Fishery Data Series No. 18-05

Anchor River Chinook Salmon Escapement, 2011

by

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and

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December 2018

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

Symbols and Abbreviations

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Weights and measures (metric)

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

Weights and measures (English)

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

Time and temperature

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

Physics and chemistry

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

General

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

Mathematics, statistics

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

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ABSTRACT

The 2011 Anchor River Chinook salmon (*Oncorhynchus tshawytscha*) escapement was censused using dual-frequency identification sonar (DIDSON) during high spring flows and by a resistance board weir when flows subsided. The Chinook salmon escapement, an estimated 3,545 fish, fell below the sustainable escapement goal (SEG) range of 3,800–10,000 Chinook salmon and was the second lowest on record. The midpoint of the Chinook salmon run was 16 June. The Chinook salmon daily escapement counts were positively correlated (r = 0.41, df = 43, P = 0.0052) with average daily river stage. The dominant age class was ocean-age-3 (41.1%, SE 2.9%). Overall mean length of males (648 mm, SE 7.5 mm) was smaller than that of females (751 mm, SE 8.4 mm).

Key words: Anchor River, Chinook salmon, *Oncorhynchus tshawytscha*, steelhead, *Oncorhynchus mykiss,* kelt emigration, run timing, diel, sustainable escapement goal, stock status, weir, sonar, DIDSON

INTRODUCTION

The Anchor River is located on the southern portion of the Kenai Peninsula (Figure 1) and supports the largest Chinook salmon (*Oncorhynchus tshawytscha*) run in the Lower Cook Inlet Management Area (LCIMA) with estimated total runs ranging from about 4,200 to 13,600 fish (2003–2010; Kerkvliet et al. 2016). There are 3 streams open to sport fishing for Chinook salmon in the LCIMA: Anchor River, Deep Creek, and Ninilchik River. In Alaska, most juvenile Chinook salmon remain in fresh water until the following spring when they migrate to the ocean as smolt in their second year. Based on scale age data, Anchor River Chinook salmon spend 1 to 4 years feeding in salt water before they return to spawn (Kerkvliet and Booz 2012). Run timing of adult Chinook salmon into these streams is approximately early May through late July with a peak in early to mid-June (Kerkvliet et al. 2008; Kerkvliet and Burwen 2010; Kerkvliet and Booz 2012; Kerkvliet et al. 2012).

The Anchor River watershed is approximately 587 km^2 with about 266 river kilometers (RKM) of anadromous streams (Table 1). The Anchor River has 2 major forks (south and north forks) and their confluence is located approximately 2.8 RKM upstream from the mouth. The south fork watershed is approximately twice the size of the north fork watershed. Because of the Anchor River's small size, geomorphology, and vegetation, water flows can rise substantially following heavy rains.

Anchor River Chinook salmon are primarily harvested during an inriver sport fishery. The inriver sport fishery is restricted by regulation through small daily and seasonal bag limits, and limits on days and areas open to sport fishing. The annual Chinook salmon catch and harvest in the Anchor River sport fishery is estimated by the ADF&G Statewide Harvest Survey (SWHS; Table 2). From 2003 through 2010, the average SWHS Chinook salmon inriver harvest was 1,258 fish. An unknown number of Anchor River Chinook salmon are also harvested in a mixed-stock sport troll fishery within Cook Inlet near the river mouth, but this harvest is assumed to be small (Kerkvliet et al. 2013).

Before 2003, enumerating Anchor River Chinook salmon escapement over the entire run was problematic because traditional methods could not operate in the river's periodic high and low water conditions. Traditional weir methods (fixed picket or resistance board weirs) commonly used in small streams could not be installed in the Anchor River in May and early June because the river is typically too high and swift at that time for installation. Likewise, traditional sonar methods (e.g., split-beam sonar) commonly used in large Alaskan rivers at the time (e.g., the Kenai River) were not suited for smaller streams like the Anchor River because of periodic low water conditions that are too shallow to insonify. Therefore, an annual aerial survey was conducted during peak spawning to index and evaluate Chinook salmon escapement (Appendix A1). However, because of the inherent biases associated with the index counts (e.g., differences in survey conditions and surveyor biases) year-to-year comparisons of Chinook salmon escapements remained difficult.

In 2003, a new dual-frequency identification sonar (DIDSON) manufactured by Sound Metrics Corporation (SMC)[1] was used to monitor Chinook salmon escapement in the Anchor River with near video-quality images (Kerkvliet et al. 2008). The DIDSON was deployed on the mainstem of the Anchor River just below the north and south forks confluence and just upstream of the fishery at a site where the river profile was relatively level (Figure 2).

The 2003 Anchor River Chinook salmon count (9,238 fish) was higher than expected even though the DIDSON began operating in late May after the beginning of the run and stopped operating in early July before the run had ended (Table 3). It is estimated that the count in 2003 represented about 70% of the true escapement based on the average proportion of the run that escaped during that time in 2004 and 2005 (2 years with similar water temperatures and flow rate patterns). From 2004 to 2008 and in 2010, the entire Chinook salmon escapement was estimated using the DIDSON during high discharge rates in the early spring through early to mid-June, and a resistance board weir was used thereafter for the rest of the season. In 2009, the DIDSON was not required because low water levels allowed for the immediate installation of the resistance board weir, which provided the first complete Anchor River Chinook salmon escapement census. Beginning in 2010, an underwater video system was incorporated into the weir and used to monitor escapement near the end of the run in early August (Kerkvliet and Booz 2018).

Anchor River Chinook salmon escapement counts based on DIDSON have a negative bias and underestimate escapement because all sonar images of fish swimming upstream and downstream are assumed to be Chinook salmon even though an unknown portion of the downstream sonar images (which are subtracted from the escapement count) include postspawning steelhead (*Oncorhynchus mykiss*) kelts emigrating out of the river. In Southcentral Alaska, steelhead are commonly referred to as "fall run" fish that immigrate into freshwater streams in the fall and overwinter before spawning in the spring. Steelhead spawning distribution in the Anchor River is unknown but thought to mostly occur upstream of the north and south forks confluence. After spawning, kelts emigrate from the river to salt water in May and June. In 2009 with early weir operation, both emigrating kelts and immigrating Chinook salmon were monitored at the sonar-weir site (Kerkvliet and Booz 2012). The midpoint of the 2009 kelt emigration (7 June) was earlier than the midpoint of the Chinook salmon immigration (23 June). Given a typical weir installation date of early to mid-June, and assuming the timing of the kelt emigration in 2009 was typical, then a large portion of the kelt emigration may occur during the DIDSON operation. Based on the census of immigrating Chinook salmon and emigrating kelts in 2009, the negative bias had the DIDSON been used would have been at most 17%. Note that this percentage is based on the lowest escapement of Chinook salmon between 2003 and 2010. A similar outmigration of steelhead during the highest measured Chinook salmon run would translate to a negative bias of about 5%.

Since 2003, the annual Chinook salmon escapement in the Anchor River has ranged from 3,455 (SE 0) in 2009 to 12,016 (SE 283) in 2004 (Table 4). Inriver exploitation rates (percentage of the

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

total run that is harvested) have ranged from less than 10% in 2003 to 21.7% in 2008; however, estimated exploitation in 2003 is positively biased and the estimate may be high because operation dates did not cover the entire run and the escapement was not completely enumerated.

The Anchor River Chinook salmon escapement goal has been refined as annual escapement data have become available (Appendix A2). In 2010, ADF&G modified the goal to a sustainable escapement goal (SEG[2]) of 3,800–10,000 Chinook salmon. The SEG was set by the full probability spawner–recruit model described in Szarzi et al. (2007) and updated with the most recent escapement and harvest through 2009 (Otis et al. 2010). The lower end of the SEG is the point estimate for maximum sustained yield and the upper bound is estimated carrying capacity. The range minimizes the risk of overfishing and allows for liberalization of the harvest when escapements are large.

Anchor River sport fishing regulations have undergone a series of changes since the early 2000s as escapement assessment has improved (Appendix A3; Kerkvliet et al. 2013). Beginning in 2009, the inriver and nearby marine fisheries were restricted by emergency order (EO) in response to low Chinook salmon escapement. Despite the restrictions, the lower bound SEG of 5,000 was not achieved. In 2010, the Alaska Board of Fisheries (BOF) reduced the annual limit from 5 Chinook salmon to 2 Chinook salmon in combination with Deep Creek and extended the conservation zone surrounding the Anchor River mouth from 1 mile north and south to 2 miles north and south from 1 April to 30 June. In addition to these restrictions, scheduled Chinook salmon sport fishery openings began on the 3-day weekend before Memorial Day weekend followed by the 4 consecutive 3-day weekends and the 5 Wednesdays following each weekend.

This report is part of a continuing series that evaluates the Anchor River Chinook salmon stock. The Chinook salmon escapement estimates will be used in future escapement goal analyses and also to manage the fishery according to the *Management of Sustainable Salmon Fisheries* and *Statewide Salmon Escapement Goals* policies (Alaska Administrative Codes 5 AAC 39.222 and 5 AAC 39.223).

OBJECTIVES

Primary Objectives

1) Estimate the Anchor River Chinook salmon escapement that passes upstream of 2.8 RKM (approximately 2 river miles) from the river mouth.
2) Estimate the age and sex composition of the Chinook salmon escapement.

Secondary Objectives

1) Estimate length-at-age and sex of the Chinook salmon escapement.
2) Examine between-reader and within-reader variation of DIDSON counts.
3) Determine seasonal and diel[3] run timing of Chinook salmon.
4) Compile and summarize river stage and temperature data.

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2 SEG is a level of escapement indicated by an index or estimate that is known to provide sustained yield for over a 5–10 year period (Alaska Administrative Code 5 ACC 39.223).

3 “Diel” is defined as “of or pertaining to a 24 h period.”

5) Examine all Chinook salmon video recorded and sampled for age, sex, and length (ASL) for an adipose fin.
6) Enumerate steelhead as they pass upstream and downstream through the weir.
7) Calculated correlation between steelhead emigration (kelt) counts and river stage and temperature.

METHODS

OPERATION DATES AND EQUIPMENT

Anchor River Chinook salmon escapement was monitored at RKM 2.8 approximately 0.02 RKM downstream of the north and south forks confluence (Figure 3). In 2011, the escapement was enumerated from 13 May at 1400 hours through 24 May at 2100 hours using the DIDSON (Figure 4). Low river conditions allowed an earlier than usual installation of the resistance board weir fitted with an underwater video system (Figure 5). The escapement was enumerated from 24 May at 2100 hours through 21 September at 2200 hours using video recordings of fish passage through the weir. During weir operation, all fish were identified to species and a census of Chinook salmon escapement was obtained. The underwater video system was provided by U.S. Fish and Wildlife Service (USFWS) and is described by Gates and Boersma (2009). The operation is described by Anderson and Stillwater Sciences (2011). The early weir installation also provided an opportunity to enumerate the outmigration of postspawning steelhead (kelts) and to determine run timing. Kelts were enumerated as they passed over the weir from 25 May at 1200 hours through 24 June at 2400 hours using a "steelhead chute" (referred to as "the chute") that was formed by weighting down a weir panel on the downstream end and positioning an above-water video camera over the chute (Figure 6). As kelts migrated downstream through the chute, their passage was monitored using a video camera and recorded to VHS. The methods associated with the above-water video camera and chute are described in Kerkvliet and Booz (2012). Additionally, all kelts that were either found dead on the weir or assisted downstream of the weir were enumerated.

During DIDSON operation, beach seines were used to capture Chinook salmon for ASL estimation. The south fork was netted once (27 May) and the north fork was netted twice (20 and 25 May). During the weir operation, a live box was used to capture Chinook salmon for ASL samples.

DIDSON and Partial Picket Weirs

In 2011, an ultra-high resolution large lens ("large lens") was used in the DIDSON. The large lens almost doubles the resolution of the standard lens and has a smaller vertical beam pattern; the resolution is also better at longer ranges (>15 m, needed at the Anchor River) than the standard lens. However, the highest image resolution for the large lens is still achieved when the DIDSON is operated at shorter ranges using the higher of 2 available frequencies (Burwen et al. 2007, 2010; Kerkvliet and Booz 2018).

Because the width of the Anchor River under high water conditions at the monitoring site (about 31 m) is greater than the effective range of the DIDSON (approximately 20 m), a partial weir was installed on each bank to narrow the insonified corridor to 20 m or less (Figures 3 and 4). The weirs were tripod and picket structures that could be removed or extended as necessary due to changing water levels. During the installation, river levels dropped sufficiently to allow the weirs to narrow the insonified corridor to about 4 m. All bottom irregularities at the base of the partial weir were sealed using sandbags that prevented fish from migrating past the DIDSON undetected.

The DIDSON was first enclosed in a SMC silt protection box and then mounted on a Remote Ocean Systems PT-25 pan-and-tilt unit to allow precise aiming. The sonar and remote aiming unit were deployed on a tripod-style mount as described in Burwen et al. (2010). The communication cables from the DIDSON lead to electronics inside a WeatherPort tent. DIDSON data were stored and processed on a Dell desktop computer. Data were collected using DIDSON software (version V5.2118-Std_rev5-88, provided by the manufacturer, Sound Metrics Corporation). Files were saved every 20 minutes and designated as first, second, and third 20-minute count files. All electronics were powered by a 2000 W generator. The DIDSON was operated at high-frequency (1.8 MHz) with a window length of 6–10.5 m.

The DIDSON was positioned approximately 0.5 m upstream and no less than 3 m towards the bank from the terminal end of the left bank weir (the left bank is defined as the left side of the river when facing downstream; Figure 3). The DIDSON lens was aimed slightly downward across the insonified corridor and was positioned at least 10 cm off the river bottom. The aim of the DIDSON resulted in an insonified cone to the terminal edge of the right bank weir that ensured full coverage of the migration corridor. An artificial target (10 lb lead downrigger ball) was dragged along the bottom between the weirs to ensure that the sonar beam was adequately covering the migration corridor.

Resistance Board Weir

The water level dropped sufficiently to install the resistance board weir on 24 May. The resistance board weir (approximately 31 m long) was installed approximately 6 m downstream from the DIDSON and partial weirs. Picket spacing for the resistance board weir and live boxes was approximately 2.8 cm (1.5 in) to block the passage of all but the smallest ocean-age-1 Chinook salmon (Figure 5). All bottom irregularities along the base of the resistance board weir were sealed using sandbags and a fencing skirt.

A live box was attached to the upstream edge of the weir and an underwater video system was then attached to the upstream edge of the live box that allowed fish to pass upstream 24 hours per day, 7 days per week. The live box and underwater video system was installed near the center of the river in the thalweg.

The underwater video system was powered by a combination of 12 V DC deep-cycle batteries and a gasoline-powered generator. The underwater video camera was mounted inside a sealed video box attached to the fish passage chute. The video box was constructed of 3.2 mm aluminum sheeting and filled with filtered water. Safety glass was installed on the front of the video box to allow for a scratch-free, clear surface through which images were captured. The passage chute was constructed from aluminum angle brackets enclosed in plywood, isolating it from exterior light. The backdrop of the passage chute, from which video images are captured, was adjusted laterally to minimize the number of fish passing through the chute at one time. The backdrop was also removed from the video chute when needed for cleaning. The video box and fish passage chute was illuminated using a pair of 12 V underwater pond lights. Pond lights were equipped with 20 W bulbs that produced a quality image and provided a consistent source of lighting during day and night hours. All video images were recorded on an external 500 gigabyte hard drive at 22 frames-per-second using a computer-based digital video recorder (DVR). The

DVR was equipped with motion detection to minimize the amount of blank video footage and review time.

Steelhead Chute

The steelhead chute was formed from 25 May through 24 June by placing 1 or 2 sandbags on the downstream end of one of the floating weir panels (Figure 6). The weight of the sandbags created a shallow stream of water that fish could use to swim downstream over the weir. The placement of the sandbags was used to adjust the water depth flowing over the weir panel so that it was deep enough to allow steelhead to swim downstream but shallow enough to prevent upstream migration. The chute was repositioned several times in order to find the section of the weir that most steelhead would pass.

Near the downstream edge of the chute, a wooden tripod was anchored such that an above-water video camera could be mounted and aimed at the chute. During suppressed light, a light (a component of the video camera) was used to illuminate the chute. The cable of the camera was fed to the electronics tent, and images were recorded continuously on VHS tapes.

ESCAPEMENT MONITORING

DIDSON

In 2011, images of fish moving either upstream or downstream were counted for all three 20-minute files for each hour the DIDSON was operated. The counts from each 20-minute file of the hour were summed to represent fish passage for a given hour. DIDSON counts were treated as follows:

1) Images of fish moving upstream were assumed to be Chinook salmon even though a very small percentage may be steelhead.
2) Images of fish moving downstream were assumed to be Chinook salmon. This assumption is flawed to some degree; it is known that a portion of the downstream counts include postspawning steelhead emigrating from the river. No adjustments were made to the downstream counts because it is impossible to differentiate downstream moving Chinook salmon from steelhead. The assumption provides a conservative count because any downstream steelhead movement past the DIDSON leads to an underestimation of the Chinook salmon escapement.

Resistance Board Weir

The underwater video system allowed fish passage 24 hours per day. Upstream fish passage data were collected on a DVR. Recordings were reviewed daily to produce timely daily escapement counts. All fish were identified to species and counted by their recorded hour. Hourly counts were summed to produce daily escapement counts. No video monitoring equipment failures occurred.

The weir was visually inspected on a daily basis for holes to ensure no fish could migrate past undetected. During the weir operation, the gate to the live box was opened daily from approximately 0800 hours to approximately midnight or earlier, depending on darkness. To avoid impeding fish passage, technicians periodically checked the live box and processed all fish as quickly as possible. Daily counts of steelhead observed passing downstream through the steelhead chute from video footage or found upstream of the weir were counted.

Biological and Environmental Sampling

Beach Seine ASL Samples

During DIDSON operation, Chinook salmon were captured upstream of the sonar site on the north and south forks of the Anchor River using a beach seine net (30.5 m long by 2 m deep with 5.1 cm stretched mesh size). The net was fished by drifting it through deep pools (Kerkvliet et al. 2008).

All captured fish were identified by species, and the mid eye to tail fork (METF) length was measured to the nearest 5 mm. Sex was visually determined through external characteristics (such as kype development or a protruding ovipositor) and 3 scales were collected from each Chinook salmon for aging (Welander 1940). The upper lobe of the caudal fin was also clipped on each captured fish before release to prevent double sampling.

Scales were aged using a microfiche reader and with methods described by Welander (1940). Scales were aged without reference to size, sex, or other data. Scale samples were aged twice to estimate within-reader variability. Since 2007, the same individual has aged Anchor River Chinook salmon scales; the individual is tested annually with known aged scales (from recovered coded-wire-tagged fish). All scale samples that had conflicting ages for the 2 estimates were re-aged to produce a resolved age that was used for composition and abundance estimates.

