324	0.226
22 Jul	0.650	0.434	0.625	0.614	0.458	0.427	0.093	0.263	0.501	0.552	0.570	0.518	0.510	0.782	0.354	0.242
23 Jul	0.680	0.467	0.653	0.669	0.479	0.465	0.117	0.308	0.518	0.567	0.605	0.585	0.566	0.804	0.378	0.286
24 Jul	0.721	0.525	0.680	0.716	0.503	0.506	0.146	0.347	0.537	0.588	0.622	0.654	0.598	0.817	0.403	0.320
25 Jul	0.759	0.600	0.706	0.742	0.528	0.527	0.181	0.386	0.555	0.599	0.664	0.704	0.637	0.827	0.423	0.362
26 Jul	0.794	0.678	0.740	0.768	0.558	0.541	0.238	0.441	0.567	0.613	0.682	0.753	0.676	0.843	0.444	0.401
27 Jul	0.822	0.731	0.752	0.789	0.584	0.549	0.277	0.512	0.595	0.662	0.700	0.798	0.717	0.865	0.458	0.430
28 Jul	0.847	0.760	0.764	0.823	0.614	0.556	0.317	0.562	0.626	0.715	0.721	0.833	0.757	0.886	0.479	0.464
29 Jul	0.872	0.784	0.777	0.847	0.640	0.565	0.362	0.598	0.662	0.758	0.736	0.856	0.802	0.907	0.504	0.488
30 Jul	0.886	0.812	0.788	0.862	0.658	0.588	0.402	0.621	0.704	0.794	0.750	0.875	0.829	0.925	0.543	0.509
31 Jul	0.897	0.834	0.802	0.877	0.672	0.615	0.435	0.644	0.736	0.830	0.762	0.886	0.855	0.938	0.586	0.521
01 Aug	0.908	0.856	0.815	0.894	0.682	0.633	0.475	0.667	0.772	0.854	0.777	0.900	0.871	0.955	0.609	0.546
02 Aug	0.916	0.879	0.829	0.913	0.695	0.644	0.508	0.684	0.800	0.882	0.801	0.913	0.887	0.968	0.631	0.567

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Table 3.–Page 2 of 2.

Date	Cumulative proportion															
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
03 Aug	0.930	0.896	0.845	0.930	0.724	0.660	0.535	0.694	0.821	0.911	0.841	0.919	0.898	0.976	0.664	0.581
04 Aug	0.945	0.916	0.861	0.943	0.756	0.673	0.565	0.708	0.844	0.930	0.856	0.926	0.909	0.982	0.701	0.594
05 Aug	0.958	0.929	0.879	0.951	0.777	0.684	0.596	0.729	0.863	0.946	0.867	0.933	0.923	0.989	0.774	0.622
06 Aug	0.969	0.943	0.894	0.966	0.796	0.711	0.616	0.755	0.880	0.955	0.879	0.946	0.932	0.995	0.816	0.647
07 Aug	0.978	0.958	0.910	0.977	0.811	0.735	0.631	0.773	0.893	0.962	0.892	0.957	0.939	1.000	0.854	0.673
08 Aug	0.985	0.972	0.929	0.985	0.819	0.745	0.640	0.788	0.903	0.967	0.904	0.961	0.945	–	0.890	0.700
09 Aug	0.992	0.979	0.953	0.992	0.840	0.753	0.649	0.816	0.915	0.973	0.917	0.969	0.952	–	0.925	0.717
10 Aug	1.000	0.986	0.972	1.000	0.873	0.760	0.656	0.832	0.931	0.982	0.928	0.979	0.961	–	0.964	0.731
11 Aug	–	0.989	0.985	–	0.904	0.771	0.665	0.857	0.947	0.987	0.934	0.986	0.967	–	0.984	0.753
12 Aug	–	0.998	0.991	–	0.936	0.809	0.681	0.882	0.963	0.992	0.940	0.994	0.974	–	0.993	0.772
13 Aug	–	1.000	0.996	–	0.957	0.853	0.695	0.898	0.974	1.000	0.949	1.000	0.979	–	0.996	0.789
14 Aug	–	–	1.000	–	0.971	0.881	0.708	0.910	0.987	–	0.959	–	0.987	–	1.000	0.810
15 Aug	–	–	–	–	0.982	0.912	0.729	0.922	0.995	–	0.973	–	0.996	–	–	0.831
16 Aug	–	–	–	–	0.988	0.942	0.752	0.933	0.998	–	0.986	–	1.000	–	–	0.852
17 Aug	–	–	–	–	0.996	0.962	0.773	0.944	1.000	–	0.992	–	–	–	–	0.869
18 Aug	–	–	–	–	1.000	0.974	0.795	0.953	–	–	0.997	–	–	–	–	0.881
19 Aug	–	–	–	–	–	0.980	0.819	0.966	–	–	1.000	–	–	–	–	0.900
21 Aug	–	–	–	–	–	0.991	0.844	0.978	–	–	–	–	–	–	–	0.924
21 Aug	–	–	–	–	–	1.000	0.860	0.985	–	–	–	–	–	–	–	0.937
22 Aug	–	–	–	–	–	–	0.882	0.993	–	–	–	–	–	–	–	0.949
23 Aug	–	–	–	–	–	–	0.901	1.000	–	–	–	–	–	–	–	0.963
24 Aug	–	–	–	–	–	–	0.915	–	–	–	–	–	–	–	–	0.979
25 Aug	–	–	–	–	–	–	0.929	–	–	–	–	–	–	–	–	0.992
26 Aug	–	–	–	–	–	–	0.944	–	–	–	–	–	–	–	–	1.000
27 Aug	–	–	–	–	–	–	0.963	–	–	–	–	–	–	–	–	–
28 Aug	–	–	–	–	–	–	0.979	–	–	–	–	–	–	–	–	–
29 Aug	–	–	–	–	–	–	0.989	–	–	–	–	–	–	–	–	–
30 Aug	–	–	–	–	–	–	0.996	–	–	–	–	–	–	–	–	–
31 Aug	–	–	–	–	–	–	1.000	–	–	–	–	–	–	–	–	–
Run midpoint	17 Jul	24 Jul	19 Jul	19 Jul	24 Jul	24 Jul	2 Aug	27 Jul	22 Jul	20 Jul	21 Jul	22 Jul	22 Jul	17 Jul	29 Jul	30 Jul
Midpoint ave:	22 Jul															
Counting days	41	44	45	41	49	52	62	54	48	44	50	44	47	38	45	57
Ave days: 47																
Number of days in which 80% of escapement occurred																
Ave: 25	20	21	32	22	29	36	32	28	24	22	27	16	21	16	30	37

Table 4.–Distribution of sockeye salmon passage by bank (% of total count) in the Kenai and Kasilof and rivers, 1979–2015.

	Kenai River		Kasilof River	
Year	North	South	North	South
1979	72	28	53	47
1980	61	39	52	48
1981	72	28	69	31
1982	39	61	73	27
1983	42	58	51	49
1984	65	35	56	44
1985	54	46	70	30
1986	62	38	57	43
1987	48	52	55	45
1988	47	53	32	68
1989	57	43	39	61
1990	62	38	29	71
1991	73	27	39	61
1992	60	40	45	55
1993	49	51	28	72
1994	52	48	47	53
1995	52	48	38	62
1996	54	46	61	39
1997	56	44	41	59
1998	55	45	36	64
1999	55	45	51	49
2000	64	36	51	49
2001	50	50	63	37
2002	49	51	48	52
2003	49	51	50	50
2004	49	51	43	57
2005	45	55	59	41
2006	41	59	67	33
2007	50	50	75	25
2008	48	52	73	27
2009	47	53	74	26
2010	51	49	70	30
2011	52	48	71	29
2012	58	42	66	34
2013	53	47	64	36
2014	45	55	62	38
2015	51	49	65	35
Ave (1979–2014)	51	49	58	42

Table 5.–Nearshore (<10 m) and offshore (>10 m) distribution of fish from both banks of the Kenai and Kasilof based on stratified (weekly) DIDSON subsample counts, 2015.

North bank								
	Kenai River				Kasilof River			
Dates	1–10 m	%	10–30 m	%	1–10 m	%	10–30 m	%
15 Jun–20 Jun	ND	ND	ND	ND	4,252	89.6	495	10.4
21 Jun–27 Jun	ND	ND	ND	ND	5,232	90.2	571	9.8
28 Jun–4Jul	2,294	78.0	646	22.0	3,173	88.8	399	11.2
5 Jul–11 Jul	7,700	88.4	1,014	11.6	6,079	96.9	193	3.1
12 Jul–18 Jul	8,546	75.4	2,790	24.6	7,262	99.0	73	1.0
19 Jul–25 Jul	27,732	84.1	5,253	15.9	9,910	99.4	63	0.6
26 Jul–1 Aug	22,934	89.4	2,722	10.6	6,286	99.6	26	0.4
2 Aug–8 Aug	17,151	85.2	2,991	14.8	4,449	99.8	10	0.2
9 Aug–14 Aug	17,281	90.4	1,843	9.6	2,739	99.9	2	0.1
16 Aug–22 Aug	15,752	88.7	2,009	11.3	ND	ND	ND	ND
23 Aug–26 Aug	6,346	81.9	1,406	18.1	ND	ND	ND	ND
Total	125,736	85.9	20,674	14.1	49,382	96.4	1,832	3.6
SD		9.1		9.1		6.5		6.5
Min		61.9		3.3		73.2		0.0
Max		96.7		38.1		100.0		26.8
South bank	1–10 m	%	10–20 m	%	1–10 m	%	10–30 m	%
15 Jun–20 Jun	ND	ND	ND	ND	3,945	83.9	756	16.1
21 Jun–27 Jun	ND	ND	ND	ND	4,021	76.2	1,257	23.8
28 Jun–4Jul	1,231	90.9	123	9.1	3,679	87.2	538	12.8
5 Jul–11 Jul	7,037	96.0	297	4.0	3,217	92.6	256	7.4
12 Jul–18 Jul	9,599	96.1	390	3.9	2,804	97.5	73	2.5
19 Jul–25 Jul	27,426	98.3	462	1.7	2,787	99.0	27	1.0
26 Jul–1 Aug	26,196	98.7	355	1.3	1,458	98.7	19	1.3
2 Aug–8 Aug	23,027	98.1	441	1.9	1,149	98.7	15	1.3
9 Aug–14 Aug	17,485	97.5	440	2.5	1,153	99.5	6	0.5
16 Aug–22 Aug	15,145	96.2	603	3.8	ND	ND	ND	ND
23 Aug–26 Aug	6,605	97.0	203	3.0	ND	ND	ND	ND
Total	133,751	97.6	3,314	2.4	24,213	89.1	2,947	10.9
SD		2.3		2.3		9.2		9.2
Min		87.5		0.6		60.1		0.0
Max		99.4		12.5		100.0		39.9

Note: Standard deviation, minimum and maximum percentages were derived from daily counts.

Table 6.–Daily fish wheel catch by salmon species for the Kenai River, 1 July–26 August 2015.

	Hours	Sockeye		Pink		Chum		Coho		Chinook	
Date	run	Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum
1 Jul	7.0	1	1	0	0	0	0	0	0	0	0
2 Jul	20.0	16	17	0	0	0	0	0	0	0	0
3 Jul	23.0	27	44	0	0	0	0	0	0	0	0
4 Jul	22.5	2	46	0	0	0	0	0	0	0	0
5 Jul	20.7	9	55	0	0	0	0	0	0	0	0
6 Jul	20.3	14	69	0	0	0	0	0	0	0	0
7 Jul	11.6	45	114	0	0	0	0	0	0	0	0
8 Jul	7.0	48	162	0	0	0	0	0	0	0	0
9 Jul	12.3	47	209	0	0	0	0	0	0	0	0
10 Jul	14.5	13	222	1	1	0	0	0	0	0	0
11 Jul	19.3	23	245	0	1	0	0	0	0	0	0
12 Jul	21.3	25	270	0	1	0	0	0	0	0	0
13 Jul	15.4	23	293	1	2	0	0	0	0	0	0
14 Jul	17.8	21	314	0	2	0	0	0	0	1	1
15 Jul	18.8	11	325	0	2	0	0	0	0	0	1
16 Jul	20.8	13	338	0	2	0	0	0	0	0	1
17 Jul	24.1	11	349	0	2	0	0	0	0	0	1
18 Jul	18.8	18	367	1	3	0	0	0	0	0	1
19 Jul	17.6	19	386	0	3	0	0	0	0	0	1
20 Jul	7.2	52	438	2	5	0	0	0	0	1	2
21 Jul	4.7	65	503	1	6	0	0	0	0	0	2
22 Jul	6.3	23	526	1	7	0	0	0	0	2	4
23 Jul	22.4	62	588	1	8	0	0	0	0	0	4
24 Jul	5.5	133	721	0	8	0	0	0	0	0	4
25 Jul	5.5	70	791	3	11	0	0	0	0	0	4
26 Jul	2.3	208	999	0	11	0	0	0	0	0	4
27 Jul	3.8	74	1,073	2	13	0	0	0	0	0	4
28 Jul	9.3	93	1,166	1	14	0	0	0	0	0	4
29 Jul	8.2	118	1,284	0	14	0	0	0	0	0	4
30 Jul	6.0	67	1,351	2	16	0	0	0	0	0	4
31 Jul	9.5	26	1,377	1	17	0	0	0	0	0	4
1 Aug	10.5	84	1,461	1	18	0	0	0	0	0	4
2 Aug	11.3	216	1,677	2	20	0	0	0	0	0	4
3 Aug	13.0	41	1,718	6	26	0	0	0	0	0	4
4 Aug	14.5	60	1,778	3	29	0	0	0	0	1	5
5 Aug	11.2	64	1,842	1	30	0	0	0	0	1	6
6 Aug	7.5	171	2,013	0	30	0	0	0	0	0	6
7 Aug	6.0	169	2,182	0	30	0	0	0	0	1	7
8 Aug	5.5	79	2,261	0	30	0	0	1	1	0	7
9 Aug	5.0	206	2,467	1	31	0	0	1	2	1	8
10 Aug	4.8	148	2,615	0	31	0	0	0	2	0	8
11 Aug	3.8	59	2,674	0	31	0	0	0	2	1	9
12 Aug	6.6	70	2,744	0	31	0	0	0	2	0	9
13 Aug	4.3	37	2,781	1	32	0	0	1	3	0	9
14 Aug	7.3	98	2,879	1	33	0	0	0	3	0	9

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Table 6.–Page 2 of 2.

Date	Hours open	Sockeye Daily	Sockeye Cum	Pink Daily	Pink Cum	Chum Daily	Chum Cum	Coho Daily	Coho Cum	Chinook Daily	Chinook Cum
15 Aug	4.7	132	3,011	0	33	0	0	0	3	0	9
16 Aug	7.6	295	3,306	5	38	0	0	5	8	0	9
17 Aug	5.8	253	3,559	3	41	0	0	3	11	0	9
18 Aug	3.0	59	3,618	0	41	0	0	0	11	0	9
19 Aug	1.0	176	3,794	0	41	0	0	0	11	0	9
20 Aug	2.7	263	4,057	0	41	0	0	7	18	0	9
21 Aug	5.5	151	4,208	0	41	0	0	3	21	0	9
22 Aug	4.0	79	4,287	0	41	0	0	0	21	0	9
23 Aug	3.0	115	4,402	1	42	0	0	4	25	0	9
24 Aug	3.3	146	4,548	0	42	0	0	1	26	0	9
25 Aug	3.7	167	4,715	1	43	0	0	8	34	0	9
26 Aug	5.7	49	4,764	0	43	0	0	2	36	0	9
Total	584.6		98.2%		0.9%		0.0%		0.7%		0.2%
Total salmon: 4,852											
CPUE: 8.3 fish/h											

Note: Other fish include 13 rainbow trout and 38 Dolly Varden. CPUE is catch per unit effort.

Table 7.–Summary of fish wheel catch and CPUE for the north bank fish wheel at RM 19 on the Kenai River, 1978–2015.

		Actual north bank fish wheel catch (salmon only)													
	Total									Total	CPUE by species				Total
Year	hours	Sockeye	%	Pink	%	Coho	%	Chinook	%	catch	Sockeye	Pink	Coho	Chinook	CPUE
1978	853.9	1,445	87.3	207	12.5	4	0.2	0	0.0	1,656	1.7	0.2	0.0	0.0	1.9
1979	301.0	151	84.8	10	5.6	13	7.3	4	2.2	178	0.5	0.0	0.0	0.0	0.6
1980	967.3	464	29.4	1,103	69.8	12	0.8	1	0.1	1,580	0.5	1.1	0.0	0.0	1.6
1981	1,210.8	496	95.0	21	4.0	3	0.6	2	0.4	522	0.4	0.0	0.0	0.0	0.4
1982	433.5	1,200	99.5	2	0.2	2	0.2	2	0.2	1,206	2.8	0.0	0.0	0.0	2.8
1983	448.0	1,678	99.8	0	0.0	3	0.2	0	0.0	1,681	3.7	0.0	0.0	0.0	3.8
1984	962.4	5,854	98.3	64	1.1	36	0.6	3	0.1	5,957	6.1	0.1	0.0	0.0	6.2
1985	394.8	3,294	98.2	37	1.1	17	0.5	7	0.2	3,355	8.3	0.1	0.0	0.0	8.5
1986	408.5	797	97.8	6	0.7	9	1.1	3	0.4	815	2.0	0.0	0.0	0.0	2.0
1987	493.1	4,795	98.1	18	0.4	59	1.2	17	0.3	4,889	9.7	0.0	0.1	0.0	9.9
1988	528.4	4,393	97.5	73	1.6	18	0.4	21	0.5	4,505	8.3	0.1	0.0	0.0	8.5
1989	357.0	6,341	98.2	69	1.1	28	0.4	16	0.2	6,454	17.8	0.2	0.1	0.0	18.1
1990	363.6	4,270	97.8	46	1.1	24	0.5	26	0.6	4,366	11.7	0.1	0.1	0.1	12.0
1991	393.0	6,732	98.6	49	0.7	25	0.4	19	0.3	6,825	17.1	0.1	0.1	0.0	17.4
1992	392.5	5,526	94.0	224	3.8	96	1.6	33	0.6	5,879	14.1	0.6	0.2	0.1	15.0
1993	515.2	4,631	99.2	16	0.3	10	0.2	10	0.2	4,667	9.0	0.0	0.0	0.0	9.1
1994	673.9	5,600	93.6	290	4.8	65	1.1	29	0.5	5,984	8.3	0.4	0.1	0.0	8.9
1995	799.4	3,022	98.5	14	0.5	10	0.3	22	0.7	3,068	3.8	0.0	0.0	0.0	3.8
1996	376.5	3,835	91.2	264	6.3	82	2.0	22	0.5	4,203	10.2	0.7	0.2	0.1	11.2
1997	553.8	8,886	96.6	21	0.2	266	2.9	30	0.3	9,203	16.0	0.0	0.5	0.1	16.6
1998	350.5	7,755	96.2	173	2.1	99	1.2	34	0.4	8,061	22.1	0.5	0.3	0.1	23.0
1999	400.8	4,600	95.9	108	2.3	56	1.2	33	0.7	4,797	11.5	0.3	0.1	0.1	12.0
2000	499.0	3,020	88.5	205	6.0	146	4.3	40	1.2	3,411	6.1	0.4	0.3	0.1	6.8
2001	446.7	3,309	96.8	36	1.1	30	0.9	45	1.3	3,420	7.4	0.1	0.1	0.1	7.7
2002	610.5	4,073	88.4	461	10.0	54	1.2	18	0.4	4,606	6.7	0.8	0.1	0.0	7.5
2003	317.1	2,749	98.0	20	0.7	12	0.4	25	0.9	2,806	8.7	0.1	0.0	0.1	8.8
2004	461.7	3,299	75.0	843	19.2	225	5.1	31	0.7	4,398	7.1	1.8	0.5	0.1	9.5
2005	184.9	3,140	97.8	27	0.8	28	0.9	16	0.5	3,211	17.0	0.1	0.2	0.1	17.4
2006	635.0	12,285	86.0	1,413	9.9	485	3.4	101	0.7	14,284	19.3	2.2	0.8	0.2	22.5
2007	933.5	6,243	98.1	16	0.3	76	1.2	27	0.4	6,362	6.7	0.0	0.1	0.0	6.8
2008	862.4	5,250	89.9	489	8.4	80	1.4	18	0.3	5,837	6.1	0.6	0.1	0.0	6.8
2009	427.2	1,435	93.9	76	5.0	10	0.7	7	0.5	1,528	3.4	0.2	0.0	0.0	3.6

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Table 7.–Page 2 of 2.

Year	Total hours	Sockeye	%	Pink	%	Coho	%	Chinook	%	Total catch	CPUE by species: Sockeye	Pink	Coho	Chinook	Total CPUE
2010	741.1	2,002	90.2	131	5.9	57	2.6	29	1.3	2,219	2.7	0.2	0.1	0.0	3.0
2011	601.2	1,999	99.0	11	0.5	2	0.1	7	0.3	2,019	3.3	0.0	0.0	0.0	3.4
2012	704.6	1,797	94.1	82	4.3	10	0.5	21	1.1	1,910	2.6	0.1	0.0	0.0	2.7
2013	529.3	1,732	95.8	36	2.0	24	1.3	16	0.9	1,808	3.3	0.1	0.0	0.0	3.4
2014	607.9	2,777	62.5	1,593	35.8	56	1.3	20	0.4	4,446	4.6	2.6	0.1	0.0	7.3
2015	584.6	4,764	98.2	43	0.9	36	0.7	9	0.2	4,852	8.1	0.1	0.1	0.0	8.3
	Ave	Average catch									Average CPUE by species				
Year	hours	Sockeye	%	Pink	%	Coho	%	Chinook	%	Total	Sockeye	Pink	Coho	Chinook	Total
Odd	517.0	3,624	97.7	33	0.9	37	1.0	17	0.5	3,711	7.0	0.1	0.1	0.0	7.2
Even	601.7	3,981	88.7	404	9.0	82	1.8	24	0.5	4,491	6.6	0.7	0.1	0.0	7.5
Ave (%): (1978–2014)			92.6		5.4		1.5		0.5		6.8	0.4	0.1	0.0	7.3
Min (%): (1978–2014)			29.4		0.0		0.1		0.0		0.4	0.0	0.0	0.0	0.4
Max (%): (1978–2014)			99.8		69.8		7.3		2.2		22.1	2.6	0.8	0.2	23.0
SD (%): (1978–2014)			12.9		12.7		1.5		0.4		5.7	0.6	0.2	0.0	6.0

Note: CPUE is catch per unit effort.

Table 8.–Age composition of sockeye salmon sampled from the Kenai River fish wheel, 1970–2015.

Year	Percentage composition by age class								Sample
	1.1	1.2	1.3	1.4	2.1	2.2	2.3	Other	size
1970	0.0	10.0	17.0	0.0	26.0	25.0	15.0	6.0	225
1971	0.0	8.0	39.0	1.0	3.0	38.0	11.0	0.0	168
1972	0.0	21.0	34.0	0.0	0.0	23.0	20.0	0.0	403
1973	0.0	5.0	68.0	1.0	1.0	8.0	16.0	0.0	632
1974	2.0	18.0	46.0	0.0	3.0	18.0	12.0	0.0	295
1975	2.0	10.0	36.0	2.0	4.0	31.0	14.0	1.0	162
1976	1.0	46.0	20.0	0.0	2.0	22.0	8.0	1.0	948
1977	0.0	6.0	76.0	1.0	0.0	7.0	10.0	0.0	1,265
1978	0.0	2.5	86.7	0.0	0.0	4.9	5.4	0.0	811
1979	0.2	19.6	63.0	0.0	0.0	10.6	6.6	0.0	601
1980	6.1	35.4	36.7	0.0	0.9	14.4	6.5	0.0	557
1981	0.0	19.7	66.4	0.0	0.5	7.9	5.3	0.2	624
1982	0.1	5.8	87.5	0.0	0.0	2.9	3.7	0.0	1,787
1983	0.3	8.4	79.0	0.3	0.5	2.2	8.9	0.4	1,765
1984	0.0	23.1	37.8	3.6	0.5	13.2	19.5	2.3	2,067
1985	0.1	15.9	56.4	0.3	0.1	14.7	11.4	1.1	2,201
1986	0.0	31.8	39.5	0.7	0.3	8.2	18.0	1.5	789
1987	0.0	12.8	78.4	0.1	0.0	3.2	5.2	0.3	745
1988	0.3	11.6	74.2	0.4	0.2	3.1	10.2	0.0	1,420
1989	0.2	5.6	26.7	0.9	0.8	7.6	57.4	0.8	1,587
1990	0.6	21.6	41.4	0.6	0.3	13.7	21.1	0.7	1,513
1991	0.1	48.2	31.6	0.2	0.4	5.7	11.4	2.4	2,502
1992	0.0	2.7	79.9	0.2	0.3	5.9	11.0	0.0	1,338
1993	0.3	12.2	30.5	2.6	6.3	6.4	41.2	0.5	2,088
1994	0.3	6.6	61.1	0.8	0.8	17.8	12.1	0.5	1,341
1995	0.3	31.9	26.4	0.4	2.4	6.6	31.3	0.7	712
1996	0.0	10.8	75.4	0.3	0.7	6.1	5.4	1.3	684
1997	0.1	7.6	75.2	0.4	0.4	2.8	13.0	0.5	963
1998	0.3	27.1	40.7	1.3	6.6	9.6	13.9	0.5	700
1999	0.0	15.1	55.4	0.4	1.2	16.8	9.6	1.5	733
2000	0.0	15.3	55.1	1.0	2.6	9.4	14.5	2.1	560
2001	0.3	10.8	68.9	0.8	1.5	8.3	9.2	0.2	601
2002	0.0	23.0	58.4	0.7	0.7	10.6	6.1	0.5	2,441
2003	0.0	14.4	57.9	0.4	0.1	8.0	18.7	0.5	1,555
2004	0.0	10.1	69.1	0.2	0.2	8.2	11.1	1.1	1,275
2005	0.0	2.8	81.3	0.3	0.2	2.8	11.8	0.8	1,893
2006	0.0	9.9	38.7	2.4	0.4	3.7	44.0	0.9	1,315
2007	0.0	5.9	78.8	1.5	0.7	4.4	7.8	0.9	759
2008	0.0	15.2	60.9	4.6	0.7	7.2	10.9	0.5	567
2009	0.3	6.1	72.6	0.9	0.1	9.8	9.7	0.4	701
2010	0.2	23.4	44.4	0.2	2.8	4.7	23.9	0.4	855
2011	0.1	8.0	38.9	0.4	1.1	5.4	45.6	0.4	791
2012	0.5	12.4	45.1	1.7	0.2	15.5	24.6	0.0	419
2013	0.2	12.1	54.8	0.6	0.4	7.2	24.2	0.6	513
2014	0.4	12.3	63.5	0.0	0.8	7.2	15.3	0.6	498
2015	0.0	18.6	47.5	0.3	0.5	6.7	26.2	0.2	1409
Ave (1970–14)	0.4	15.1	55.0	0.8	1.7	10.4	15.8	0.7	1,039

Note: Ages in European notation.

