Fishery Data Series No. 12-59

Anchor River Chinook and Coho Salmon Escapement, 2007–2008

by

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and

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October 2012

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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TABLE OF CONTENTS

Page

TABLE OF CONTENTS (Continued)

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

ABSTRACT

In 2007 and 2008, the escapements of Chinook salmon (*Oncorhynchus tshawytscha*) and coho salmon (*O. kisutch*) were estimated using Dual-frequency IDentification SONar (DIDSON) during high spring flows, and were then censused using a resistance board weir when flows subsided. In fall 2007, the Alaska Department of Fish and Game, Division of Sport Fish, established a lower bound sustainable escapement goal (SEG) of 5,000 Chinook salmon, and the Alaska Board of Fisheries liberalized fishing regulations to provide additional harvest opportunities on Anchor River Chinook salmon. The 2007 Anchor River Chinook salmon escapement was the third highest (9,622 fish, SE 238) and the 2008 escapement was the lowest (5,806 fish, SE 169) since 2004, when escapement monitoring was first conducted over the entire run. The aerial index of Chinook salmon escapement was 678 fish in 2007 and 528 fish in 2008. The dominant Chinook salmon age class was ocean age 3 in both 2007 (53.4%, SE 3.7) and 2008 (68.5%, SE 4.3). The 2007 Anchor River coho salmon escapement (8,226 fish) was the fourth highest and the 2008 escapement (5,951 fish) was the fifth highest of the past 9 years of escapement counts. The dominant coho salmon age class was age 2.1 in both 2007 (84.2%, SE 2.8) and 2008 (80.0%, SE 3.6). The variation in counts of coho salmon passing through the resistance board weir was significantly correlated ($P < 0.001$) with average river stage in 2007.

Key words: Anchor River, Chinook salmon, *Oncorhynchus tshawytscha*, coho salmon, *Oncorhynchus kisutch*, run, escapement, run timing, diel, diurnal, low bound SEG, 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 freshwater Chinook salmon (*Oncorhynchus tshawytscha*) and coho salmon (*O. kisutch*) sport fisheries in the Lower Cook Inlet Management Area (LCIMA). The Anchor River watershed is approximately 587 km^2, with about 266 river km (RKM) of anadromous streams (Table 1). The Anchor River has 2 major forks (South and North forks), which are located approximately 2.8 RKM upstream from the mouth. The South Fork watershed is approximately twice the size as the North Fork watershed. Because of the Anchor River's small size, geomorphology, and vegetation, water flows can rise substantially following heavy rains.

Early Anchor River fishery studies reach back to approximately 1954 (R.W. Allin, U.S. Fish and Wildlife Service, *unpublished*[1]). The early studies were initiated to characterize fish stocks following the construction of the highway to Homer in 1949, which increased access to the Anchor River fishery (Appendix A1). From 1976 to 2002, the methods used by the Alaska Department of Fish and Game (ADF&G), Division of Sport Fish (SF), to evaluate fishing pressures and run size of Anchor River fish stocks were limited to the following:

1) statewide harvest survey (SWHS) estimates of sport harvest and catch for each species and overall fishing effort collected annually via mail questionnaires since 1977 (Table 2, Appendix A2)
2) index counts of Chinook salmon escapement from combined aerial and ground counts (1976–1995) and then from aerial counts only thereafter (Table 3, Appendix A1)
3) nine years (1987–1995) of fish counts from a weir operated approximately 1.6 RKM (1 mile) upstream from the mouth of the Anchor River (only partial counts of Chinook salmon runs were obtained, but complete counts of coho salmon runs were obtained for 4 of 9 years; see Table 4).

[1] Allin, R. W. *Unpublished*. Stream survey of Anchor River. U. S. Fish and Wildlife Service. Federal Aid in Fish Restoration Project. Job Completion Report (circa 1954), 4(2): 47-66, Territory of Alaska. Archived at ADFG, Homer.