Mainstem Resistance Board Weir ASL Samples

Throughout the weir operation, Chinook salmon ASL sampling was scheduled every other day by applying a sampling proportion of 0.12 to the cumulative Chinook salmon weir count since the last sampling event and rounding up to the nearest whole number. The sampling rate was based on historical run data.

The upper lobe of the caudal fin was clipped on each ASL sampled Chinook salmon to prevent double sampling in case of a weir failure. ASL data were collected and scales were aged as detailed above.

Adipose Fin Inspection

Each Chinook salmon captured with a beach seine, sampled at the weir, or observed using video recordings was inspected for the presence of an adipose fin. During ASL sampling, if a fish was found missing an adipose fin, indicating a hatchery-reared fish, it was sacrificed and the head was sent to the ADF&G Mark, Tag, and Age Lab to identify the release site using coded wire tag (CWT) information recovered from the head. Recovered CWTs were used to validate age data.

Steelhead Chute

Technicians viewed 664.5 hours of video recordings of the steelhead chute to enumerate fish passage. There were 67.5 nonrecorded hours due to a camera malfunction. As VHS recordings were reviewed, fish were identified to species and then tallied by hour to determine the daily counts. These daily counts were added to any steelhead found dead on the weir and those assisted downstream of the weir along the weir section that did not have a chute. On 15 June, a second chute was formed to facilitate downstream passage because greater than 12 steelhead were observed upstream of the weir and appeared reluctant to pass through the chute. While the secondary chute was formed, a technician kept watch for fish, but no fish were observed using the chute.

Environmental Data

Water temperatures were recorded by datalogger every 15 minutes by Cook Inletkeeper (CIK), a citizen-based nonprofit group. The logger was installed approximately 0.1 RKM downstream of the sonar-weir site (Mauger 2013). Daily temperatures (average, minimum, and maximum) were averaged from logger readings collected every 15 minutes.

River stage data were recorded hourly from the gauge station (USGS 15239900) by the U.S. Geological Survey (USGS). The station is located on the south fork at approximately 11.4 RKM from the mouth of the Anchor River at a bridge on the New Sterling Highway.

DATA ANALYSIS

Escapement

Net DIDSON counts of upstream passage for the *j*th hour (*j* = 1,..,24) of the *k*th day of the season were calculated as follows:

$$n_{jk} = u_{jk} - d_{jk} \tag{1}$$

where

u_{jk} = upstream counts in hour *j* of day *k*, and

d_{jk} = downstream counts in hour *j* of day *k*.

Hourly counts (n_{jk}) were summed to provide daily counts of escapement (C_k) and total escapement passage (C_D) during DIDSON system operation:

$$\hat{C}_k = \sum_{j=1}^{24} n_{jk} \tag{2}$$

and

$$\hat{C}_D = \sum_{k=1}^{K} \hat{C}_k , \tag{3}$$

where K is the total number of days of operation of the DIDSON system in the year in question.

The total Chinook salmon passage over the entire season was calculated as follows:

$$\hat{C}_T = \hat{C}_D + C_W \tag{4}$$

where C_W is the count of Chinook salmon through the weir.

Count Diagnostics

Re-counted DIDSON files provided a measure of reproducibility for escapement counts and a quality control measure. Between-reader and within-reader variability were assessed for the 2 crewmembers responsible for counting DIDSON files.

Between-reader variability was assessed by comparing counts from Reader A with counts from Reader B for three 20-minute files each day. Within-reader variability was assessed for a particular reader by comparing counts from three 20-minute DIDSON files each day (i.e., each file was read twice by a particular reader). Re-counted files were chosen to represent challenging counting conditions (e.g., high upstream and downstream counts and milling activity); the analysis therefore revealed worst-case scenarios of between- and within-reader variability. The following statistics were calculated for the between- and within-reader analyses:

1) Kendall's tau was calculated for each pair of counts for the same files as well as for all first and second readings. (Kendall's tau ranges from −1 to 1, representing perfect negative and positive correlation, respectively).
2) Intraclass correlation coefficient *r* was calculated for each pair of readers counting the same files (Shrout and Fleiss 1979). This statistic is a function of the correlation and agreement between counts. It ranges from 0 to 1; it is high when there is little variation between the scores given to each count. The function icc() in the R package {irr} was used with model argument set to "twoway" and type argument to "agreement."
3) A Tukey difference plot was made for each pair of readers counting the same files (Bland and Altman 1986). These plots are of differences between counts against the average of the scores of the readers.

Run Timing

Chinook salmon run timing at the sonar-weir site was described using cumulative daily counts and associated percentages. The midpoint of the Chinook salmon run was defined as the date nearest the 50% cumulative count. The correlation of daily counts with daily river stage averages and river temperatures was examined with Pearson's correlation coefficient (r) for the middle 80% of the run. The hypothesis that there was no correlation ($r = 0$) was tested.

Diel run timing was evaluated using 24-hour DIDSON counts and video-weir counts. The hourly DIDSON and weir counts were expressed as the percentage of fish counted each hour. Hourly counts during the weir period were not adjusted to censor hours when the live box was closed for ASL sampling because closure time was not recorded.

Age and Sex Composition and Length-at-Age

Age and sex composition was estimated from samples obtained from beach seining in the north and south forks upstream of the sonar during the DIDSON period and from systematic samples taken at the weir. The DIDSON period was short and consequently only 13 Chinook salmon were sampled via netting; netting and weir samples were therefore pooled.

The estimated proportion of Chinook salmon of age or sex class *k* (or a combination thereof) in the escapement was calculated as follows:

$$\hat{p}_k = \frac{n_k}{n}, \tag{5}$$

where

n_k = the total number of salmon of age or sex class k in n and

n = the number of salmon sampled.

The estimated variance of proportion $\hat{p}_k$ was calculated as follows:

$$\mathrm{var}(\hat{p}_k) = \left(\frac{C_T - n}{C_T}\right)\frac{\hat{p}_k(1-\hat{p}_k)}{n-1}, \tag{6}$$

where C_T is calculated in Equation 4.

The estimated total number of Chinook salmon of age or sex class k was calculated as follows:

$$\hat{N}_k = C_T\,\hat{p}_k. \tag{7}$$

The estimated variance of $\hat{N}_k$ was calculated as follows:

$$\mathrm{var}(\hat{N}_k) = C_T^{\,2}\,\mathrm{var}(\hat{p}_k). \tag{8}$$

Mean lengths-at-age and their variances were estimated using standard summary statistics.

The within-reader variability of Chinook salmon scale age estimates was calculated using a coefficient of variation (CV) expressed as the ratio of the standard deviation over the mean age (Campana 2001):

$$CV_j = 100\% \times \frac{\sqrt{\sum_{i=1}^{R}\frac{(X_{ij} - X_j)^2}{R-1}}}{X_j} \tag{9}$$

where

X_{ij} = the ith age estimate of the jth fish,

X_j = the mean age estimate of the jth fish, and

R = the number of times each fish is aged.

Steelhead

In 2011, the spawning condition of steelhead was based on examination of fish handled in the live box. For the purpose of this report, the categories used to describe the spawning condition of steelhead are the same as those used in 2009 (Kerkvliet and Booz 2012) and are described as follows:

1) Fall immigrants are those steelhead counted upstream through the weir starting on 1 July; these fish overwinter in the Anchor River before spawning in the spring.
2) Prespawning immigrants are those steelhead counted upstream through the weir through 30 June; these fish are thought to be migrating to their spawning areas on the north and south forks of the Anchor River.
3) Postspawning emigrants (kelts) are steelhead counted moving downstream through the weir through 30 June as they emigrate to salt water.

The number of postspawning emigrants (kelts) was calculated as the total number of fish counted passing downstream through the chute, those assisted over the weir by hand, and those found dead on the weir. The counts were considered a census during the weir operation period through 30 June. Kelts migrating downstream during the DIDSON period were not included in this count.

Pearson's correlation coefficient (r) was used to compare daily kelt counts to daily river temperature and stage averages.

Simple linear interpolation was used for counts corresponding to hours where the weir camera malfunctioned.

RESULTS

ESCAPEMENT

In 2011, the Anchor River Chinook salmon escapement of 3,545 fish was below the SEG range of 3,800–10,000 fish (Table 4, Appendix B1). The escapement was based on a census of sonar counts (247 fish) and weir counts (3,298 fish).

The DIDSON portion of the escapement was based on 548 upstream and 301 downstream counts (Appendix C1). During DIDSON operation, the ratio of upstream to downstream moving fish averaged 1.9:1.0.

Netting on the south fork on 27 May captured 9 Chinook salmon and 3 steelhead. For the north fork, only 1 fish of each species was captured on 20 May, whereas 3 Chinook salmon and 4 steelhead were captured on 25 May (Table 5). Steelhead accounted for 38% (8/21) of all the fish caught. No adjustments were made to the upstream DIDSON counts based on the netting composition.

COUNT DIAGNOSTICS

Between-reader variability was evaluated for 72 DIDSON files (Table 6). The correlation (Kendall's tau) between Reader A and Reader B was 0.89. Intraclass correlation was also high (r = 0.93). Agreement was 87.5%. Tukey difference plots indicate between-reader counts were more variable for low counts (Figure 7). Differences in counts between each reader are also shown in Table 6.

Within-reader variability was also evaluated for 72 (different) DIDSON files for both Reader A and Reader B (Table 6). Kendall's tau correlations were 0.88 and 0.84 for readers A and B, respectively. Intraclass correlations were 0.94 (Reader A) and 0.96 (Reader B). Percent agreements were 83.3% (Reader A) and 86.1% (Reader B). Tukey difference plots indicate within-reader counts were more variable for low counts (Figure 8). Differences in counts within specific readers are also shown in Table 6.

RUN TIMING

The midpoint of the Anchor River Chinook salmon run was 16 June (Figure 9, Appendix B1). The middle 80% of the run was counted from 27 May to 10 July (45 days).

During DIDSON operation, most of the upstream and downstream counts (approximately 84% and 73%, respectively) were counted from 1400 hours to 0559 hours (representing 67% of the days; Figure 10). Peak upstream counts occurred at 0000, 0200, and 0300 hours. Peak downstream counts occurred at 0000, 0400, 1300, 1600, and 1700 hours.

During video-weir operation, a similar but more extreme pattern was found compared to that observed for the DIDSON period: about 94% of the Chinook salmon were counted between 1400 to 0559 hours, and peak counts occurred from 0100 to 0300 hours (Figure 11).

River levels remained low throughout most of the run (Figure 12 and Appendix D1). As the river level began dropping beginning in mid-June, fish passage through the weir was low, although large numbers of maturing Chinook salmon were observed holding throughout the river downstream of the weir in deep pools and channels. The river rose approximately 9 cm from 2–3 July, and then the river began to subside (Appendix D1). During this 2-day period, the final large pulse of Chinook salmon (n = 268) passed through the weir (Appendix B1).

During the middle 80% of the Chinook salmon run, daily counts were positively correlated with average river stage (r = 0.41, df = 43, P = 0.0052; Figure 12) but not average river temperature (r = −0.14, df = 43, P = 0.359; Figure 13). Average water temperature was negatively correlated with average river stage (r = −0.72, df = 43, P < 0.0001). During the middle 80% of the run, river stage averaged 31.9 cm (range 22.6–45.2 cm) and river temperature averaged 10.9°C (range 8.5–14.3°C; Appendices D1 and D2).

AGE AND SEX COMPOSITION AND LENGTH-AT-AGE

There were 338 Chinook salmon sampled for age analysis (13 netting and 325 weir samples) of which 282 had readable scales. Because only a small percentage of the escapement was estimated using DIDSON, samples were combined to characterize the age composition. The within-reader coefficient of variation (Equation 9) of all age estimates from Chinook salmon scales was 1.54%.

Ocean-age-3 was the dominant age class (41.1%, SE 2.9%) for the 2011 Anchor River Chinook salmon escapement (Table 7). Ocean-age-2 was the dominant age class for males (44.7%, SE 3.0%), whereas ocean-age-3 was the dominant age class for females (22.7%, SE 2.5%). The overall mean length of males (648 mm, SE 8 mm) was smaller than females (751 mm, SE 8 mm). The sex ratio of the samples was 1.8 males to 1 female.

ADIPOSE FIN INSPECTION

The adipose fin was present on all 338 Chinook salmon examined, indicating none of these were hatchery-reared fish and therefore none had CWTs. Most Chinook salmon were examined during ASL sampling from the live box (n = 325) and from beach seine catches (n = 13).

STEELHEAD

In 2011, a total of 217 steelhead were counted downstream of the weir from 25 May to 24 June (Appendix E1). Of the total counted, 191 were enumerated using VHS recording, 8 were assisted downstream of the weir, 3 were found spawned-out and dead on the weir, and 15 were interpolated for missing hours. From 24 May to 30 June, 11 steelhead were observed moving upstream through the weir. From July 1 through September 21, 132 fall immigrant steelhead were counted moving upstream through the weir (Figure 14). The sex composition was evaluated for 123 fall immigrants of which 85 were female and 38 were male.

The midpoint of the kelt emigration at the weir site was 14 June (Figure 9). Most of the kelts (88.9%; n = 169) emigrated downstream of the weir between midnight and 0259 hours

(Figure 15). The kelt emigration timing was not correlated with river stage (r = 0.296, df = 29, P = 0.105) or river temperature (r = -0.114, df = 29, P = 0.539; Figures 16 and 17).

DISCUSSION

The 2011 Chinook salmon estimated escapement of 3,545 fish was below the sustainable escapement goal (SEG) range (3,800–10,000 fish) and was the second lowest since 2003 (Table 4). The weir was installed earlier than average in the season as a result of the low river levels in May and most (93%) of the escapement was monitored using an underwater video system. The early weir installation also provided opportunity to enumerate steelhead kelts through most of their emigration.

During most of the 2011 Chinook salmon fishery, inriver fishing conditions were reported by anglers and department staff as good to excellent early in the season with the low river conditions. The Wednesday openings proved especially popular days to fish. During the second and third Wednesday openings (1 and 8 June, respectively), escapement counts were noticeably lower than the Tuesday before and the Thursday after the openings. When escapement was projected to fall below the SEG, the fishery was progressively restricted. Bait was prohibited starting on the fourth weekend opening (11–13 June) and this was continued into the fourth Wednesday opening (15 June) before the fishery was closed through the end of June.

In late June, large numbers of Chinook salmon were observed holding in the lower reaches, and at that point, it was deemed unlikely that the escapement goal would be reached. Effective 1–15 July, gear was restricted to 1 unbaited single hook and the area downstream of the of the weir was extended from 300 feet to approximately 1,000 feet to protect Chinook salmon holding in the area open to other fishing but closed to Chinook salmon fishing. In addition, the marine fishery was also restricted by maintaining the closed area surrounding the Anchor River through the end of July. In 2011, 22% of the escapement was counted from 1 July to 31 July.

The 2011 run size (4,118 fish) was closest in number, historically, to the 2009 run (4,192 fish; Table 4). In both years, river levels were low during most of the fishery resulting in good fishing conditions, and harvest was allowed for 12 days (through the third Wednesday opening) before the fisheries were closed by emergency order (EO); however in 2011, bait was restricted on the third weekend whereas in 2009, bait was allowed. The 2011 exploitation rate was slightly lower than in 2009. In terms of run timing, the midpoint of the 2011 escapement (16 June) was 8 days earlier than that in 2009 (23 June) at the weir site. It is likely the higher exploitation rate in 2009 had some influence on the later run timing compared to 2011.

Little information is available about emigration, immigration, and abundance of steelhead in the Anchor River. In 1988, 1989, and 1992, steelhead immigration counts were 878, 769, and 1,261 fish, respectively (Table 3; Larson and Balland 1989; Larson 1990, 1993). For these years, the midpoint of immigration occurred between 13 and 25 September and 90% of the immigration was complete by 2 October. At the current sonar-weir site located approximately 2 miles upstream of the mouth, steelhead immigration was monitored through 29 September in 2010 through a cooperative agreement with USFWS and 586 immigrating steelhead were counted (Anderson and Stillwater Sciences 2011; Kerkvliet et al. 2013). Although the 2010 run was not monitored into October, the sonar-weir enumeration was probably a good index of run strength, with a midpoint (11 September) slightly earlier than the historical midpoint.

The emigration of steelhead from the Anchor River was first monitored in 2009 (Kerkvliet and Booz 2012). The emigration was about 36% higher in 2009 (605 fish) than in 2011 (217 fish), and the midpoint of the emigration in 2009 (7 June) was 7 days earlier than in 2011 (14 June; Figure 9). Anchor River steelhead emigration timing was similar to the timing observed in Crooked Creek (16 May–21 June 2008, 12 May–15 June 2009; Gates and Boersma 2010). Given the 2010 immigration and the number of emigrating kelts in 2011 (217), overwintering and spawning survival is estimated at approximately 37%.

The underwater video system proved to be an efficient escapement monitoring method. However, because the underwater video system allowed passage 24 hours per day, fish did not tend to build up in the weir live box and this made collecting ASL samples from Chinook salmon more difficult (because salmon are normally captured and sampled in the box). Therefore, we needed to keep the weir closed for extended periods to achieve daily sampling goals. During future video weir operations, samples should be collected from fish captured with a beach seine to increase capture efficiency and avoid impeding the run.

The return in 2011 of ocean-age-4 Chinook salmon marked the final adult return from brood year (BY) 2005 and the second year that production could be fully assessed. The production trend in 2005 was similar to 2004 (Kerkvliet et al. 2008; Kerkvliet and Burwen 2010). Production from the record high 2004 and 2005 escapements (12,016 fish, SE 283 and 11,156 fish, SE 229, respectively), were poor based on return-per-spawner (0.29 and 0.46, respectively; Tables 8 and 9). Based on an updated spawner–recruit analysis, the upper bound of the escapement goal (10,000 fish) is the estimated population carrying capacity (Otis et al. 2010). The high 2004 and 2005 escapements and low return-per-spawner from these brood years are consistent with this analysis. It is expected that with additional years of production data, the low production of brood years 2004 and 2005 can be more thoroughly evaluated by comparing production from contrasting escapements.

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TABLES

Table 1.–Drainage characteristics of the north and south forks of Anchor River.

Drainage characteristics	Anchor River		
	North fork	South fork	Total
Watershed area (km^2)	181.5	405.3	586.8
Wetland area (km^2)	92.9	189.0	281.9
Percent wetland	51.2	46.6	48.0
Stream length (RKM)	149	352	501
Anadromous stream length (RKM)	90	176	266

Source: S. Baird, Research Analyst, Kachemak Bay Research Reserve in Homer, AK, unpublished data, 2006.

Note: "RKM" means river kilometers.

Table 2.–Statewide Harvest Survey estimates of Chinook salmon harvest and catch and number of days open to harvest for Anchor River Chinook salmon, 1977–2011.