Table 9.–Average lengths of the major age classes of sockeye salmon sampled from the Kenai River fish wheel, 1983–2015.

		Male		Female		Both		Ratio		Male		Female		Both		Ratio
Year	Age class	Length (mm)	*n*	Length (mm)	*n*	Length (mm)	*n*	Male: Female	Age class	Length (mm)	*n*	Length (mm)	*n*	Length (mm)	*n*	Male: Female
1983	1.2	524	25	520	30	522	55	0.8:1	1.3	598	215	577	269	586	484	0.8:1
1984		474	280	473	196	474	476	1.4:1		582	385	559	395	571	780	1.0:1
1985		492	184	490	186	491	370	1.0:1		575	496	552	824	560	1,320	0.6:1
1986		488	155	492	96	489	251	1.6:1		584	112	564	200	571	312	0.6:1
1987		513	39	502	56	507	95	0.7:1		604	183	586	401	591	584	0.5:1
1988		521	79	511	84	516	163	0.9:1		598	428	572	624	583	1,052	0.7:1
1989		464	51	463	40	463	91	1.3:1		592	213	565	218	578	431	1.0:1
1990		474	168	478	127	476	295	1.3:1		586	358	559	318	574	676	1.1:1
1991		488	613	497	577	492	1,190	1.1:1		561	357	539	441	549	798	0.8:1
1992		480	13	462	25	468	38	0.5:1		573	370	549	714	557	1,084	0.5:1
1993		474	123	481	132	477	255	0.9:1		583	247	556	390	566	637	0.6:1
1994		452	46	462	42	457	88	1.1:1		579	367	552	452	564	819	0.8:1
1995		492	116	487	111	489	227	1.0:1		584	81	564	107	572	188	0.8:1
1996		507	47	519	27	511	74	1.7:1		607	243	589	273	597	516	0.9:1
1997		480	34	489	39	485	73	0.9:1		593	372	571	352	582	724	1.1:1
1998		483	95	494	95	488	190	1.0:1		577	146	547	139	562	285	1.1:1
1999		490	72	488	39	490	111	1.8:1		600	202	576	204	588	406	1.0:1
2000		513	47	513	43	513	90	1.1:1		605	159	584	165	594	324	1.0:1
2001		522	35	507	30	515	65	1.2:1		596	196	577	218	586	414	0.9:1
2002		503	306	502	256	503	562	1.2:1		606	665	580	760	592	1,425	0.9:1
2003		483	116	466	117	474	233	1.0:1		593	387	574	504	582	891	0.8:1
2004		497	64	482	65	489	129	1.0:1		585	396	569	485	576	881	0.8:1
2005		483	27	495	30	490	57	0.9:1		588	649	564	883	574	1,532	0.7:1
2006		498	72	497	58	497	130	1.2:1		572	239	553	270	562	509	0.9:1
2007		512	21	499	24	505	45	0.9:1		594	313	567	285	581	598	1.1:1
2008		472	45	465	41	468	86	1.1:1		595	160	576	185	585	345	0.9:1
2009		482	24	492	19	486	43	1.3:1		594	206	578	303	584	509	0.7:1
2010		474	121	493	79	481	200	1.5:1		578	163	568	217	573	380	0.8:1
2011		462	35	479	28	470	63	1.3:1		591	124	568	184	577	308	0.7:1
2012		461	36	474	16	465	52	2.3:1		592	81	569	108	579	189	0.7:1
2013		467	38	472	24	469	62	1.6:1		576	114	559	167	566	281	0.7:1
2014		454	45	464	16	457	61	2.8:1		576	140	552	176	563	316	0.8:1
2015		451	174	459	105	454	279	1.7:1		558	219	537	434	544	653	0.5:1
Ave (1983–2014)		487	99	490	86	488	185	1.2:1		588	274	565	351	575	625	0.8:1

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Table 9.–Page 2 of 2.

Year	Age class	Male Length (mm)	Male *n*	Female Length (mm)	Female *n*	Both Length (mm)	Both *n*	Ratio Male: Female	Age class	Male Length (mm)	Male *n*	Female Length (mm)	Female *n*	Both Length (mm)	Both *n*	Ratio Male: Female
1983	2.2	524	25	520	30	522	55	0.8:1	2.3	595	26	582	35	587	61	0.7:1
1984		505	116	508	159	507	275	0.7:1		570	210	557	192	564	402	1.1:1
1985		513	132	513	196	513	328	0.7:1		570	106	555	129	562	235	0.8:1
1986		ND	ND	ND	ND	ND	ND	ND		585	52	568	89	575	141	0.6:1
1987		510	11	517	13	514	24	0.8:1		608	15	583	24	593	39	0.6:1
1988		527	20	527	24	527	44	0.8:1		596	53	577	92	584	145	0.6:1
1989		499	47	505	73	503	120	0.6:1		605	402	579	501	591	903	0.8:1
1990		494	88	496	113	495	201	0.8:1		589	177	568	132	580	309	1.3:1
1991		497	68	486	89	491	157	0.8:1		572	153	543	139	558	292	1.1:1
1992		485	31	485	44	485	75	0.7:1		570	46	547	88	555	134	0.5:1
1993		514	58	519	76	517	134	0.8:1		583	357	560	503	570	860	0.7:1
1994		481	67	488	171	486	238	0.4:1		578	73	551	89	563	162	0.8:1
1995		504	23	521	24	513	47	1.0:1		588	114	569	109	578	223	1.0:1
1996		511	18	520	24	516	42	0.8:1		606	18	598	19	602	37	0.9:1
1997		489	12	504	15	498	27	0.8:1		600	52	567	73	581	125	0.7:1
1998		501	28	507	39	504	67	0.7:1		574	48	559	49	566	97	1.0:1
1999		517	38	512	85	513	123	0.4:1		592	37	574	33	583	70	1.1:1
2000		519	35	518	20	519	55	1.8:1		603	44	583	41	593	85	1.1:1
2001		519	14	538	36	533	50	0.4:1		600	26	579	29	588	55	0.9:1
2002		515	117	513	142	514	259	0.8:1		604	75	579	74	591	149	1.0:1
2003		514	45	515	73	515	118	0.6:1		594	135	574	163	583	298	0.8:1
2004		513	34	512	71	512	105	0.5:1		596	71	566	71	581	142	1.0:1
2005		499	20	508	39	505	59	0.5:1		582	110	561	111	572	221	1.0:1
2006		521	17	523	31	522	48	0.5:1		577	250	557	329	566	579	0.8:1
2007		517	11	520	22	519	33	0.5:1		587	26	568	33	576	59	0.8:1
2008		489	14	504	27	499	41	0.5:1		589	37	572	25	582	62	1.5:1
2009		506	26	534	43	524	69	0.6:1		591	29	578	39	583	68	0.7:1
2010		488	27	498	13	491	40	2.1:1		591	75	568	129	576	204	0.6:1
2011		479	24	518	19	496	43	1.3:1		596	161	572	200	583	361	0.8:1
2012		496	29	518	36	508	65	0.8:1		594	47	568	56	580	103	0.8:1
2013		488	20	510	17	498	37	1.2:1		591	43	563	81	573	124	0.5:1
2014		485	19	497	17	491	36	1.1:1		578	31	555	45	565	76	0.7:1
2015		471	53	487	46	479	99	1.2:1		554	123	537	241	543	364	0.5:1
Ave (1983–2014)		504	40	508	57	507	97	0.7:1		588	97	566	116	576	213	0.8:1
2015 (all ages)		515	577	524	832	520	1409	0.7:1								

Table 10.–Number of 10 minute subsamples by count range for Kenai and Kasilof rivers, 2015.

Kenai River

	North bank				South bank			
Count range	Nearshore	%	Offshore	%	Nearshore	%	Offshore	%
<100	894	65.4	1,344	98.3	899	65.7	1,367	100.0
100–199	340	24.9	23	1.7	305	22.3	0	0.0
200–299	93	6.8	0	0.0	91	6.7	0	0.0
300–399	29	2.1	0	0.0	48	3.5	0	0.0
400–499	7	0.5	0	0.0	16	1.2	0	0.0
500–599	4	0.3	0	0.0	7	0.5	0	0.0
600–699	1	0.1	0	0.0	1	0.1	0	0.0
700–899	0	0.0	0	0.0	1	0.1	0	0.0
Total subsamples	1,368	100.0	1,367	100	1,368	100.0	1,367	100.0
Ave count/subsample	92		15		98		3	

Kasilof River

	North bank				South bank			
Count range	Nearshore	%	Offshore	%	Nearshore	%	Offshore	%
<100	1,374	94.8	1,445	100	1,444	98.9	1,461	100
100–199	63	4.3	0	0.0	16	1.1	0	0.0
200–299	12	0.8	0	0.0	0	0.0	0	0.0
300–399	0	0.0	0	0.0	0	0.0	0	0.0
Total	1,449	100.0	1,445		1,460	100.0	1,461	100
Ave count/subsample	34		1		17		2	

Table 11.–Mean annual water level gain, turbidity (secchi depth), air and water temperature measured at the Kasilof and Kenai river sonar sites, 1979–2015.

	Kasilof River				Kenai River			
Year	Water level gain (m)	Secchi disk (cm)	Air ºC	Water ºC	Water level gain (m)	Secchi disk (cm)	Air ºC	Water ºC
1979	ND	ND	ND	ND	ND	ND	ND	ND
1980	ND	ND	ND	ND	ND	ND	ND	ND
1981	ND	ND	ND	ND	ND	ND	ND	ND
1982	1.0	ND	12.0	10.2	0.5	ND	14.2	9.3
1983	ND	ND	ND	ND	0.4	ND	ND	12.6
1984	0.6	ND	ND	14.4	0.5	ND	ND	12.5
1985	0.8	ND	ND	13.0	ND	ND	ND	ND
1986	1.3	ND	ND	11.0	ND	ND	ND	ND
1987	ND	ND	ND	ND	0.4	ND	14.7	9.3
1988	ND	ND	ND	ND	0.3	ND	15.8	11.8
1989	1.3	ND	16.6	13.3	0.8	73.9	15.1	6.8
1990	0.8	ND	17.2	15.0	0.5	77.7	15.0	12.6
1991	0.6	ND	15.7	13.3	0.2	89.9	13.4	12.8
1992	0.8	ND	18.0	13.0	0.5	88.9	15.0	12.0
1993	0.9	ND	19.0	16.2	0.7	99.8	16.6	13.0
1994	1.5	ND	17.1	13.2	0.4	87.6	14.3	11.4
1995	0.9	ND	16.0	12.5	0.4	101.6	14.1	11.1
1996	1.0	ND	16.0	13.0	0.8	52.3	13.6	12.1
1997	1.2	ND	19.0	16.0	0.3	66.5	14.0	14.0
1998	0.9	ND	13.6	16.5	0.5	69.1	13.4	12.0
1999	1.0	ND	13.4	14.6	0.4	74.2	13.9	12.5
2000	1.0	ND	11.3	14.6	0.4	77.7	13.3	11.6
2001	0.7	ND	18.6	15.5	0.4	80.0	13.8	12.4
2002	1.1	ND	17.8	9.1	0.3	99.3	15.0	12.6
2003	1.1	ND	17.1	10.4	0.5	58.4	15.1	12.3
2004	1.1	ND	19.9	13.5	0.5	83.3	16.1	14.3
2005	0.9	ND	19.6	14.8	0.2	109.2	14.1	14.2
2006	0.9	ND	16.7	12.5	0.4	107.7	13.0	11.7
2007	1.0	50.4	17.9	14.9	0.4	85.3	13.6	12.5
2008	0.9	ND	16.0	11.3	0.4	92.7	12.5	10.6
2009	1.2	ND	17.0	12.3	1.1	74.1	13.8	12.5
2010	0.9	ND	15.8	12.2	0.4	99.1	13.2	10.2
2011	1.1	ND	17.5	12.8	0.6	86.7	13.8	12.3
2012	0.9	74.3	16.4	11.4	0.3	108.7	13.0	10.4
2013	1.2	51.4	18.7	12.4	0.3	82.6	14.8	11.7
2014	1.1	ND	15.9	12.4	0.8	81.6	14.9	12.2
2015	0.8	ND	17.7	13.4	0.5	96.5	14.2	12.3
Summary 1979– 2014								
Ave	1.0	ND	16.7	13.2	0.5	84.9	14.2	11.8
Min	0.6	ND	11.3	9.1	0.2	52.3	12.5	6.8
Max	1.5	ND	19.9	16.5	1.1	109.2	16.6	14.3

Note: Water level gain is the overall water level rise during the sonar season.

Table 12.–Daily (DIDSON) estimates of the sockeye salmon escapement into the Kasilof River, 2015.

	Sockeye salmon				
Date	Daily	Cum	Date	Daily	Cum
15 Jun	9,078	9,078	16 Jul	10,800	279,626
16 Jun	6,930	16,008	17 Jul	4,926	284,552
17 Jun	6,906	22,914	18 Jul	7,002	291,554
18 Jun	7,080	29,994	19 Jul	12,726	304,280
19 Jun	11,325	41,319	20 Jul	10,896	315,176
20 Jun	15,366	56,685	21 Jul	12,246	327,422
21 Jun	15,954	72,639	22 Jul	7,836	335,258
22 Jun	12,665	85,304	23 Jul	12,163	347,420
23 Jun	6,792	92,096	24 Jul	8,322	355,742
24 Jun	17,016	109,112	25 Jul	11,118	366,860
25 Jun	3,342	112,454	26 Jul	10,463	377,323
26 Jun	5,040	117,494	27 Jul	11,489	388,811
27 Jun	5,788	123,281	28 Jul	6,605	395,417
28 Jun	4,266	127,547	29 Jul	5,796	401,213
29 Jun	11,808	139,355	30 Jul	4,554	405,767
30 Jun	4,068	143,423	31 Jul	4,602	410,369
1 Jul	5,220	148,643	1 Aug	3,168	413,537
2 Jul	8,664	157,307	2 Aug	2,730	416,267
3 Jul	4,122	161,429	3 Aug	4,680	420,947
4 Jul	8,586	170,015	4 Aug	4,734	425,681
5 Jul	5,214	175,229	5 Aug	7,578	433,259
6 Jul	16,182	191,411	6 Aug	5,940	439,199
7 Jul	8,778	200,189	7 Aug	4,020	443,219
8 Jul	5,148	205,337	8 Aug	4,056	447,275
9 Jul	8,730	214,067	9 Aug	3,764	451,039
10 Jul	7,932	221,999	10 Aug	3,450	454,489
11 Jul	6,486	228,485	11 Aug	6,132	460,621
12 Jul	6,261	234,746	12 Aug	3,888	464,509
13 Jul	9,330	244,076	13 Aug	2,862	467,371
14 Jul	11,940	256,016	14 Aug	3,306	470,677
15 Jul	12,810	268,826			
Sockeye salmon 95% CI				469,545–471,808	

Table 13.–Cumulative proportion by date of sockeye salmon escapement into the Kasilof River, 2001–2015.

	Cumulative proportion														
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
15 Jun	0.006	0.027	0.004	0.007	0.022	0.009	0.012	0.001	0.008	0.009	0.022	0.007	0.014	0.017	0.019
16 Jun	0.020	0.039	0.007	0.010	0.043	0.013	0.025	0.002	0.015	0.014	0.035	0.009	0.023	0.032	0.034
17 Jun	0.043	0.051	0.009	0.013	0.073	0.018	0.033	0.004	0.018	0.016	0.043	0.011	0.027	0.048	0.049
18 Jun	0.064	0.067	0.011	0.017	0.115	0.023	0.039	0.005	0.022	0.018	0.054	0.015	0.031	0.078	0.064
19 Jun	0.085	0.095	0.017	0.022	0.164	0.030	0.045	0.008	0.028	0.021	0.078	0.020	0.043	0.119	0.088
20 Jun	0.097	0.119	0.032	0.034	0.211	0.039	0.051	0.018	0.049	0.023	0.099	0.027	0.053	0.156	0.120
21 Jun	0.110	0.138	0.053	0.053	0.238	0.054	0.057	0.031	0.060	0.031	0.121	0.036	0.080	0.178	0.154
22 Jun	0.124	0.157	0.065	0.092	0.246	0.065	0.067	0.049	0.065	0.048	0.144	0.043	0.110	0.195	0.181
23 Jun	0.146	0.174	0.092	0.138	0.251	0.076	0.079	0.074	0.073	0.086	0.190	0.049	0.129	0.213	0.196
24 Jun	0.174	0.185	0.113	0.187	0.261	0.087	0.086	0.090	0.084	0.121	0.235	0.058	0.149	0.222	0.232
25 Jun	0.210	0.194	0.128	0.222	0.283	0.104	0.094	0.111	0.104	0.143	0.272	0.066	0.178	0.246	0.239
26 Jun	0.229	0.212	0.152	0.224	0.303	0.124	0.096	0.161	0.116	0.169	0.275	0.076	0.206	0.291	0.250
27 Jun	0.258	0.230	0.155	0.226	0.316	0.144	0.103	0.187	0.137	0.200	0.285	0.093	0.252	0.301	0.262
28 Jun	0.294	0.233	0.156	0.232	0.329	0.164	0.119	0.213	0.142	0.207	0.290	0.116	0.269	0.310	0.271
29 Jun	0.307	0.235	0.165	0.239	0.355	0.184	0.122	0.221	0.153	0.218	0.315	0.130	0.290	0.316	0.296
30 Jun	0.330	0.239	0.188	0.247	0.361	0.191	0.123	0.236	0.166	0.244	0.318	0.148	0.307	0.333	0.305
1 Jul	0.344	0.266	0.197	0.250	0.385	0.197	0.128	0.243	0.199	0.252	0.330	0.163	0.312	0.340	0.316
2 Jul	0.375	0.280	0.214	0.253	0.421	0.211	0.139	0.253	0.214	0.260	0.357	0.179	0.316	0.355	0.334
3 Jul	0.389	0.313	0.248	0.257	0.438	0.225	0.143	0.263	0.229	0.275	0.363	0.193	0.336	0.370	0.343
4 Jul	0.409	0.346	0.264	0.265	0.459	0.244	0.152	0.267	0.262	0.287	0.373	0.196	0.354	0.377	0.361
5 Jul	0.414	0.354	0.268	0.268	0.483	0.261	0.156	0.274	0.271	0.310	0.379	0.201	0.357	0.394	0.372
6 Jul	0.424	0.379	0.284	0.274	0.501	0.275	0.160	0.279	0.298	0.314	0.392	0.202	0.363	0.417	0.407
7 Jul	0.449	0.427	0.314	0.289	0.510	0.288	0.174	0.299	0.313	0.323	0.394	0.208	0.366	0.443	0.425
8 Jul	0.476	0.469	0.329	0.299	0.527	0.295	0.201	0.309	0.320	0.333	0.402	0.216	0.376	0.458	0.436
9 Jul	0.482	0.487	0.351	0.302	0.537	0.310	0.218	0.317	0.339	0.339	0.411	0.223	0.391	0.483	0.455
10 Jul	0.493	0.514	0.379	0.305	0.549	0.330	0.225	0.332	0.353	0.351	0.414	0.234	0.445	0.494	0.472
11 Jul	0.498	0.525	0.410	0.307	0.582	0.337	0.243	0.339	0.396	0.360	0.420	0.243	0.456	0.517	0.485
12 Jul	0.505	0.533	0.463	0.314	0.613	0.342	0.248	0.354	0.411	0.387	0.423	0.250	0.463	0.539	0.499
13 Jul	0.513	0.546	0.480	0.377	0.640	0.348	0.253	0.362	0.427	0.403	0.430	0.261	0.488	0.549	0.519
14 Jul	0.530	0.553	0.504	0.538	0.654	0.358	0.267	0.392	0.465	0.428	0.434	0.279	0.529	0.568	0.544
15 Jul	0.562	0.570	0.523	0.603	0.665	0.400	0.277	0.455	0.535	0.456	0.439	0.346	0.617	0.607	0.571
16 Jul	0.596	0.582	0.603	0.634	0.684	0.437	0.289	0.518	0.561	0.503	0.481	0.424	0.682	0.635	0.594
17 Jul	0.640	0.597	0.675	0.653	0.696	0.447	0.298	0.559	0.584	0.587	0.536	0.432	0.743	0.659	0.605
18 Jul	0.688	0.621	0.706	0.666	0.716	0.456	0.369	0.585	0.601	0.649	0.598	0.453	0.777	0.708	0.619

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Table 13.–Page 2 of 2.

	Cumulative proportion														
Date	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
19 Jul	0.706	0.642	0.722	0.676	0.731	0.469	0.425	0.648	0.636	0.678	0.620	0.473	0.808	0.732	0.646
20 Jul	0.717	0.678	0.734	0.684	0.744	0.476	0.449	0.666	0.657	0.709	0.668	0.507	0.856	0.754	0.670
21 Jul	0.729	0.687	0.757	0.711	0.755	0.484	0.520	0.689	0.667	0.736	0.684	0.585	0.867	0.793	0.696
22 Jul	0.733	0.708	0.787	0.724	0.766	0.491	0.585	0.717	0.673	0.760	0.708	0.636	0.875	0.812	0.712
23 Jul	0.746	0.723	0.820	0.741	0.785	0.498	0.623	0.735	0.680	0.780	0.754	0.653	0.883	0.833	0.738
24 Jul	0.800	0.752	0.834	0.755	0.802	0.504	0.663	0.753	0.687	0.807	0.787	0.672	0.891	0.854	0.756
25 Jul	0.901	0.791	0.852	0.769	0.817	0.518	0.728	0.783	0.704	0.816	0.819	0.743	0.904	0.867	0.779
26 Jul	0.911	0.812	0.864	0.780	0.830	0.527	0.784	0.831	0.740	0.822	0.849	0.799	0.916	0.879	0.802
27 Jul	0.927	0.823	0.882	0.788	0.837	0.537	0.819	0.871	0.776	0.834	0.873	0.848	0.934	0.889	0.826
28 Jul	0.936	0.835	0.901	0.799	0.846	0.590	0.833	0.894	0.788	0.856	0.886	0.874	0.942	0.899	0.840
29 Jul	0.950	0.852	0.917	0.807	0.861	0.676	0.848	0.906	0.808	0.866	0.898	0.893	0.952	0.913	0.852
30 Jul	0.967	0.862	0.929	0.815	0.880	0.705	0.863	0.915	0.831	0.875	0.910	0.908	0.958	0.926	0.862
31 Jul	0.980	0.873	0.939	0.822	0.889	0.739	0.881	0.927	0.845	0.889	0.919	0.922	0.968	0.949	0.872
1 Aug	0.988	0.887	0.947	0.827	0.896	0.771	0.894	0.938	0.862	0.899	0.928	0.934	0.976	0.965	0.879
2 Aug	0.993	0.908	0.956	0.833	0.902	0.806	0.903	0.947	0.878	0.920	0.936	0.943	0.982	0.974	0.884
3 Aug	1.000	0.925	0.963	0.843	0.911	0.829	0.910	0.957	0.895	0.927	0.943	0.951	0.987	0.977	0.894
4 Aug	–	0.940	0.967	0.864	0.915	0.855	0.922	0.967	0.913	0.931	0.951	0.960	0.990	0.984	0.904
5 Aug	–	0.949	0.973	0.877	0.923	0.870	0.931	0.974	0.930	0.941	0.960	0.968	0.994	0.988	0.921
6 Aug	–	0.958	0.979	0.887	0.933	0.880	0.938	0.980	0.944	0.952	0.970	0.974	0.997	0.995	0.933
7 Aug	–	0.969	0.985	0.897	0.936	0.886	0.949	0.984	0.953	0.959	0.974	0.980	1.000	1.000	0.942
8 Aug	–	0.978	0.990	0.906	0.940	0.892	0.962	0.988	0.965	0.967	0.979	0.984	–	–	0.950
9 Aug	–	0.987	0.994	0.923	0.943	0.901	0.974	0.994	0.975	0.972	0.986	0.988	–	–	0.958
10 Aug	–	0.994	1.000	0.935	0.947	0.909	0.980	1.000	0.982	0.975	0.993	0.991	–	–	0.966
11 Aug	–	1.000	–	0.946	0.954	0.923	0.989	–	0.987	0.979	1.000	0.994	–	–	0.979
12 Aug	–	–	–	0.957	0.968	0.940	0.996	–	0.994	0.984	–	0.997	–	–	0.987
13 Aug	–	–	–	0.970	0.980	0.956	1.000	–	1.000	0.989	–	1.000	–	–	0.993
14 Aug	–	–	–	0.982	0.991	0.966	–	–	–	0.994	–	–	–	–	1.000
15 Aug	–	–	–	0.992	1.000	0.978	–	–	–	1.000	–	–	–	–	–
16 Aug	–	–	–	1.000	–	0.987	–	–	–	–	–	–	–	–	–
17 Aug	–	–	–	–	–	0.994	–	–	–	–	–	–	–	–	–
18 Aug	–	–	–	–	–	1.000	–	–	–	–	–	–	–	–	–
Run midpoint	12 Jul	10 Jul	14 Jul	14 Jul	6 Jul	24 Jul	21 Jul	16 Jul	15 Jul	16 Jul	17 Jul	20 Jul	14–Jul	11–Jul	12–Jul
Midpoint ave:	15 Jul														
Number of days in which 80% of escapement occurred															
Ave: 40	35	44	35	47	46	46	37	35	41	40	40	33	34	40	45

Table 14.–Daily fish wheel catch by species for the Kasilof River, 2015.