In 2003, a new project was initiated to estimate Chinook salmon escapement (Appendix A1). In 2004, the project was expanded to include monitoring the coho salmon escapement. This escapement project has substantially increased our knowledge of the stock status for Anchor River Chinook and coho salmon.

CHINOOK SALMON BACKGROUND

Chinook salmon return to streams in LCIMA from approximately early May through late July with a peak in early June. The Anchor River, Deep Creek, and Ninilchik River produce the largest runs of Chinook salmon in LCIMA, with the Anchor River producing the largest run.

Historically, monitoring Chinook salmon over the entire run in the Anchor River was problematic because traditional methods could not operate in both the high water conditions in May and the periodic low water conditions in June and July. For example, traditional sonar methods (e.g. spit-beam sonar), commonly used in large Alaskan rivers (e.g. the Kenai River), were not suited for smaller streams like the Anchor River. Also, 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 was typically too high and swift for installation. Therefore, aerial surveys were conducted once a year during peak spawning to index Chinook salmon escapement (Appendix A1). The aerial surveys provided a method for evaluating escapement trends. 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 escapement remained imprecise.

The Alaska Board of Fisheries (BOF) listed Anchor River Chinook salmon as a "stock of management concern" in fall 1999 in response to guidelines established in the Sustainable Salmon Fisheries Policy (Alaska Administrative Code 5 AAC 39.222). In fall 2001, BOF restricted the fishery from 5 to 4 consecutive 3-day weekends beginning with Memorial Day weekend (Appendix A3). This was because of a chronic inability to maintain the Chinook salmon escapement within the bounds of the sustainable escapement goal (SEG) that was established in 2000 (this SEG was based on index counts; Szarzi and Begich 2004a-b; Appendix A2, Appendix A3). The "stock of management concern" listing highlighted the need for an alternative method for monitoring Anchor River Chinook salmon escapement.

Simultaneously with the listing, SF was considering the feasibility of using a new sonar system called **D**ual frequency **ID**entification **SON**ar (DIDSON) for estimating escapement on small streams like the Anchor River. In 2003, a DIDSON was deployed in the Anchor River to test its utility for monitoring Chinook salmon escapement (Kerkvliet et al. 2008; Appendix A1). The monitoring site was selected because it was located on the mainstem of the river (just below the North and South forks confluence), upstream of the fishery (approximately 2.8 RKM from the mouth), and because the river profile was relatively level (Figure 2). In 2003, the DIDSON was deployed soon after ice-out in late May when river levels were high. For the first year of operation, the DIDSON was operated throughout most of the Chinook salmon run (late May to early July) and proved to be a useful tool for estimating Chinook salmon escapement. Beginning in 2004, Chinook salmon escapement was monitored using either DIDSON and 2 partial picket weirs (DIDSON system) to funnel fish into the ensonified corridor, or a full resistance board weir (Figure 3). The DIDSON system was used in May and June when river levels were high; once river levels subsided sufficiently, a full resistance board weir was installed. After the resistance board weir was operational, the DIDSON system was removed. The resistance board weir provided a census rather than an estimate of escapement. The resistance board weir was selected over a fixed picket weir, because debris could more easily be removed, reducing the likelihood of weir failure.

Chinook salmon escapement estimates from 2003 to 2006 were much higher than those expected from historic aerial index counts (Kerkvliet et al. 2008; Kerkvliet and Burwen 2010). Chinook salmon escapement estimates from 2003 to 2006 ranged from 8,945 (SE 289) to 12,016 (SE 283) fish, and exploitation rates were low (9.9% to 13.5%) based on freshwater harvest (Table 5). In 2004, SF issued an emergency order (EO) that added a fifth weekend of fishing during the Chinook salmon season; this decision was based on the low 2003 exploitation rate and the apparent low midseason exploitation rate in 2004. The EO marked the transition from management decisions based on the SEG; to decisions based on DIDSON and weir count data.