	Chinook salmon				Chinook salmon opening days				
	Harvest		Catch		Weekend days [a]			Harvest	
Year	Estimate	SE	Estimate	SE	Before MD [b]	On and after MD [c]	Wednesdays	Total days [d]	Per day
1977	1,077	–	NA	–	0	8	0	8	135
1978	2,109	–	NA	–	0	12	0	12	176
1979	1,913	–	NA	–	0	12	0	12	159
1980	605	–	NA	–	0	12	0	12	50
1981	1,069	–	NA	–	0	12	0	12	89
1982	718	–	NA	–	0	12	0	12	60
1983	1,269	–	NA	–	0	12	0	12	106
1984	998	–	NA	–	0	12	0	12	83
1985	672	–	NA	–	0	12	0	12	56
1986	1,098	–	NA	–	0	12	0	12	92
1987	761	–	NA	–	0	12	0	12	63
1988	976	–	NA	–	0	15	0	15	65
1989	578	–	NA	–	0	15	0	15	39
1990	1,479	–	4,119	–	0	15	0	15	99
1991	1,047	–	2,540	–	0	15	0	15	70
1992	1,685	–	4,506	–	0	15	0	15	112
1993	2,787	–	6,022	–	0	15	0	15	186
1994	2,478	–	3,890	–	0	15	0	15	165
1995	1,475	–	3,545	–	0	15	0	15	98
1996	1,483	201	6,594	1,883	0	15	0	15	99
1997	1,563	186	5,289	1,072	0	15	0	15	104
1998	783	119	2,443	361	0	15	0	15	52
1999	1,409	192	6,903	1,769	0	15	0	15	94
2000	1,730	193	5,200	797	0	15	0	15	115
2001	889	162	2,415	452	0	15	0	15	59
2002	1,047	192	4,103	854	0	12	0	12	87
2003	1,011	157	4,311	792	0	12	0	12	84
2004	1,561	198	5,561	1,214	0	15	0	15	104
2005	1,432	233	5,028	1,386	3	12	0	15	95
2006	1,394	197	4,638	1,011	3	12	0	15	93
2007	2,081	326	9,792	1,812	3	12	0	15	139
2008	1,486	241	3,245	542	3	12	5	20	74
2009	737	212	2,296	518	3	6	3	12	61
2010	364	118	889	287	3	6	3	12	30
2011	573	163	1,227	497	3	6	3	12	48
Average									
1977–2010	1,287	–	–	–	1	13	0	14	94
2003–2010	1,258	210	4,470	945	2	11	1	15	85

Source: Alaska Sport Fishing Survey database [Internet]. 1996– . Anchorage, AK: Alaska Department of Fish and Game, Division of Sport Fish (cited August 2015). Available from: http://www.adfg.alaska.gov/sf/sportfishingsurvey/.

Note: "Harvest" is number of fish kept, "catch" is fish harvested plus released, "NA" means not applicable, and the en dash means not calculated.

[a] Weekend openings consisted of Saturday and Sunday from 1977 to 1987 and Saturday–Monday since 1988.

[b] Before the Memorial Day weekend.

[c] On and after the Memorial Day weekend.

[d] Days open for Chinook salmon harvest (regulatory openings adjusted by emergency orders as needed).

Table 3.–Anchor River weir and DIDSON fish counts by species, 1987–1995 and 2003–2011.

				Fish counts						
Year	Project dates	Location (RKM) [a]	Method	Chinook salmon [b]	Dolly Varden [c]	Pink salmon [c]	Chum salmon	Sockeye salmon	Coho salmon [d]	Rainbow trout or steelhead [e]
1987 [f]	04 Jul–10 Sep	1.6	fixed picket weir	204	19,062	2,084	19	33	2,409	136
1988 [f]	03 Jul–05 Oct	1.6	fixed picket weir	245	14,935	777	24	30	2,805	878
1989 [f]	06 Jul–05 Nov	1.6	resistance board weir	95	11,384	4,729	165	212	20,187	769
1990 [f]	04 Jul–15 Aug	1.6	resistance board weir	144	10,427	355	17	39	190	3
1991 [f]	04 Jul–15 Aug	1.6	resistance board weir	39	18,002	1,757	9	46	13	5
1992 [f]	04 Jul–01 Oct	1.6	resistance board weir	129	10,051	992	39	174	4,596	1,261
1993 [f]	03 Jul–16 Aug	1.6	resistance board weir	90	8,262	1,019	12	71	290	1
1994 [f]	03 Jul–16 Aug	1.6	resistance board weir	111	17,259	723	2	61	420	1
1995 [f]	04 Jul–12 Aug	1.6	resistance board weir	112	10,994	1,094	4	73	725	10
2003 [g]	30 May–09 Jul	2.8	DIDSON	9,238 [h]	–	–	–	–	–	–
2004 [g]	15 May–13 Sep	2.8	DIDSON, resistance board weir	12,016 [h,i]	7,846	1,079	79	45	5,728	20
2005 [g]	13 May–09 Sep	2.8	DIDSON, resistance board weir	11,156 [h,i]	5,719	4,916	146	319	18,977	107
2006 [g, j]	15 May–24 Aug	2.8	DIDSON, resistance board weir	8,945 [h,i]	234	954	45	38	10,181 [j]	4
2007 [g]	14 May–12 Sep	2.8	DIDSON, resistance board weir	9,622 [h,i]	1,309	3,916	156	200	8,226	325
2008	13 May–11 Sep	2.8	DIDSON, resistance board weir	5,806 [h,i]	1,344	2,017	66	52	5,951	258
2009	12 May–11 Sep	2.8	resistance board weir	3,455	1,404	4,975	68	62	2,692	54
2010	13 May–29 Sep	2.8	DIDSON, resistance board weir	4,449 [h,i]	1,352	972	67	212	6,014	586
2011	13 May–21 Sep	2.8	DIDSON, resistance board weir	3,545 [h,i]	1,523	2,169	60	47	1,866	132

[a] River kilometers (RKM) from mouth of the Anchor River.

[b] Chinook salmon counts represent escapement because there is no harvest above the monitoring site. The run was only partially counted in 1987–1995 due to weir operation dates and location, and in 2003 due to weir operation dates.

[c] Incomplete Dolly Varden–pink salmon counts due to picket spacing of the weir (2004–2008) because smaller fish were able to pass through the weir pickets undetected.

[d] Incomplete coho salmon counts due to project operation dates (1991, 1993–1995, 2005–2006).

[e] Counts beginning July 1 through end of weir operation. Incomplete counts due to project operation dates and weir location (1987, 1990–1991, 1993–1995, and 2004–2009).

[f] Source for 1987: Larson et al. (1988); 1988: Larson and Balland (1989); 1989: Larson (1990); 1990: Larson (1991); 1991: Larson (1992); 1992: Larson (1993); 1993: Larson (1994); 1994: Larson (1995); 1995: Larson (1997), when escapement weir was located approximately 1.6 RKM from mouth.

[g] Source for 2003–2004: Kerkvliet et al. (2008); 2005–2006: Kerkvliet and Burwen (2010); 2007–2008: Kerkvliet et al. (2012); 2009: Kerkvliet and Booz (2012). 2010–2011: Kerkvliet and Booz (2018).

[h] All DIDSON images and the associated counts were assumed to be Chinook salmon.

[i] Chinook salmon estimates based on combined DIDSON and weir census. If DIDSON was operated in July, counts were apportioned between large fish (Chinook salmon) and small fish (Dolly Varden and pink salmon).

[j] No counts were collected from 19 to 21 August because the weir washed out due to flooding. The DIDSON was operated again from 22 to 24 August; an estimated 3,292 coho salmon were counted.

Table 4.–Anchor River Chinook salmon escapement, freshwater harvest, total run, and exploitation estimates, 2003–2011.

			Chinook salmon					
			Escapement		Inriver harvest		Total inriver run [b]	
Year	Escapement goal [a]	Project dates	Estimate	SE	Estimate	SE	Estimate	Exploitation rate (%)
2003	750–1,500	May 30–Jul 09	9,238 [c]	0	1,011	157	10,249	9.9 [d]
2004	750–1,500	May 15–Sep 15	12,016 [e]	283	1,561	198	13,577	11.5
2005	No goal	May 13–Sep 09	11,156 [e]	229	1,432	233	12,588	11.4
2006	No goal	May 15–Aug 24	8,945 [e]	289	1,394	197	10,339	13.5
2007	No goal	May 14–Sep 12	9,622 [e]	238	2,081	326	11,703	17.8
2008	5,000	May 13–Sep 12	5,806 [e]	169	1,486	241	7,418	21.7
2009	5,000	May 12–Sep 11	3,455 [f]	0	737	212	4,192	17.6
2010	5,000	May 13–Sep 29	4,449 [e]	103	364	118	4,813	7.6
2011	3,800–10,000	May 13–Sep 21	3,545 [e]	0	573	163	4,118	13.9
Averages								
2009–2011			3,816		558		4,374	13.0
2003–2011			7,581		1,196		8,777	13.9

Source: Harvest estimates from Alaska Sport Fishing Survey database [Internet]. 1996– . Anchorage, AK: Alaska Department of Fish and Game, Division of Sport Fish (cited August 2015). Available from: http://www.adfg.alaska.gov/sf/sportfishingsurvey/.

[a] Sustainable escapement goal (SEG) used to manage the fishery. The 2003 and 2004 SEG based on aerial index count (Otis and Hasbrouck 2004). The 2008–2011 SEG is based on a Ricker recruitment model (Szarzi et al. 2007; Otis et al. 2010).

[b] "Total inriver run" is escapement plus freshwater harvest; total does not account for the marine harvest.

[c] The estimate is based on a census of all DIDSON files. Escapement was not fully assessed due to operation dates not spanning the entire run.

[d] Exploitation is conservative because escapement was not fully enumerated.

[e] The estimate is based on expanded DIDSON counts and weir counts.

[f] Escapement is based on weir counts.

Table 5.–Species composition in beach seine catches on the north and south forks of the Anchor River, 2011.

South fork			North fork		
Sample date	Chinook salmon	Steelhead	Sample dates	Chinook salmon	Steelhead
27 May	9	3	20 May	1	1
			25 May	3	4
Total	9	3		4	5

Table 6.–Between- and within-reader correlation analyses for DIDSON counts, Anchor River, 2011.

			Accumulated counts					
	Reader combination	Number of files	First reader	Second reader	Kendall's tau	Intraclass correlation (*r*)	Intraclass 95% CI	Percent agreement
Between reader	A and B	72	34	31	0.89	0.93	0.89, 0.95	87.5
Within reader	A and A	36	15	12	0.88	0.94	0.885, 0.969	83.3
	B and B	72	39	33	0.84	0.96	0.944, 0.978	86.1
	Overall	108	54	45	0.85	0.96	0.940, 0.972	85.2

Table 7.–The estimated ocean age, sex, and length composition of the Anchor River Chinook salmon escapement, 2011.

		Composition by ocean age					Composition
Sex	Parameter	1	2	3	4	Total	by sex [a]
Female							
	Sample size [b]	0	15	64	10	89	101
	Estimated percent	0	5.3	22.7	3.5		29.9
	SE percent	0	1.3	2.5	1.1		2.5
	Estimated abundance	NA	188	805	124		1,060
	SE abundance	NA	46	89	39		89
	Length samples	NA	15	64	10		101
	Mean length (mm)	NA	617	770	855		751
	SE mean length (mm)	NA	9	6	12		8
Male							
	Sample size [b]	9	126	52	6	193	237
	Estimated percent	3.2	44.7	18.4	2.1		70.1
	SE percent	1.0	3.0	2.3	0.9		2.5
	Estimated abundance	113	1,585	652	74		2,485
	SE abundance	35	106	82	32		89
	Length samples	9	126	52	6		237
	Mean length (mm)	402	600	778	883		648
	SE mean length (mm)	29	4	8	22		8
All							
	Sample size [b]	9	141	116	16	282	338
	Estimated percent	3.2	50	41.1	5.7		
	SE percent	1.0	3.0	2.9	1.4		
	Estimated abundance	113	1,773	1,457	202		3,545
	SE abundance	35	106	103	50		0.0
	Length samples	9	141	116	16		338
	Mean length (mm)	402	602	774	866		679
	SE mean length (mm)	29	4	5	11		6

Note: "NA" means not applicable. Age, sex, and length-at-age compositions are based on pooled samples collected from nets on the south and north forks and the mainstem weir.

[a] In some cases where sex was determined, scales could not be read and age was not determined (thus, total sample sizes for age and sex differ).

[b] Unweighted sample sizes by age class and sex.

Table 8.–Anchor River Chinook salmon estimated escapement and freshwater harvest by ocean-age composition, 2003–2011.

	Escapement										Freshwater harvest					
											Number of fish					
			Percent by ocean age				Number of fish at ocean age						Ocean age			
Run year	Estimate	SE	1	2	3	4	1	2	3	4	Estimate	SE	1	2	3	4
2003 [a]	9,238	0	5.1	23.0	57.8	13.8	471	2,125	5,340	1,275	1,011	157	52	233	584	140
2004	12,016	283	8.8	20.7	48.6	21.9	1,057	2,487	5,840	2,632	1,561	198	137	323	759	342
2005	11,156	229	5.0	23.9	52.2	18.9	558	2,666	5,823	2,108	1,432	233	72	342	748	271
2006	8,945	289	6.4	16.5	52.1	25.0	572	1,476	4,660	2,236	1,394	197	89	230	726	349
2007	9,622	238	0.5	22.0	53.4	24.1	48	2,116	5,138	2,319	2,081	326	10	458	1,111	502
2008	5,806	169	4.4	21.8	68.5	5.2	255	1,266	3,977	302	1,612	241	71	351	1,104	84
2009	3,455	0	7.8	51.1	36.7	4.4	269	1,766	1,268	152	737	212	57	377	270	32
2010	4,449	103	7.0	36.1	51.3	5.6	311	1,606	2,282	249	364	118	25	131	187	20
2011	3,545	0	3.2	50.0	41.1	5.7	113	1,773	1,457	202	573	163	18	287	236	33
Average 2003–2011	7,581	146	5	29	51	14	406	1,920	3,976	1,275	1,196	205	59	304	636	197

[a] Escapement was not fully assessed due to operation dates.

Table 9.–Anchor River Chinook salmon estimated return per spawner by brood year, 2003–2011.

	Number of fish returning by brood year			
Brood year	Escapement by brood year	Freshwater harvest	Total return	Return per spawner
2003	6,817	1,684	8,501	0.92 [a]
2004	2,831	653	3,484	0.29
2005	4,505	667	5,172	0.46
2006	NA	NA	NA	NA
2007	NA	NA	NA	NA
2008	NA	NA	NA	NA
2009	NA	NA	NA	NA
2010	NA	NA	NA	NA
2011	NA	NA	NA	NA

Note: “NA” means not available.

[a] Positively biased estimate because escapement was not fully assessed.

FIGURES

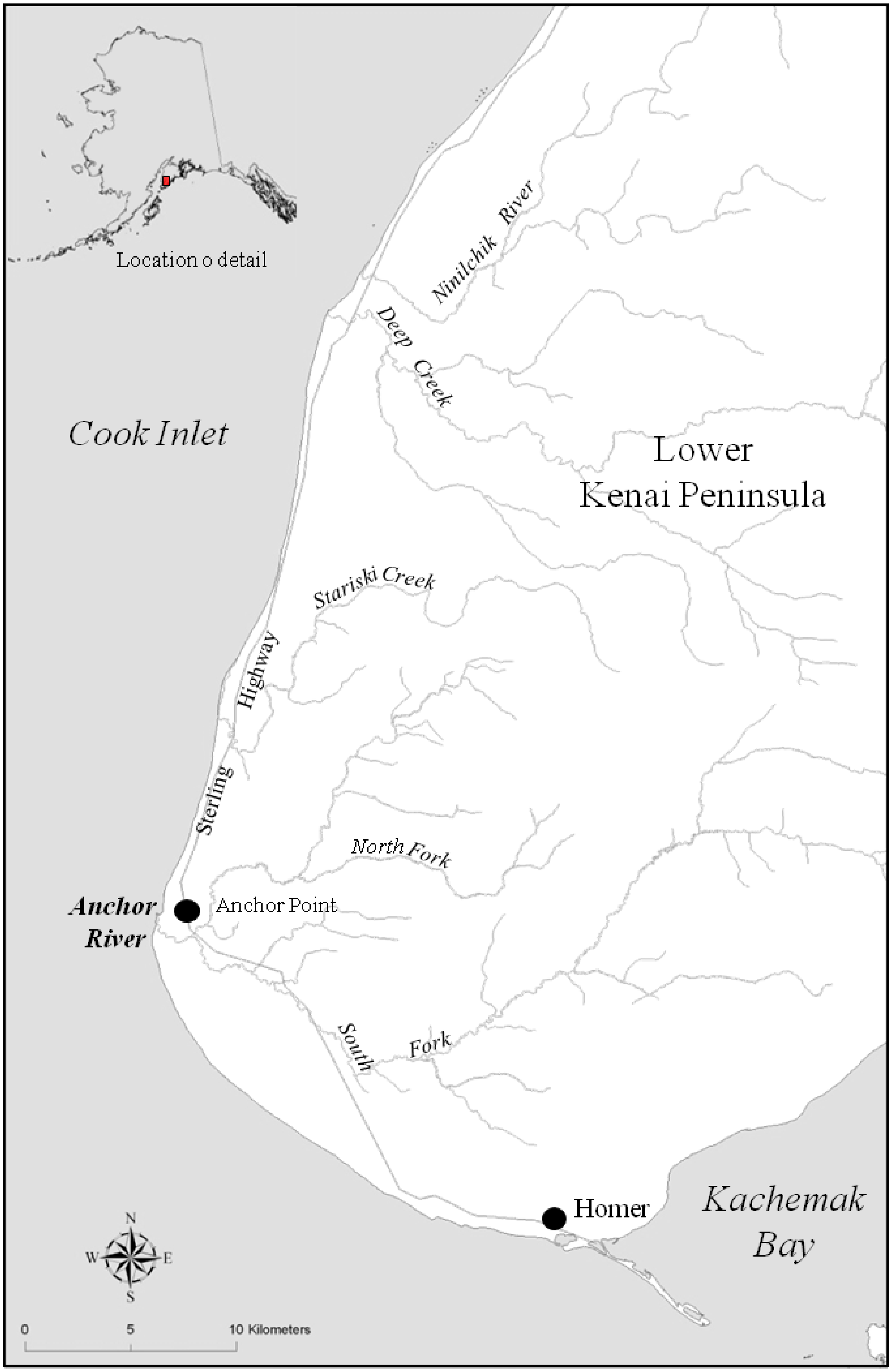

Figure 1.–Location of Anchor River and other roadside tributaries in the Lower Cook Inlet Management Area.