	Hours	Sockeye		Pink		Coho		Chinook	
Date	open	Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum
15 Jun	7.8	41	41	0	0	0	0	0	0
16 Jun	9.8	107	148	0	0	0	0	0	0
17 Jun	6.2	21	169	0	0	0	0	0	0
18 Jun	5.0	20	189	0	0	0	0	0	0
19 Jun	2.5	49	238	0	0	0	0	0	0
20 Jun	0.0	0	238	0	0	0	0	0	0
21 Jun	4.3	59	297	0	0	0	0	0	0
22 Jun	3.2	214	511	0	0	0	0	0	0
23 Jun	4.6	74	585	0	0	0	0	0	0
24 Jun	3.8	169	754	0	0	0	0	0	0
25 Jun	7.0	0	754	0	0	0	0	0	0
26 Jun	15.9	0	754	0	0	0	0	0	0
27 Jun	3.6	38	792	0	0	0	0	0	0
28 Jun	14.8	13	805	0	0	0	0	0	0
29 Jun	12.5	23	828	0	0	0	0	0	0
30 Jun	6.7	62	890	0	0	0	0	0	0
1 Jul	10.5	46	936	0	0	0	0	0	0
2 Jul	11.5	104	1,040	0	0	0	0	0	0
3 Jul	6.0	30	1,070	0	0	0	0	0	0
4 Jul	5.3	98	1,168	0	0	0	0	1	1
5 Jul	3.3	58	1,226	0	0	0	0	1	2
6 Jul	14.3	214	1,440	1	1	0	0	0	2
7 Jul	4.2	138	1,578	0	1	0	0	0	2
8 Jul	9.9	17	1,595	1	2	0	0	0	2
9 Jul	11.0	29	1,624	0	2	0	0	0	2
10 Jul	5.4	27	1,651	0	2	0	0	0	2
11 Jul	5.0	7	1,658	0	2	0	0	0	2
12 Jul	9.4	59	1,717	8	10	0	0	0	2
13 Jul	3.3	50	1,767	6	16	0	0	0	2
14 Jul	5.0	24	1,791	7	23	0	0	1	3
15 Jul	5.5	37	1,828	2	25	0	0	0	3
16 Jul	5.8	47	1,875	4	29	0	0	0	3
17 Jul	7.4	55	1,930	2	31	0	0	0	3
18 Jul	5.5	6	1,936	2	33	0	0	0	3
19 Jul	5.3	50	1,986	6	39	0	0	0	3
20 Jul	5.8	51	2,037	5	44	0	0	0	3
21 Jul	5.0	51	2,088	0	44	0	0	0	3
22 Jul	5.0	26	2,114	0	44	0	0	0	3
23 Jul	8.7	35	2,149	1	45	0	0	0	3
24 Jul	9.5	9	2,158	0	45	0	0	0	3
25 Jul	11.0	78	2,236	0	45	1	1	0	3
26 Jul	8.0	28	2,264	0	45	0	1	0	3
27 Jul	7.0	33	2,297	0	45	0	1	0	3
28 Jul	6.2	40	2,337	0	45	0	1	0	3
29 Jul	8.0	13	2,350	0	45	0	1	0	3
30 Jul	12.7	12	2,362	0	45	0	1	0	3
31 Jul	9.3	6	2,368	0	45	0	1	0	3

-continued-

Table 14.–Page 2 of 2.

Date	Hours open	Sockeye Daily	Sockeye Cum	Pink Daily	Pink Cum	Coho Daily	Coho Cum	Chinook Daily	Chinook Cum
1 Aug	15.2	32	2,400	0	45	0	1	0	3
2 Aug	12.0	15	2,415	0	45	0	1	0	3
3 Aug	11.8	22	2,437	0	45	0	1	0	3
4 Aug	10.2	7	2,444	0	45	0	1	0	3
5 Aug	12.7	29	2,473	1	46	1	2	1	4
6 Aug	11.1	50	2,523	0	46	0	2	2	6
7 Aug	9.6	18	2,541	0	46	0	2	0	6
8 Aug	13.0	6	2,547	0	46	0	2	0	6
9 Aug	10.2	5	2,552	0	46	0	2	1	7
10 Aug	18.1	11	2,563	0	46	0	2	2	9
11 Aug	7.8	19	2,582	0	46	1	3	0	9
12 Aug	12.1	23	2,605	0	46	0	3	0	9
13 Aug	13.0	9	2,614	0	46	0	3	0	9
14 Aug	23.8	24	2,638	0	46	0	3	2	11
Totals	517.7		97.8%		1.7%		0.1%		0.4%

Total salmon catch: 2,698

CPUE (fish/h): 5.2

Efficiency: 3.6% of total north bank count (fish wheel catch adjusted to 24 hours).

Table 15.–Summary of north bank Kasilof River fish wheel catches and CPUE, 1984–2015.

	Total	Actual north bank fish wheel catch (salmon only)								Total	CPUE by species				Total
Year	hours	Sockeye	%	Pink	%	Coho	%	Chinook	%	catch	Sockeye	Pink	Coho	Chinook	CPUE
1984	809.5	3,907	97.7	44	1.1	8	0.2	41	1.0	4,000	4.8	0.1	0.0	0.1	4.9
1985	747.0	4,996	98.3	49	1.0	4	0.1	32	0.6	5,081	6.7	0.1	0.0	0.0	6.8
1986	613.0	7,186	97.4	77	1.0	6	0.1	108	1.5	7,377	11.7	0.1	0.0	0.2	12.0
1987	768.4	3,910	96.2	20	0.5	0	0.0	136	3.3	4,066	5.1	0.0	0.0	0.2	5.3
1988	720.0	4,662	96.7	37	0.8	3	0.1	119	2.5	4,821	6.5	0.1	0.0	0.2	6.7
1989	959.1	4,017	94.0	154	3.6	5	0.1	99	2.3	4,275	4.2	0.2	0.0	0.1	4.5
1990	1,073.8	1,750	93.4	26	1.4	0	0.0	98	5.2	1,874	1.6	0.0	0.0	0.1	1.7
1991	557.7	1,889	95.9	65	3.3	1	0.1	14	0.7	1,969	3.4	0.1	0.0	0.0	3.5
1992	778.8	2,380	95.0	40	1.6	2	0.1	82	3.3	2,504	3.1	0.1	0.0	0.1	3.2
1993	840.0	2,100	93.9	52	2.3	0	0.0	85	3.8	2,237	2.5	0.1	0.0	0.1	2.7
1994	609.3	3,514	97.3	37	1.0	3	0.1	59	1.6	3,613	5.8	0.1	0.0	0.1	5.9
1995	678.2	2,023	96.4	28	1.3	1	0.0	46	2.2	2,098	3.0	0.0	0.0	0.1	3.1
1996	505.8	3,009	98.9	5	0.2	2	0.1	28	0.9	3,044	5.9	0.0	0.0	0.1	6.0
1997	505.0	2,076	97.0	16	0.7	3	0.1	46	2.1	2,141	4.1	0.0	0.0	0.1	4.2
1998	462.9	1,937	96.6	18	0.9	4	0.2	47	2.3	2,006	4.2	0.0	0.0	0.1	4.3
1999	503.0	1,952	92.1	108	5.1	2	0.1	58	2.7	2,120	3.9	0.2	0.0	0.1	4.2
2000	670.5	1,792	94.2	37	1.9	16	0.8	57	3.0	1,902	2.7	0.1	0.0	0.1	2.8
2001	391.4	1,765	96.4	23	1.3	1	0.1	42	2.3	1,831	4.5	0.1	0.0	0.1	4.7
2002	843.4	2,449	96.9	29	1.1	13	0.5	37	1.5	2,528	2.9	0.0	0.0	0.0	3.0
2003	822.2	1,704	98.3	15	0.9	0	0.0	14	0.8	1,733	2.1	0.0	0.0	0.0	2.1
2004	953.6	1,991	95.7	48	2.3	2	0.1	39	1.9	2,080	2.1	0.1	0.0	0.0	2.2
2005	785.1	1,812	95.5	66	3.5	0	0.0	19	1.0	1,897	2.3	0.1	0.0	0.0	2.4
2006	739.5	1,630	94.4	39	2.3	24	1.4	34	2.0	1,727	2.2	0.1	0.0	0.0	2.3
2007	877.3	1,580	97.8	15	0.9	4	0.2	17	1.1	1,616	1.8	0.0	0.0	0.0	1.8
2008	448.1	1,931	99.4	9	0.5	1	0.1	2	0.1	1,943	4.3	0.0	0.0	0.0	4.3
2009	514.2	1,390	96.8	42	2.9	0	0.0	4	0.3	1,436	2.7	0.1	0.0	0.0	2.8
2010	863.5	1,533	97.4	18	1.1	3	0.2	20	1.3	1,574	1.8	0.0	0.0	0.0	1.8
2011	601.2	1,395	98.7	12	0.8	1	0.1	5	0.4	1,413	2.3	0.0	0.0	0.0	2.4
2012	744.9	2,075	99.4	7	0.3	0	0.0	5	0.2	2,087	2.8	0.0	0.0	0.0	2.8
2013	799.3	2,006	98.2	21	1.0	1	0.0	15	0.7	2,043	2.5	0.0	0.0	0.0	2.6
2014	558.4	2,279	92.4	173	7.0	3	0.1	12	0.5	2,467	4.1	0.3	0.0	0.0	4.4
2015	517.7	2,638	97.8	46	1.7	3	0.1	11	0.4	2,698	5.1	0.1	0.0	0.0	5.2
Ave			96.5		1.6		0.1		1.7		3.6	0.1	0.0	0.1	3.7
Min			92.1		0.2		0.0		0.1		1.6	0.0	0.0	0.0	1.7
Max			99.4		7.0		1.4		5.2		11.7	0.3	0.0	0.2	12.0
SD			1.9		1.5		0.3		1.2		2.0	0.1	0.0	0.0	2.1

Table 16.–Age composition of sockeye salmon sampled from the Kasilof River fish wheel catch, 1969–2015.

	% Composition by age class								
Year	1.1	1.2	1.3	1.4	2.1	2.2	2.3	Other	*n*
1969	0.0	14.0	39.0	1.0	0.0	30.0	16.0	0.0	399
1970	0.0	2.0	37.0	2.0	0.0	16.0	11.0	2.0	297
1971	0.0	6.0	69.0	0.0	0.0	8.0	16.0	1.0	153
1972	0.0	42.0	36.0	1.0	0.0	3.0	18.0	0.0	668
1973	0.0	20.0	57.0	0.0	0.0	19.0	4.0	0.0	374
1974	0.0	35.0	59.0	0.0	0.0	4.0	2.0	0.0	254
1975	1.0	29.0	7.0	0.0	0.0	58.0	4.0	1.0	931
1976	0.2	35.9	24.1	0.0	0.0	28.2	11.4	0.2	755
1977	0.3	29.4	30.0	0.0	0.8	27.8	11.7	0.0	1,209
1978	0.0	41.3	40.1	0.0	0.0	10.4	8.2	0.0	967
1979	0.7	58.9	28.2	0.0	0.0	10.5	1.6	0.1	590
1980	2.1	67.0	23.1	0.1	0.0	5.0	2.7	0.0	899
1981	0.0	28.9	63.6	0.0	0.0	5.9	1.6	0.0	1,479
1982	0.8	30.6	54.4	0.0	0.2	9.3	4.7	0.0	1,518
1983	0.0	49.5	33.1	0.0	0.0	12.9	4.5	0.0	1,997
1984	0.0	50.5	24.8	0.0	0.2	17.9	6.6	0.0	2,269
1985	0.2	57.3	21.8	0.1	0.1	17.8	2.6	0.1	3,063
1986	0.0	40.9	42.0	0.3	0.1	11.9	4.6	0.2	1,660
1987	0.2	43.4	27.4	0.0	0.1	22.4	6.4	0.0	1,248
1988	0.1	33.7	36.4	0.2	0.1	17.6	12.0	0.0	2,282
1989	0.0	14.9	35.3	0.1	0.1	36.6	13.0	0.0	1,301
1990	0.4	32.9	20.7	0.3	0.0	33.2	12.4	0.3	762
1991	0.0	31.5	33.4	0.1	0.1	29.0	5.8	0.1	2,106
1992	0.0	21.1	27.5	0.0	0.2	35.3	16.0	0.0	1,717
1993	0.4	16.3	29.8	0.0	0.4	28.0	25.2	0.0	571
1994	0.0	26.4	28.4	0.0	0.0	28.2	17.0	0.0	723
1995	0.2	44.0	15.5	0.0	0.0	25.0	15.3	0.0	587
1996	0.0	24.8	48.3	0.0	0.0	21.4	5.6	0.0	721
1997	0.0	21.1	54.8	0.0	0.0	13.5	10.7	0.0	758
1998	0.1	39.7	28.1	0.4	0.6	22.2	8.9	0.0	857
1999	0.0	29.7	33.8	0.2	0.1	26.7	9.4	0.1	964
2000	0.1	41.9	33.9	0.0	0.4	11.4	12.3	0.0	747
2001	0.4	29.3	48.6	0.2	0.2	16.5	4.8	0.2	564
2002	0.3	33.9	38.1	0.3	1.5	19.3	6.6	0.1	746
2003	0.7	37.3	26.1	0.0	0.2	29.3	6.5	0.0	1,298
2004	0.1	43.7	18.9	0.1	0.2	32.6	4.3	0.1	908
2005	0.7	38.8	32.8	0.0	0.3	18.7	8.8	0.0	1,278
2006	0.5	35.3	30.5	0.0	0.4	27.4	5.8	0.1	737
2007	0.7	44.8	25.3	0.0	0.2	19.3	9.9	0.0	628
2008	0.4	39.5	38.3	0.0	0.2	17.9	3.7	0.0	448
2009	0.0	8.5	60.4	0.3	0.0	17.2	13.6	0.0	331
2010	1.1	27.7	31.2	0.0	1.5	31.2	7.1	0.2	477
2011	1.4	13.7	31.5	0.0	2.7	25.2	25.6	0.0	489
2012	6.8	34.0	10.6	0.0	4.4	37.6	6.6	0.0	473
2013	1.9	34.5	26.7	0.0	1.2	31.8	3.7	0.2	516
2014	1.7	42.4	29.4	0.0	2.7	20.6	2.9	0.4	524
2015	0.6	21.0	34.7	0.0	1.4	35.1	7.1	0.2	1,122
Ave (1969–14)	0.5	33.1	34.6	0.1	0.4	21.5	8.9	0.1	965

Table 17.–Average lengths of the major age classes of sockeye salmon sampled from the Kasilof River fish wheel, 1983–2015.

		Male		Female		Total		Ratio		Male		Female		Total		Ratio
Year	Age class	Length (mm)	*n*	Length (mm)	*n*	Length (mm)	*n*	Male: Female	Age class	Length (mm)	*n*	Length (mm)	*n*	Length (mm)	*n*	Male: Female
1983	1.2	493	113	491	78	492	191	1.4:1	1.3	558	170	547	187	552	357	0.9:1
1984		480	544	478	428	479	972	2.6:1		539	304	533	383	535	687	0.8:1
1985		474	723	472	897	473	1620	0.8:1		531	341	527	433	529	774	0.8:1
1986		482	266	482	368	482	634	0.7:1		550	342	543	405	546	747	0.8:1
1987		472	282	470	257	471	539	1.1:1		553	191	551	154	552	345	1.2:1
1988		480	353	477	480	478	833	0.7:1		550	311	543	382	546	693	0.8:1
1989		476	77	476	107	476	184	0.8:1		552	233	544	253	547	486	0.9:1
1990		462	139	458	91	460	230	1.5:1		518	81	523	106	521	187	0.8:1
1991		467	326	461	305	464	631	1.1:1		531	418	518	335	525	753	1.3:1
1992		468	184	465	212	467	396	0.9:1		535	195	527	197	531	392	1.0:1
1993		479	40	479	53	479	93	0.8:1		550	101	542	69	547	170	1.5:1
1994		465	96	466	95	465	191	1.0:1		539	102	530	103	535	205	1.0:1
1995		491	117	483	141	487	258	0.8:1		542	42	534	49	538	91	0.9:1
1996		476	96	475	83	475	179	1.2:1		565	214	557	134	562	348	1.6:1
1997		456	80	452	80	454	160	1.0:1		555	223	541	192	548	415	1.2:1
1998		475	178	468	162	472	340	1.1:1		527	110	525	131	526	241	0.8:1
1999		479	140	474	146	476	286	1.0:1		543	167	542	159	542	326	1.1:1
2000		481	162	474	162	478	324	1.0:1		555	140	547	122	551	262	1.2:1
2001		479	77	477	88	478	165	0.9:1		549	149	545	125	547	274	1.2:1
2002		486	114	476	139	480	253	0.8:1		555	144	544	140	549	284	1.1:1
2003		481	230	480	247	481	477	0.9:1		546	167	546	207	546	374	0.8:1
2004		482	181	475	216	478	397	0.8:1		549	82	539	90	544	172	0.9:1
2005		470	260	468	350	469	610	0.7:1		544	142	543	149	543	291	1:1
2006		464	112	458	148	461	260	0.8:1		519	111	513	114	516	225	1.0:1
2007		468	127	464	154	466	281	0.8:1		545	77	538	82	542	159	0.9:1
2008		456	100	454	103	455	203	1.0:1		539	67	533	61	536	128	1.1:1
2009		483	15	485	13	484	28	1.2:1		547	96	542	104	545	200	0.9:1
2010		471	54	466	78	468	132	0.7:1		538	64	532	85	534	149	0.8:1
2011		461	35	465	32	463	67	1.1:1		551	59	549	95	549	154	0.6:1
2012		530	83	466	78	499	161	1.1:1		548	16	530	34	536	50	0.5:1
2013		470	81	467	97	469	178	0.8:1		544	73	537	65	541	138	1.1:1
2014		465	110	465	112	465	222	.98:1		537	71	533	83	535	154	0.9:1
2015		467	102	467	129	467	231	0.8:1		521	159	518	230	519	389	0.7:1
Ave (1982–2014)		476	172	471	188	473	359	0.9:1		544	156	537	163	541	320	.96:1

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Table 17.–Page 2 of 2.

Year	Age class	Male Length (mm)	Male *n*	Female Length (mm)	Female *n*	Total Length (mm)	Total *n*	Ratio Male: Female	Age class	Male Length (mm)	Male *n*	Female Length (mm)	Female *n*	Total Length (mm)	Total *n*	Ratio Male: Female
1983	2.2	ND	ND	ND	ND	ND	ND	ND	2.3	ND	ND	ND	ND	546	ND	ND
1984		484	202	482	223	483	425	0.9:1		533	102	526	80	530	182	1.3:1
1985		482	248	476	319	479	567	0.8:1		ND	ND	ND	ND	ND	ND	ND
1986		492	78	489	115	490	193	0.7:1		ND	ND	ND	ND	ND	ND	ND
1987		478	137	474	141	476	278	1.0:1		548	37	541	44	544	81	0.8:1
1988		486	173	479	220	482	393	0.8:1		544	104	543	115	543	219	0.9:1
1989		479	200	480	253	479	453	0.8:1		535	94	537	82	536	176	1.1:1
1990		453	104	457	111	455	215	0.9:1		514	63	529	61	522	124	1.0:1
1991		471	289	480	301	475	590	1.0:1		516	61	514	64	515	125	1.0:1
1992		464	264	465	427	464	691	0.6:1		534	112	532	122	533	234	0.9:1
1993		486	58	480	102	482	160	0.7:1		542	66	533	78	537	144	0.8:1
1994		469	96	470	108	470	204	0.9:1		545	49	528	74	535	123	0.7:1
1995		492	61	485	86	488	147	0.7:1		546	42	536	48	541	90	0.9:1
1996		482	69	472	85	476	154	0.8:1		553	21	556	19	554	40	1.1:1
1997		459	47	450	55	454	102	0.9:1		546	39	526	42	536	81	0.9:1
1998		473	95	469	95	471	190	1.0:1		523	40	519	36	521	76	1.1:1
1999		480	125	475	132	477	257	1.0:1		538	41	530	50	534	91	0.8:1
2000		486	36	482	52	483	88	0.7:1		551	47	551	48	551	95	1.0:1
2001		482	41	473	52	477	93	0.8:1		556	17	540	10	550	27	1.7:1
2002		480	50	470	94	473	144	0.5:1		550	25	546	24	548	49	1.0:1
2003		481	162	479	186	480	348	0.9:1		546	39	537	53	541	92	0.7:1
2004		482	126	475	170	478	296	0.7:1		536	25	523	14	531	39	1.8:1
2005		478	109	467	165	472	274	0.7:1		544	40	533	48	539	88	0.8:1
2006		464	82	466	120	465	202	0.7:1		527	21	521	22	524	43	1.0:1
2007		465	53	462	68	463	121	0.8:1		526	36	517	26	522	62	1.4:1
2008		462	41	458	56	460	97	0.7:1		532	11	501	6	520	17	1.8:1
2009		481	23	480	34	481	57	0.7:1		544	24	531	21	538	45	1.1:1
2010		472	59	474	90	473	149	0.7:1		526	19	521	15	524	34	1.3:1
2011		469	54	469	69	469	123	0.8:1		550	59	543	66	547	125	0.9:1
2012		481	78	468	100	474	178	0.8:1		536	18	527	13	532	31	1.4:1
2013		475	82	475	82	475	164	1.0:1		547	11	523	8	537	19	1.4:1
2014		480	47	476	61	478	108	0.8:1		544	5	524	10	531	15	0.5:1
2015		474	163	475	234	474	397	0.7:1		523	31	511	49	515	80	0.6:1
Ave (1982–2014)		476	106	473	135	474	241	0.8:1		539	44	531	45	535	89	1.0:1
2015 (all ages)		486	476	491	646	489	1122	0.7:1								

Table 18.–Index (ground or aerial counts) and weir counts of salmon in various northern district spawning areas in 2015.

	Number of fish observed or estimated				
Water body-method-source	Sockeye	Pink	Chum	Coho	Chinook
Alexander Creek (aerial survey, ADF&G-SF)	0	0	0	0	1,117
Birch Creek (aerial survey, ADF&G, SF)	0	0	0	191	0
Cache Creek (aerial survey ADF&G, SF)	0	0	0	0	363
Chelatna Lake (weir, ADF&G CF)	69,897	4	25	93	114
Chuitna River (aerial survey, ADF&G CF)	0	0	0	0	1,965
Chulitna River (aerial survey, ADF&G-SF)	0	0	0	0	3,137
Clear Creek (aerial survey, ADF&G-SF)	0	0	0	0	1,205
Coal Creek (aerial survey, ADF&G, SF)	0	0	0	0	455
Cottonwood Creek (foot survey, ADF&G, SF)	0	0	0	1,068	0
Deception Creek (aerial survey, ADF&G SF)[a]					
Deshka River (weir, ADF&G SF)	21	6,328	171	10,842	24,316
Fish Creek (weir, ADF&G, SF)	102,367	543	71	7,921	5
Goose Creek (aerial survey, ADF&G, SF)[a]					
Indian River (aerial survey, ADF&G, SF)[a]					
Jim Creek, Upper (foot survey, ADF&G, SF)	0	0	0	374	0
Judd Lake (weir, ADF&G CF)	47,934	101	33	20	73
Kashwitna River (aerial survey, ADF&G, SF)	0	0	0	0	224
Lake Creek (aerial survey, ADF&G-SF)	0	0	0	0	4,686
Larson L (weir ADF&G CF)	23,185	55	24	60	1
Lewis River (aerial survey, ADF&G-SF)	0	0	0	0	5
Little Susitna (weir/aerial survey, ADF&G-SF)	1,499	1,357	57,750	12,756	4,902
Little Willow Creek (aerial survey, ADF&G-SF)	0	0	0	0	788
McRoberts Creek (weir, ADF&G, SF)	0	0	0	3,572	0
Montana Creek (aerial survey, ADF&G, SF)	0	0	0	0	1,416
Moose Creek (aerial survey, ADF&G, SF)[a]					
Peters Creek (foot survey, ADF&G, SF)	0	0	0	0	1,514
Portage Creek (aerial survey, ADF&F, SF)[a]					
Prairie Creek (aerial survey, ADF&G-SF)	0	0	0	0	3,290
Question Creek (aerial survey, ADF&G, SF)	0	0	0	166	0
Sheep Creek (survey, ADF&G, SF)[a]					
Talachulitna River (aerial, ADF&G-CF)	0	0	0	0	2,582
Theodore River (aerial, ADF&G-CF)	0	0	0	0	426
Willow Creek (aerial survey, ADF&G, SF)	0	0	0	0	2,046
Total index	244,903	8,388	58,074	37,063	54,630
Yentna index (Chelatna + Judd)	117,831				
Combined Susitna index (SEG = Chelatna + Judd + Larson)	141,016				

[a] No counts conducted due to poor water visibility.

Table 19.–Daily fish wheel catch by species for the north bank of the Yentna River, 2015.

	Hours	Sockeye		Pink		Chum		Coho		Chinook	
Date	open	Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum
7 Jul	17.7	5	5	8	8	3	3	0	0	4	4
8 Jul	17.3	4	9	11	19	6	9	1	1	5	9
9 Jul	17.7	18	27	36	55	7	16	2	3	2	11
10 Jul	17.1	16	43	42	97	9	25	1	4	0	11
11 Jul	18.0	10	53	60	157	18	43	9	13	4	15
12 Jul	18.0	12	65	83	240	32	75	20	33	5	20
13 Jul	17.9	8	73	83	323	26	101	14	47	2	22
14 Jul	18.0	9	82	70	393	24	125	6	53	0	22
15 Jul	18.1	16	98	67	460	28	153	5	58	1	23
16 Jul	17.6	3	101	21	481	8	161	2	60	2	25
17 Jul	18.0	20	121	176	657	26	187	17	77	2	27
18 Jul	17.2	28	149	187	844	31	218	6	83	0	27
19 Jul	18.3	105	254	444	1,288	63	281	38	121	1	28
20 Jul	17.9	45	299	569	1,857	68	349	65	186	1	29
21 Jul	18.2	65	364	793	2,650	119	468	71	257	1	30
22 Jul	18.1	33	397	486	3,136	78	546	26	283	0	30
23 Jul	18.1	20	417	320	3,456	46	592	25	308	1	31
24 Jul	17.7	27	444	137	3,593	42	634	11	319	0	31
25 Jul	17.9	180	624	525	4,118	166	800	51	370	0	31
26 Jul	17.6	113	737	565	4,683	129	929	74	444	0	31
27 Jul	17.5	89	826	783	5,466	152	1,081	99	543	0	31
28 Jul	16.5	59	885	649	6,115	79	1,160	82	625	1	32
29 Jul	17.1	111	996	559	6,674	90	1,250	69	694	1	33
30 Jul	17.7	122	1,118	432	7,106	86	1,336	74	768	0	33
31 Jul	17.5	114	1,232	342	7,448	82	1,418	43	811	0	33
1 Aug	17.6	114	1,346	291	7,739	113	1,531	66	877	0	33
2 Aug	17.3	106	1,452	310	8,049	100	1,631	59	936	0	33
3 Aug	17.1	89	1,541	194	8,243	101	1,732	57	993	0	33
4 Aug	17.5	87	1,628	150	8,393	130	1,862	47	1,040	0	33
5 Aug	19.1	59	1,687	92	8,485	92	1,954	59	1,099	0	33
6 Aug	17.6	65	1,752	130	8,615	104	2,058	131	1,230	0	33
7 Aug	17.5	79	1,831	146	8,761	98	2,156	117	1,347	1	34
8 Aug	17.5	92	1,923	241	9,002	109	2,265	83	1,430	2	36
9 Aug	17.4	60	1,983	208	9,210	56	2,321	42	1,472	0	36
10 Aug	17.0	48	2,031	139	9,349	61	2,382	41	1,513	0	36
11 Aug	17.5	34	2,065	76	9,425	44	2,426	32	1,545	0	36
12 Aug	17.6	34	2,099	63	9,488	61	2,487	27	1,572	0	36
13 Aug	17.7	30	2,129	56	9,544	71	2,558	12	1,584	0	36
14 Aug	17.8	50	2,179	69	9,613	82	2,640	24	1,608	0	36
15 Aug	17.7	53	2,232	68	9,681	125	2,765	20	1,628	0	36
16 Aug	17.7	38	2,270	51	9,732	68	2,833	13	1,641	0	36
17 Aug	17.5	34	2,304	48	9,780	63	2,896	29	1,670	0	36
Totals	741.8		13.8		58.6		17.4		10.0		0.2
Total catch:	16,686	salmon									
CPUE (fish/h):	22.5										

Note: Other species may include white fish, longnose suckers, rainbow trout and a northern pike.

Table 20.–Summary of fish wheel catch and CPUE by species for the north bank of the Yentna River, 1985–2015.

	Total	Actual fish wheel catch - north bank										Total	CPUE by species					Total
	hours	Sockeye	%	Pink	%	Chum	%	Coho	%	King	%	catch	Sockeye	Pink	Chum	Coho	King	CPUE
1985	702.5	1,099	17.5	4,415	70.4	502	8.0	241	3.8	14	0.2	6,271	1.6	6.3	0.6	0.3	0.0	8.9
1986	573.2	219	4.9	3,571	80.6	362	8.2	194	4.4	83	1.9	4,429	0.4	6.2	0.9	0.3	0.1	7.7
1987	936.4	1,393	25.5	2,983	54.5	876	16.0	172	3.1	47	0.9	5,471	1.5	3.2	2.8	0.2	0.1	5.8
1988	517.2	981	16.6	3,320	56.2	1,433	24.2	137	2.3	39	0.7	5,910	1.9	6.4	4.6	0.3	0.1	11.4
1989	790.2	2,016	13.8	8,099	55.3	3,669	25.1	803	5.5	46	0.3	14,633	2.6	10.2	2.3	1.0	0.1	18.5
1990	517.6	867	11.5	5,246	69.5	1,165	15.4	248	3.3	27	0.4	7,553	1.7	10.1	1.8	0.5	0.1	14.6
1991	530.1	768	16.2	2,071	43.8	946	20.0	932	19.7	15	0.3	4,732	1.4	3.9	2.3	1.8	0.0	8.9
1992	582.6	693	8.2	5,867	69.7	1,345	16.0	499	5.9	13	0.2	8,417	1.2	10.1	1.4	0.9	0.0	14.4
1993	399.1	931	13.9	4,789	71.3	549	8.2	432	6.4	17	0.3	6,718	2.3	12.0	1.5	1.1	0.0	16.8
1994	492.1	1,374	28.6	2,309	48.0	734	15.3	379	7.9	10	0.2	4,806	2.8	4.7	1.6	0.8	0.0	9.8
1995	511.8	815	17.8	2,343	51.0	826	18.0	587	12.8	19	0.4	4,590	1.6	4.6	0.9	1.1	0.0	9.0
1996	472.4	708	16.0	2,815	63.6	409	9.2	481	10.9	13	0.3	4,426	1.5	6.0	0.6	1.0	0.0	9.4
1997	849.5	2,294	48.1	1,610	33.8	551	11.6	301	6.3	14	0.3	4,770	2.7	1.9	1.0	0.4	0.0	5.6
1998	1,094.1	12,067	37.7	17,057	53.3	1,102	3.4	1,712	5.4	54	0.2	31,992	11.0	15.6	1.0	1.6	0.0	29.2
1999	206.0	1,004	33.5	1,301	43.4	211	7.0	464	15.5	16	0.5	2,996	4.9	6.3	1.2	2.3	0.1	14.5
2000	133.9	904	14.8	4,710	76.9	155	2.5	345	5.6	9	0.1	6,123	6.8	35.2	3.5	2.6	0.1	45.7
2001	145.1	898	13.6	4,705	71.4	501	7.6	477	7.2	13	0.2	6,594	6.2	32.4	3.2	3.3	0.1	45.4
2002	161.7	564	6.3	7,286	80.9	516	5.7	618	6.9	17	0.2	9,001	3.5	45.1	3.4	3.8	0.1	55.7
2003	179.5	2,331	34.5	3,367	49.9	602	8.9	442	6.5	12	0.2	6,754	13.0	18.8	1.4	2.5	0.1	37.6
2004	243.3	394	5.8	4,613	68.1	338	5.0	1,406	20.8	22	0.3	6,773	1.6	19.0	0.8	5.8	0.1	27.8
2005	314.3	582	13.2	2,131	48.5	250	5.7	1,420	32.3	13	0.3	4,396	1.9	6.8	0.8	4.5	0.0	14.0
2006	640.8	1,472	5.7	19,480	75.0	705	2.7	4,295	16.5	27	0.1	25,979	2.3	30.4	1.1	6.7	0.0	40.5
2007	242.9	554	14.4	2,349	61.1	152	4.0	786	20.4	6	0.2	3,847	2.3	9.7	0.6	3.2	0.0	15.8
2008	197.3	752	13.8	3,949	72.6	194	3.6	528	9.7	18	0.3	5,441	3.8	20.0	1.0	2.7	0.1	27.6
2009	631.4	1,061	1.9	50,671	91.5	1,262	2.3	2,363	4.3	33	0.1	55,390	1.7	80.3	2.0	3.7	0.1	87.7
2010	997.2	2,038	13.6	8,821	58.7	2,031	13.5	2,110	14.0	21	0.1	15,021	2.0	8.8	2.0	2.1	0.0	15.1
2011	961.0	1,338	6.9	9,775	50.3	5,093	26.2	3,202	16.5	23	0.1	19,431	1.4	10.2	5.3	3.3	0.0	20.2
2012	904.5	965	5.1	15,319	81.1	387	2.0	2,191	11.6	34	0.2	18,896	1.1	16.9	0.4	2.4	0.0	20.9
2013	206.9	134	2.7	4,230	85.0	93	1.9	503	10.1	17	0.3	4,977	0.6	20.4	0.4	2.4	0.1	24.1
2014	565.2	775	9.1	5,758	67.7	996	11.7	948	11.1	34	0.4	8,511	1.4	10.2	1.8	1.7	0.1	15.1
2015	741.8	2,304	13.8	9,780	58.6	2,896	17.4	1,670	10.0	36	0.2	16,686	3.1	13.2	3.9	2.3	0.0	22.5
Historical ave			13.1		68.9		8.8		8.9		0.2		2.3	11.9	1.5	1.5	0.0	17.2
Historical min			1.9		33.8		1.9		1.1		0.1		0.4	1.7	0.2	0.1	0.0	2.7
Historical max			48.1		91.5		26.2		32.3		1.9		13.0	80.3	5.3	6.7	0.1	87.7
Historical SD			10.8		14.3		6.9		6.8		0.4		2.8	15.6	1.2	1.7	0.0	17.7
Pre 1998 ave %			15.7		63.6		14.4		5.9		0.4		1.4	5.7	1.3	0.5	0.0	9.0
1998–present			12.1		70.5		7.0		10.2		0.2		3.5	20.5	2.0	3.0	0.0	29.0

Table 21.–Daily fish wheel catch by species for the south bank of the Yentna River, 2015.

Date	Hours	Sockeye		Pink		Chum		Coho		Chinook	
	open	Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum
7 Jul	17.2	12	12	6	6	0	0	0	0	0	0
8 Jul	17.5	25	37	26	32	0	0	0	0	3	3
9 Jul	16.3	38	75	60	92	8	8	1	1	4	7
10 Jul	17.8	44	119	96	188	10	18	0	1	4	11
11 Jul	18.0	53	172	153	341	21	39	9	10	2	13
12 Jul	18.0	94	266	204	545	24	63	22	32	1	14
13 Jul	17.8	100	366	119	664	20	83	11	43	1	15
14 Jul	17.9	82	448	87	751	23	106	10	53	3	18
15 Jul	18.0	82	530	83	834	29	135	11	64	1	19
16 Jul	17.7	100	630	103	937	19	154	8	72	0	19
17 Jul	18.0	88	718	258	1,195	49	203	33	105	5	24
18 Jul	17.2	159	877	146	1,341	54	257	21	126	0	24
19 Jul	17.8	257	1,134	256	1,597	40	297	24	150	0	24
20 Jul	17.6	241	1,375	459	2,056	37	334	54	204	0	24
21 Jul	17.9	321	1,696	782	2,838	89	423	86	290	0	24
22 Jul	17.9	238	1,934	842	3,680	84	507	68	358	1	25
23 Jul	18.2	264	2,198	590	4,270	66	573	74	432	0	25
24 Jul	17.9	324	2,522	397	4,667	104	677	76	508	0	25
25 Jul	17.9	384	2,906	501	5,168	111	788	88	596	1	26
26 Jul	17.7	542	3,448	893	6,061	155	943	147	743	0	26
27 Jul	17.5	651	4,099	788	6,849	111	1,054	152	895	1	27
28 Jul	16.7	425	4,524	954	7,803	92	1,146	162	1,057	0	27
29 Jul	17.9	408	4,932	645	8,448	60	1,206	173	1,230	0	27
30 Jul	16.8	379	5,311	480	8,928	79	1,285	12	1,242	0	27
31 Jul	18.0	385	5,696	507	9,435	94	1,379	124	1,366	0	27
1 Aug	17.8	380	6,076	523	9,958	120	1,499	170	1,536	0	27
2 Aug	17.9	362	6,438	392	10,350	125	1,624	143	1,679	0	27
3 Aug	17.6	344	6,782	269	10,619	104	1,728	125	1,804	0	27
4 Aug	17.9	332	7,114	215	10,834	134	1,862	90	1,894	0	27
5 Aug	17.8	275	7,389	162	10,996	152	2,014	98	1,992	0	27
6 Aug	17.4	329	7,718	278	11,274	147	2,161	154	2,146	1	28
7 Aug	17.8	328	8,046	215	11,489	124	2,285	109	2,255	1	29
8 Aug	17.7	369	8,415	195	11,684	108	2,393	80	2,335	0	29
9 Aug	17.7	324	8,739	186	11,870	68	2,461	67	2,402	0	29
10 Aug	17.9	268	9,007	146	12,016	73	2,534	65	2,467	0	29
11 Aug	17.8	295	9,302	105	12,121	54	2,588	47	2,514	0	29
12 Aug	17.7	221	9,523	93	12,214	57	2,645	38	2,552	0	29
13 Aug	17.1	220	9,743	72	12,286	51	2,696	24	2,576	0	29
14 Aug	18.0	252	9,995	64	12,350	87	2,783	31	2,607	2	31
15 Aug	18.0	177	10,172	77	12,427	119	2,902	29	2,636	0	31
16 Aug	17.6	156	10,328	78	12,505	63	2,965	29	2,665	0	31
17 Aug	17.8	145	10,473	39	12,544	68	3,033	31	2,696	0	31
Totals	742.7		36.4		43.6		10.5		9.4		0.1
Total catch:	28,777	salmon									
CPUE (fish/h): 38.7											

Note: Other species may include whitefish, Dolly Varden, burbot and rainbow trout.

Table 22.–Summary of the fish wheel catch and CPUE by species for the south bank of the Yentna River, 1985–2015.

	Total	Fish wheel catch - south bank										Total	CPUE by species					Total
	hours	Sockeye	%	Pink	%	Chum	%	Coho	%	King	%	catch	Sockeye	Pink	Chum	Coho	King	CPUE
1985	883.1	5,616	35.7	8,855	56.2	521	3.3	724	4.6	35	0.2	15,751	6.4	10.0	0.6	0.8	0.0	17.8
1986	608.8	973	13.3	5,422	73.9	589	8.0	327	4.5	28	0.4	7,339	1.6	8.9	1.0	0.5	0.0	12.1
1987	824.2	2,216	32.5	3,333	48.8	966	14.1	293	4.3	20	0.3	6,828	2.7	4.0	1.2	0.4	0.0	8.3
1988	529.4	2,457	26.9	4,536	49.6	1,635	17.9	494	5.4	20	0.2	9,142	4.6	8.6	3.1	0.9	0.0	17.3
1989	818.1	3,856	27.7	7,169	51.5	1,804	12.9	1,081	7.8	23	0.2	13,932	4.7	8.8	2.2	1.3	0.0	17.0
1990	542.2	4,201	32.2	7,058	54.1	1,129	8.6	657	5.0	11	0.1	13,056	7.7	13.0	2.1	1.2	0.0	24.1
1991	445.0	5,368	42.7	3,368	26.8	877	7.0	2,936	23.4	10	0.1	12,559	12.1	7.6	2.0	6.6	0.0	28.2
1992	612.87	3,887	22.2	9,966	56.8	1,940	11.1	1,737	9.9	9	0.1	17,539	6.3	16.3	3.2	2.8	0.0	28.6
1993	446.5	8,561	34.7	12,416	50.3	1,508	6.1	2,178	8.8	25	0.1	24,688	19.2	27.8	3.4	4.9	0.1	55.3
1994	651.3	8,251	55.6	3,763	25.4	1,260	8.5	1,553	10.5	12	0.1	14,839	12.7	5.8	1.9	2.4	0.0	22.8
1995	456.3	2,737	36.3	2,335	31.0	691	9.2	1,766	23.4	11	0.1	7,540	6.0	5.1	1.5	3.9	0.0	16.5
1996	306.5	2,498	28.7	4,335	49.7	752	8.6	1,119	12.8	15	0.2	8,719	8.1	14.1	2.5	3.7	0.0	28.4
1997	318.2	5,431	79.5	672	9.8	317	4.6	397	5.8	18	0.3	6,835	17.1	2.1	1.0	1.2	0.1	21.5
1998	1,114.4	14,394	34.5	21,258	51.0	1,667	4.0	4,326	10.4	50	0.1	41,695	12.9	19.1	1.5	3.9	0.0	37.4
1999	206.3	3,790	42.4	3,213	35.9	223	2.5	1,689	18.9	34	0.4	8,949	18.4	15.6	1.1	8.2	0.2	43.4
2000	125.4	2,611	19.6	9,494	71.4	123	0.9	1,051	7.9	15	0.1	13,294	20.8	75.7	1.0	8.4	0.1	106.0
2001	157.7	2,527	27.7	4,369	47.8	460	5.0	1,755	19.2	20	0.2	9,131	16.0	27.7	2.9	11.1	0.1	57.9
2002	140.7	2,716	14.8	11,590	63.3	712	3.9	3,274	17.9	16	0.1	18,308	19.3	82.4	5.1	23.3	0.1	130.2
2003	146.7	6,095	44.9	4,927	36.3	869	6.4	1,659	12.2	15	0.1	13,565	41.5	33.6	5.9	11.3	0.1	92.5
2004	203.0	2,712	17.4	8,147	52.3	835	5.4	3,832	24.6	43	0.3	15,569	13.4	40.1	4.1	18.9	0.2	76.7
2005	277.6	2,588	26.2	2,280	23.1	571	5.8	4,433	44.9	12	0.1	9,884	9.3	8.2	2.1	16.0	0.0	35.6
2006	636.4	9,277	26.4	15,261	43.4	862	2.5	9,747	27.7	34	0.1	35,181	14.6	24.0	1.4	15.3	0.1	55.3
2007	240.4	2,998	51.8	1,410	24.4	261	4.5	1,117	19.3	2	0.0	5,788	12.5	5.9	1.1	4.6	0.0	24.1
2008	210.7	2,696	36.9	3,245	44.4	349	4.8	1,022	14.0	4	0.1	7,316	12.8	15.4	1.7	4.9	0.0	34.7
2009	629.9	6,901	9.7	55,213	77.8	2,254	3.2	6,569	9.3	33	0.0	70,970	11.0	87.7	3.6	10.4	0.1	112.7
2010	992.0	6,251	24.5	11,053	43.4	4,159	16.3	4,022	15.8	8	0.0	25,493	6.3	11.1	4.2	4.1	0.0	25.7
2011	976.2	4,348	17.1	6,550	25.8	11,310	44.6	3,164	12.5	7	0.0	25,379	4.5	6.7	11.6	3.2	0.0	26.0
2012	933.5	1,626	7.3	17,622	79.0	826	3.7	2,204	9.9	19	0.1	22,297	1.7	18.9	0.9	2.4	0.0	23.9
2013	184.1	726	8.6	6,213	73.5	176	2.1	1,321	15.6	17	0.2	8,453	3.9	33.7	1.0	7.2	0.1	45.9
2014	569.5	3,012	32.8	3,687	40.2	696	7.6	1,768	19.3	11	0.1	9,174	5.3	6.5	1.2	3.1	0.0	16.1
2015	742.7	10,473	36.4	12,544	43.6	3,033	10.5	2,696	9.4	31	0.1	28,777	14.1	16.9	4.1	3.6	0.0	38.7
Historical ave			26.6		52.5		7.7		13.0		0.1		7.6	14.9	2.2	3.7	0.0	28.5
Historical min			7.3		9.8		0.9		2.8		0.0		1.6	1.2	0.3	0.2	0.0	4.2
Historical max			79.5		79.0		44.6		44.9		0.8		41.5	87.7	11.6	23.3	0.2	130.2
Historical SD			15.5		17.8		7.8		8.8		0.2		8.0	22.1	2.2	5.8	0.0	31.5
Pre 1998 ave %			34.5		49.1		7.8		8.5		0.2		6.1	8.7	1.4	1.5	0.0	17.7
1998–present			23.2		53.6		8.0		15.1		0.1		10.1	23.3	3.5	6.6	0.0	43.5

Table 23.–Age composition of sockeye salmon sampled from fish wheels on the Yentna River, 1983–2015.

	% Composition by age class[a]											
Year	0.2	0.3	1.1	1.2	1.3	1.4	2.1	2.2	2.3	2.4	Other	*n*
1983	0.4	0.4	4.7	66.9	22.6	0.2	0.9	1.7	1.7	0.0	0.5	1,024
1984	0.2	1.6	1.3	23.7	59.6	0.1	0.3	6.5	6.7	0.0	0.0	2,253
1985	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1986	1.0	1.1	0.0	21.2	65.3	0.2	0.3	4.7	6.2	0.0	0.0	688
1987	1.3	2.4	0.9	23.3	50.6	1.0	0.0	8.6	11.7	0.0	0.0	1,089
1988	2.7	2.4	0.4	33.5	41.9	0.2	1.7	6.5	10.4	0.1	0.0	1,727
1989	4.1	6.2	0.7	20.3	53.7	0.3	0.5	5.5	8.6	0.0	0.0	1,602
1990	0.8	2.4	0.3	29.9	47.6	0.7	0.1	9.8	8.2	0.1	0.2	1,916
1991	2.1	10.6	0.1	25.2	43.6	0.1	0.1	7.1	11.0	0.1	0.1	1,509
1992	1.6	0.7	1.0	31.4	29.2	0.1	0.4	17.1	18.2	0.1	0.4	1,451
1993	1.0	4.6	0.1	32.1	35.5	0.0	0.4	11.7	14.5	0.1	0.0	1,390
1994	1.3	3.9	0.6	23.2	43.2	0.2	0.0	9.7	17.6	0.0	0.3	637
1995	2.2	5.1	0.8	19.7	51.3	0.4	0.2	8.5	11.6	0.0	0.2	507
1996	3.2	3.2	0.4	25.5	43.8	0.0	0.4	9.4	14.0	0.0	0.0	466
1997	1.1	10.5	0.1	32.4	43.7	0.1	0.1	4.7	7.2	0.0	0.1	751
1998	0.7	5.7	0.3	15.7	62.7	0.3	0.0	4.0	10.5	0.0	0.0	1,500
1999	3.6	3.4	0.0	23.4	52.0	0.9	0.0	8.6	8.1	0.0	0.0	444
2000	0.0	5.9	0.0	8.6	61.5	0.2	0.0	3.3	20.2	0.2	0.0	546
2001	0.0	3.4	0.8	21.3	47.8	0.0	0.4	8.4	17.7	0.0	0.2	475
2002	1.7	2.0	0.7	28.8	51.0	0.0	0.0	5.5	10.2	0.0	0.2	459
2003	0.5	2.5	0.1	16.1	63.6	0.4	0.5	6.0	10.3	0.0	0.0	812
2004	0.6	1.1	0.7	17.0	50.0	0.6	0.0	8.3	21.7	0.0	0.0	460
2005	0.5	4.0	1.7	22.7	54.4	0.1	0.1	6.2	10.1	0.0	0.2	823
2006	2.2	3.1	0.5	44.0	39.3	0.2	0.0	5.0	5.8	0.0	0.0	605
2007	1.9	3.6	0.3	18.9	60.9	0.0	0.6	6.3	7.4	0.0	0.1	366
2008	0.8	6.3	1.6	11.8	56.0	0.5	1.1	7.6	13.9	0.0	0.4	382
2009	2.9	2.9	1.5	33.9	31.6	0.8	2.1	17.2	7.2	0.0	0.0	664
2010	12.5	4.2	1.6	39.4	23.3	0.0	1.5	5.8	11.5	0.0	0.2	879
2011	0.4	18.1	0.9	11.3	55.9	0.2	4.3	3.9	5.1	0.0	0.0	565
2012	2.0	2.0	0.0	19.4	43.7	2.0	4.5	10.7	12.7	0.0	0.0	355
2013	2.8	2.8	5.4	22.7	52.5	0.2	4.5	4.7	4.3	0.0	0.0	422
2014	1.9	1.7	0.3	39.4	33.3	0.8	0.0	12.4	10.2	0.0	0.0	363
2015	0.4	5.5	0.1	18.9	62.3	0.1	0.2	2.9	9.5	0.0	0.1	1,212
Ave (1983–14)	1.8	4.1	0.8	26.7	47.8	0.3	0.6	7.4	10.4	0.0	0.1	836

Table 24.–Average lengths by age class of sockeye salmon sampled from the Yentna River fish wheels, 1992–2015.

		Male		Female		Both		
Year	Age class	Length (mm)	*n*	Length (mm)	*n*	Length (mm)	*n*	Male-Female
1992	1.2	444	360	470	115	450	475	3.1:1
1993		465	279	484	167	472	446	1.7:1
1994		468	107	484	41	473	148	2.6:1
1995		460	58	472	42	465	100	1.4:1
1996		463	78	469	41	465	119	1.9:0
1997		479	110	479	133	479	243	0.8:1
1998		485	104	486	132	486	236	0.8:1
1999		469	56	484	48	476	104	1.2:1
2000		462	35	458	12	461	47	2.9:1
2001		477	53	490	48	483	101	1.1:1
2002		486	76	495	56	490	132	1.4:1
2003		473	77	486	54	478	131	1.4:1
2004		466	53	490	25	474	78	2.1:1
2005		456	125	466	62	459	187	2.0:1
2006		485	134	487	132	486	266	1.0:1
2007		455	43	483	26	466	69	1.7:1
2008		456	40	482	5	459	45	8.0:1
2009		472	139	488	86	478	225	1.6:1
2010		462	208	478	138	468	346	1.5:1
2011		452	35	497	29	472	64	1.2:1
2012		475	40	478	29	476	69	1.4:1
2013		446	65	480	31	457	96	2.1:1
2014		458	96	470	47	462	143	2.0:1
2015		471	118	468	122	469	240	1.0:1
Average (1986–2014)		463	132	478	80	469	213	1.7:1
1992	1.3	546	188	543	242	544	430	0.8:1
1993		561	228	549	266	554	494	0.9:1
1994		596	133	561	142	578	275	0.9:1
1995		568	124	545	136	556	260	0.9:1
1996		589	107	568	97	579	204	1.1:1
1997		585	155	555	173	569	328	0.9:1
1998		562	453	538	487	550	940	0.9:1
1999		581	135	553	96	569	231	1.4:1
2000		600	180	568	156	585	336	1.2:1
2001		586	111	555	116	570	227	1.0:1
2002		596	113	561	121	578	234	0.9:1
2003		576	270	548	246	563	516	1.1:1
2004		574	93	553	137	562	230	0.7:1
2005		568	222	546	226	557	448	1.0:1
2006		567	99	554	139	559	238	0.7:1
2007		575	109	552	114	563	223	1.0:1
2008		571	99	555	115	563	214	0.9:1
2009		580	92	557	118	567	210	0.8:1
2010		569	79	548	126	556	205	0.6:1
2011		577	166	561	150	570	316	1.1:1
2012		581	77	555	78	568	155	1:1
2013		572	129	545	92	561	221	1.4:1
2014		564	50	560	71	561	121	0.7:1
2015		553	331	530	408	541	739	0.8:1
Average (1986–2014)		575	182	552	199	563	381	0.9:1

-continued-

Table 24.–Page 2 of 2.