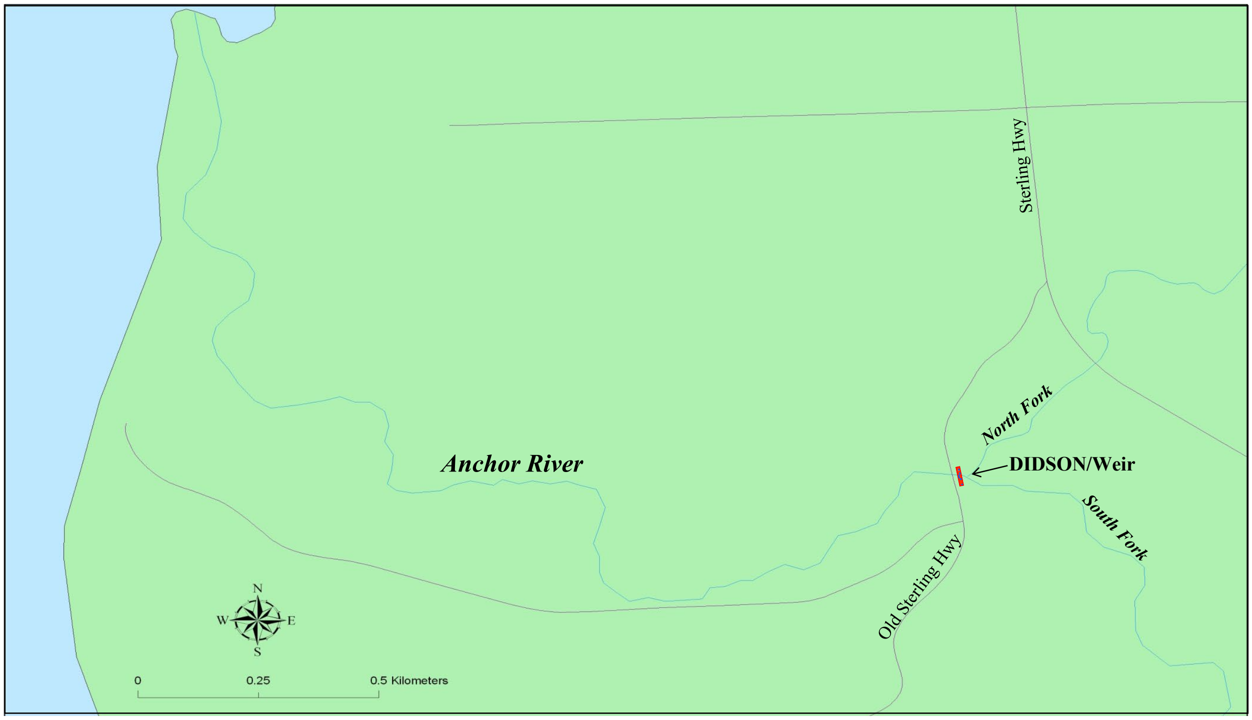

Figure 2.–Location of the mainstem DIDSON weir site on the Anchor River (lat 59.772233, long −151.835033).

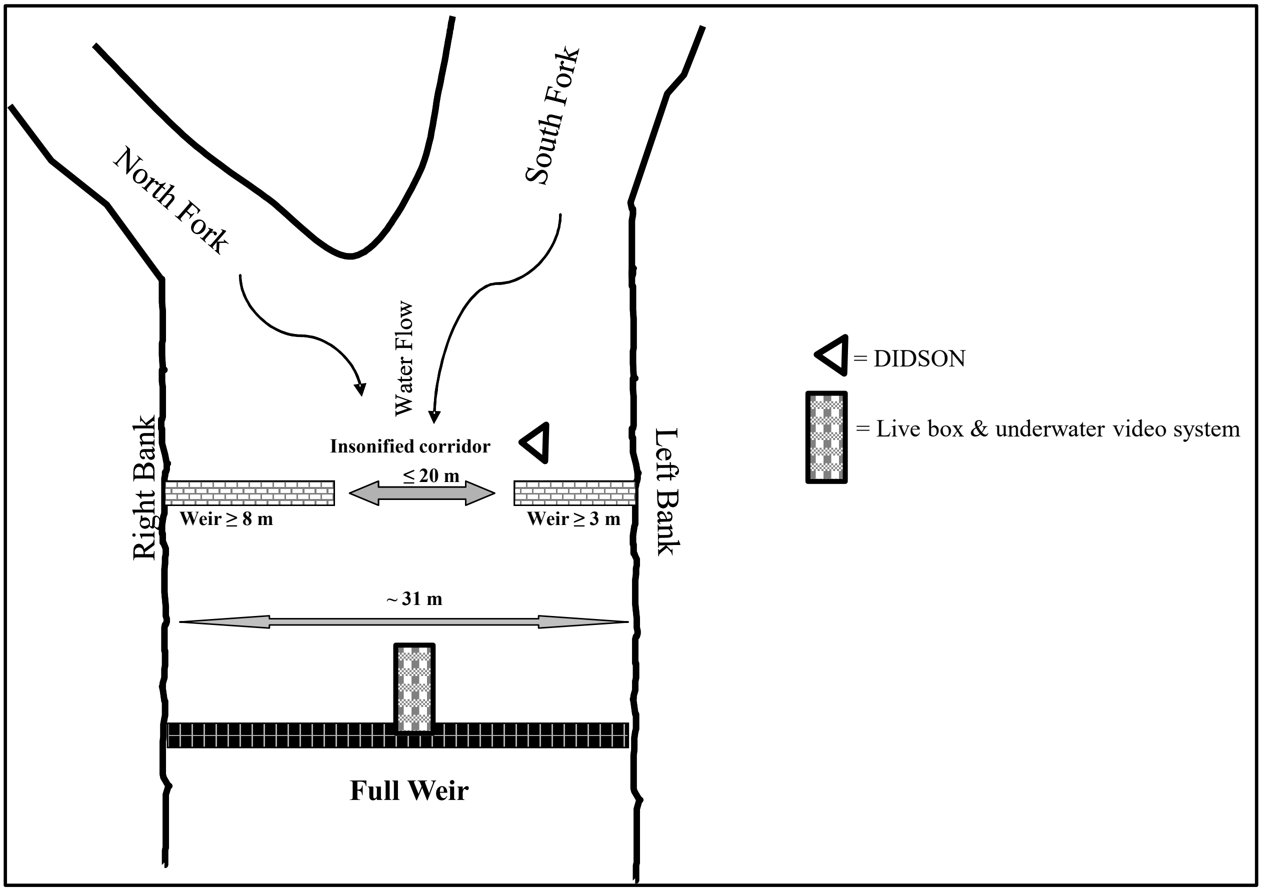

Figure 3.–Locations of the mainstem DIDSON, partial weirs, and mainstem full weir site on the mainstem of the Anchor River.

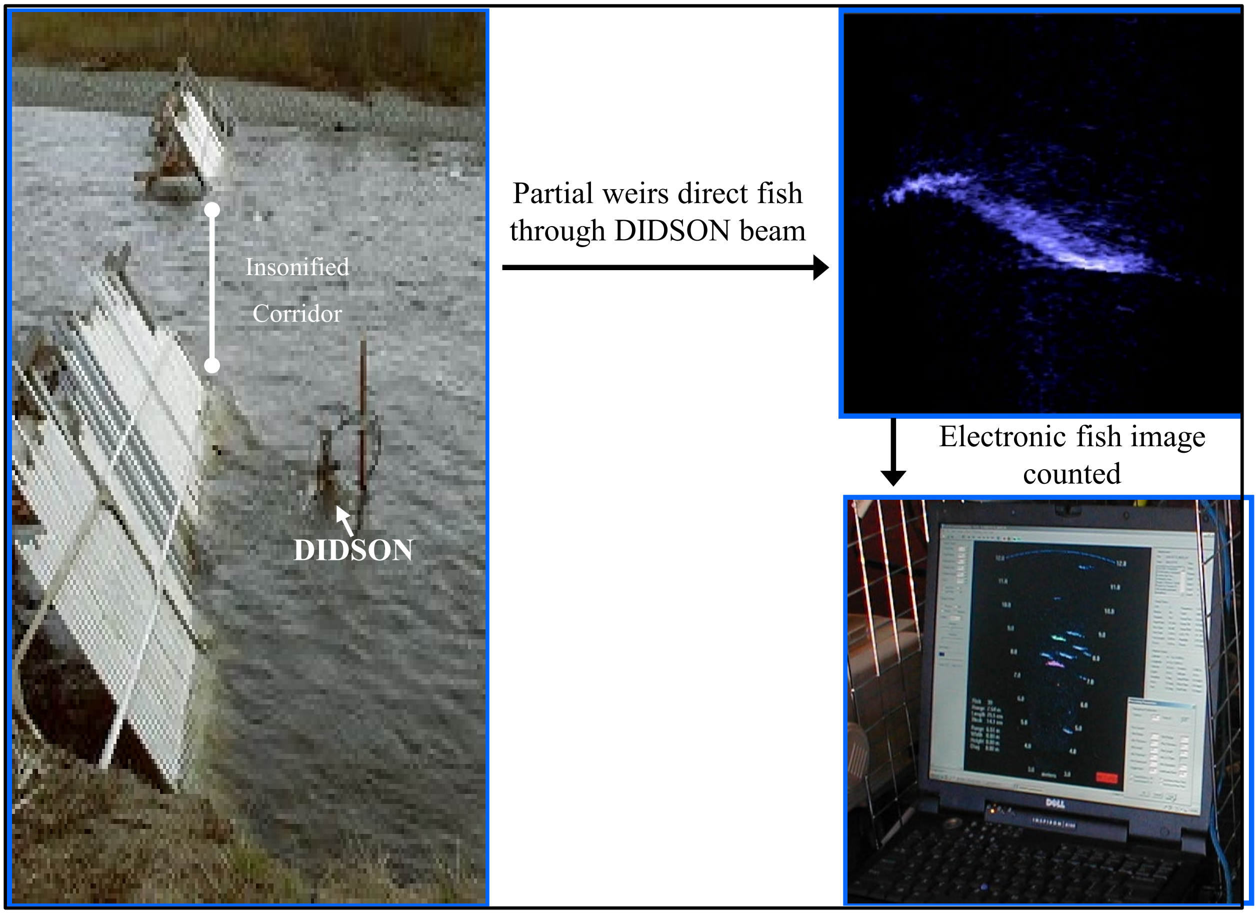

Figure 4.–DIDSON is used with partial weirs (left) to funnel fish through the DIDSON beam.

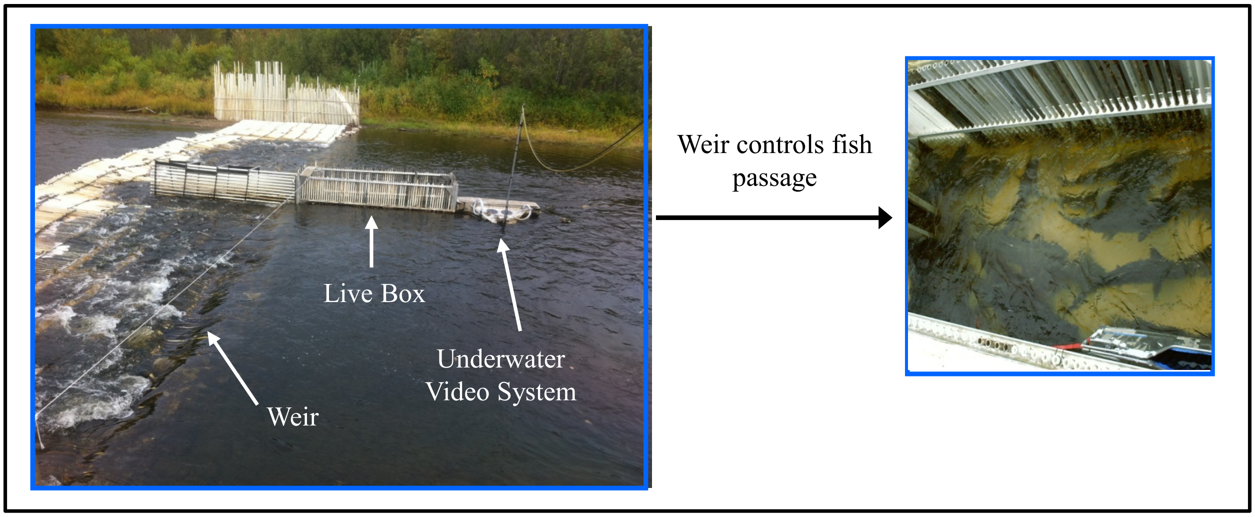

Figure 5.–Resistance board weir with midchannel live box and underwater video system on the Anchor River, 2011.

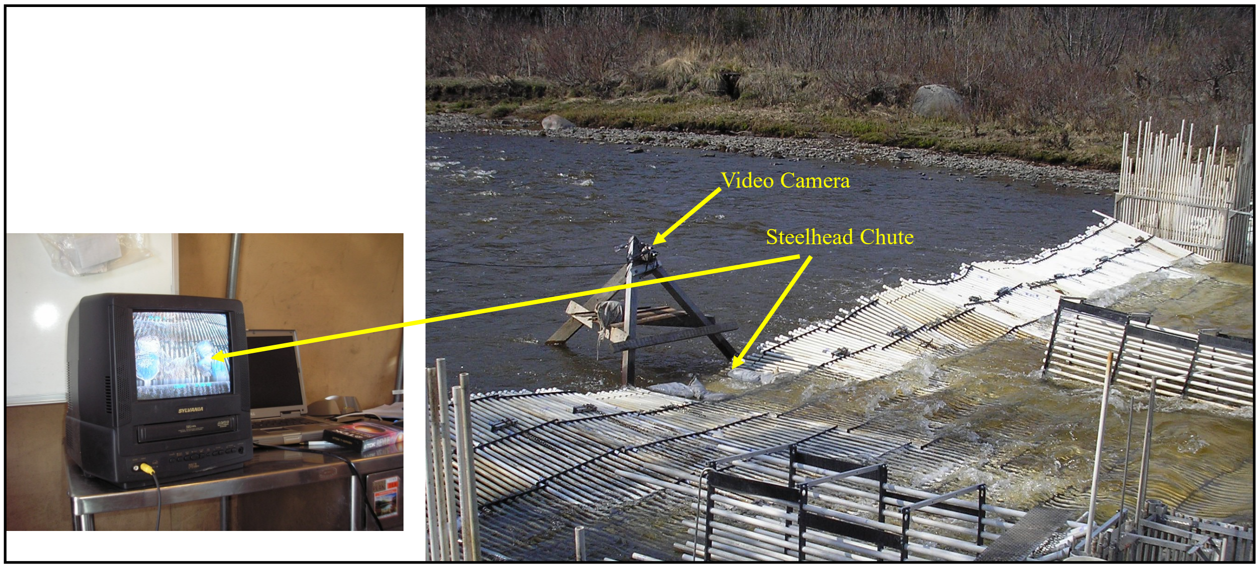

Figure 6.–Location of the “steelhead chute” and video camera, Anchor River, 2011.

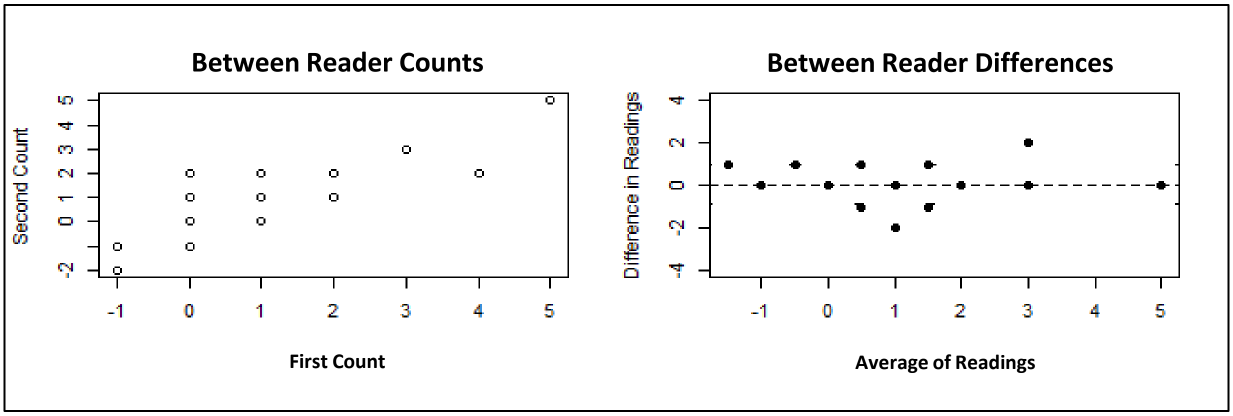

Figure 7.–Between-reader counts (left; Reader A on *x* axis and Reader B on *y* axis) and Tukey difference plots (right) for 2 readers of selected DIDSON files, Anchor River, 2011.

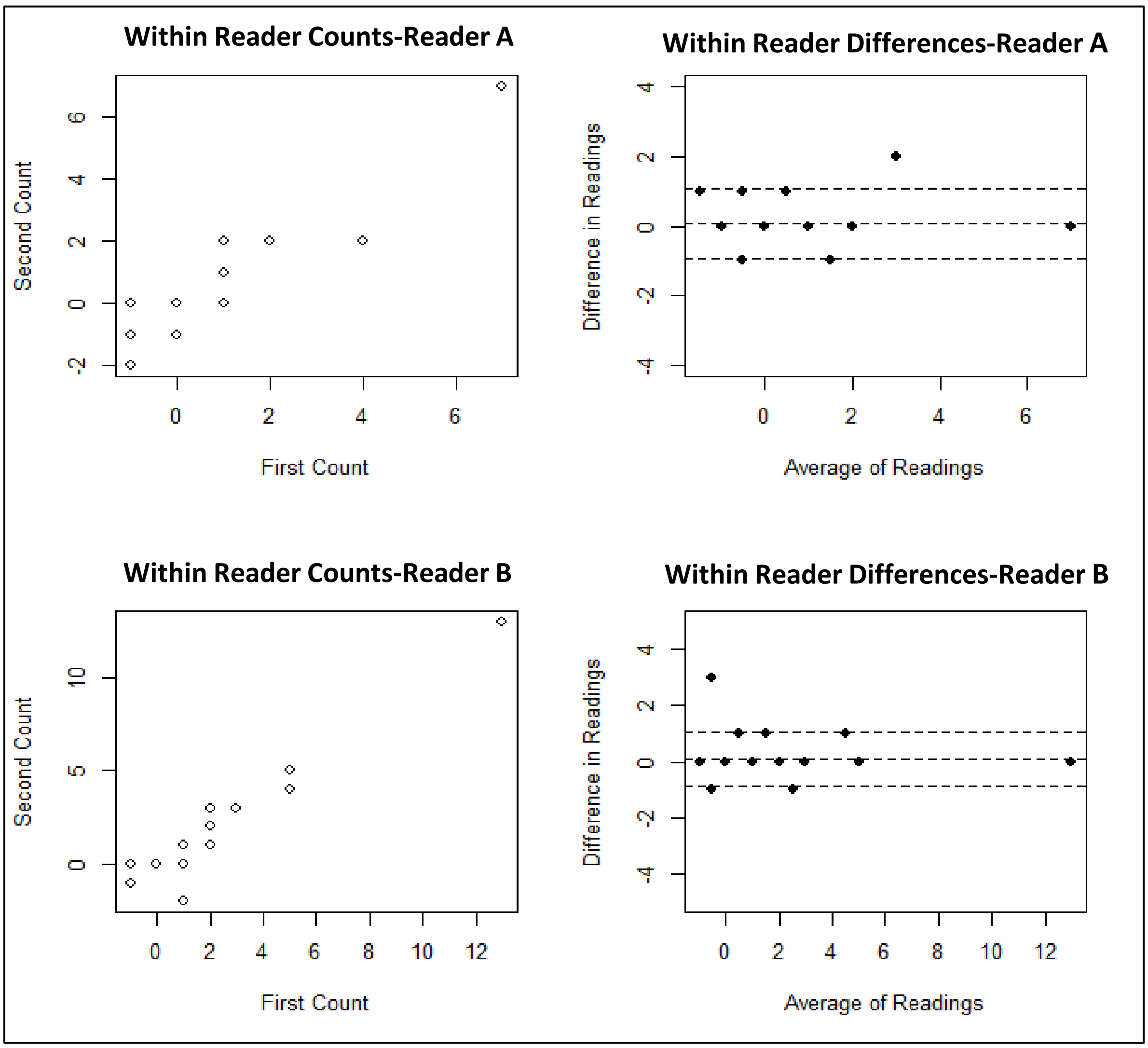

Figure 8.–Within-reader counts (left) and Tukey difference plots (right) for 2 readers of selected DIDSON files, Anchor River, 2011.

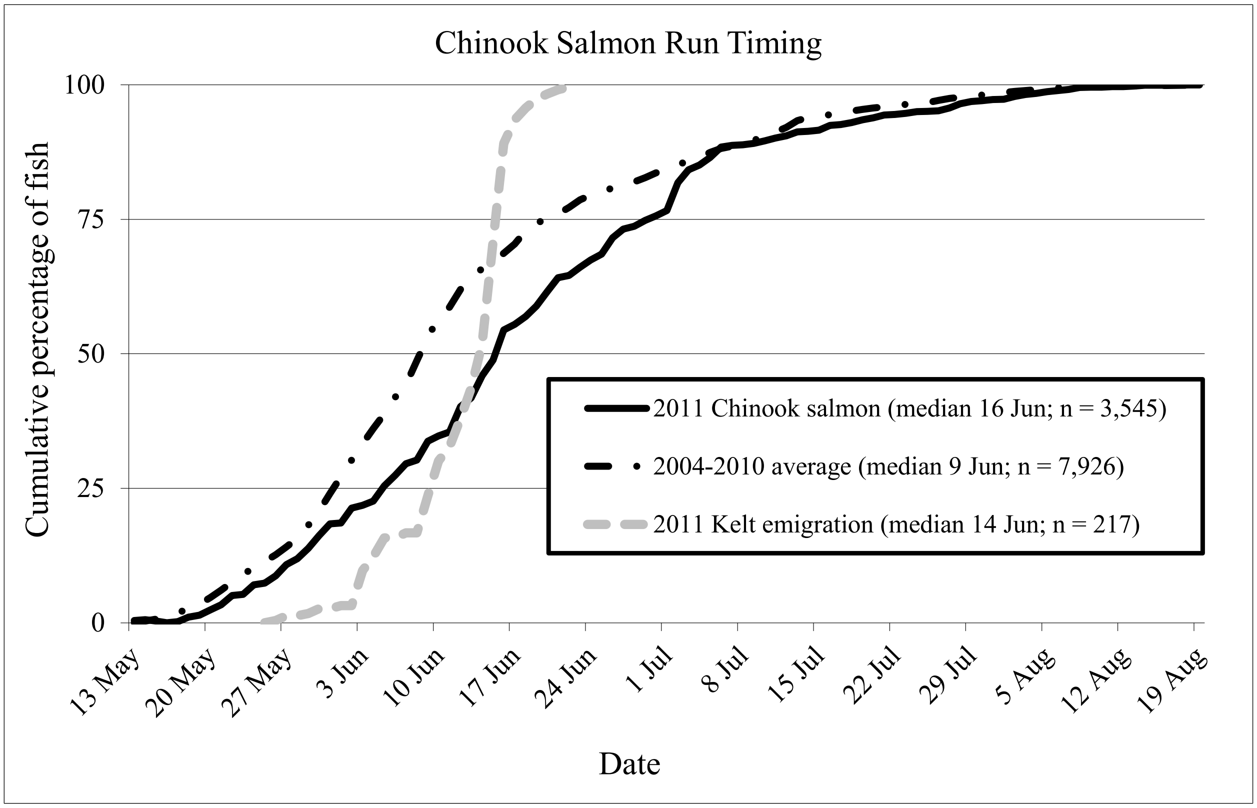

Figure 9.–Chinook salmon run timing of the 2011 immigration compared to the recent average (2004–2010) and compared to the emigration of steelhead kelts at the mainstem Anchor River sonar-weir site.

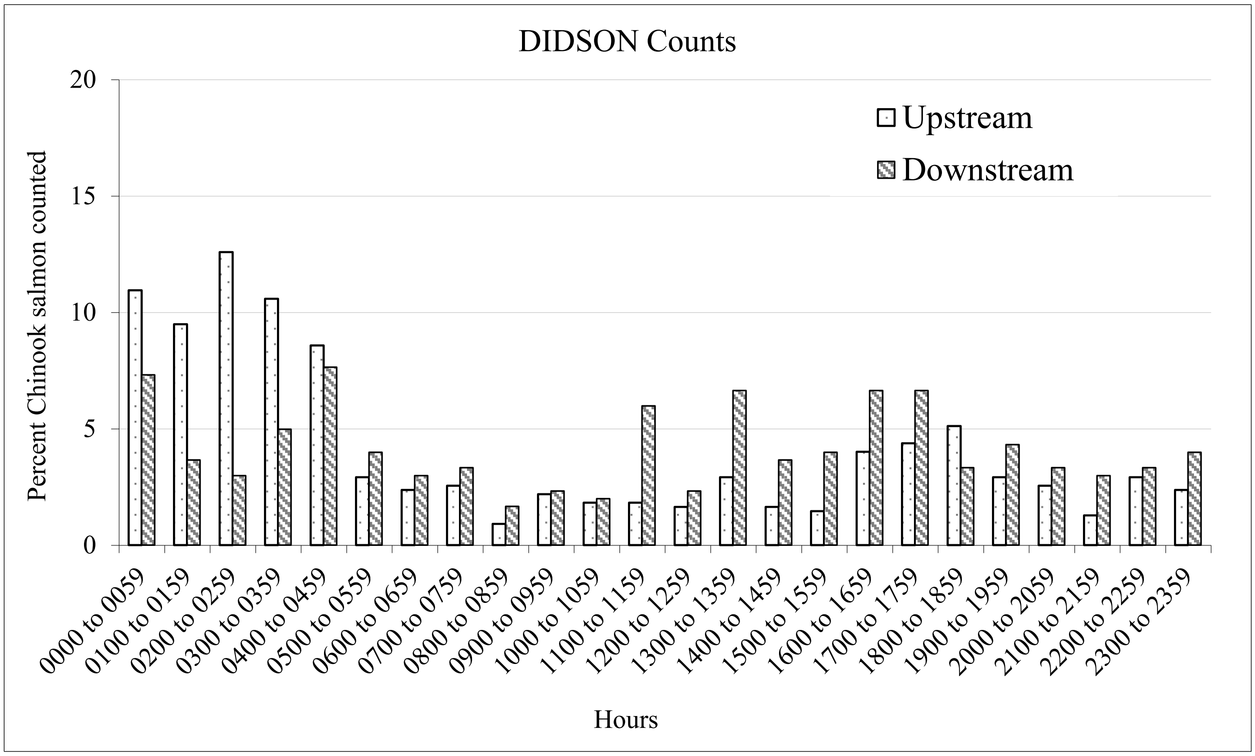

Figure 10.–Percent of all upstream and downstream images counted by hour during 13 to 24 May based on 20-minute DIDSON counts, Anchor River, 2011.

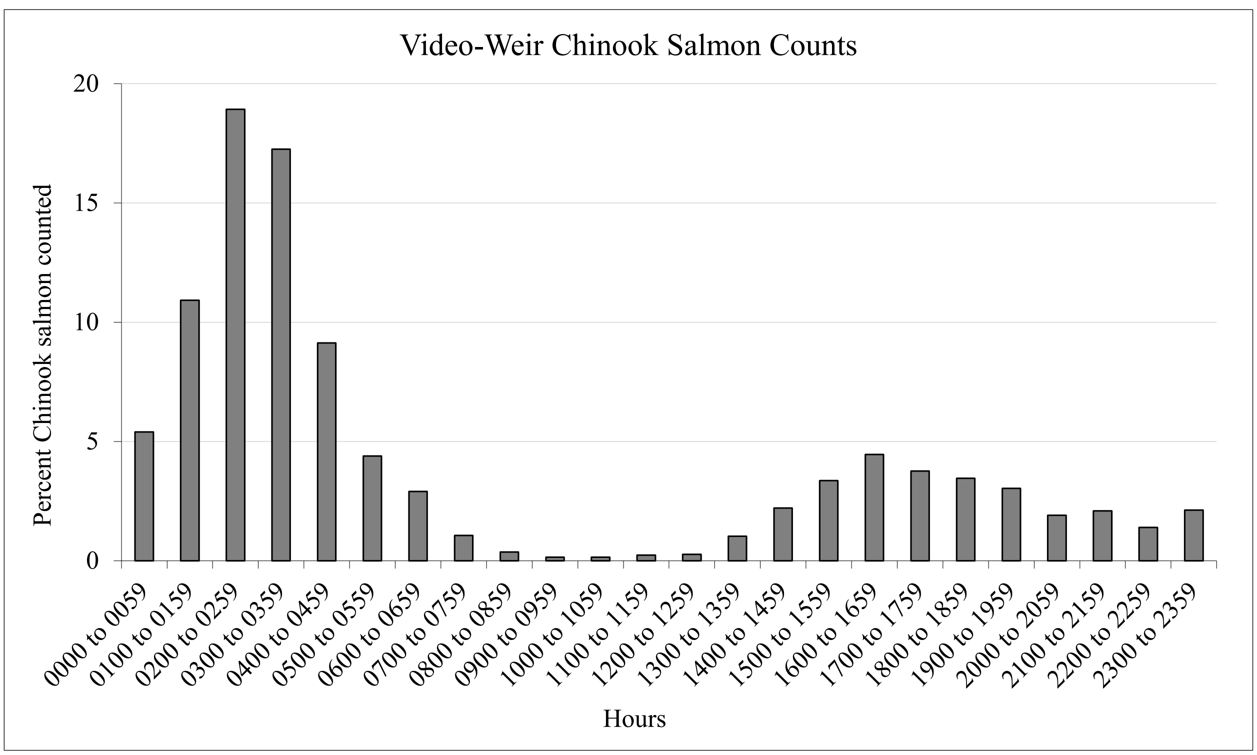

Figure 11.–Percent of Chinook salmon counted by hour during 24 May through 21 September based on video-weir counts, Anchor River, 2011.

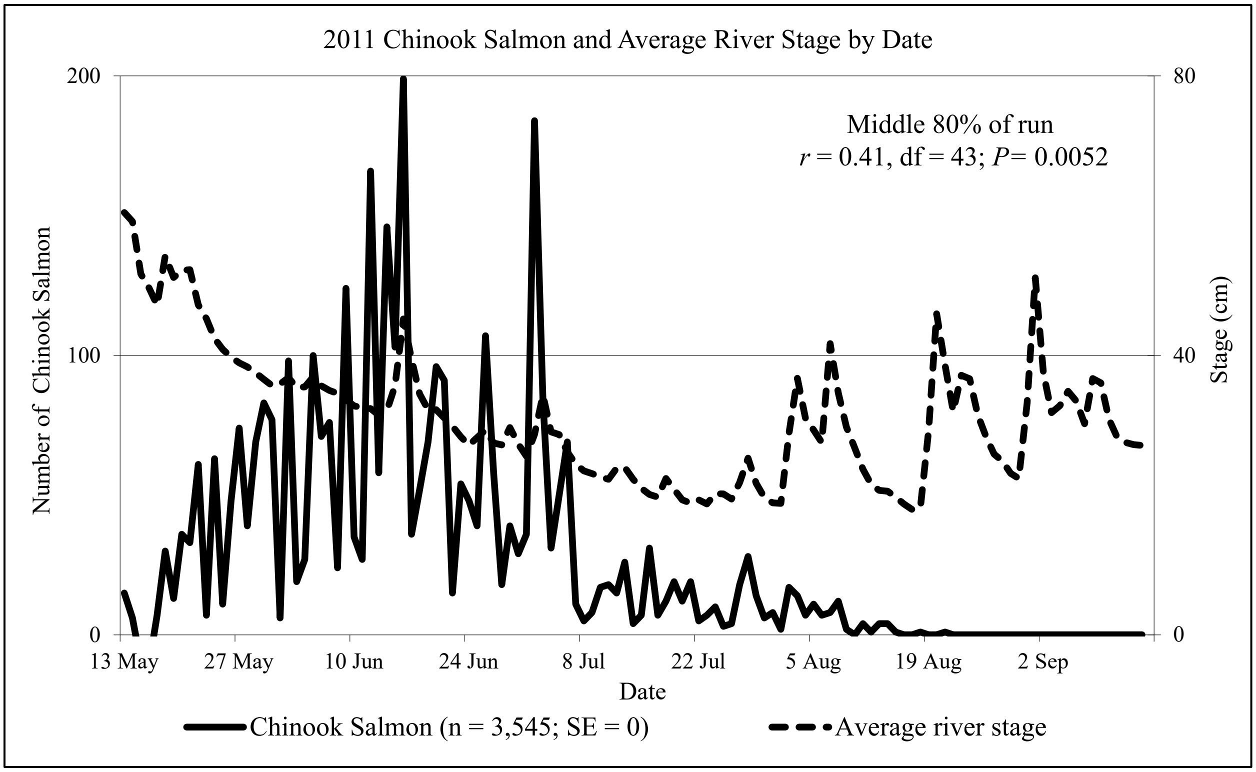

Figure 12.–Daily counts of Chinook salmon at the sonar-weir site plotted against daily river stage averages by date, Anchor River, 2011.

Note: Stage data collected at gauge station USGS 15239900 located at approximately 11.4 RKM on the south fork, Anchor River.

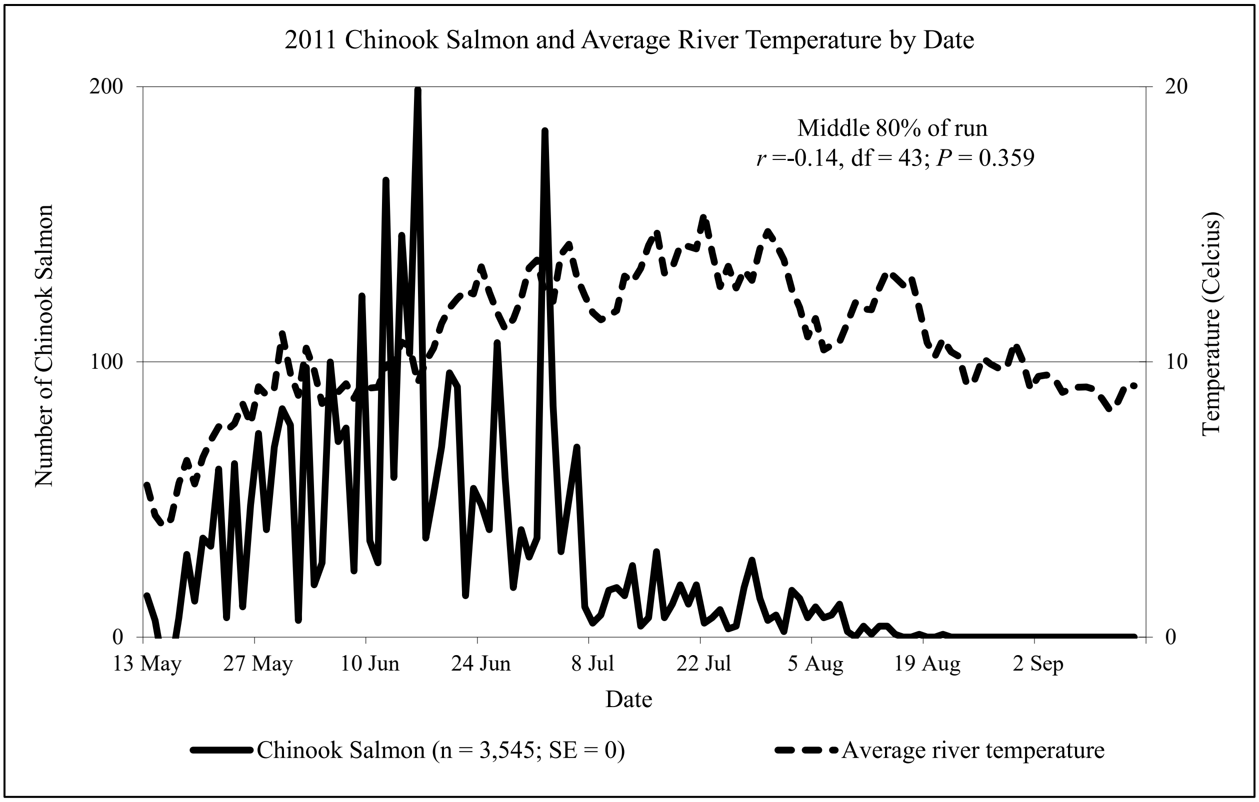

Figure 13.–Daily counts of Chinook salmon at the sonar-weir site plotted against daily river temperature averages by date, Anchor River, 2011.

Note: Temperature data collected approximately 0.1 RKM downstream of the south and north forks confluence of the Anchor River.