Year	Age class	Male Length (mm)	Male *n*	Female Length (mm)	Female *n*	Both Length (mm)	Both *n*	Male-Female
1992	2.2	452	181	471	53	456	234	3.4:1
1993		476	93	487	69	481	162	1.3:1
1994		487	30	490	32	488	62	0.9:1
1995		472	23	488	20	479	43	1.2:1
1996		472	21	498	23	486	44	0.9:1
1997		497	15	460	20	475	35	0.8:1
1998		482	36	487	24	484	60	1.5:1
1999		483	16	491	22	487	38	0.7:1
2000		470	10	477	8	473	18	1.3:1
2001		487	19	482	21	485	40	0.9:1
2002		482	16	486	9	483	25	1.8:1
2003		472	23	486	26	480	49	0.9:1
2004		474	24	486	14	478	38	1.7:1
2005		462	29	488	22	473	51	1.3:1
2006		500	17	490	13	496	30	1.3:1
2007		471	8	493	15	486	23	0.5:1
2008		468	19	495	10	477	29	1.9:1
2009		492	73	495	41	493	114	1.8:1
2010		468	26	487	25	477	51	1.0:1
2011		474	15	488	7	479	22	2.1:1
2012		474	17	483	21	479	38	0.8:1
2013		505	8	468	12	483	20	0.7:1
2014		477	27	485	18	480	45	1.5:1
2015		469	32	451	6	466	38	5.3:1
Average (1986–2014)		473	37	483	29	478	67	1.3:1
1992	2.3	564	123	538	126	551	249	1.0:1
1993		562	74	544	128	550	202	0.6:1
1994		600	56	561	56	580	112	1.0:1
1995		578	25	544	34	559	59	0.7:1
1996		585	31	558	34	571	65	0.9:1
1997		575	34	548	20	565	54	1.7:1
1998		558	82	534	76	547	158	1.1:1
1999		585	16	546	20	563	36	0.8:1
2000		597	55	563	55	580	110	1.0:1
2001		575	34	552	50	561	84	0.7:1
2002		589	21	551	26	568	47	0.8:1
2003		562	50	543	34	555	84	1.5:1
2004		579	41	551	59	560	100	0.7:1
2005		557	32	537	51	545	83	0.6:1
2006		562	13	553	22	556	35	0.6:1
2007		568	12	544	15	555	27	0.8:1
2008		565	26	535	27	550	53	1.0:1
2009		560	18	548	30	553	48	0.6:1
2010		559	39	545	62	551	101	0.6:1
2011		564	14	544	15	554	29	0.9:1
2012		571	23	540	22	556	45	1:1
2013		581	9	547	9	564	18	1:1
2014		579	22	557	15	570	37	1.5:1
2015		541	41	530	77	534	118	0.5:1
Average (1986–2014)		573	43	547	49	559	92	0.9:1
2015 summary (all ages)		528	559	517	653	522	1212	0.9:1

Table 25.–Kenai and Kasilof rivers observer count variability analysis.

Kenai R. crew	File size[a]	*n*[b]	Observer: 1	2	3	4	5	2015 ave[c]	SD	Orig[d]
Average	<100	2	55	55	52	53	54	69	1.4	51
	100–199	2	122	121	119	118	121	120	1.8	121
	200–299	2	250	199	242	238	234	232	19.6	232
	0–299	6	142	125	137	136	136	135	6.3	135
R^2			0.9996	0.8462	0.9996	0.9993	0.9986	–	–	0.9905
Average	300–399	2	392	357	372	364	352	367	15.5	374
	400–499	4	467	445	452	427	445	447	14.1	483
	500–599	5	602	567	538	528	542	555	29.9	528
	300–599	11	515	484	476	461	472	482	20.1	483
R^2			0.9095	0.9202	0.9525	0.9755	0.9116	–	–	0.5872
Average	600–699	5	690	659	640	619	634	648	27.3	654
	700–799	3	811	745	741	730	759	757	31.6	740
	800–899	2	796	884	947	773	903	860	73.5	818
	600–899	10	747	730	732	683	725	723	24.0	713
R^2			0.6155	0.9228	0.9255	0.8293	0.9550	–	–	0.7318
Average	>900	8	1,119	1,169	1,179	1,150	1,140	1,151	23.6	1,112
R^2			0.8548	0.8735	0.9813	0.8398	0.9317	–	–	0.9089
Average count[e]		35	655	649	652	626	639	644	11.7	633
Diff from average			11	5	7	–49	–5	–	–	–11.4
R^2 average[f]			0.9786	0.9898	0.9932	0.9868	0.9896	–	–	0.9761

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Table 25.–Page 2 of 2.

Kasilof R. crew	File size[a]	*n*[b]	Observer: 1	2	3	2015 ave	SD	Orig
Average	<99	12	58	58	59	58	0.5	59
R^2			0.9996	0.9995	0.9995	–	–	0.9982
Average	100–199	7	156	151	157	155	3.2	157
R^2			0.9929	0.9962	0.9947	–	–	0.9846
Average	>200	5	421	386	400	402	17.5	404
R^2			0.9817	0.9902	0.9956	–	–	0.9822
Average count[c]	All	24	162	153	158	158	4.6	159
Diff from average			4.3	–4.7	0.4	–	–	1
R^2 average			0.9958	0.9981	0.9991	–	–	0.9969

[a] Range of the number of fish per DIDSON file.

[b] Number of files containing the same range of fish abundance.

[c] 2015 Average

[d] Original average

[e] Average count for all comparison files.

[f] The R^2 values were calculated using crew averages compared to observer counts and original counts made in 2012–2014.

Table 26.–Late run sockeye salmon weir and ground survey counts in 4 index streams in the Kenai River drainage, 1969–2015.

	Ptarmigan Creek	Quartz Creek		Hidden Lake	Russian River Above weir	Russian River Below weir	Area
Year	Ground	Weir	Ground	Weir	Weir	Ground	index
1969	ND	ND	487	500	28,872	1,100	30,959
1970	ND	ND	200	323	26,200	222	26,945
1971	45	ND	808	1,958	54,421	11,442	68,674
1972	ND	ND	ND	4,956	79,115	7,113	91,184
1973	1,041	ND	3,173	690	25,068	6,680	36,652
1974	558	ND	288	1,150	24,904	2,210	29,110
1975	186	ND	1,068	1,375	31,961	690	35,280
1976	505	ND	3,372	4,860	31,939	3,470	44,146
1977	1,513	ND	3,037	1,055	21,362	17,090	44,057
1978	3,529	ND	10,627	4,647	34,334	18,330	71,467
1979	532	ND	277	5,762	87,852	3,920	98,343
1980	5,752	ND	7,982	27,448	83,984	3,220	128,386
1981	1,421	ND	5,998	15,939	44,523	4,160	72,041
1982	7,525	70,540	ND	9,790	30,790	45,000	163,645
1983	9,709	73,345	ND	11,297	33,734	44,000	172,085
1984	18,000	37,659	ND	27,784	92,659	3,000	179,102
1985	26,879	ND	ND	24,784	136,969	8,650	197,282
1986	ND	ND	ND	17,530	40,281	15,230	73,041
1987	14,187	ND	45,400	43,487	53,932	76,530	233,536
1988	31,696	ND	ND	50,907	42,476	30,360	155,439
1989	3,484	ND	ND	7,770	138,377	28,480	178,111
1990	2,230	ND	ND	77,959	83,434	11,760	175,383
1991	4,628	ND	ND	35,576	78,175	22,267	105,070
1992	3,147	ND	ND	32,912	62,584	4,980	103,623
1993	ND	ND	ND	11,582	99,259	12,258	123,099
1994	1,077	ND	ND	6,086	122,277	15,211	144,651
1995	ND	ND	1,372	7,542	61,982	12,479	83,375
1996	ND	ND	4,181	55,256	34,691	31,601	125,729
1997	ND	ND	27,660	56,053	65,905	11,337	160,955
1998	ND	ND	11,130	67,727	113,480	19,593	211,930
1999	ND	ND	3,951	49,406	139,863	19,514	212,734
2000	ND	ND	1,389	45,685	56,580	13,930	117,584
2001	ND	ND	4,792	42,462	74,964	17,044	139,262
2002	ND	ND	66,294	71,983	62,115	6,858	140,956
2003	ND	ND	19,106	11,734	157,469	27,474	215,783
2004	4,428	ND	13,225	18,172	110,244	30,458	176,527
2005	3,036	ND	6,580	13,000[a]	59,473	29,048	98,137
2006	3,461	ND	28,335	38,535	89,160	18,452	177,943
2007	1,938	ND	38,954	16,734	53,068	4,504	115,198
2008	5,530	ND	16,622	15,214	46,638	9,750	93,754
2009	3,980	ND	11,262	11,011	80,088	10,740	117,081
2010	2,184	ND	5,098	41,503	38,848	16,656	104,289
2011	ND	ND	8,779	17,771	41,529	35,415	103,494
2012	1,166	ND	14,093	30,466	54,911	25,471	126,107
2013	3,648	ND	8,457	21,157	31,573	18,972	83,807
2014	2,685	ND	14,943	21,838	52,277	10,659	102,402
2015	ND	ND	4,931	18,777	46,223	11,172	81,103

[a] Count is incomplete, hole discovered in weir on August 11.

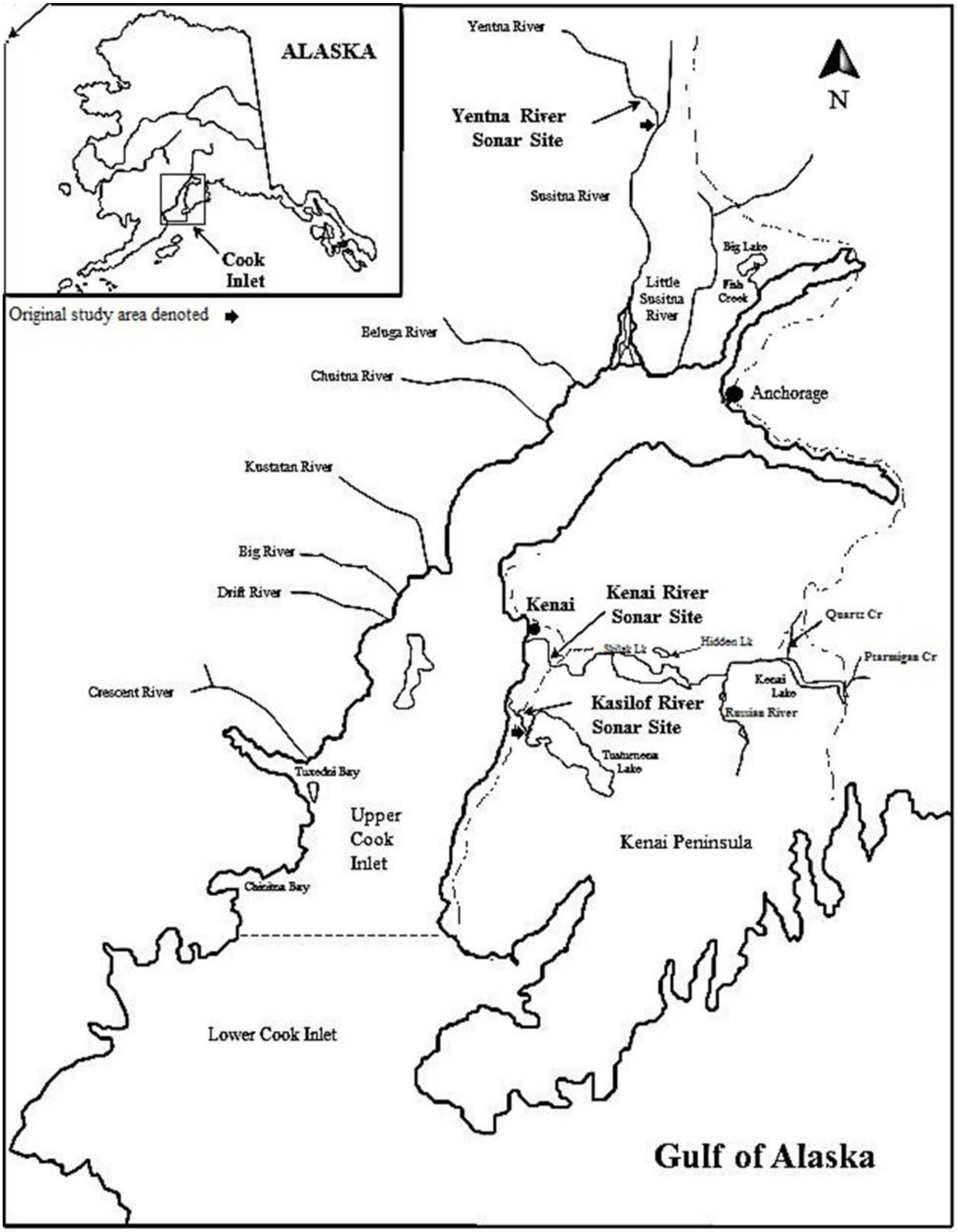


Figure 1.–Map of Upper Cook Inlet, Alaska, showing the locations of the Kenai, Kasilof and Yentna rivers escapement and research projects.

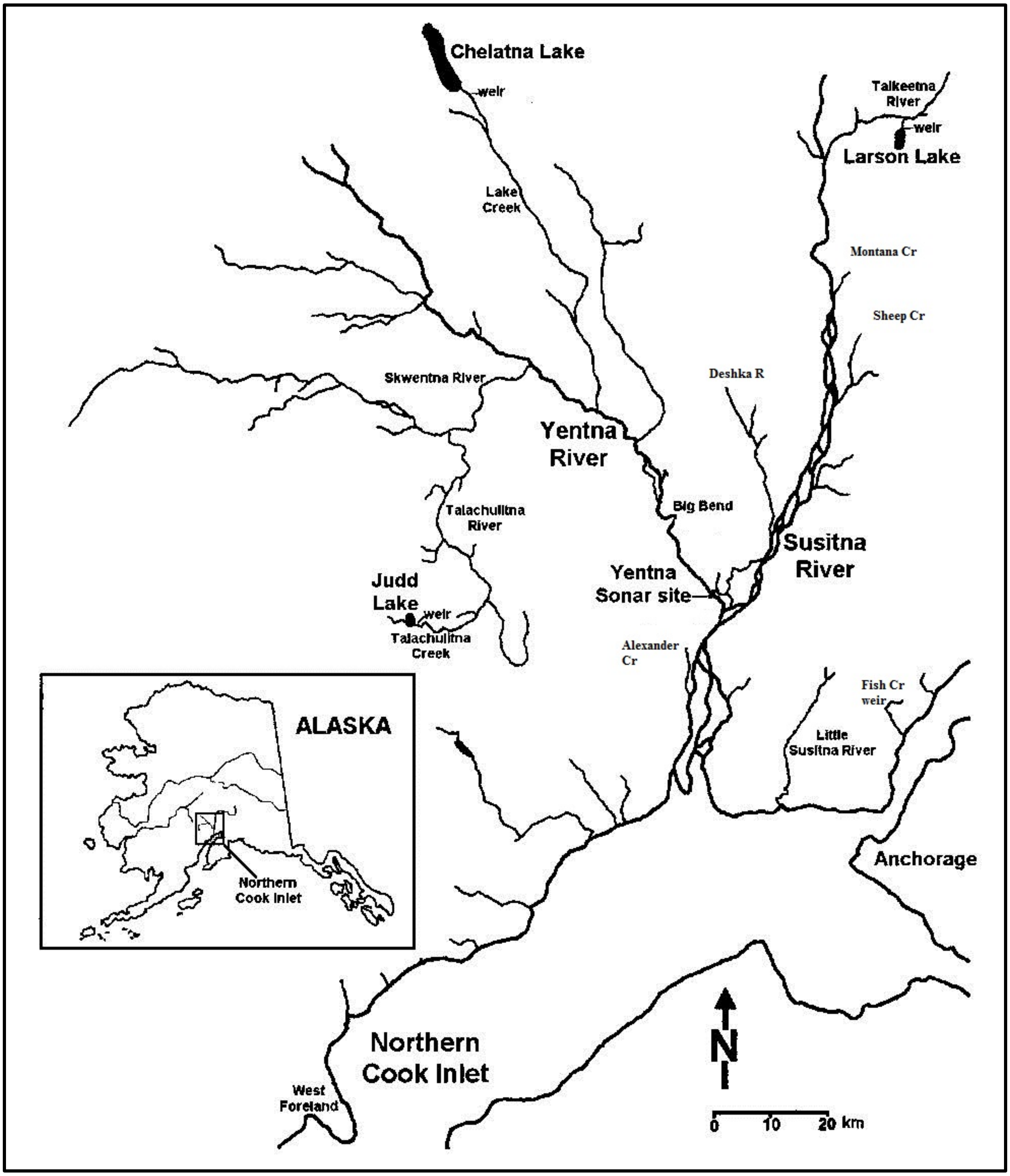


Figure 2.–Map of Susitna Valley, Alaska, showing Chelatna, Judd and Larson Lake weirs, which replaced Yentna River sonar in providing salmon escapement estimates for the Susitna River drainage.

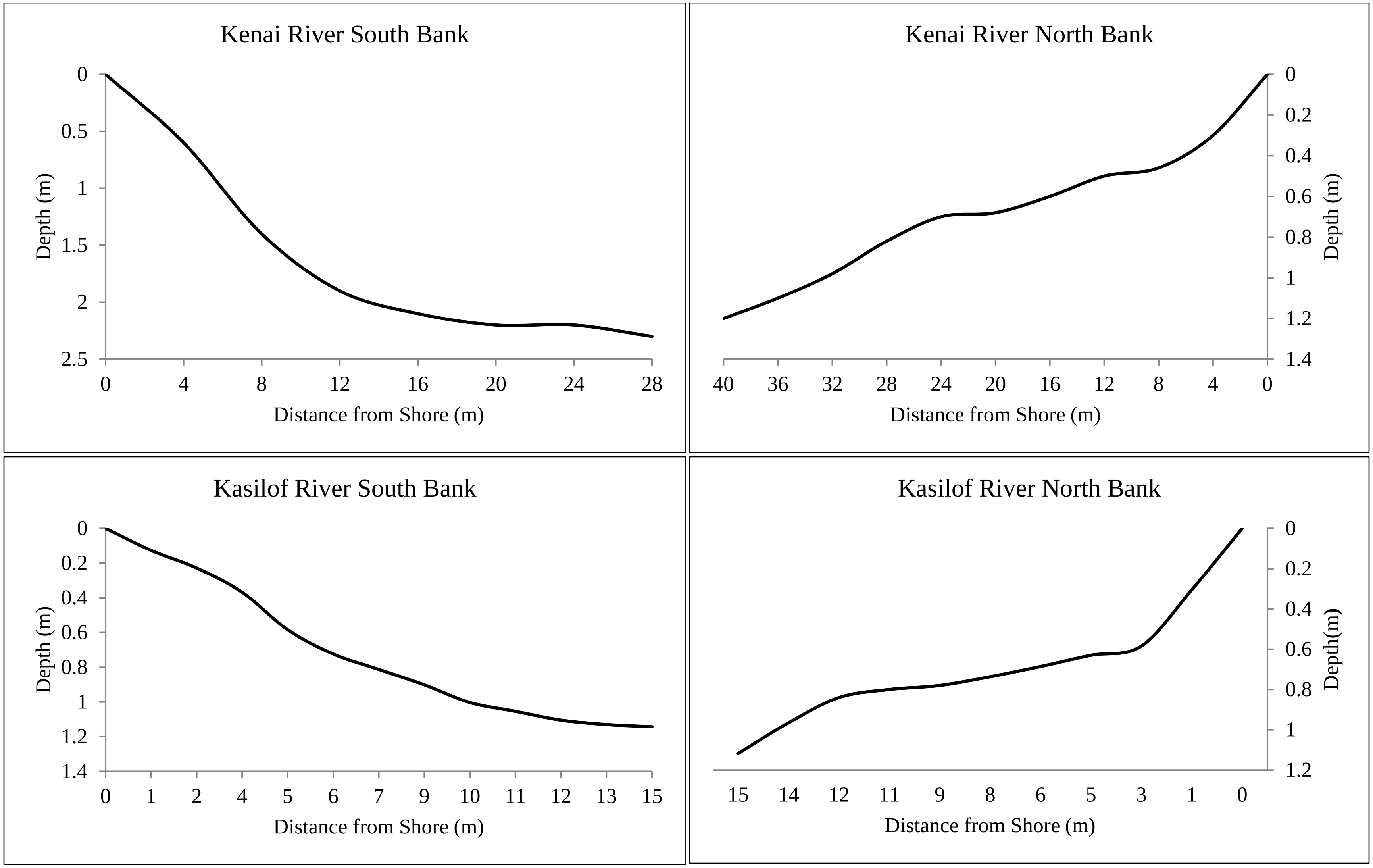


Figure 3.–River bottom profiles of the Kenai and Kasilof sonar sites, 2015.

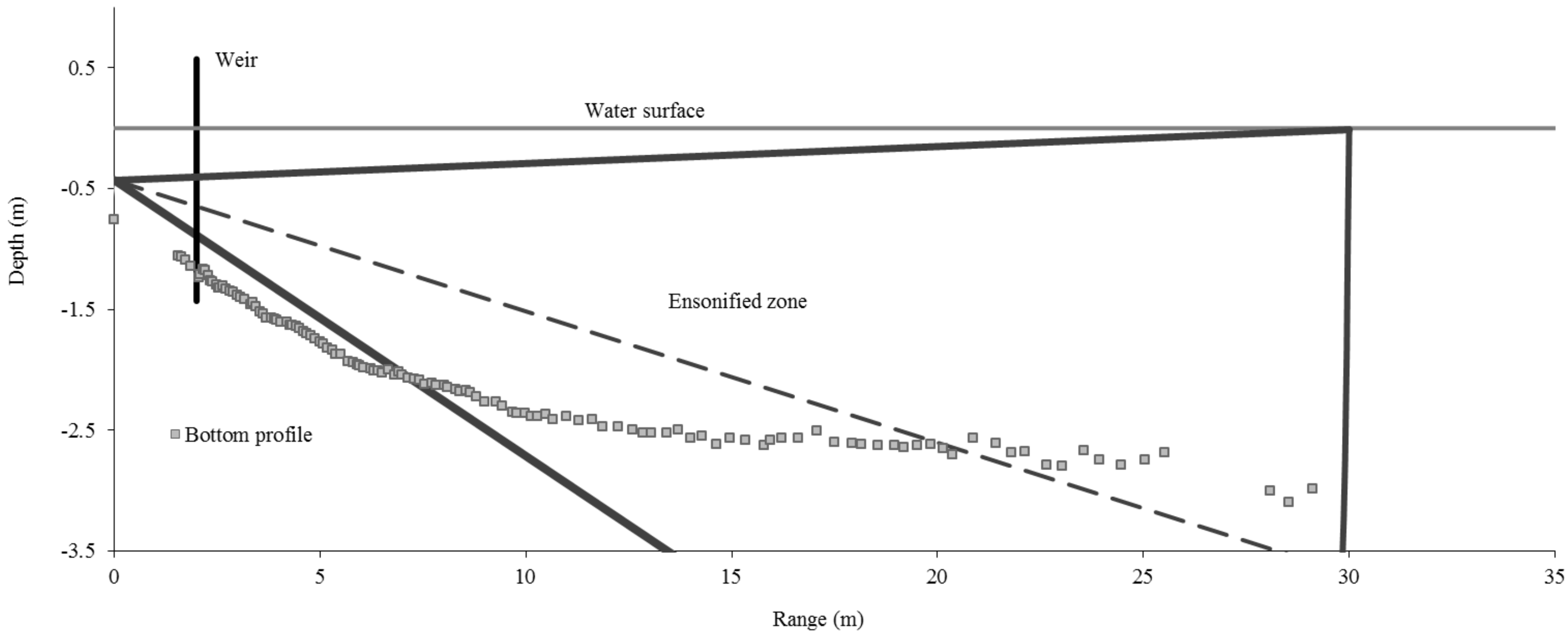


Figure 4.–Representative river bottom profile and DIDSON ensonified zone.

Figure 5.–Typical fish wheel installation, Kenai River fish wheel and weir.

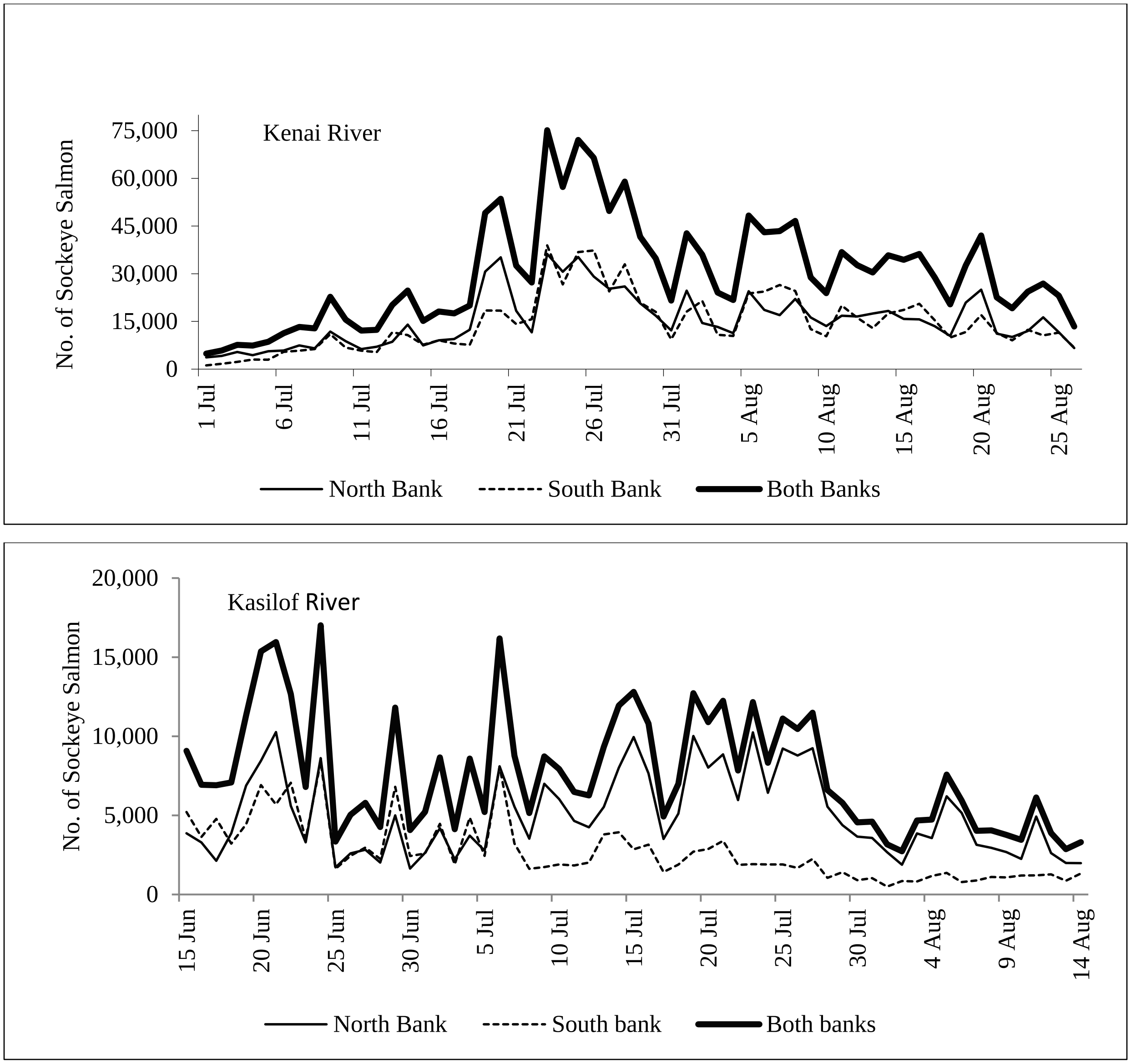
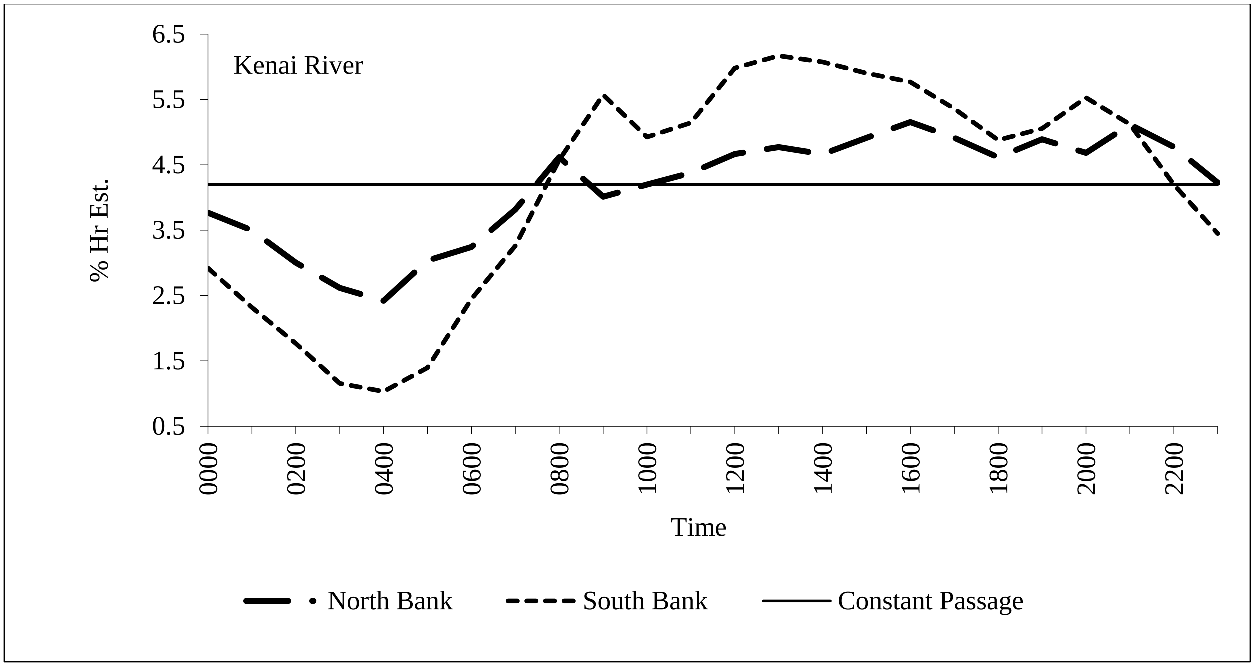


Figure 6.–Total daily escapement estimates by bank for sockeye salmon in the Kenai and Kasilof rivers, 2015.



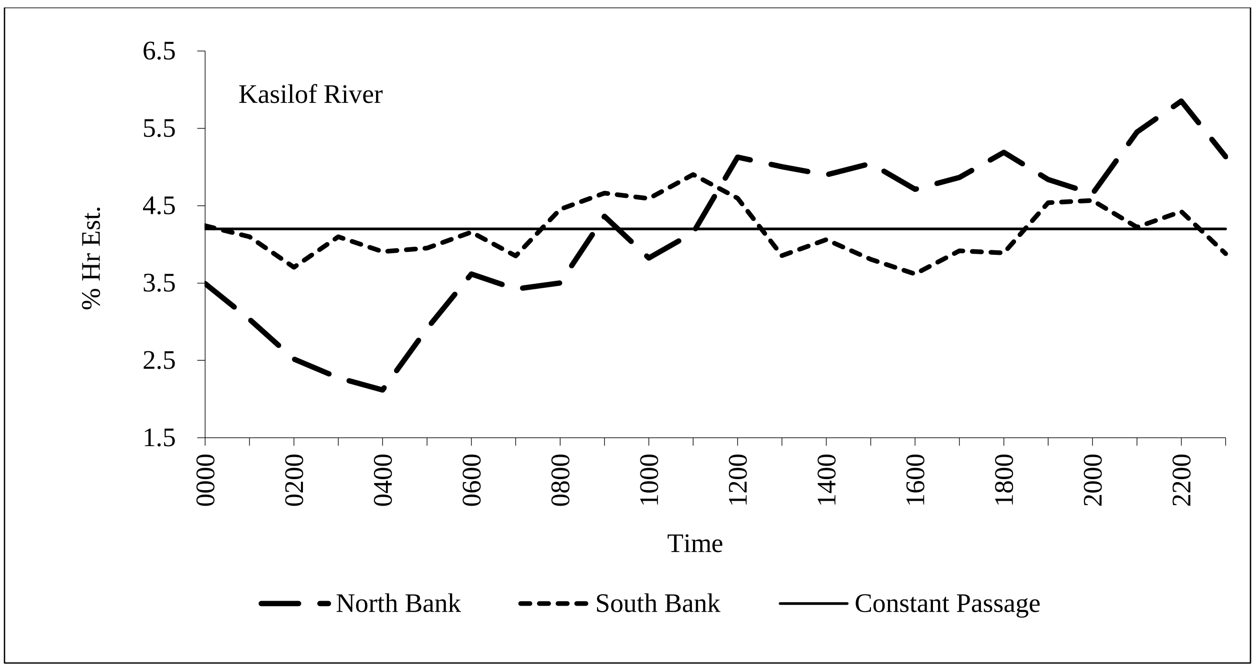
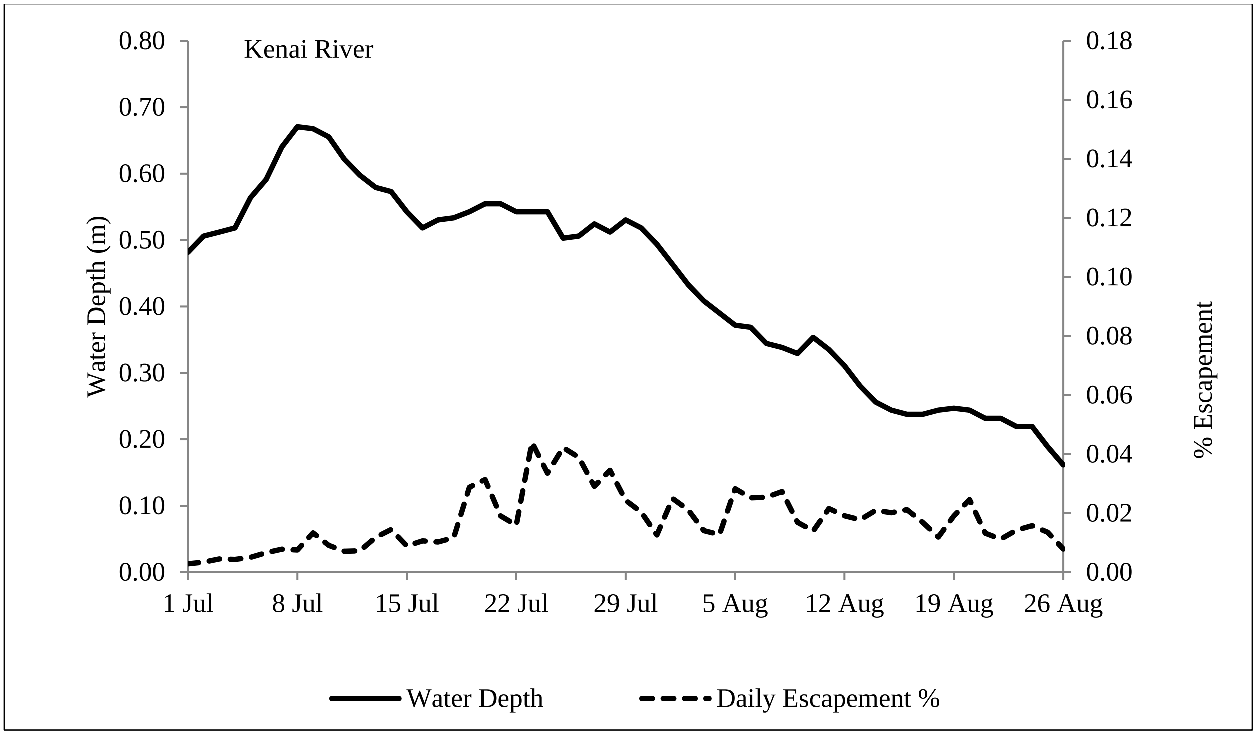


Figure 7.–Mean hourly salmon migration rates by bank in the Kenai and Kasilof rivers, 2015.

Note: The straight line represents a (hypothetical) constant passage rate over a 24-hour period.



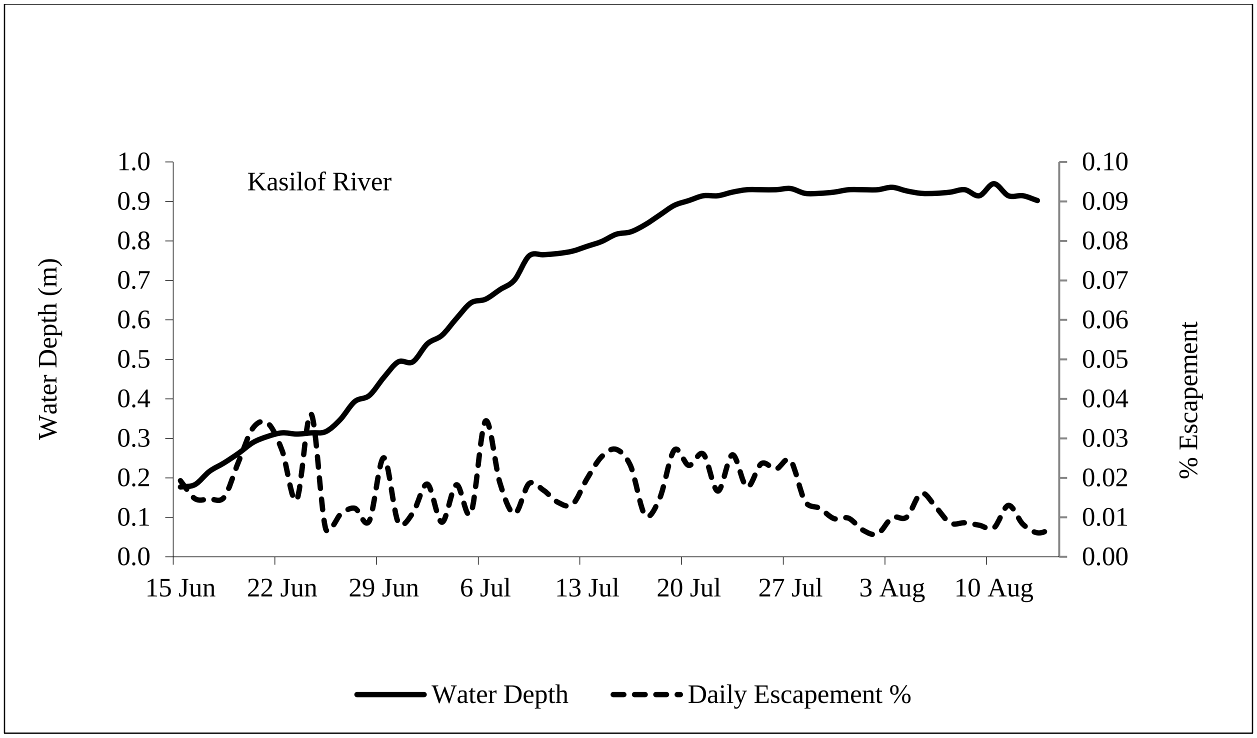
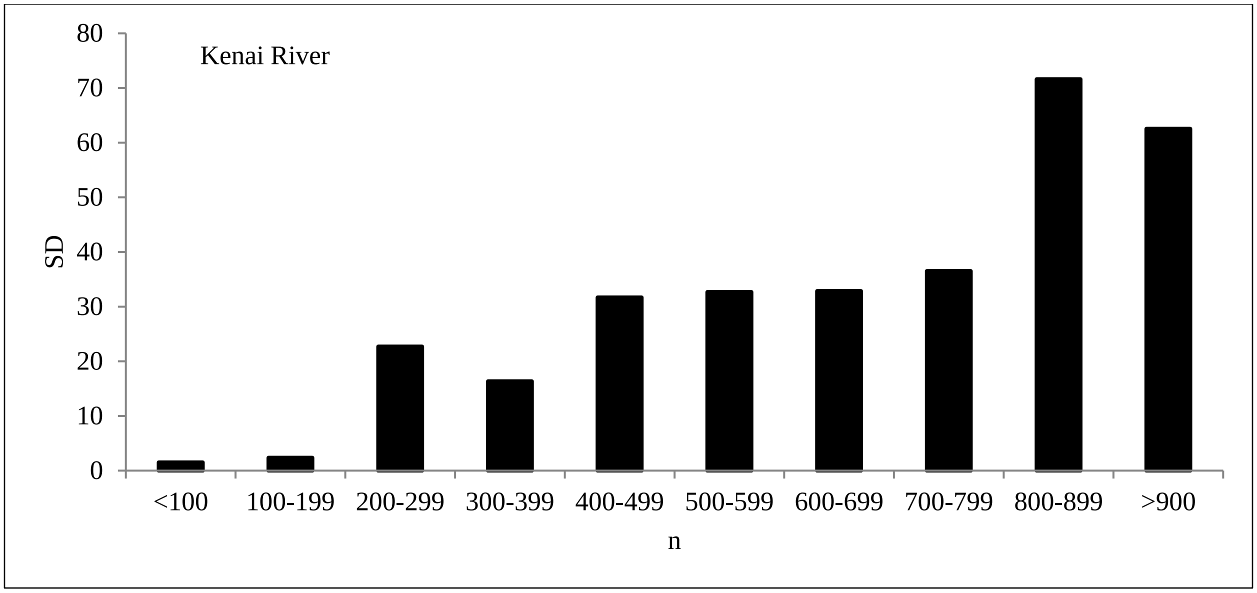


Figure 8.–Daily water level fluctuations (solid line) for the Kenai and Kasilof rivers, 2015.

Note: Daily escapement timing for sockeye salmon (dotted line) is included for comparison.



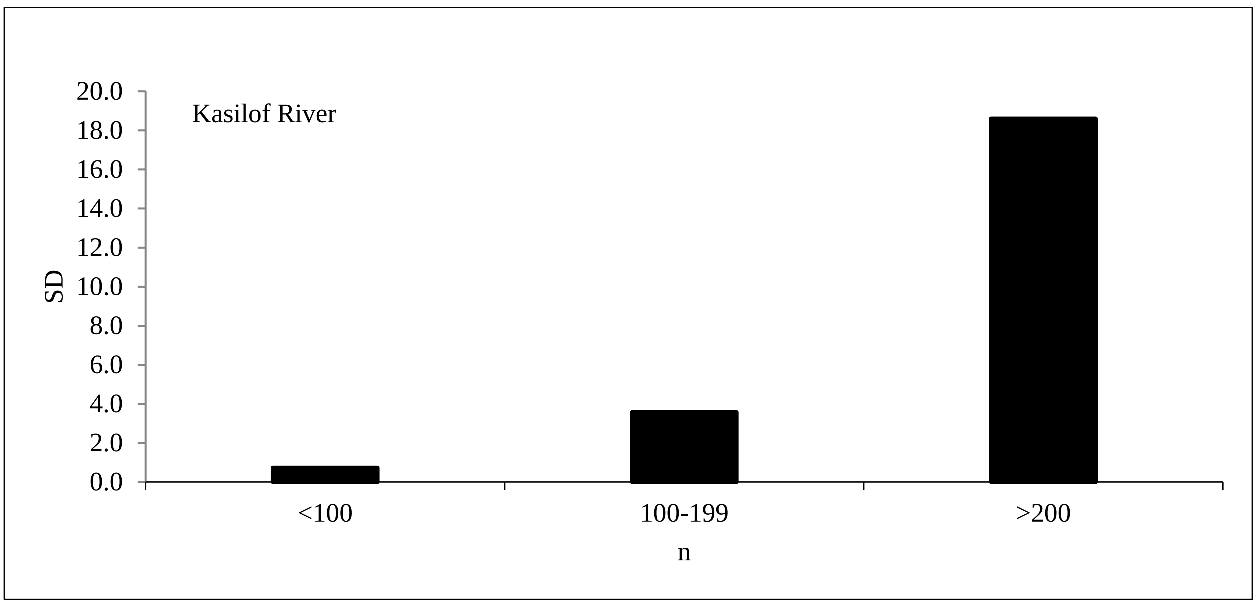
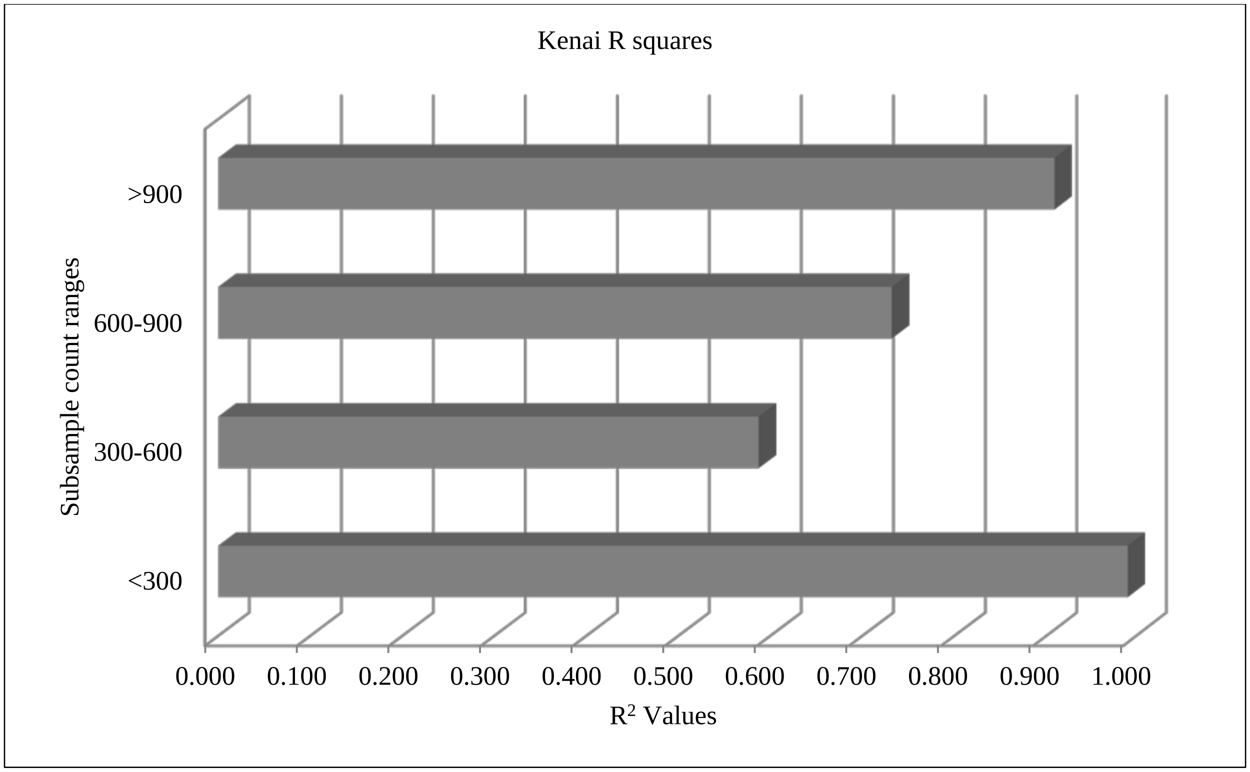


Figure 9.–Stratified average standard deviations between individual observer (subsample) counts and average crew counts for Kenai and Kasilof rivers sonar crews.

Note: Differences between observers increased with greater fish densities.



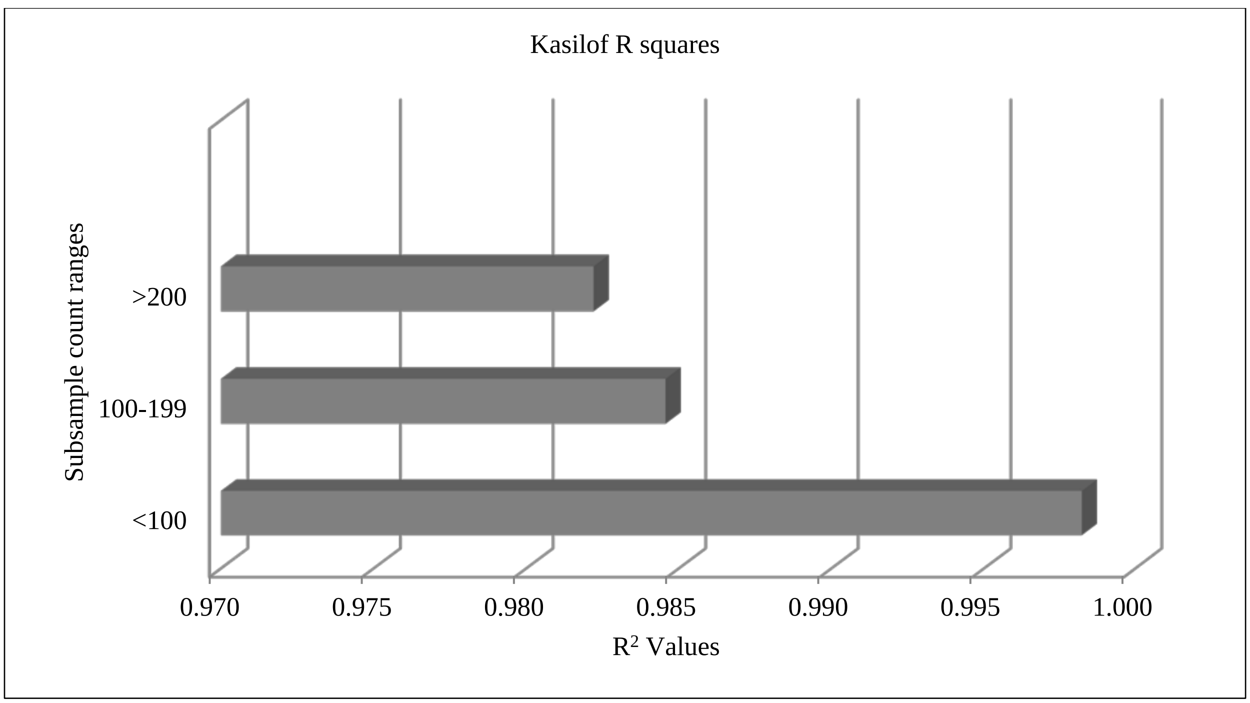


Figure 10.–Average R^2's among observer subsample counts for Kenai and Kasilof river sonar crews.

APPENDIX A: KENAI RIVER DATA

Appendix A1.–Salmon escapement estimates (DIDSON) along the north bank of the Kenai River, 2015.

	Sockeye		Pink		Coho		Chinook	
Date	Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum
1 Jul	3,704	3,704	0	0	0	0	0	0
2 Jul	4,152	7,856	0	0	0	0	0	0
3 Jul	5,394	13,250	0	0	0	0	0	0
4 Jul	4,398	17,648	0	0	0	0	0	0
5 Jul	5,604	23,252	0	0	0	0	0	0
6 Jul	5,840	29,092	0	0	0	0	0	0
7 Jul	7,479	36,571	0	0	0	0	0	0
8 Jul	6,540	43,111	0	0	0	0	0	0
9 Jul	11,802	54,913	0	0	0	0	0	0
10 Jul	8,810	63,722	0	0	0	0	0	0
11 Jul	6,306	70,028	0	0	0	0	0	0
12 Jul	7,028	77,057	0	0	0	0	0	0
13 Jul	8,592	85,649	0	0	0	0	0	0
14 Jul	14,028	99,677	0	0	0	0	0	0
15 Jul	7,458	107,135	0	0	0	0	0	0
16 Jul	9,066	116,201	0	0	0	0	0	0
17 Jul	9,480	125,681	0	0	0	0	0	0
18 Jul	12,384	138,065	0	0	0	0	0	0
19 Jul	30,684	168,749	0	0	0	0	0	0
20 Jul	35,172	203,921	0	0	0	0	0	0
21 Jul	18,354	222,275	0	0	0	0	0	0
22 Jul	11,568	233,843	0	0	0	0	0	0
23 Jul	36,228	270,071	0	0	0	0	0	0
24 Jul	30,630	300,701	0	0	0	0	0	0
25 Jul	35,274	335,975	0	0	0	0	0	0
26 Jul	29,115	365,089	0	0	0	0	0	0
27 Jul	25,276	390,365	0	0	0	0	0	0
28 Jul	26,012	416,377	0	0	0	0	0	0
29 Jul	20,700	437,077	0	0	0	0	0	0
30 Jul	16,782	453,859	0	0	0	0	0	0
31 Jul	12,189	466,048	0	0	0	0	0	0
1 Aug	24,660	490,708	0	0	0	0	0	0
2 Aug	14,507	505,215	0	0	0	0	0	0
3 Aug	13,271	518,486	0	0	0	0	0	0
4 Aug	11,316	529,802	0	0	0	0	0	0
5 Aug	24,498	554,300	0	0	0	0	0	0
6 Aug	18,636	572,936	0	0	0	0	0	0
7 Aug	16,972	589,908	0	0	0	0	0	0
8 Aug	22,061	611,970	0	0	0	0	0	0
9 Aug	16,260	628,230	0	0	0	0	0	0

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	Sockeye		Pink		Coho		Chinook	
Date	Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum
10 Aug	13,548	641,778	0	0	0	0	0	0
11 Aug	16,806	658,584	0	0	0	0	0	0
12 Aug	16,560	675,144	0	0	0	0	0	0
13 Aug	17,484	692,628	0	0	0	0	0	0
14 Aug	18,300	710,928	0	0	0	0	0	0
15 Aug	15,786	726,714	0	0	0	0	0	0
16 Aug	15,678	742,392	0	0	0	0	0	0
17 Aug	13,486	755,877	0	0	0	0	0	0
18 Aug	10,452	766,329	0	0	0	0	0	0
19 Aug	20,928	787,257	0	0	0	0	0	0
20 Aug	25,008	812,265	0	0	0	0	0	0
21 Aug	11,180	823,445	0	0	0	0	0	0
22 Aug	10,098	833,543	0	0	0	0	0	0
23 Aug	11,982	845,525	0	0	0	0	0	0
24 Aug	16,284	861,809	0	0	0	0	0	0
25 Aug	11,638	873,447	0	0	0	0	0	0
26 Aug	6,656	880,103	0	0	0	0	0	0
Sockeye 95% CI		879,998–880,208						

Appendix A2.–Salmon escapement estimates (DIDSON) along the south bank of the Kenai river, 2015.