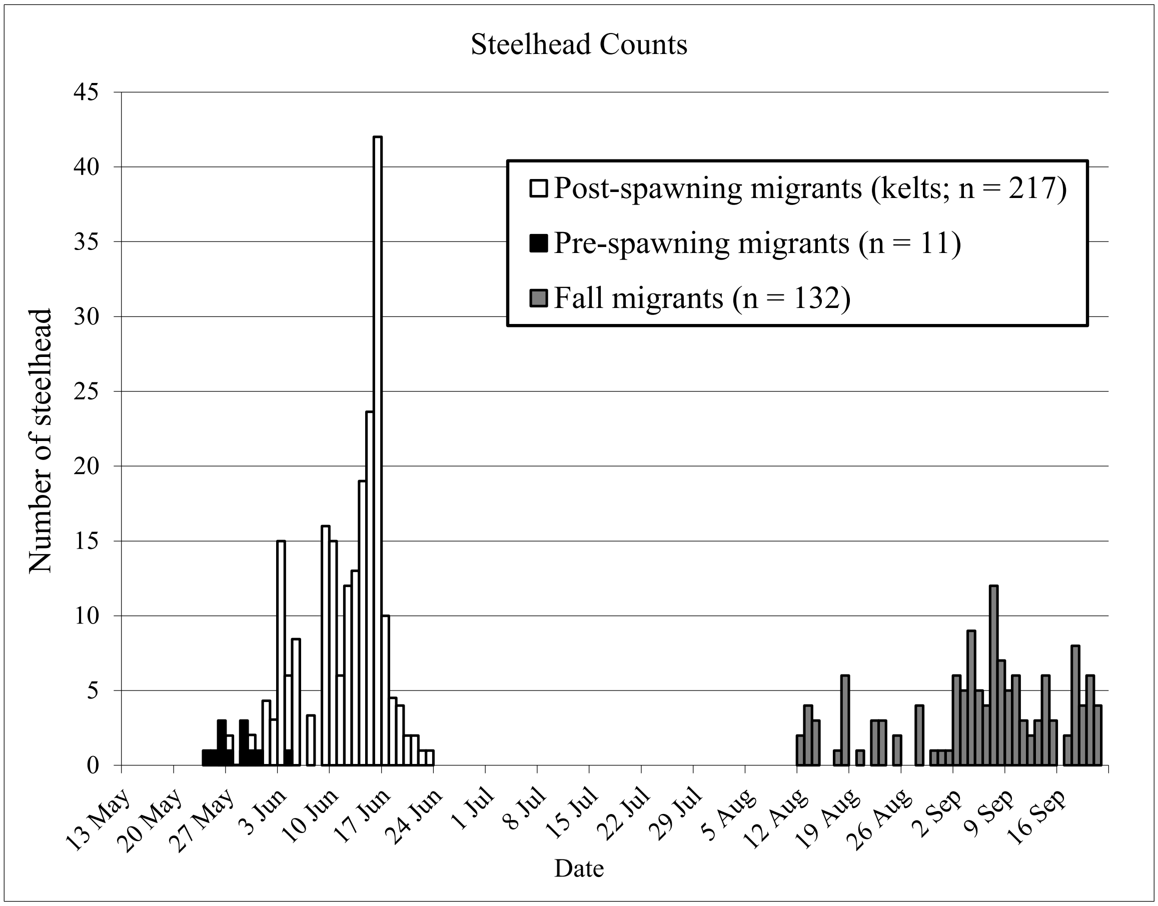

Figure 14.–Anchor River steelhead counts at the Anchor River sonar-weir site, 2011.

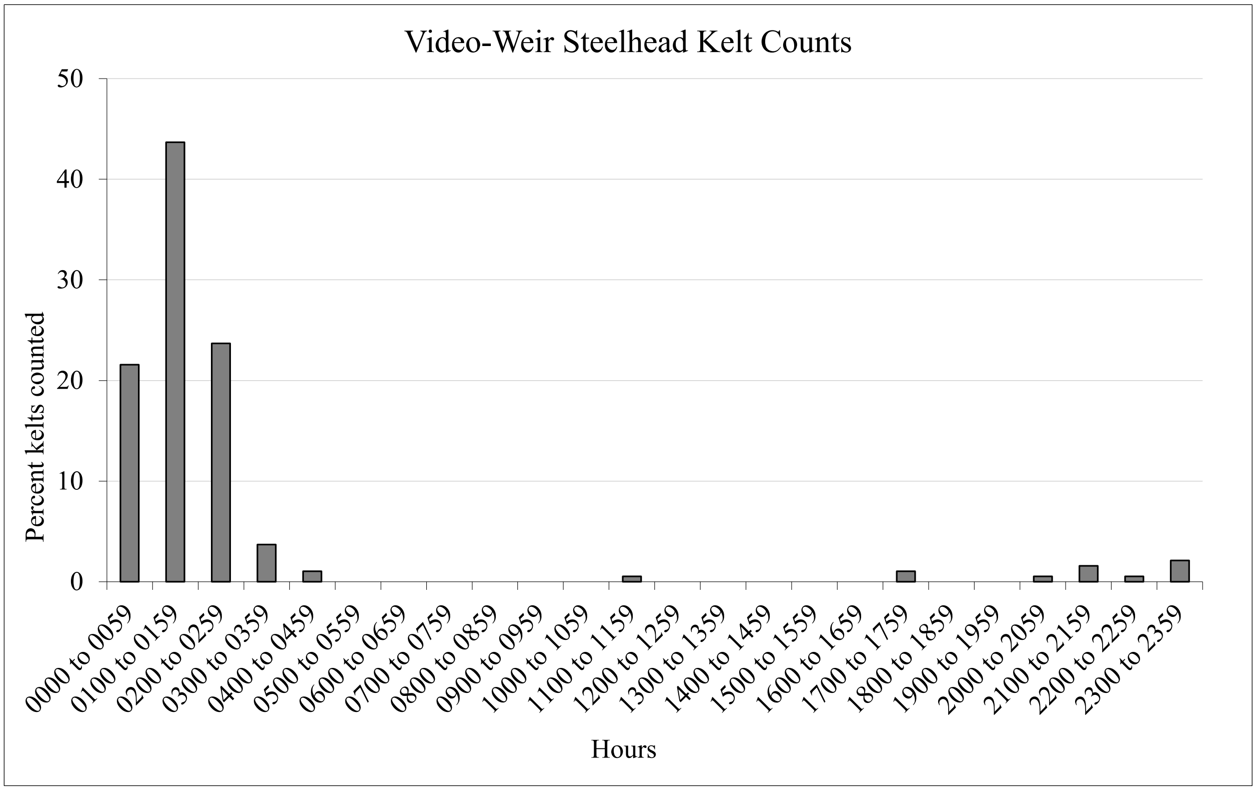

Figure 15.–Percent of steelhead kelts counted by hour during 25 May through 24 June, Anchor River, 2011.

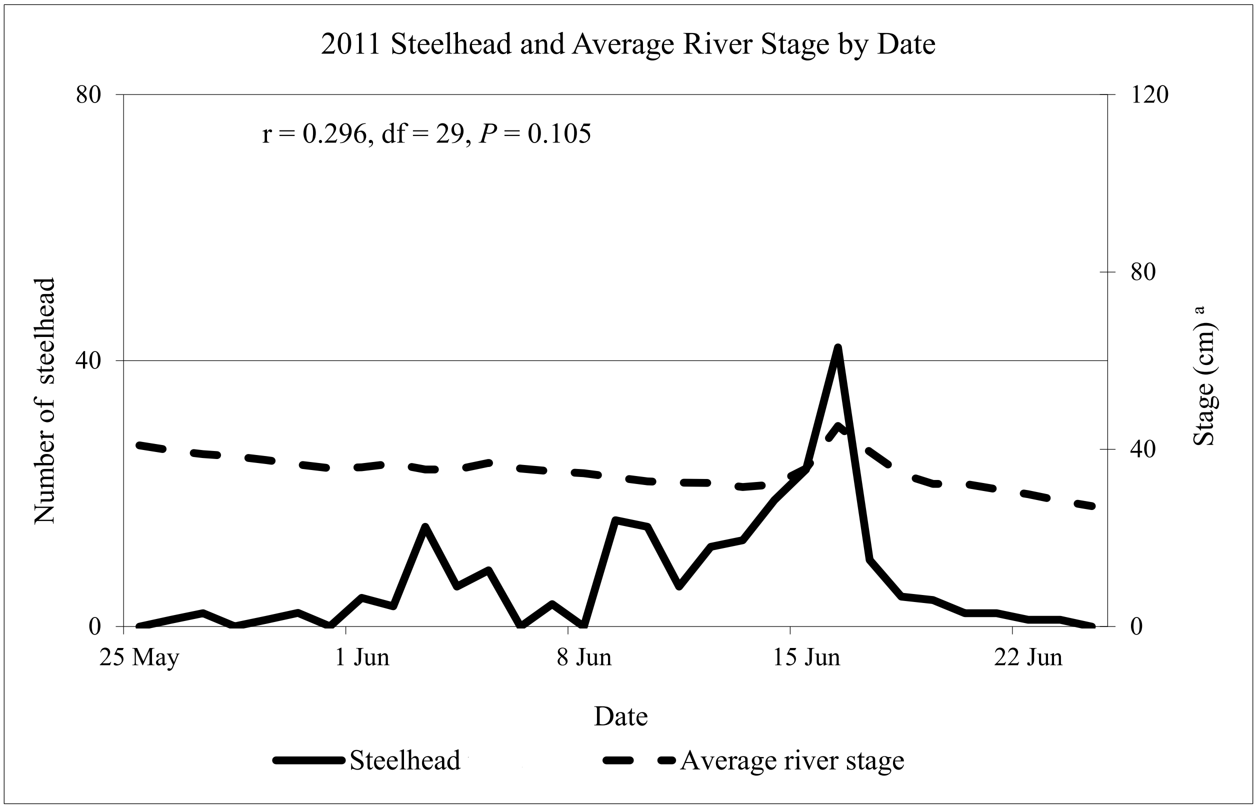

Figure 16.–Daily counts of emigrating steelhead from the Anchor River plotted against average daily river stage by date, 2011

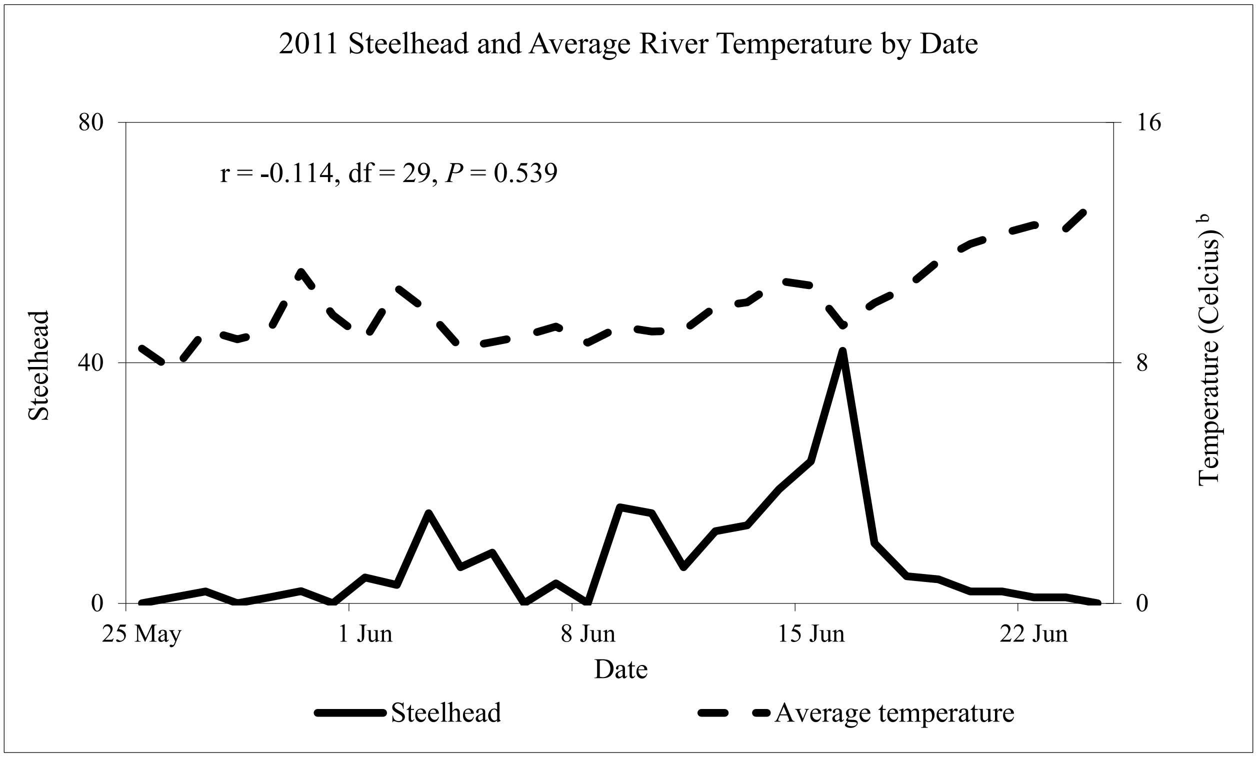

Figure 17.–Daily counts of emigrating steelhead trout from the Anchor River plotted against average daily river temperature by date, 2011.

APPENDIX A: MONITORING TIMELINES FOR ANCHOR RIVER CHINOOK SALMON

Appendix A1.–Timeline of escapement monitoring for Chinook salmon on the Anchor River, 1950–2011.

Year(s)	Escapement monitoring
1950s	Periodic fisheries investigations in the Anchor River were conducted by U.S. Fish and Wildlife Service. Chinook salmon escapement was monitored with weirs at various lower river locations on the North and South forks and mainstem. Aerial and foot surveys were also conducted.
1962–1969	Annual Chinook salmon escapement was estimated with a combination aerial and ground index survey. Surveys were conducted once annually over a standard length of river. Aerial surveys were done from a fixed-wing aircraft (Super Cub). Foot surveys were conducted within a subsection of the aerial survey from the Sterling Highway Bridge upstream approximately 4 river kilometers (RKM) to forks. Where the foot survey was conducted, if the foot survey counts were greater than the aerial counts, the total aerial count was expanded by the difference. In 1966, no aerial surveys were conducted due to poor viewing conditions. Note: "standard length" and the location of the Sterling Highway Bridge (old versus new) could not be determined.
1970–1974	The ground index subsection was expanded to approximately 8 RKM from Glanville lumber to forks. No aerial survey was conducted in 1970 or 1971. Note: "forks" is assumed to be North and South forks confluence.
1975–1982	Aerial surveys were conducted using rotary-wing aircraft to index Chinook salmon escapement. Surveys were conducted once annually over a standard section of the South Fork of the Anchor River. Foot surveys continued as before. Note: "forks" is assumed to be North and South forks confluence.
1983–1994	The index subsection for combined aerial and foot surveys was reduced back to approximately 4 RKM from Sterling Highway Bridge to forks. Note: "standard length" and the location of the Sterling Highway bridge (old versus new) could not be determined.
1995–2002	The foot survey was discontinued. Periodic foot surveys were conducted over additional stream reaches such as North Fork, Beaver Creek, and above forks. Aerial surveys continued.
2003	In addition to the aerial survey, the feasibility of using DIDSON[4] sonar as an escapement monitoring tool was tested on the mainstem of the Anchor River just below the confluence of the North and South forks at RKM 2.8. DIDSON was only operated from 30 May through 9 July, not over the entire run.
2004	Chinook salmon escapement was monitored over the entire run at approximately RKM 2.8 through a combination of DIDSON during periods of high water and resistance board weir during periods of low water. A weir was operated on the North Fork to monitor the entire run at approximately RKM 6.2. Aerial surveys of the North Fork and South Fork index areas were used to compare index to total escapement estimates.
2005–2008	Chinook salmon escapement was monitored over the entire run at approximately RKM 2.8 through a combination of DIDSON during periods of high water and resistance board weir during periods of low water. Aerial surveys were continued through 2008 to compare index to total run estimates.
2009	Chinook salmon escapement was censused using a resistance board weir over the entire run at approximately RKM 2.8 because of low water levels. A foot survey of the historical index area was conducted from the new Sterling Highway Bridge (lat 59.746895, long −151.754319) to the confluence of the North and South Forks (lat 59.772253, long −151.834263).

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4 Dual frequency identification sonar (DIDSON).

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Year(s)	Escapement monitoring
2010	Chinook salmon escapement was monitored over the entire run at approximately RKM 2.8 through a combination of DIDSON during periods of high water and resistance board weir during periods of low water. Escapement monitoring in August and September was conducted through a cooperative agreement with USFWS. USFWS monitored escapement using the resistance board weir and an underwater video camera (Anderson and Stillwater Sciences 2011).
2011	Chinook salmon escapement was monitored over the entire run at approximately RKM 2.8 through a combination of DIDSON, during periods of high water, and resistance board weir fitted with an underwater video camera during periods of low water. Escapement monitoring in August and September was conducted through a cooperative agreement with USFWS.

Appendix A2.–Timeline of sport harvest monitoring and escapement goals for Chinook salmon on the Anchor River, 1950–2011.

Year (s)	Sport harvest assessment
1950s	Periodic fisheries investigations in the Anchor River were conducted by U.S. Fish and Wildlife Service. Chinook salmon harvest was monitored through creel surveys.
1966–1977	Punch cards were used to enforce daily and seasonal limits (Hammarstrom et al. 1985).
1971–1977	Punch card returns were the primary source of harvest data. Effort was estimated by car counts each day at campgrounds and parking areas from 1971 to 1976.
1972–1986	Creel surveys were conducted at the Deep Creek access from 1972 to1986 and 1994 (Nelson 1994, 1995). A creel survey at the Anchor River–Whiskey Gulch access was conducted in 1986 (Nelson 1994).
1976–1983	Age composition of the Chinook salmon harvest was estimated for the Anchor River, Deep Creek, and Ninilchik River (Hammarstrom et al. 1985).
1977 to present	Statewide Harvest Surveys (SWHS) were conducted and produced annual estimates of total catch and harvest for Chinook salmon in the Anchor River.