	Sockeye		Pink		Coho		Chinook	
Date	Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum
1 Jul	1,176	1,176	0	0	0	0	0	0
2 Jul	1,698	2,874	0	0	0	0	0	0
3 Jul	2,264	5,138	0	0	0	0	0	0
4 Jul	3,000	8,138	0	0	0	0	0	0
5 Jul	2,988	11,126	0	0	0	0	0	0
6 Jul	5,454	16,580	0	0	0	0	0	0
7 Jul	5,808	22,388	0	0	0	0	0	0
8 Jul	6,300	28,688	0	0	0	0	0	0
9 Jul	10,968	39,656	0	0	0	0	0	0
10 Jul	6,778	46,433	0	0	0	0	0	0
11 Jul	5,829	52,262	0	0	0	0	0	0
12 Jul	5,345	57,607	0	0	0	0	0	0
13 Jul	11,580	69,187	0	0	0	0	0	0
14 Jul	10,716	79,903	0	0	0	0	0	0
15 Jul	7,690	87,593	0	0	0	0	0	0
16 Jul	9,048	96,641	0	0	0	0	0	0
17 Jul	8,049	104,690	0	0	0	0	0	0
18 Jul	7,625	112,315	0	0	0	0	0	0
19 Jul	18,474	130,789	0	0	0	0	0	0
20 Jul	18,428	149,217	0	0	0	0	0	0
21 Jul	14,193	163,409	0	0	0	0	0	0
22 Jul	15,694	179,103	0	0	0	0	0	0
23 Jul	38,922	218,026	0	0	0	0	0	0
24 Jul	26,650	244,676	0	0	0	0	0	0
25 Jul	36,826	281,501	0	0	0	0	0	0
26 Jul	37,327	318,829	0	0	0	0	0	0
27 Jul	24,473	343,302	0	0	0	0	0	0
28 Jul	32,973	376,275	0	0	0	0	0	0
29 Jul	20,920	397,196	0	0	0	0	0	0
30 Jul	18,009	415,204	0	0	0	0	0	0
31 Jul	9,376	424,580	0	0	0	0	0	0
1 Aug	18,070	442,650	0	0	0	0	0	0
2 Aug	21,468	464,118	0	0	0	0	0	0
3 Aug	10,793	474,911	0	0	0	0	0	0
4 Aug	10,427	485,338	0	0	0	0	0	0
5 Aug	23,820	509,158	0	0	0	0	0	0
6 Aug	24,402	533,560	0	0	0	0	0	0
7 Aug	26,457	560,017	0	0	0	0	0	0
8 Aug	24,570	584,586	0	0	0	0	0	0
9 Aug	12,606	597,192	0	0	0	0	0	0

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Appendix A2.–Page 2 of 2.

	Sockeye		Pink		Coho		Chinook	
Date	Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum
10 Aug	10,351	607,544	0	0	0	0	0	0
11 Aug	20,016	627,560	0	0	0	0	0	0
12 Aug	16,140	643,700	0	0	0	0	0	0
13 Aug	12,927	656,626	0	0	0	0	0	0
14 Aug	17,517	674,143	0	0	0	0	0	0
15 Aug	18,615	692,758	0	0	0	0	0	0
16 Aug	20,543	713,301	0	0	0	0	0	0
17 Aug	15,366	728,667	0	0	0	0	0	0
18 Aug	9,918	738,584	0	0	0	0	0	0
19 Aug	11,663	750,247	0	0	0	0	0	0
20 Aug	17,015	767,262	0	0	0	0	0	0
21 Aug	11,402	778,664	0	0	0	0	0	0
22 Aug	9,055	787,720	0	0	0	0	0	0
23 Aug	12,364	800,083	0	0	0	0	0	0
24 Aug	10,626	810,709	0	0	0	0	0	0
25 Aug	11,470	822,180	0	0	0	0	0	0
26 Aug	6,768	828,948	0	0	0	0	0	0
Sockeye 95% CI	828,846–829,049							

Appendix A3.–Kenai River north bank DIDSON estimates (all species) by day and hour, 2015.

	Estimates by hour											
Date	1	2	3	4	5	6	7	8	9	10	11	12
1 Jul	222	96	102	60	(12)	54	108	48	108	120	186	174
2 Jul	138	108	84	54	48	54	90	114	150	114	192	126
3 Jul	168	144	36	54	126	102	72	240	342	318	462	396
4 Jul	132	156	18	84	192	102	300	168	324	198	126	162
5 Jul	258	162	162	66	96	60	210	234	198	198	402	432
6 Jul	312	348	108	114	180	132	246	108	138	282	180	198
7 Jul	252	234	222	129	120	258	306	342	684	306	216	756
8 Jul	294	174	90	126	126	228	96	300	156	192	120	246
9 Jul	354	468	276	210	156	120	162	636	1,044	342	414	324
10 Jul	444	210	258	300	186	132	294	312	600	540	576	1,176
11 Jul	120	150	186	42	78	54	162	156	96	48	90	294
12 Jul	222	276	174	66	102	150	222	498	486	432	600	558
13 Jul	144	210	132	84	96	222	396	426	258	414	438	522
14 Jul	552	684	642	420	66	120	174	498	654	858	654	486
15 Jul	72	390	138	252	258	90	222	522	390	474	258	630
16 Jul	150	156	108	72	60	264	24	78	126	264	180	612
17 Jul	150	90	84	66	222	384	294	552	390	348	330	450
18 Jul	222	114	24	60	72	216	126	48	42	138	78	12
19 Jul	768	852	420	300	240	402	306	492	1,284	870	462	1,356
20 Jul	1,614	882	1,188	474	330	504	168	486	888	1,032	1,248	726
21 Jul	1,554	498	456	234	204	390	312	564	714	378	672	1,014
22 Jul	120	138	186	252	246	270	420	210	210	288	234	318
23 Jul	600	576	486	246	300	1,158	366	750	684	816	984	1,896
24 Jul	1,794	1,806	1,494	918	588	1,248	846	1,134	1,098	1,368	936	1,452
25 Jul	558	672	204	642	456	408	390	336	732	864	900	1,026
26 Jul	984	1,128	840	726	714	318	300	738	1,284	828	1,608	660
27 Jul	1,248	1,380	354	660	276	300	204	390	426	900	1,176	1,596
28 Jul	354	696	510	564	432	318	318	276	1,014	1,182	1,170	876
29 Jul	438	372	324	306	264	504	276	990	402	1,062	768	1,038
30 Jul	612	996	1,140	414	252	420	330	702	582	444	1,296	780
31 Jul	312	186	588	438	276	576	222	288	258	456	138	486

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	Estimates by hour												Daily
Date	13	14	15	16	17	18	19	20	21	22	23	24	total
1 Jul	414	294	234	222	168	228	216	198	168	90	132	74	3,704
2 Jul	42	390	456	264	366	126	144	150	282	246	204	210	4,152
3 Jul	288	234	354	318	318	288	210	102	186	114	276	246	5,394
4 Jul	378	216	270	318	90	114	96	54	192	246	240	222	4,398
5 Jul	426	270	318	294	414	198	138	156	186	180	228	318	5,604
6 Jul	306	318	234	720	678	258	174	126	144	138	318	80	5,840
7 Jul	438	600	414	360	228	378	312	180	162	216	204	162	7,479
8 Jul	252	228	210	204	150	252	336	570	462	1,068	306	354	6,540
9 Jul	1,338	894	618	240	642	282	618	594	204	618	1,050	198	11,802
10 Jul	372	384	612	240	408	390	332	300	246	180	132	186	8,810
11 Jul	294	408	246	168	324	798	618	504	252	324	540	354	6,306
12 Jul	522	810	318	222	156	144	284	162	216	156	108	144	7,028
13 Jul	366	264	1,080	186	426	264	198	732	612	336	162	624	8,592
14 Jul	612	828	1,614	618	744	978	732	432	378	768	288	228	14,028
15 Jul	372	282	384	552	456	204	300	276	198	324	288	126	7,458
16 Jul	282	378	792	546	1,050	744	330	372	498	978	516	486	9,066
17 Jul	432	402	438	702	744	696	618	438	510	528	270	342	9,480
18 Jul	72	186	258	246	702	750	1,212	1,368	1,926	1,662	1,656	1,194	12,384
19 Jul	1,116	1,272	966	1,236	1,974	1,440	2,190	2,172	3,498	2,172	2,352	2,544	30,684
20 Jul	1,158	1,560	1,704	1,734	2,844	2,520	1,710	2,358	2,466	3,870	1,722	1,986	35,172
21 Jul	1,386	474	684	636	1,386	810	498	1,500	1,164	1,284	774	768	18,354
22 Jul	384	348	642	558	594	516	642	918	1,068	486	1,692	828	11,568
23 Jul	2,406	2,214	2,154	2,520	2,118	2,184	1,980	2,196	2,106	3,216	1,896	2,376	36,228
24 Jul	1,962	1,686	1,902	1,344	1,164	1,602	1,068	942	1,290	1,632	666	690	30,630
25 Jul	2,046	1,638	594	2,046	2,094	3,396	2,646	3,162	2,382	2,778	2,640	2,664	35,274
26 Jul	1,230	1,290	1,698	1,824	2,100	2,394	1,584	1,801	1,461	1,007	1,242	1,356	29,115
27 Jul	948	2,232	1,608	894	1,674	1,572	862	1,170	1,596	1,440	1,680	690	25,276
28 Jul	498	1,740	2,046	2,448	2,352	2,090	2,070	2,604	792	726	606	330	26,012
29 Jul	1,464	1,356	684	1,458	816	858	1,422	1,158	1,380	1,236	858	1,266	20,700
30 Jul	756	726	912	1,602	1,002	834	630	540	432	594	438	348	16,782
31 Jul	432	492	444	798	954	540	882	414	570	861	870	708	12,189

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	Estimates by hour											
Date	1	2	3	4	5	6	7	8	9	10	11	12
1 Aug	762	684	588	612	510	480	1,236	996	1,482	858	1,632	852
2 Aug	528	348	786	678	960	960	1,200	1,194	1,128	450	750	252
3 Aug	486	888	612	792	870	630	744	714	972	348	450	666
4 Aug	360	426	492	1,020	678	528	582	1,134	1,002	546	660	234
5 Aug	558	504	672	924	1,038	1,062	672	1,032	888	1,104	1,272	756
6 Aug	1,374	1,266	1,014	1,398	1,278	1,512	1,254	774	1,044	990	612	426
7 Aug	150	558	792	490	1,074	1,566	1,566	1,098	708	1,044	762	864
8 Aug	804	444	606	558	360	744	1,128	2,040	1,482	1,662	2,693	774
9 Aug	1,722	924	912	654	396	690	732	1,002	1,026	606	636	672
10 Aug	1,362	1,092	528	498	642	438	264	810	864	540	564	888
11 Aug	996	678	648	348	384	990	906	1,296	2,058	846	474	780
12 Aug	888	870	654	288	258	606	1,044	456	1,182	960	420	372
13 Aug	1,746	1,620	822	600	378	636	558	906	924	558	576	678
14 Aug	936	696	702	504	216	456	534	744	990	1,026	954	1,032
15 Aug	606	930	492	618	600	636	912	738	522	630	330	630
16 Aug	288	402	672	270	348	534	732	588	1,326	804	234	756
17 Aug	270	540	624	480	528	612	1,284	666	948	270	744	498
18 Aug	312	228	594	576	534	816	486	342	288	714	540	540
19 Aug	480	498	408	618	504	360	642	498	1,476	1,014	576	1,242
20 Aug	1,182	792	834	924	1,128	1,164	1,020	858	1,608	1,422	1,452	1,296
21 Aug	516	354	444	438	402	396	504	522	654	558	438	512
22 Aug	330	246	114	162	174	336	546	288	426	252	342	558
23 Aug	258	372	234	282	306	156	372	396	606	630	804	570
24 Aug	540	276	564	330	576	288	684	720	540	564	768	1,050
25 Aug	204	342	252	234	82	240	708	810	402	438	708	642
26 Aug	336	468	348	308	330	324	276	330	318	396	462	198
Total	33,156	30,798	26,442	23,037	21,304	26,718	28,548	33,588	40,626	35,304	36,947	38,516
%	3.8	3.5	3.0	2.6	2.4	3.0	3.2	3.8	4.6	4.0	4.2	4.4
Cum	3.8	7.3	10.3	12.9	15.3	18.3	21.6	25.4	30.0	34.0	38.2	42.6

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Appendix A3.–Page 4 of 4.

	Estimates by hour												Daily
Date	13	14	15	16	17	18	19	20	21	22	23	24	total
1 Aug	360	834	1,512	2,388	924	852	792	942	1,368	888	1,680	1,428	24,660
2 Aug	288	642	450	762	324	426	480	257	210	450	372	612	14,507
3 Aug	408	408	318	852	798	282	336	240	270	257	462	468	13,271
4 Aug	498	198	162	258	414	366	354	204	120	282	384	414	11,316
5 Aug	666	744	726	924	768	1,566	2,208	1,266	1,248	1,362	1,692	846	24,498
6 Aug	384	246	546	468	432	540	900	630	354	282	348	564	18,636
7 Aug	1,176	1,314	294	642	180	288	360	324	366	384	474	498	16,972
8 Aug	1,944	1,266	594	672	690	384	360	288	336	600	1,098	534	22,061
9 Aug	510	318	270	162	240	522	294	270	450	792	774	1,686	16,260
10 Aug	240	780	354	288	354	264	294	612	534	312	336	690	13,548
11 Aug	378	810	786	570	576	690	534	810	312	348	204	384	16,806
12 Aug	816	918	648	1,002	744	636	498	996	606	486	492	720	16,560
13 Aug	696	954	1,200	414	426	948	546	354	480	462	438	564	17,484
14 Aug	894	588	438	1,230	1,026	564	738	966	996	924	732	414	18,300
15 Aug	804	744	498	624	624	420	522	882	840	636	936	612	15,786
16 Aug	338	522	1,074	546	954	462	570	870	960	978	1,108	342	15,678
17 Aug	696	576	624	600	942	282	354	322	258	378	558	432	13,486
18 Aug	438	228	384	144	456	528	306	336	282	282	576	522	10,452
19 Aug	594	750	456	468	1,230	1,656	2,016	966	1,200	1,092	1,164	1,020	20,928
20 Aug	1,026	654	702	1,278	888	1,530	1,356	1,008	480	828	870	708	25,008
21 Aug	894	450	402	384	282	162	138	222	402	792	822	492	11,180
22 Aug	1,374	792	780	612	336	240	204	138	132	342	894	480	10,098
23 Aug	582	540	450	354	1,098	564	468	846	798	918	258	120	11,982
24 Aug	864	990	1,344	924	672	624	540	1,332	882	726	336	150	16,284
25 Aug	858	942	852	942	690	456	264	192	204	666	306	204	11,638
26 Aug	348	378	300	222	156	150	138	132	108	90	336	204	6,656
Total	41,066	42,000	41,052	43,248	45,360	43,250	40,622	43,054	41,223	45,031	42,004	37,209	880,103
%	4.7	4.8	4.7	4.9	5.2	4.9	4.6	4.9	4.7	5.1	4.8	4.2	1.000
Cum	47.3	52.0	56.7	61.6	66.8	71.7	76.3	81.2	85.9	91.0	95.8	100.0	
95% Confidence interval			879,998–880,208										

Appendix A4.–Kenai River south bank DIDSON estimates (all species) by day and hour, 2015.

	Estimates by hour											
Date	1	2	3	4	5	6	7	8	9	10	11	12
1 Jul	18	48	30	6	0	0	42	36	36	48	30	18
2 Jul	66	30	24	18	30	24	36	36	54	108	48	60
3 Jul	96	66	90	66	6	24	18	102	33	156	54	90
4 Jul	102	90	72	54	66	30	84	66	90	156	84	258
5 Jul	60	90	42	108	30	18	48	42	108	120	126	138
6 Jul	114	108	126	54	54	42	54	42	114	198	282	360
7 Jul	210	204	54	72	36	60	174	150	468	240	354	420
8 Jul	204	132	96	72	54	114	78	120	54	96	150	168
9 Jul	192	282	84	72	72	18	96	54	54	498	762	444
10 Jul	276	108	162	60	18	24	102	234	606	846	438	372
11 Jul	270	264	150	66	12	72	90	66	234	150	120	288
12 Jul	222	438	78	36	34	60	48	132	228	228	324	534
13 Jul	174	132	36	78	54	60	168	282	324	330	258	972
14 Jul	186	336	144	60	72	138	192	408	612	510	906	372
15 Jul	702	528	360	126	84	210	312	324	510	540	552	246
16 Jul	120	132	24	30	24	72	162	60	108	252	246	342
17 Jul	210	282	102	48	60	201	294	246	540	276	486	612
18 Jul	78	114	84	48	48	48	132	53	36	108	78	102
19 Jul	1,236	522	312	72	30	372	360	564	1,056	1,356	540	942
20 Jul	648	840	247	55	42	246	444	258	756	636	570	372
21 Jul	1,269	846	318	222	96	402	528	612	618	348	720	798
22 Jul	492	114	66	18	36	138	157	134	102	318	240	444
23 Jul	1,224	474	450	96	42	324	432	1,026	1,878	2,052	1,560	2,154
24 Jul	1,698	1,230	576	162	246	630	522	1,848	1,404	1,566	1,254	1,554
25 Jul	912	576	588	366	120	210	348	306	492	828	564	842
26 Jul	1,338	462	852	438	240	444	444	1,392	2,610	2,748	2,052	2,832
27 Jul	816	510	336	168	41	162	174	702	660	1,080	1,008	990
28 Jul	552	216	396	150	150	108	414	306	810	1,692	1,608	1,338
29 Jul	894	672	366	234	66	192	432	654	1,248	1,356	1,110	828
30 Jul	822	390	264	144	96	192	288	384	609	1,758	1,548	744
31 Jul	246	234	258	198	78	81	180	198	420	786	582	222

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Appendix A4.–Page 2 of 4.

Date	Estimates by hour												Daily
	13	14	15	16	17	18	19	20	21	22	23	24	total
1 Jul	24	108	168	90	60	48	72	54	60	60	42	78	1,176
2 Jul	72	96	72	96	96	48	78	102	192	138	102	72	1,698
3 Jul	108	186	138	126	216	150	42	66	100	174	42	114	2,264
4 Jul	264	396	252	96	96	60	78	48	108	144	222	84	3,000
5 Jul	348	198	198	162	174	192	66	132	138	114	168	168	2,988
6 Jul	438	234	384	414	510	336	108	408	102	294	306	372	5,454
7 Jul	276	210	252	480	378	546	198	396	204	168	96	162	5,808
8 Jul	180	168	132	276	258	498	642	696	1,104	438	342	228	6,300
9 Jul	414	210	462	540	1,218	1,080	666	630	942	846	876	456	10,968
10 Jul	276	186	288	372	366	174	180	334	276	192	408	480	6,778
11 Jul	300	504	462	588	480	207	438	354	174	54	276	210	5,829
12 Jul	342	534	546	264	187	258	324	126	186	150	18	48	5,345
13 Jul	1,116	1,140	642	990	648	648	1,398	696	450	426	384	174	11,580
14 Jul	786	1,020	726	534	498	642	402	534	414	414	312	498	10,716
15 Jul	348	264	192	486	298	312	156	294	354	210	192	90	7,690
16 Jul	420	588	612	504	246	306	318	618	696	1,266	924	978	9,048
17 Jul	558	354	336	372	444	510	594	414	210	318	354	228	8,049
18 Jul	186	174	270	360	408	876	690	618	732	714	792	876	7,625
19 Jul	1,146	480	954	1,044	582	816	966	666	1,542	1,464	498	954	18,474
20 Jul	1,032	828	714	852	1,116	1,824	1,746	1,254	1,062	1,434	906	546	18,428
21 Jul	750	1,194	558	534	786	504	762	510	510	396	576	336	14,193
22 Jul	486	540	462	624	806	924	1,008	1,032	2,160	2,370	1,428	1,596	15,694
23 Jul	2,268	2,376	1,962	1,827	1,695	1,356	1,734	2,394	3,270	3,570	2,478	2,280	38,922
24 Jul	1,668	1,162	1,128	816	1,038	1,248	840	942	1,044	930	1,842	1,302	26,650
25 Jul	1,648	2,274	984	1,650	1,926	2,166	3,258	2,514	5,434	3,246	3,276	2,298	36,826
26 Jul	2,832	1,992	2,100	2,418	2,148	1,080	1,182	2,401	1,566	1,518	1,398	840	37,327
27 Jul	1,956	2,166	1,536	1,338	2,118	2,544	1,044	1,710	894	1,410	612	498	24,473
28 Jul	1,244	2,756	2,910	2,940	2,676	3,102	2,112	1,458	2,388	1,656	1,242	750	32,973
29 Jul	1,602	1,104	1,740	1,098	1,170	1,500	912	762	1,158	880	462	480	20,920
30 Jul	1,272	1,266	1,398	1,236	1,512	738	738	660	870	426	354	300	18,009
31 Jul	492	384	456	744	480	438	534	690	384	600	492	198	9,376

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Appendix A4.–Page 3 of 4.

Date	Estimates by hour 1	2	3	4	5	6	7	8	9	10	11	12
1 Aug	120	132	258	174	228	174	438	414	846	1,296	816	636
2 Aug	792	1,866	1,392	510	438	558	816	1,056	1,260	2,196	948	1,650
3 Aug	234	318	498	282	258	378	306	588	609	762	480	324
4 Aug	348	216	462	450	204	168	324	918	822	755	444	504
5 Aug	192	108	306	600	342	318	792	438	1,734	1,488	1,074	918
6 Aug	384	774	636	438	1,284	786	1,950	1,782	1,638	1,842	2,136	1,530
7 Aug	756	438	324	186	372	858	996	2,190	2,424	1,566	3,060	3,624
8 Aug	486	534	420	396	186	498	1,536	918	996	1,019	720	948
9 Aug	978	528	192	138	162	216	426	894	906	786	1,134	708
10 Aug	288	258	211	108	108	102	156	564	414	450	696	864
11 Aug	378	300	234	192	102	186	180	240	1,518	2,034	1,152	2,196
12 Aug	378	258	102	54	54	150	426	240	480	558	528	606
13 Aug	456	522	156	192	266	252	570	534	576	894	648	582
14 Aug	132	348	423	168	66	138	498	642	684	900	942	510
15 Aug	168	198	240	270	210	78	546	444	732	862	954	942
16 Aug	150	228	210	168	210	282	672	612	1,032	1,716	1,116	1,422
17 Aug	438	348	372	409	552	384	624	426	1,188	1,182	1,098	600
18 Aug	138	126	240	192	252	216	342	312	588	594	372	504
19 Aug	168	156	60	90	66	42	108	287	288	234	348	432
20 Aug	270	186	192	216	252	263	492	474	564	990	1,104	762
21 Aug	366	132	68	168	96	120	300	474	276	408	288	576
22 Aug	150	169	96	60	96	114	228	456	282	318	300	528
23 Aug	318	168	246	186	84	114	240	390	216	414	348	288
24 Aug	360	222	186	168	234	72	168	126	342	486	294	474
25 Aug	163	133	208	264	288	306	234	624	486	606	456	497
26 Aug	162	84	144	114	114	90	78	144	132	456	720	156
Total	24,219	19,220	14,664	9,590	8,561	11,579	20,298	27,023	37,905	46,195	40,830	42,637
%	2.9	2.3	1.8	1.2	1.0	1.4	2.4	3.3	4.6	5.6	4.9	5.1
Cum	2.9	5.2	7.0	8.2	9.2	10.6	13.0	16.3	20.9	26.4	31.4	36.5

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Appendix A4.–Page 4 of 4.

Date	Estimates by hour 13	14	15	16	17	18	19	20	21	22	23	24	Daily total
1 Aug	624	720	2,400	1,422	942	570	756	834	1,518	1,558	600	594	18,070
2 Aug	1,008	948	1,206	1,116	846	252	468	396	486	438	510	312	21,468
3 Aug	480	480	594	696	738	471	432	312	324	450	468	312	10,793
4 Aug	252	336	432	360	696	582	306	300	222	450	420	456	10,427
5 Aug	618	780	498	2,592	2,352	1,452	798	504	468	1,566	1,860	2,022	23,820
6 Aug	840	966	582	546	606	642	516	738	942	534	804	1,506	24,402
7 Aug	1,179	1,548	1,032	744	726	672	444	678	906	750	624	360	26,457
8 Aug	2,562	1,800	1,710	876	732	594	1,001	1,388	1,410	1,926	996	918	24,570
9 Aug	816	612	588	306	480	282	366	444	564	306	426	348	12,606
10 Aug	1,080	576	546	768	348	462	450	570	294	228	462	348	10,351
11 Aug	2,358	1,950	1,758	1,116	804	804	522	336	378	504	474	300	20,016
12 Aug	2,298	1,116	1,638	1,164	1,224	900	1,014	660	1,002	564	372	354	16,140
13 Aug	852	1,632	727	1,002	720	354	186	570	462	480	114	180	12,927
14 Aug	989	2,616	1,848	1,374	834	852	684	972	786	468	420	222	17,517
15 Aug	822	1,998	2,040	2,220	1,398	966	810	558	702	630	522	306	18,615
16 Aug	1,014	762	1,950	2,214	1,572	1,152	485	1,092	1,014	702	534	234	20,543
17 Aug	816	720	1,386	617	1,056	762	456	414	384	540	366	228	15,366
18 Aug	738	378	534	978	852	684	528	438	264	264	264	120	9,918
19 Aug	780	906	594	894	1,044	888	1,068	858	954	540	576	282	11,663
20 Aug	918	1,176	546	492	828	1,518	1,668	1,476	984	834	480	330	17,015
21 Aug	498	822	828	552	726	864	894	984	660	576	426	300	11,402
22 Aug	654	552	708	738	450	600	558	732	396	504	144	222	9,055
23 Aug	660	684	1,188	660	882	960	963	991	624	876	666	198	12,364
24 Aug	552	486	1,104	474	1,062	888	852	786	468	396	330	96	10,626
25 Aug	702	684	630	858	804	666	600	864	606	210	366	216	11,470
26 Aug	618	792	240	276	444	450	336	498	288	138	168	126	6,768
Total	49,580	51,131	50,341	48,926	47,799	44,418	40,448	41,905	45,830	42,453	34,812	28,584	828,948
%	6.0	6.2	6.1	5.9	5.8	5.4	4.9	5.1	5.5	5.1	4.2	3.4	
Cum	42.5	48.7	54.7	60.6	66.4	71.8	76.6	81.7	87.2	92.4	96.6	100.0	
95% Confidence interval													828,846–829,049

APPENDIX B: KASILOF RIVER DATA

Appendix B1.–Estimated sockeye salmon escapement (DIDSON) along the north bank of the Kasilof River, 2015.

Date	Daily	Cum	Date	Daily	Cum
15 Jun	3,864	3,864	16 Jul	7,650	157,859
16 Jun	3,288	7,152	17 Jul	3,510	161,369
17 Jun	2,124	9,276	18 Jul	5,112	166,481
18 Jun	3,864	13,140	19 Jul	10,020	176,501
19 Jun	6,885	20,025	20 Jul	8,022	184,522
20 Jun	8,454	28,479	21 Jul	8,856	193,378
21 Jun	10,266	38,745	22 Jul	5,970	199,348
22 Jun	5,603	44,348	23 Jul	10,243	209,592
23 Jun	3,300	47,648	24 Jul	6,426	216,018
24 Jun	8,622	56,270	25 Jul	9,222	225,240
25 Jun	1,716	57,986	26 Jul	8,783	234,022
26 Jun	2,598	60,584	27 Jul	9,240	243,262
27 Jun	2,824	63,407	28 Jul	5,556	248,818
28 Jun	2,022	65,429	29 Jul	4,386	253,204
29 Jun	5,004	70,433	30 Jul	3,654	256,858
30 Jun	1,638	72,071	31 Jul	3,570	260,428
1 Jul	2,634	74,705	1 Aug	2,670	263,098
2 Jul	4,194	78,899	2 Aug	1,878	264,976
3 Jul	2,220	81,119	3 Aug	3,858	268,834
4 Jul	3,720	84,839	4 Aug	3,564	272,398
5 Jul	2,772	87,611	5 Aug	6,210	278,608
6 Jul	8,106	95,717	6 Aug	5,160	283,768
7 Jul	5,550	101,267	7 Aug	3,138	286,906
8 Jul	3,528	104,795	8 Aug	2,946	289,852
9 Jul	6,996	111,791	9 Aug	2,684	292,536
10 Jul	6,030	117,821	10 Aug	2,250	294,786
11 Jul	4,650	122,471	11 Aug	4,926	299,712
12 Jul	4,242	126,713	12 Aug	2,616	302,328
13 Jul	5,532	132,245	13 Aug	1,992	304,320
14 Jul	8,010	140,255	14 Aug	1,980	306,300
15 Jul	9,954	150,209			
Sockeye 95% CI				305,422–307,179	

Appendix B2.–Estimated sockeye salmon escapement (DIDSON) along the south bank of the Kasilof River, 2015.

Date	Daily	Cum	Date	Daily	Cum
15 Jun	5,214	5,214	16 Jul	3,150	121,767
16 Jun	3,642	8,856	17 Jul	1,416	123,183
17 Jun	4,782	13,638	18 Jul	1,890	125,073
18 Jun	3,216	16,854	19 Jul	2,706	127,779
19 Jun	4,440	21,294	20 Jul	2,874	130,653
20 Jun	6,912	28,206	21 Jul	3,390	134,043
21 Jun	5,688	33,894	22 Jul	1,866	135,909
22 Jun	7,062	40,956	23 Jul	1,919	137,828
23 Jun	3,492	44,448	24 Jul	1,896	139,724
24 Jun	8,394	52,842	25 Jul	1,896	141,620
25 Jun	1,626	54,468	26 Jul	1,680	143,300
26 Jun	2,442	56,910	27 Jul	2,249	145,549
27 Jun	2,964	59,874	28 Jul	1,049	146,598
28 Jun	2,244	62,118	29 Jul	1,410	148,008
29 Jun	6,804	68,922	30 Jul	900	148,908
30 Jun	2,430	71,352	31 Jul	1,032	149,940
1 Jul	2,586	73,938	1 Aug	498	150,438
2 Jul	4,470	78,408	2 Aug	852	151,290
3 Jul	1,902	80,310	3 Aug	822	152,112
4 Jul	4,866	85,176	4 Aug	1,170	153,282
5 Jul	2,442	87,618	5 Aug	1,368	154,650
6 Jul	8,076	95,694	6 Aug	780	155,430
7 Jul	3,228	98,922	7 Aug	882	156,312
8 Jul	1,620	100,542	8 Aug	1,110	157,422
9 Jul	1,734	102,276	9 Aug	1,080	158,502
10 Jul	1,902	104,178	10 Aug	1,200	159,702
11 Jul	1,836	106,014	11 Aug	1,206	160,908
12 Jul	2,019	108,033	12 Aug	1,272	162,180
13 Jul	3,798	111,831	13 Aug	870	163,050
14 Jul	3,930	115,761	14 Aug	1,326	164,376
15 Jul	2,856	118,617			
Sockeye 95% CI					164,113–164,639

Appendix B3.–Kasilof river north bank DIDSON subsample estimates by day and hour, 2015.

	Estimates by hour											
Date	1	2	3	4	5	6	7	8	9	10	11	12
15 Jun	192	168	84	90	408	450	102	138	168	102	48	78
16 Jun	270	306	348	126	198	564	192	78	150	24	84	48
17 Jun	66	60	84	72	90	228	180	60	108	18	102	108
18 Jun	246	192	108	60	12	90	132	90	60	60	114	90
19 Jun	330	396	264	204	216	78	168	174	183	174	228	252
20 Jun	600	240	108	174	84	126	48	174	72	162	138	294
21 Jun	756	390	186	198	144	210	120	234	198	780	66	144
22 Jun	414	540	486	234	192	300	162	169	144	132	84	102
23 Jun	138	66	84	72	18	30	30	0	12	18	48	66
24 Jun	408	168	96	72	90	150	138	132	96	150	312	378
25 Jun	228	162	78	42	90	48	60	102	72	138	12	30
26 Jun	24	60	48	102	72	54	54	72	66	36	36	78
27 Jun	144	246	180	108	36	144	264	144	228	132	180	102
28 Jun	42	42	60	102	30	66	84	36	36	42	54	6
29 Jun	84	132	222	480	306	96	120	96	108	150	42	42
30 Jun	30	78	24	78	108	18	60	54	60	18	54	42
1 Jul	36	54	18	30	132	54	12	54	240	108	72	24
2 Jul	126	102	132	90	138	552	600	258	450	222	108	60
3 Jul	60	84	24	42	48	48	114	36	126	156	84	66
4 Jul	102	90	42	36	48	114	258	294	102	186	180	162
5 Jul	156	66	66	48	36	42	60	114	54	48	54	186
6 Jul	204	186	186	150	60	156	144	156	450	594	294	246
7 Jul	420	396	366	330	150	84	30	48	60	360	372	108
8 Jul	372	407	311	239	105	55	51	38	18	42	96	384
9 Jul	312	126	102	84	132	72	48	72	126	108	114	114
10 Jul	240	102	162	120	114	126	150	132	66	84	42	102
11 Jul	78	300	486	384	234	216	174	210	72	180	72	18
12 Jul	24	12	18	30	36	48	108	126	168	144	168	48
13 Jul	216	204	210	420	252	288	402	510	294	330	90	174
14 Jul	60	114	30	78	492	444	222	246	348	450	516	246
15 Jul	180	126	18	48	6	228	522	132	204	576	288	498
16 Jul	192	168	198	276	348	384	678	312	318	840	366	372
17 Jul	132	150	120	54	48	54	30	258	192	144	198	216
18 Jul	72	24	42	6	54	54	66	66	300	258	168	246
19 Jul	564	282	162	354	102	96	114	174	492	702	432	540
20 Jul	246	216	138	126	54	180	276	192	300	750	504	444
21 Jul	150	90	102	30	36	66	102	180	108	510	510	810
22 Jul	354	414	342	240	114	216	354	228	90	210	768	564
23 Jul	120	180	144	114	108	126	396	246	486	348	600	1,050
24 Jul	282	222	246	168	114	156	342	258	216	114	114	132
25 Jul	138	216	78	66	114	348	258	594	504	420	222	270
26 Jul	42	174	186	126	42	36	216	222	444	564	342	474
27 Jul	24	24	54	12	24	144	426	822	462	324	234	504
28 Jul	66	114	84	48	132	240	276	420	234	240	264	282
29 Jul	60	54	48	36	120	384	342	270	306	180	168	126
30 Jul	48	36	42	36	96	108	330	168	180	180	240	180
31 Jul	66	18	30	48	48	36	162	276	102	330	264	258

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	Estimates by hour												Daily
Date	13	14	15	16	17	18	19	20	21	22	23	24	total
15 Jun	138	186	108	42	78	84	180	54	48	126	264	528	3,864
16 Jun	24	18	66	72	30	42	156	84	30	108	180	90	3,288
17 Jun	102	96	54	36	24	48	42	30	72	66	162	216	2,124
18 Jun	108	102	108	114	90	102	156	276	180	510	414	450	3,864
19 Jun	120	66	84	90	108	90	84	174	222	708	1,422	1,050	6,885
20 Jun	126	108	252	150	240	468	306	366	1,188	1,290	768	972	8,454
21 Jun	252	264	54	132	156	510	522	1,254	708	1,314	1,368	306	10,266
22 Jun	126	306	330	132	180	198	231	210	174	324	252	180	5,603
23 Jun	12	66	90	192	126	150	144	150	264	222	480	822	3,300
24 Jun	576	480	618	552	726	360	384	264	306	846	672	648	8,622
25 Jun	132	150	78	42	54	42	24	36	18	6	42	30	1,716
26 Jun	144	126	132	402	168	264	126	114	84	96	132	108	2,598
27 Jun	42	138	60	252	72	78	48	66	42	30	44	43	2,824
28 Jun	12	24	54	84	198	174	168	270	138	120	72	108	2,022
29 Jun	54	24	84	90	396	846	600	270	342	156	222	42	5,004
30 Jun	66	36	48	96	48	210	84	36	156	120	96	18	1,638
1 Jul	114	54	60	78	114	150	300	102	174	228	270	156	2,634
2 Jul	36	102	24	72	72	12	246	294	54	204	156	84	4,194
3 Jul	66	48	0	24	24	36	84	192	132	198	222	306	2,220
4 Jul	120	114	96	12	90	108	174	384	504	66	240	198	3,720
5 Jul	162	138	120	156	204	150	48	186	162	138	132	246	2,772
6 Jul	498	336	378	330	216	396	186	372	354	912	762	540	8,106
7 Jul	198	222	126	168	204	156	138	60	198	204	696	456	5,550
8 Jul	282	168	144	48	126	66	24	78	18	66	72	318	3,528
9 Jul	498	792	822	642	744	636	468	246	246	192	96	204	6,996
10 Jul	168	228	648	690	762	438	552	360	252	210	108	174	6,030
11 Jul	138	90	120	576	378	192	264	162	96	84	84	42	4,650
12 Jul	198	138	162	312	372	306	210	324	474	528	42	246	4,242
13 Jul	192	96	102	126	180	300	318	330	192	210	48	48	5,532
14 Jul	426	318	504	240	348	288	906	492	216	294	396	336	8,010
15 Jul	354	432	288	462	294	264	792	582	288	780	1,260	1,332	9,954
16 Jul	246	336	324	216	246	228	210	588	174	162	198	270	7,650
17 Jul	174	198	36	90	90	24	114	78	276	306	246	282	3,510
18 Jul	504	270	240	390	114	174	228	168	396	630	186	456	5,112
19 Jul	918	906	858	702	432	342	294	132	216	636	348	222	10,020
20 Jul	564	756	378	318	450	408	486	486	258	324	702	252	8,808
21 Jul	756	576	624	360	318	348	318	354	402	306	1,116	684	8,856
22 Jul	486	300	288	162	84	66	138	18	66	102	156	210	5,970
23 Jul	1,272	1,296	1,026	552	270	246	528	330	246	282	126	444	10,536
24 Jul	432	468	438	528	318	180	528	264	258	228	246	174	6,426
25 Jul	324	408	906	1,308	1,248	498	372	132	438	156	168	36	9,222
26 Jul	498	498	600	888	612	893	720	396	300	312	150	48	8,783
27 Jul	282	300	396	516	678	1,326	912	534	210	270	558	204	9,240
28 Jul	276	108	144	174	258	420	594	276	504	204	114	84	5,556
29 Jul	72	246	42	132	246	258	276	132	456	126	150	156	4,386
30 Jul	222	102	150	258	90	126	132	372	120	174	180	84	3,654
31 Jul	180	90	168	174	102	150	108	348	114	102	228	168	3,570

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Date	Estimates by hour 1	2	3	4	5	6	7	8	9	10	11	12
1 Aug	138	84	66	84	72	90	318	138	132	54	282	180
2 Aug	96	6	30	48	24	12	36	282	66	24	90	66
3 Aug	150	102	42	66	24	60	24	36	294	108	144	300
4 Aug	60	96	84	78	30	24	48	30	96	270	36	30
5 Aug	252	288	312	108	162	126	108	42	42	228	738	336
6 Aug	96	120	42	12	24	102	198	54	102	84	90	366
7 Aug	180	120	66	90	48	42	120	108	84	6	90	114
8 Aug	126	138	90	108	108	102	174	120	132	90	84	132
9 Aug	36	66	72	58	74	88	104	86	108	120	84	132
10 Aug	84	60	48	72	90	54	78	54	6	60	24	42
11 Aug	150	12	60	48	96	228	336	366	168	216	144	84
12 Aug	120	78	72	48	48	102	192	90	144	192	162	108
13 Aug	60	66	72	42	42	84	126	108	72	36	108	42
14 Aug	72	84	36	48	36	30	78	144	42	84	132	60
Total	10,734	9,317	7,739	6,993	6,509	8,951	11,117	10,523	10,761	13,410	11,754	12,756
%	3.5	3.0	2.5	2.3	2.1	2.9	3.6	3.4	3.5	4.4	3.8	4.1
Cum	3.5	6.5	9.0	11.3	13.4	16.3	20.0	23.4	26.9	31.2	35.1	39.2

Date	Estimates by hour 13	14	15	16	17	18	19	20	21	22	23	24	Daily total
1 Aug	204	72	36	24	18	18	78	180	96	36	90	180	2,670
2 Aug	270	78	78	36	72	72	42	78	72	144	114	42	1,878
3 Aug	600	306	204	138	108	180	90	84	360	258	72	108	3,858
4 Aug	372	24	294	222	210	192	198	198	264	318	126	264	3,564
5 Aug	306	870	282	456	330	228	186	132	90	66	390	132	6,210
6 Aug	348	378	624	510	330	312	336	276	246	156	108	246	5,160
7 Aug	234	306	234	174	186	216	180	168	54	84	102	132	3,138
8 Aug	90	72	246	294	306	138	126	42	72	72	18	66	2,946
9 Aug	132	246	78	102	252	192	180	168	114	60	90	42	2,684
10 Aug	12	210	108	108	138	192	216	54	222	114	96	108	2,250
11 Aug	216	186	114	132	66	186	246	486	624	426	252	84	4,926
12 Aug	108	186	126	18	12	90	84	120	96	132	198	90	2,616
13 Aug	138	72	168	36	54	66	42	186	138	114	60	60	1,992
14 Aug	42	54	30	78	24	24	24	276	96	102	228	156	1,980
Total	15,762	15,384	15,054	15,510	14,484	14,957	15,951	14,874	14,310	16,758	17,990	15,781	307,379
%	5.1	5.0	4.9	5.0	4.7	4.9	5.2	4.8	4.7	5.5	5.9	5.1	
Cum	44.4	49.4	54.3	59.3	64.0	68.9	74.1	78.9	83.6	89.0	94.9	100.0	
95% Confidence interval										307,337–307,422			

Appendix B4.–Kasilof River south bank DIDSON subsample estimates by day and hour, 2015.

	Estimates by hour											
Date	1	2	3	4	5	6	7	8	9	10	11	12
15 Jun	30	114	186	228	384	438	348	180	480	354	264	162
16 Jun	276	198	174	252	162	210	72	90	84	42	108	60
17 Jun	546	402	306	294	156	240	162	60	84	96	48	84
18 Jun	300	246	192	246	78	66	174	198	66	156	234	234
19 Jun	192	156	234	270	246	246	198	486	66	102	90	114
20 Jun	330	348	264	192	174	84	132	312	288	210	204	1,080
21 Jun	252	402	216	276	162	180	162	264	492	198	150	180
22 Jun	258	282	348	588	468	300	198	168	288	408	222	168
23 Jun	180	114	108	72	84	36	6	18	42	30	36	132
24 Jun	336	306	438	276	234	90	84	48	90	270	144	660
25 Jun	306	96	120	84	24	36	48	30	90	54	48	108
26 Jun	12	18	36	54	24	42	24	6	18	54	48	60
27 Jun	192	252	144	60	96	138	480	108	42	198	120	78
28 Jun	66	54	78	60	66	42	42	30	48	90	30	78
29 Jun	126	174	174	930	744	612	396	180	48	84	114	60
30 Jun	66	12	60	96	198	48	120	138	102	24	36	90
1 Jul	24	6	42	54	120	126	54	144	96	48	60	84
2 Jul	78	96	114	144	90	654	642	90	414	372	360	42
3 Jul	78	54	36	18	6	84	156	84	96	300	144	108
4 Jul	138	162	78	96	108	150	162	666	78	312	660	426
5 Jul	90	78	30	48	18	12	24	54	216	108	162	30
6 Jul	546	468	330	192	276	204	234	414	912	912	282	360
7 Jul	288	192	186	102	120	66	60	78	126	168	204	132
8 Jul	66	96	96	108	102	84	36	6	48	78	66	114
9 Jul	54	84	84	36	30	6	54	60	6	30	36	54
10 Jul	36	54	144	48	54	84	90	78	48	126	126	102
11 Jul	84	150	258	210	198	186	78	30	90	42	66	30
12 Jul	33	0	42	66	72	18	138	60	72	30	84	156
13 Jul	168	102	96	324	720	252	402	252	234	162	42	156
14 Jul	54	120	48	12	150	240	60	156	360	240	150	180
15 Jul	54	42	54	30	6	60	216	120	228	198	240	120
16 Jul	378	288	72	114	54	156	180	228	54	24	198	114
17 Jul	120	90	78	78	42	60	12	78	42	96	192	48
18 Jul	18	6	12	24	6	18	24	24	486	174	102	24
19 Jul	66	90	78	72	30	186	114	108	288	360	234	78
20 Jul	120	132	30	42	84	54	252	114	90	234	210	252
21 Jul	78	102	42	36	24	30	54	78	72	78	324	390
22 Jul	120	204	78	90	72	90	84	54	24	60	108	168
23 Jul	30	36	72	78	48	30	72	66	84	114	150	216
24 Jul	60	84	48	72	48	54	60	84	48	90	102	84
25 Jul	30	54	24	60	102	60	42	90	48	42	156	72
26 Jul	12	42	48	24	12	114	66	24	48	42	30	36
27 Jul	6	6	24	12	26	66	81	60	168	84	156	114
28 Jul	42	18	54	30	42	54	42	78	66	6	30	48
29 Jul	42	42	36	30	66	48	72	78	30	48	12	48
30 Jul	36	24	30	12	6	18	18	54	66	24	54	144
31 Jul	6	24	36	24	6	12	42	24	12	96	132	222

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	Estimates by hour												Daily
Date	13	14	15	16	17	18	19	20	21	22	23	24	total
15 Jun	306	90	228	144	96	168	282	66	114	204	144	204	5,214
16 Jun	48	60	66	12	24	90	216	102	78	360	480	378	3,642
17 Jun	132	108	78	54	66	60	102	330	414	192	330	438	4,782
18 Jun	192	78	150	42	84	96	60	102	78	54	36	54	3,216
19 Jun	132	48	102	90	78	108	132	180	720	162	132	156	4,440
20 Jun	816	192	198	180	198	252	180	522	378	150	60	168	6,912
21 Jun	270	168	216	258	144	252	180	642	108	288	156	72	5,688
22 Jun	174	222	372	162	102	168	180	102	378	516	696	294	7,062
23 Jun	252	156	168	168	264	114	126	192	384	132	288	390	3,492
24 Jun	342	546	570	630	282	192	378	330	414	288	888	558	8,394
25 Jun	60	138	90	66	54	60	12	18	6	12	24	42	1,626
26 Jun	132	162	378	342	210	144	156	138	132	78	18	156	2,442
27 Jun	48	126	48	216	222	84	72	72	48	42	42	36	2,964
28 Jun	30	78	54	90	186	174	180	258	138	156	60	156	2,244
29 Jun	54	126	48	162	558	294	84	960	570	162	96	48	6,804
30 Jun	78	36	42	48	78	276	138	66	282	168	174	54	2,430
1 Jul	108	42	48	24	96	84	330	90	72	342	282	210	2,586
2 Jul	54	54	48	24	42	192	306	168	36	54	282	114	4,470
3 Jul	36	36	12	12	0	18	18	138	72	96	132	168	1,902
4 Jul	288	180	66	36	102	54	102	132	318	66	300	186	4,866
5 Jul	132	54	102	84	36	54	60	42	330	366	96	216	2,442
6 Jul	78	408	174	126	138	216	150	192	132	630	444	258	8,076
7 Jul	210	252	168	150	54	30	72	30	78	84	234	144	3,228
8 Jul	180	66	126	48	30	12	48	54	36	24	30	66	1,620
9 Jul	18	252	174	294	36	198	66	24	66	30	18	24	1,734
10 Jul	24	18	96	90	42	114	108	114	108	60	66	72	1,902
11 Jul	36	18	42	42	36	42	42	24	30	48	24	30	1,836
12 Jul	48	48	36	54	78	168	168	240	216	66	36	90	2,019
13 Jul	66	108	54	6	42	126	96	102	72	90	84	42	3,798
14 Jul	72	102	324	132	168	498	480	78	36	114	102	54	3,930
15 Jul	120	198	174	150	72	114	36	180	72	126	186	60	2,856
16 Jul	60	252	72	84	78	96	102	198	90	114	90	54	3,150
17 Jul	78	48	18	36	24	24	30	48	18	78	60	18	1,416
18 Jul	276	78	36	108	30	42	48	96	96	84	42	36	1,890
19 Jul	60	24	150	24	24	84	60	132	48	138	102	156	2,706
20 Jul	270	78	90	168	96	48	222	72	36	336	42	84	3,156
21 Jul	222	324	180	300	210	132	168	72	66	132	240	36	3,390
22 Jul	132	30	156	30	72	30	30	24	18	54	12	126	1,866
23 Jul	402	138	36	84	18	42	54	18	60	36	24	66	1,974
24 Jul	138	102	222	192	90	96	54	30	30	60	6	42	1,896
25 Jul	132	144	138	90	108	216	90	72	36	48	12	30	1,896
26 Jul	60	18	48	156	318	252	114	54	96	12	30	24	1,680
27 Jul	48	90	174	192	456	144	66	36	72	72	18	78	2,249
28 Jul	36	18	36	72	36	108	47	24	30	12	36	84	1,049
29 Jul	102	42	24	48	48	24	48	156	90	108	138	30	1,410
30 Jul	36	12	6	36	42	36	54	66	72	24	6	24	900
31 Jul	30	72	36	6	48	24	36	24	42	36	12	30	1,032

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	Estimates by hour											
Date	1	2	3	4	5	6	7	8	9	10	11	12
1 Aug	42	18	12	12	12	0	24	18	30	18	48	18
2 Aug	36	12	36	6	18	12	0	12	12	30	90	54
3 Aug	12	42	30	30	30	36	42	48	24	18	36	54
4 Aug	36	90	90	12	24	12	30	60	6	96	78	18
5 Aug	36	78	132	72	54	12	18	18	30	42	108	36
6 Aug	18	42	30	48	18	0	18	0	0	6	18	30
7 Aug	18	36	54	42	24	36	24	36	36	24	18	18
8 Aug	36	66	36	48	24	78	96	12	30	42	18	18
9 Aug	48	24	48	48	42	72	114	60	36	6	30	36
10 Aug	12	36	54	42	60	30	12	24	6	48	48	24
11 Aug	90	42	30	24	0	30	12	24	36	102	108	42
12 Aug	72	60	36	66	60	36	90	84	60	90	84	60
13 Aug	48	12	18	6	24	30	30	18	36	54	18	72
14 Aug	60	72	18	30	6	42	72	78	18	36	96	96
Total	6,987	6,750	6,102	6,750	6,434	6,510	6,849	6,342	7,338	7,680	7,566	8,076
%	4.2	4.1	3.7	4.1	3.9	4.0	4.2	3.9	4.5	4.7	4.6	4.9
Cum	4.2	8.3	12.0	16.1	20.0	24.0	28.2	32.0	36.5	41.1	45.7	50.6

	Estimates by hour												Daily
Date	13	14	15	16	17	18	19	20	21	22	23	24	total
1 Aug	0	18	36	18	18	24	12	42	12	18	24	24	498
2 Aug	132	0	42	30	24	18	12	30	90	48	48	60	852
3 Aug	36	66	6	48	48	36	24	66	48	12	6	24	822
4 Aug	78	72	42	108	84	12	24	48	30	30	36	54	1,170
5 Aug	48	84	210	60	60	72	66	54	18	30	6	24	1,368
6 Aug	102	42	72	78	36	42	36	30	60	18	18	18	780
7 Aug	66	18	66	36	30	78	42	6	54	18	24	78	882
8 Aug	24	42	108	84	78	54	60	0	48	60	6	42	1,110
9 Aug	90	54	54	30	36	30	18	48	120	12	18	6	1,080
10 Aug	96	78	36	42	42	96	96	120	90	48	36	24	1,200
11 Aug	96	78	36	48	36	24	72	78	36	30	108	24	1,206
12 Aug	18	66	30	36	30	18	120	42	24	54	6	30	1,272
13 Aug	54	48	54	18	54	36	42	54	24	24	60	36	870
14 Aug	114	42	24	72	66	60	0	48	54	48	84	90	1,326
Total	7,572	6,348	6,690	6,270	5,958	6,450	6,407	7,476	7,524	6,954	7,290	6,390	164,713
%	4.6	3.9	4.1	3.8	3.6	3.9	3.9	4.5	4.6	4.2	4.4	3.9	
Cum	55.2	59.1	63.1	66.9	70.6	74.5	78.4	82.9	87.5	91.7	96.1	100.0	
95% Confidence interval										164,680–164,746			