Year (s)	Escapement goals
1993–1997	The first biological escapement goal (BEG) of 1,790 Chinook salmon was adopted in 1993. The BEG was the average of the expanded estimates from aerial and foot survey index counts conducted from 1966 to 1969 and from 1972 to 1991.
1998–2000	In 1998, the BEG was rescaled to a range of 1,050–2,200 Chinook salmon and was based on historical aerial survey counts and their relationship to sport harvest. The escapement range was approximated with a median aerial survey count of 1,211 Chinook salmon. The upper end of the range was the value that 20% of the annual aerial counts were above. The lower end was the value that 40% of the annual aerial counts were below (Szarzi and Begich 2004: page 22).
2001–2004	In 2001, the sustainable escapement goal (SEG) of 750 to 1500 Chinook salmon was adopted. The SEG was the 25th and 75th percentiles of the annual aerial counts from 1976 through 2000 (Szarzi and Begich 2004: page 22). During the Alaska Board of Fisheries (BOF) meeting in February 1999, in response to the guidelines established in the *Sustainable Salmon Fisheries Policy*, BOF designated Anchor River Chinook salmon as a stock of “management concern” defined in the policy as “a concern arising from a chronic inability, despite use of specific management measures, to maintain escapements for a salmon stock within the bounds of the SEG, BEG, [optimal escapement goal] OEG, or other specified management objectives for the fishery” (5 AAC 39.222 [f] [21]) (Szarzi and Begich 2004: page 25).
2005–2007	In 2005, the SEG was repealed and no new goal was adopted in anticipation that SF would collect sufficient escapement data with the DIDSON–weir project to recommend an escapement goal (Szarzi et al. 2007).
2008	ADF&G adopted a lower bound SEG of 5,000 Chinook salmon. The SEG was based on a full probability spawner-recruit model that incorporated aerial survey data and SWHS harvest estimates from 1977 to 2007 and the total escapement estimates and age composition data collected from the DIDSON–weir project from 2003 to 2007 (Szarzi et al. 2007).
2010	A full probability spawner–recruit model (Szarzi et al. 2007) was updated with escapement and harvest data through 2009. The recommended lower bound of the SEG of 3,800 is the point estimate (posterior median) of SMSY from the full probability model, including the recent data. The upper bound is the point estimate of carrying capacity, 10,000 from the updated model (Otis et al. 2010).

Appendix A3.–Timeline of the freshwater fishing regulations and emergency orders (EOs) for Chinook salmon on the Anchor River, 1960–2011.

Closed areas for Chinook salmon

Year	Chinook salmon fishing regulations
1960–2010	Salmon fishing closed upstream of the junction of North and South forks.
1996-2011	The area above forks was closed to all fishing until August 1 to protect spawning salmon.

Recording requirements

Year	Chinook salmon fishing regulations
1966–1980	A Chinook salmon punch card was required by all anglers, including those under 16 years of age.
1981–2011	Anglers recorded Chinook salmon harvest on the back of a sport fishing license or harvest card.

Open season for Chinook salmon by regulation

Year	Chinook salmon fishing regulations
1960	May 7 to December 31.
1961	May 7 to July 1 only.
1962–1963	May 7 to July 8 only.
1964–1965	Closed
1966	May 28 to June 26 and limited to weekends and holidays or until 500 Chinook salmon 20 inches (in) or longer was attained among the Anchor River, Deep Creek, Ninilchik and Kenai Rivers.
1967	May 27 to June 11 opened continuously or until 500 Chinook salmon 20 in or longer was attained among the Anchor River, Deep Creek, Ninilchik and Kenai Rivers.
1968	May 25 to June 9 opened continuously or until 500 Chinook salmon 20 in or longer was attained among the Anchor River, Deep Creek, Ninilchik and Kenai Rivers. .
1969	May 24 to June 8 opened continuously or until 200 Chinook salmon 20 in or longer was attained among the Anchor River, Deep Creek, Ninilchik and Kenai Rivers.
1970	May 30 to June14 opened continuously or until 200 Chinook salmon 20 in or longer was attained among the Anchor River, Deep Creek, Ninilchik and Kenai Rivers.
1971	Beginning on the Memorial Day weekend for two consecutive 2-day weekends (Saturday and Sunday). Quota eliminated.
1972	Beginning on the Memorial Day weekend for two consecutive 2-day weekends.
1973–1975	Beginning on the Memorial Day weekend for three consecutive 2-day weekends.
1976–1977	Beginning on the Memorial Day weekend for four consecutive 2-day weekends.
1978–1988	Beginning on the Memorial Day weekend for four consecutive 3-day weekends (weekends include Monday).
1989–2001	Beginning on the Memorial Day weekend for five consecutive 3-day weekends (weekends include Monday).
2002–2004	Beginning on the Memorial Day weekend for four consecutive 3-day weekends (weekends include Monday).
2005-2007	Beginning on the 3-day weekend before the Memorial Day weekend and four consecutive 3-day weekends.
2008–2011	Beginning on the 3-day weekend before the Memorial Day weekend and four consecutive 3-day weekends. Also the Wednesdays following each weekend opening.

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Bag, possession, and season limits	
Year	Chinook salmon fishing regulations
1960	Bag and possession limit: 3 salmon over 16 inches in length, of which not more than 2 could be Chinook salmon 20 inches or more in length.
1961–1962	Bag and possession limit: 3 salmon over 20 inches in length, of which not more than 1 could be Chinook salmon 20 inches or more in length.
1963	Bag and possession limit: salmon 16 inches or more in length; 6 coho salmon; 3 pink, chum or sockeye salmon; or 1 Chinook salmon.
1964–1965	Closed.
1966–1978	Bag and possession limit: 1 Chinook salmon 20 inches or more in length.
	Bag and possession limit: 10 Chinook salmon less than 20 inches long.
	Season limit: 2 Chinook salmon 20 inches or more in length.
1979–1985	Bag and possession limit: 1 Chinook salmon 20 inches or more in length.
	Bag and possession limit: 10 Chinook salmon less than 20 inches long.
	Season limit: 5 Chinook salmon 20 inches or more in length.
1986–1995	Bag limit: 1 Chinook salmon 16 inches or more in length.
	Bag and possession limit: 10 Chinook salmon less than 16 inches long.
	Season limit: 5 Chinook salmon 16 inches or more in length.
1996–1998	Bag limit: 1 Chinook salmon 16 inches or more in length.
	Bag and possession limit: 10 Chinook salmon less than 16 inches long.
	Season limit: 2 Chinook salmon 16 inches or more in length from Deep Creek or the Anchor River combined.
	After harvesting a Chinook salmon 16 inches or more in length from Deep Creek or the Anchor River, an angler may not fish in either drainage for the rest of that day.
1996–1998	Bag limit: 1 Chinook salmon 16 inches or more in length.
	Bag and possession limit: 10 Chinook salmon less than 16 inches long.
	Season limit: 2 Chinook salmon 16 inches or more in length from Deep Creek or the Anchor River combined.
	After harvesting a Chinook salmon 16 inches or more in length from Deep Creek or the Anchor River, an angler may not fish in either drainage for the rest of that day.
1999–2007	Bag limit: 1 Chinook salmon 20 inches or more in length.
	Bag and possession limit: 10 Chinook salmon less than 20 inches long.
	Season limit: 2 Chinook salmon 20 inches or more in length from Deep Creek or the Anchor River combined.
	After harvesting a Chinook salmon 20 inches or more in length from Deep Creek or the Anchor River an angler may not fish in either drainage for the rest of that day.
2008–2010	Bag limit: 1 Chinook salmon 20 inches or more in length.
	Bag and possession limit: 10 Chinook salmon less than 20 inches length.
	Season limit: 5 Chinook salmon 20 inches or more in length.
2011	Bag limit: 1 Chinook salmon 20 inches or more in length.
	Bag and possession limit: 10 Chinook salmon less than 20 in length.
	Season limit: 2 Chinook salmon 20 inches or more in length from Deep Creek or the Anchor River combined. After harvesting a Chinook salmon 20 inches or more in length from Deep Creek or the Anchor River an angler may not fish in either drainage for the rest of that day.

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Emergency orders (EOs)	
Year	Chinook salmon fishing regulations
1971	EO extended the Chinook salmon fishery on Anchor River and Deep Creek an additional 2-day weekend due to low catches (Nelson 1972)
1972	EO extended the Chinook salmon fishery on Anchor River and Deep Creek an additional 2-day weekend due to low catches (Nelson 1972).
1988	EO 2-KS-1-04-88 extended the Chinook salmon fishery on Anchor River and Deep Creek an additional weekend. Highly turbid river conditions early in the season depressed angler success rates and managers' expectations (D. C. Nelson, unpublished[5]).
2004	EO 2-KS-7-07-04 opened the Anchor River Chinook salmon fishery from 0000 hours on Saturday, 26 June through 2359 hours on 28 June from the mouth of the Anchor River to 600 ft downstream of the confluence of the North and South forks. Bag limit: 1 Chinook salmon per day.
2009	EO 2-KS-7-08-09 closed the Anchor River drainage from its mouth upstream to the North and South forks to fishing and increased the closed area in the salt waters of Cook Inlet at the mouth of the Anchor River from 2 miles to 4 miles beginning 0001 hours on Saturday, 6 June through 2359 hours on Tuesday, 30 June.
2010	EO 2-KS-7-10-10 prohibited the use of bait in the Anchor River, Deep Creek, and Ninilchik River drainages and increased the closed area in the salt waters of Cook Inlet at the mouth of the Anchor River from 1 to 2 miles north and south of the Anchor River mouth and 1 mile offshore beginning 0001 hours on Saturday, 5 June through 2359 hours on Wednesday, 30 June.
2010	EO 2-KS-7-15-10 prohibited the retention of Chinook salmon in the Anchor River drainage from its mouth upstream to the junction of the North and South forks beginning 0001 hours on Saturday, 12 June through 2359 hours on Wednesday, 30 June. Chinook salmon may not be possessed or retained; Chinook salmon caught may not be removed from the water and must be released immediately. EO 2-KS-7-10-10 which prohibited the use of bait in the Anchor River, Deep Creek, and Ninilchik River drainages remained in effect.
2010	EO 2-KS-7-28-10 closed the salt waters of Cook Inlet at the mouth of the Anchor River to all sport fishing from 2 miles north and south of the Anchor River mouth and 1 mile offshore beginning 0001 hours on Thursday, 1 July through 2359 hours on Saturday, 31 July.
2010	EO 2-KS-7-36-10 rescinded EO 2-KS-7-28-10 issued 29 June 2010. Effective 0001 hours on Tuesday, 13 July, the salt waters of Cook Inlet at the mouth of the Anchor River from 2 miles north and south of the Anchor River mouth and 1 mile offshore were open to all sport fishing.
2011	EO 2-KS-7-06-11 prohibited the use of bait in the Anchor River, Deep Creek, and Ninilchik River drainages beginning 11 June 2011 through 11:50 PM, Wednesday, 22 June 2011.
2011	EO 2-KS-7-07-11 closed the waters of the Anchor River drainage from its mouth upstream to the junction of the North and South forks to sport fishing beginning 12:01 AM, Wednesday, 15 June 2011 through 11:59 PM, Thursday, 30 June 2011.
2011	EO 2-KS-7-16-11 required the use of only one unbaited, single-hook, artificial lure in the flowing waters of the Anchor River drainage, and closed the salt waters of Cook Inlet at the mouth of the Anchor River to all sport fishing from two miles north and south of the Anchor River mouth and one mile offshore beginning 12:01 AM, Friday, 1 July 2011 through 11:59 PM, Sunday, 31 July 2011.

[5] Nelson, D. C. *Unpublished*. A review of Alaska's Kenai Peninsula east side beach recreational razor clam (*Siliqua patula*, Dixon) fishery, 1965-1980. Alaska Department of Fish and Game, Division of Sport Fish, Soldotna, Alaska.

APPENDIX B: DAILY ESCAPEMENT COUNTS AT THE ANCHOR RIVER SONAR-WEIR SITE, 2011

Appendix B1.–Daily and cumulative (cum.) escapement of Chinook salmon; Dolly Varden; pink, chum, sockeye, and coho salmon; and steelhead trout counted at the Anchor River sonar-weir site, 2011.

	Chinook count[a]			Dolly Varden count			Pink count			Chum count			Sockeye count			Coho count			Steelhead count [b]		
Date	Daily	Cum.	%	Daily	Cum.	%	Daily	Cum.	%	Daily	Cum.	%	Daily	Cum.	%	Daily	Cum.	%	Daily	Cum.	%
13 May	15	15	0	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
14 May	6	21	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
15 May	−10	11	0	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
16 May	−11	0	0	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
17 May	7	7	0	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
18 May	30	37	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
19 May	13	50	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
20 May	36	86	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
21 May	33	119	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
22 May	61	180	5	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
23 May	7	187	5	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
24 May [c]	63	250	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1
25 May	11	261	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	1
26 May	48	309	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	5	3
27 May	74	383	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	6	4
28 May	39	422	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	9	6
29 May	69	491	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	10	7
30 May	83	574	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	11	8
31 May	77	651	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	8
1 Jun	6	657	19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	8
2 Jun	98	755	21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	8
3 Jun	19	774	22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	8
4 Jun	27	801	23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	12	8
5 Jun	100	901	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	8
6 Jun	71	972	27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	8
7 Jun	76	1,048	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	8
8 Jun	24	1,072	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	8
9 Jun	124	1,196	34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	8
10 Jun	35	1,231	35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	8
11 Jun	27	1,258	35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	8
12 Jun	166	1,424	40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	8

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	Chinook count[a]			Dolly Varden count			Pink count			Chum count			Sockeye count			Coho count			Steelhead count [b]		
Date	Daily	Cum.	%	Daily	Cum.	%	Daily	Cum.	%	Daily	Cum.	%	Daily	Cum.	%	Daily	Cum.	%	Daily	Cum.	%
13 Jun	58	1,482	42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	8
14 Jun	146	1,628	46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	8
15 Jun	103	1,731	49	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	8
16 Jun	199	1,930	54	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	8
17 Jun	36	1,966	55	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	8
18 Jun	52	2,018	57	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	8
19 Jun	69	2,087	59	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	8
20 Jun	96	2,183	62	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	8
21 Jun	91	2,274	64	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	8
22 Jun	15	2,289	65	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	8
23 Jun	54	2,343	66	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	8
24 Jun	48	2,391	67	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	8
25 Jun	39	2,430	69	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	12	8
26 Jun	107	2,537	72	1	1	0	21	22	1	0	0	0	0	0	0	0	0	0	0	12	8
27 Jun	58	2,595	73	0	1	0	10	32	1	0	0	0	0	0	0	0	0	0	0	12	8
28 Jun	18	2,613	74	0	1	0	0	32	1	0	0	0	0	0	0	0	0	0	0	12	8
29 Jun	39	2,652	75	1	2	0	1	33	2	0	0	0	0	0	0	0	0	0	0	12	8
30 Jun	29	2,681	76	0	2	0	1	34	2	0	0	0	0	0	0	0	0	0	0	12	8
1 Jul	36	2,717	77	0	2	0	11	45	2	0	0	0	0	0	0	0	0	0	0	12	8
2 Jul	184	2,901	82	0	2	0	86	131	6	0	0	0	0	0	0	0	0	0	0	12	8
3 Jul	84	2,985	84	0	2	0	32	163	8	0	0	0	0	0	0	0	0	0	0	12	8
4 Jul	31	3,016	85	3	5	0	35	198	9	0	0	0	0	0	0	0	0	0	0	12	8
5 Jul	50	3,066	86	8	13	0	34	232	11	0	0	0	0	0	0	0	0	0	0	12	8
6 Jul	69	3,135	88	7	20	1	7	239	11	0	0	0	0	0	0	0	0	0	0	12	8
7 Jul	11	3,146	89	3	23	1	11	250	12	0	0	0	0	0	0	0	0	0	0	12	8
8 Jul	5	3,151	89	1	24	1	2	252	12	0	0	0	0	0	0	0	0	0	0	12	8
9 Jul	8	3,159	89	0	24	1	0	252	12	0	0	0	0	0	0	0	0	0	0	12	8
10 Jul	17	3,176	90	12	36	1	20	272	13	0	0	0	2	2	4	0	0	0	0	12	8
11 Jul	18	3,194	90	28	64	2	16	288	13	0	0	0	0	2	4	0	0	0	0	12	8
12 Jul	15	3,209	91	45	109	3	9	297	14	0	0	0	0	2	4	0	0	0	0	12	8
13 Jul	26	3,235	91	55	164	4	19	316	15	0	0	0	0	2	4	0	0	0	0	12	8

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	Chinook count[a]			Dolly Varden count			Pink count			Chum count			Sockeye count			Coho count			Steelhead count [b]		
Date	Daily	Cum.	%	Daily	Cum.	%	Daily	Cum.	%	Daily	Cum.	%	Daily	Cum.	%	Daily	Cum.	%	Daily	Cum.	%
14 Jul	4	3,239	91	19	183	5	11	327	15	0	0	0	0	2	4	0	0	0	0	12	8
15 Jul	7	3,246	92	17	200	5	17	344	16	0	0	0	0	2	4	0	0	0	0	12	8
16 Jul	31	3,277	92	58	258	7	15	359	17	0	0	0	0	2	4	0	0	0	0	12	8
17 Jul	7	3,284	93	91	349	9	13	372	17	1	1	2	0	2	4	0	0	0	0	12	8
18 Jul	12	3,296	93	126	475	12	18	390	18	0	1	2	0	2	4	0	0	0	0	12	8
19 Jul	19	3,315	94	122	597	15	34	424	20	0	1	2	0	2	4	0	0	0	0	12	8
20 Jul	12	3,327	94	314	911	23	63	487	22	0	1	2	0	2	4	0	0	0	0	12	8
21 Jul	19	3,346	94	422	1,333	34	92	579	27	0	1	2	0	2	4	0	0	0	0	12	8
22 Jul	5	3,351	95	318	1,651	43	34	613	28	0	1	2	0	2	4	0	0	0	0	12	8
23 Jul	7	3,358	95	186	1,837	47	34	647	30	0	1	2	3	5	11	0	0	0	0	12	8
24 Jul	10	3,368	95	120	1,957	50	22	669	31	0	1	2	0	5	11	0	0	0	0	12	8
25 Jul	3	3,371	95	171	2,128	55	49	718	33	0	1	2	1	6	13	0	0	0	0	12	8
26 Jul	4	3,375	95	180	2,308	59	28	746	34	0	1	2	0	6	13	0	0	0	0	12	8
27 Jul	18	3,393	96	418	2,726	70	57	803	37	0	1	2	0	6	13	1	1	0	0	12	8
28 Jul	28	3,421	97	259	2,985	77	64	867	40	1	2	3	0	6	13	4	5	0	0	12	8
29 Jul	14	3,435	97	96	3,081	79	44	911	42	0	2	3	0	6	13	1	6	0	0	12	8
30 Jul	6	3,441	97	171	3,252	84	35	946	44	0	2	3	0	6	13	1	7	0	0	12	8
31 Jul	8	3,449	97	105	3,357	86	13	959	44	0	2	3	0	6	13	1	8	0	0	12	8
1 Aug	2	3,451	97	0	3,357	86	29	988	46	0	2	3	0	6	13	0	8	0	0	12	8
2 Aug	17	3,468	98	22	3,379	87	32	1,020	47	0	2	3	1	7	15	3	11	1	0	12	8
3 Aug	14	3,482	98	66	3,445	89	19	1,039	48	0	2	3	0	7	15	4	15	1	0	12	8
4 Aug	7	3,489	98	36	3,481	90	27	1,066	49	0	2	3	2	9	19	6	21	1	0	12	8
5 Aug	11	3,500	99	71	3,552	91	34	1,100	51	0	2	3	3	12	26	10	31	2	0	12	8
6 Aug	7	3,507	99	64	3,616	93	27	1,127	52	1	3	5	1	13	28	8	39	2	0	12	8
7 Aug	8	3,515	99	30	3,646	94	57	1,184	55	0	3	5	0	13	28	19	58	3	0	12	8
8 Aug	12	3,527	99	11	3,657	94	14	1,198	55	0	3	5	0	13	28	9	67	4	0	12	8
9 Aug	2	3,529	100	35	3,692	95	29	1,227	57	0	3	5	0	13	28	12	79	4	0	12	8
10 Aug	0	3,529	100	28	3,720	96	31	1,258	58	0	3	5	0	13	28	20	99	5	0	12	8
11 Aug	4	3,533	100	31	3,751	97	33	1,291	60	2	5	8	0	13	28	33	132	7	0	12	8
12 Aug	1	3,534	100	13	3,764	97	19	1,310	60	0	5	8	1	14	30	45	177	9	2	14	10
13 Aug	4	3,538	100	13	3,777	97	21	1,331	61	0	5	8	0	14	30	38	215	12	4	18	13

-continued-

Date	Chinook count[a]			Dolly Varden count			Pink count			Chum count			Sockeye count			Coho count			Steelhead count [b]		
	Daily	Cum.	%	Daily	Cum.	%	Daily	Cum.	%	Daily	Cum.	%	Daily	Cum.	%	Daily	Cum.	%	Daily	Cum.	%
14 Aug	4	3,542	100	21	3,798	98	22	1,353	62	0	5	8	1	15	32	22	237	13	3	21	15
15 Aug	1	3,543	100	18	3,816	98	26	1,379	64	7	12	20	0	15	32	29	266	14	0	21	15
16 Aug	0	3,543	100	19	3,835	99	12	1,391	64	1	13	22	0	15	32	23	289	15	0	21	15
17 Aug	0	3,543	100	19	3,854	99	7	1,398	64	0	13	22	1	16	34	31	320	17	1	22	15
18 Aug	1	3,544	100	10	3,864	100	7	1,405	65	0	13	22	0	16	34	33	353	19	6	28	19
19 Aug	0	3,544	100	5	3,869	100	94	1,499	69	0	13	22	1	17	36	244	597	32	0	28	19
20 Aug	0	3,544	100	3	3,872	100	59	1,558	72	1	14	23	0	17	36	115	712	38	1	29	20
21 Aug	1	3,545	100	6	3,878	100	70	1,628	75	1	15	25	0	17	36	56	768	41	0	29	20
22 Aug	0	3,545	100	0	3,878	100	44	1,672	77	0	15	25	0	17	36	17	785	42	3	32	22
23 Aug	0	3,545	100	1	3,879	100	49	1,721	79	6	21	35	2	19	40	95	880	47	3	35	24
24 Aug	0	3,545	100	0	3,879	100	5	1,726	80	2	23	38	2	21	45	18	898	48	0	35	24
25 Aug	0	3,545	100	0	3,879	100	11	1,737	80	7	30	50	0	21	45	30	928	50	2	37	26
26 Aug	0	3,545	100	0	3,879	100	22	1,759	81	0	30	50	1	22	47	23	951	51	0	37	26
27 Aug	0	3,545	100	0	3,879	100	21	1,780	82	2	32	53	0	22	47	38	989	53	0	37	26
28 Aug	0	3,545	100	0	3,879	100	28	1,808	83	3	35	58	4	26	55	59	1,048	56	4	41	28
29 Aug	0	3,545	100	0	3,879	100	12	1,820	84	2	37	62	0	26	55	28	1,076	58	0	41	28
30 Aug	0	3,545	100	0	3,879	100	19	1,839	85	2	39	65	1	27	57	30	1,106	59	1	42	29
31 Aug	0	3,545	100	0	3,879	100	68	1,907	88	1	40	67	4	31	66	132	1,238	66	1	43	30
1 Sep	0	3,545	100	0	3,879	100	41	1,948	90	8	48	80	0	31	66	108	1,346	72	1	44	31
2 Sep	0	3,545	100	1	3,880	100	23	1,971	91	1	49	82	2	33	70	37	1,383	74	6	50	35
3 Sep	0	3,545	100	1	3,881	100	9	1,980	91	0	49	82	0	33	70	25	1,408	75	5	55	38
4 Sep	0	3,545	100	1	3,882	100	9	1,989	92	0	49	82	0	33	70	48	1,456	78	9	64	44
5 Sep	0	3,545	100	0	3,882	100	13	2,002	92	1	50	83	1	34	72	26	1,482	79	5	69	48
6 Sep	0	3,545	100	0	3,882	100	19	2,021	93	0	50	83	1	35	74	29	1,511	81	4	73	51
7 Sep	0	3,545	100	0	3,882	100	25	2,046	94	1	51	85	2	37	79	46	1,557	83	12	85	59
8 Sep	0	3,545	100	0	3,882	100	39	2,085	96	0	51	85	2	39	83	121	1,678	90	7	92	64
9 Sep	0	3,545	100	0	3,882	100	16	2,101	97	1	52	87	0	39	83	18	1,696	91	5	97	67
10 Sep	0	3,545	100	0	3,882	100	8	2,109	97	0	52	87	1	40	85	6	1,702	91	6	103	72
11 Sep	0	3,545	100	0	3,882	100	13	2,122	98	0	52	87	1	41	87	7	1,709	92	3	106	74
12 Sep	0	3,545	100	0	3,882	100	9	2,131	98	1	53	88	0	41	87	16	1,725	92	2	108	75
13 Sep	0	3,545	100	0	3,882	100	14	2,145	99	1	54	90	0	41	87	12	1,737	93	3	111	77

-continued-

	Chinook count[a]			Dolly Varden count			Pink count			Chum count			Sockeye count			Coho count			Steelhead count [b]		
Date	Daily	Cum.	%	Daily	Cum.	%	Daily	Cum.	%	Daily	Cum.	%	Dly.	Cum.	%	Dly.	Cum.	%	Dly.	Cum.	%
14 Sep	0	3,545	100	0	3,882	100	10	2,155	99	1	55	92	3	44	94	11	1,748	94	6	117	81
15 Sep	0	3,545	100	4	3,886	100	3	2,158	99	0	55	92	2	46	98	9	1,757	94	3	120	83
16 Sep	0	3,545	100	0	3,886	100	1	2,159	100	0	55	92	0	46	98	20	1,777	95	0	120	83
17 Sep	0	3,545	100	0	3,886	100	6	2,165	100	0	55	92	0	46	98	8	1,785	96	2	122	85
18 Sep	0	3,545	100	0	3,886	100	1	2,166	100	1	56	93	1	47	100	15	1,800	96	8	130	90
19 Sep	0	3,545	100	0	3,886	100	0	2,166	100	2	58	97	0	47	100	13	1,813	97	4	134	93
20 Sep	0	3,545	100	0	3,886	100	0	2,166	100	1	59	98	0	47	100	37	1,850	99	6	140	97
21 Sep	0	3,545	100	0	3,886	100	3	2,169	100	1	60	100	0	47	100	16	1,866	100	4	144	100

Note: En dash denotes no information.

[a] Escapement census using DIDSON hourly counts (247, SE 0) from 13 to 24 May and a census through the weir (3,298) from 24 May to 21 September.

[b] Based on steelhead life history, counts from 24 May through 30 June are considered prespawning fish and counts from 31 July to 21 September are considered fall immigrants.

[c] DIDSON count is 60; weir count is 3.

APPENDIX C: COUNTS BASED ON DIDSON FILES

Appendix C1.–Daily upstream, downstream, and net counts based on DIDSON files, Anchor River, 2011.

Date	Upstream	Downstream	Net count [a]	Minutes counted [b]
13 May	29	14	15	600
14 May	18	12	6	1,440
15 May	15	25	-10	1,440
16 May	14	25	-11	1,440
17 May	28	21	7	1,440
18 May	50	20	30	1,440
19 May	41	28	13	1,440
20 May	85	49	36	1,440
21 May	59	26	33	1,440
22 May	79	18	61	1,440
23 May	43	36	7	1,440
24 May	87	27	60	1,320
Total	548	301	247	16,320

[a] Net count equals upstream count minus downstream count.

[b] Minutes based on counts from 13 May at 1400 hours to 24 May at 2100 hours.

APPENDIX D: DAILY RIVER STAGE AND TEMPERATURE FOR ANCHOR RIVER, 2011

Appendix D1.–Daily river stage average for the south fork of the Anchor River, 2011.

	Daily river stage average (cm) [a]											
Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	116.0	54.0	43.8	76.6	64.7	35.9	25.6	18.8	51.1	33.8	36.3	73.2
2	138.5	52.7	43.3	73.0	59.9	36.8	28.7	28.8	37.5	45.5	29.5	73.7
3	137.8	51.9	42.9	71.2	59.6	35.4	34.3	36.7	31.8	55.9	27.6	75.5
4	134.4	52.4	42.7	76.7	61.0	35.5	29.0	31.0	32.8	42.8	38.1	95.0
5	129.0	53.5	42.7	80.3	64.1	36.9	28.7	29.3	34.9	37.9	34.5	85.8
6	114.8	53.2	42.8	80.6	65.7	35.6	26.2	27.5	33.5	39.3	33.8	71.3
7	100.0	52.2	43.6	80.2	68.2	35.0	24.4	41.7	30.2	46.1	32.2	74.7
8	90.4	52.4	44.9	98.6	65.8	34.6	23.5	34.6	36.7	51.2	23.7	75.4
9	84.9	56.2	46.3	104.9	64.1	33.7	23.1	29.8	36.1	44.8	24.0	69.7
10	78.9	62.3	46.6	99.3	64.6	32.8	22.6	26.7	30.9	39.6	33.3	55.9
11	73.6	64.2	46.2	85.7	67.0	32.5	22.3	23.7	28.2	36.2	30.8	75.1
12	68.7	61.3	45.4	75.4	60.1	32.4	23.8	21.5	27.5	33.3	33.1	63.3
13	64.0	55.9	45.2	72.2	60.5	31.5	24.0	20.7	27.2	32.9	32.6	61.1
14	58.3	52.7	44.9	70.5	59.2	32.1	22.2	20.6	27.1	33.1	35.3	59.6
15	52.2	51.8	45.0	71.4	51.6	35.6	21.0	19.7	26.1	38.6	36.2	69.8
16	48.5	49.9	45.7	79.6	49.7	45.2	20.1	18.8	26.7	38.7	37.6	72.9
17	44.6	46.9	47.0	92.0	47.2	39.5	19.7	17.9	27.9	36.6	56.5	70.5
18	41.7	45.8	48.8	98.8	54.3	34.5	22.4	18.2	30.9	34.3	70.1	93.1
19	40.1	46.3	50.6	100.7	51.1	32.2	20.8	29.1	30.6	29.6	76.5	70.0
20	39.2	46.1	51.6	94.2	52.1	32.2	19.3	45.9	50.0	27.4	82.4	71.2
21	38.7	45.5	52.4	95.9	52.3	31.0	18.8	38.6	56.4	32.4	84.9	64.3
22	38.2	44.0	53.7	94.2	47.2	29.9	19.3	32.0	47.4	32.4	85.4	65.2
23	38.8	42.8	54.6	111.1	45.3	28.4	18.7	37.2	40.2	30.7	82.8	47.3
24	42.3	42.9	55.5	117.1	42.4	27.1	20.2	36.6	36.0	34.1	81.5	45.7
25	50.3	44.3	56.7	96.7	40.9	28.2	20.2	31.5	33.3	77.7	73.0	58.3
26	63.3	44.9	57.8	86.4	39.7	29.3	19.5	28.4	32.2	78.2	73.7	68.7
27	68.7	43.8	58.1	82.2	38.9	27.5	21.8	25.9	36.1	53.7	72.1	68.6
28	64.0	42.5	58.3	68.5	38.4	27.2	25.3	24.9	35.1	46.1	74.7	64.6
29	59.2		59.2	60.5	37.5	29.7	21.7	23.1	36.2	42.4	60.1	64.8
30	58.5		67.2	71.0	36.6	27.3	19.7	22.4	35.6	39.9	72.7	58.2
31	56.2		74.8		35.7		18.9	33.2		35.1		41.3

Source: retrieved on 2012-08-31 13:12:42 EDT (nadww01) from http://waterdata.usgs.gov/ak/nwis/uv/?site_no=15239900&PARAmeter_cd=00065,00060.

[a] Stage data were collected at gauge station USGS 15239900, located approximately 11.4 RKM on the south fork, Anchor River.

Appendix D2.–Daily river temperature average (°C), Anchor River, 2011.

	Daily temperature average (°C)														
	May			June			July			August			September		
Day	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
1	1.63	0.52	2.91	8.78	7.92	9.76	13.70	11.69	16.20	13.71	12.63	15.06	9.01	7.37	10.47
2	2.67	0.52	4.96	10.50	7.32	14.43	12.44	11.47	14.00	12.63	11.90	13.59	9.48	8.89	10.39
3	2.58	1.72	3.79	9.70	8.97	11.61	12.20	8.87	15.96	11.98	10.79	13.62	9.52	8.49	10.69
4	3.35	1.72	5.54	8.49	7.59	9.24	13.90	11.03	17.53	10.91	10.20	11.78	9.39	8.72	10.30
5	3.27	1.12	5.54	8.69	7.02	11.22	14.28	10.83	18.06	11.58	9.44	14.36	8.89	7.95	9.78
6	3.82	1.12	6.41	8.90	6.15	11.47	13.09	10.91	15.18	10.44	9.63	11.73	9.01	8.27	10.10
7	3.76	2.02	5.25	9.21	7.97	10.42	12.41	10.10	14.55	10.60	8.69	12.94	9.08	8.59	9.63
8	3.45	2.61	4.67	8.68	7.62	9.76	11.79	10.52	13.09	10.73	9.71	11.69	9.08	8.32	10.08
9	3.31	2.32	4.67	9.21	7.52	11.39	11.53	10.22	12.85	11.42	9.44	14.27	9.00	7.14	11.10
10	4.02	1.72	6.41	9.05	7.82	10.22	11.67	10.22	13.47	12.15	9.66	15.27	8.65	7.17	10.47
11	4.53	2.32	6.69	9.08	7.72	10.47	11.86	10.64	12.70	11.92	8.92	15.13	8.23	6.66	9.76
12	5.10	2.32	7.86	9.87	8.32	11.59	13.11	11.05	16.44	11.90	9.34	14.22	8.56	8.02	9.14
13	5.53	2.61	8.14	10.01	8.89	11.57	12.90	10.61	15.27	12.68	11.39	14.29	9.18	8.17	10.61
14	4.42	3.49	6.41	10.72	8.67	13.55	13.40	10.10	17.25	13.31	11.42	15.58	9.13	8.10	10.10
15	4.03	2.91	5.25	10.57	9.29	12.39	14.23	11.22	17.87	13.07	10.42	15.87	9.05	7.92	10.44
16	4.28	3.49	4.67	9.24	7.87	10.86	14.79	12.20	17.87	12.79	9.61	16.37	7.92	6.56	9.02
17	5.59	3.49	8.14	10.00	7.22	13.06	13.23	12.20	14.48	13.06	11.13	14.94	8.18	7.09	9.51
18	6.42	5.25	7.27	10.50	8.37	12.82	13.41	10.35	16.99	11.95	11.03	13.02	7.45	6.23	8.59
19	5.56	4.67	6.41	11.39	9.29	14.10	14.22	10.69	18.18	10.69	10.12	11.71	6.92	6.46	7.34
20	6.53	4.37	8.72	11.95	9.90	14.31	14.20	10.35	18.37	10.21	9.41	11.03	6.88	6.26	7.24
21	7.14	5.25	9.30	12.30	10.86	14.65	14.11	12.82	15.77	10.83	9.93	12.12	7.42	6.94	8.02
22	7.65	5.54	10.16	12.59	10.12	15.89	15.40	12.20	19.63	10.36	9.95	10.76	7.39	6.91	7.90
23	7.51	6.41	8.72	12.47	9.81	15.32	13.98	12.94	16.18	10.19	9.31	11.39	6.77	5.75	7.97
24	7.76	4.96	11.03	13.45	10.88	16.84	12.73	11.57	14.39	9.16	8.07	10.03	7.21	6.33	8.30
25	8.47	6.12	10.93	12.54	11.71	13.55	13.48	11.13	16.77	9.37	8.74	10.08	6.70	5.41	8.02
26	7.74	6.41	9.26	11.80	10.03	13.28	12.68	10.57	14.75	10.15	8.79	11.90	6.12	4.77	7.85
27	9.10	6.71	12.49	11.20	10.39	11.98	13.34	11.22	16.63	9.92	8.92	11.44	5.28	4.01	6.97
28	8.79	8.07	10.32	11.55	9.51	14.53	12.96	10.37	15.65	9.76	7.22	12.58	4.96	3.80	6.51
29	9.05	6.91	12.03	12.31	9.51	15.56	14.11	10.79	17.84	9.78	7.42	12.17	4.70	3.59	5.72
30	11.02	8.05	14.65	13.42	10.59	16.56	14.74	12.39	17.51	10.71	9.93	11.69	3.70	2.29	4.74
31	9.59	8.94	11.32				14.28	11.81	17.44	10.05	9.34	10.69			

Source: Temperature data collected by Sue Mauger of Cook Inlet Keeper 0.1 RKM downstream of the resistance board weir.

APPENDIX E: DAILY COUNTS OF STEELHEAD KELTS AT THE ANCHOR RIVER WEIR-SONAR SITE, 2011

Appendix E1.–Daily counts of steelhead kelts at the Anchor River sonar-weir site, 2011.

			Cumulative	
Date	Hours recorded [a]	Daily count	Count	%
25 May	12.00	0	0	0
26 May	24.00	1	1	0
27 May	24.00	2	3	1
28 May	23.50	0	3	1
29 May	24.00	1	4	2
30 May	20.75	2	6	3
31 May	23.50	0	6	3
1 Jun	0.00	4	10	5
2 Jun	13.50	3	13	6
3 Jun	24.00	15	28	13
4 Jun	24.00	6	34	16
5 Jun	22.00	8	43	20
6 Jun	24.00	0	43	20
7 Jun	11.00	3	46	21
8 Jun	15.75	0	46	21
9 Jun	24.00	16	62	29
10 Jun	24.00	15	77	36
11 Jun	24.00	6	83	38
12 Jun	24.00	12	95	44
13 Jun	24.00	13	108	50
14 Jun	24.00	19	127	59
15 Jun	21.00	24	151	69
16 Jun	24.00	42	193	89
17 Jun	24.00	10	203	93
18 Jun	21.50	5	207	95
19 Jun	24.00	4	211	97
20 Jun	24.00	2	213	98
21 Jun	24.00	2	215	99
22 Jun	24.00	1	216	100
23 Jun	24.00	1	217	100
24 Jun	24.00	0	217	100