In fall 2004, significant changes were made that affected the Chinook salmon sport fishery: BOF rescinded the stock of concern listing and liberalized the Chinook salmon sport fishery by adding a fifth opening weekend before Memorial Day, and SF rescinded the SEG (Szarzi et al. 2007a-b; Appendix A3).

From 2005 to 2007, the Anchor River Chinook salmon stock was managed without an escapement goal. During these years, escapement levels were thought to be near carrying capacity. In fall 2007, SF established a lower bound SEG of 5,000 Chinook salmon (Szarzi et al. 2007a), and BOF liberalized the freshwater and marine fisheries to provide additional harvest opportunities on Anchor River Chinook salmon through the following regulation changes (Appendix A2, Appendix A3):

1. The annual limit for Anchor River Chinook salmon greater than 20 in long was increased from 2 to 5.
2. The number of days open to freshwater fishing was increased from 15 to 20 days by allowing fishing on Wednesdays following the weekend openings.
3. The area open to fishing at the mouth of the Anchor River in the saltwater King Salmon Special Harvest Area (1 April–30 June) was increased by moving the closure boundaries from 2 miles north and south of the mouth to 1 mile north and south of the mouth.

COHO SALMON BACKGROUND

Coho salmon stocks are widely distributed throughout the Lower Kenai Peninsula and spawn in a variety of freshwater habitats. Run timing of coho salmon in LCIMA streams is approximately mid-July through mid-September with a peak in mid-August to early September.

Anchor River coho salmon escapement counts were opportunistically collected from 1987 through 1995 at a weir operated for the purpose of counting Dolly Varden or immigrating steelhead trout. The weir was located approximately 1.6 RKM (1 mile) from the river mouth, which was within the river section open to sport fishing. The weir was operated for 4 years (1987–1989, and 1992) throughout the coho salmon immigration, and reported weir counts ranged from 2,409 to 20,187 fish (Table 4). Because the weir was located within the river section open to sport fishing, counts are considered maximum escapement counts because of the unknown harvest that occurred upstream of the weir.

In 2004, escapement monitoring at the sonar-weir site was expanded to include coho salmon and was the only coho salmon stock monitored by SF in the LCIMA (Kerkvliet et al. 2008). The

2004 coho salmon escapement was 5,728 fish (Table 4). The weir washed out during the coho salmon runs in 2005 and 2006. The 2005 count of the coho salmon run was considered a reasonable approximation of the final escapement (18,977 fish) because the weir washed out late in the run on 9 September (Kerkvliet and Burwen 2010). However, the same was not true for the 2006 count because the weir washed out near the peak of the coho salmon run. In 2006, the early run strength of coho salmon, along with reports that fishing continued to be exceptionally good after the weir washed out, suggests the 2006 estimate of escapement of coho salmon was much higher than that reported through 24 August (10,181 fish). From 2004 to 2006, most coho salmon were counted (78%, 72%, and 81%, respectively) during high river conditions.

From 1987 to 1989 and 1992, the freshwater exploitation on Anchor River coho salmon ranged from 11.5% to 45.5% based on the maximum escapement weir counts and estimated freshwater harvest (Table 6). Freshwater exploitation was 43.3% in 2004, less than 22% in 2005, and less than 28% in 2006 (Kerkvliet and Burwen 2010; Kerkvliet et al. 2008). BOF adopted the current bag and possession limits of 2 coho salmon 16 inches or longer for the eastside streams of Cook Inlet in 1999 (Szarzi and Begich 2004a). Currently no Cook Inlet coho salmon stock has an escapement goal.

OBJECTIVES AND TASKS

OBJECTIVES

1) Estimate the Anchor River Chinook salmon escapement that passes upstream of 2.8 RKM (approximately 2 river miles) from the mouth of the Anchor River from approximately 13 May through 11 September.
2) Census the Anchor River coho salmon escapement that passes upstream of 2.8 RKM from the mouth of the Anchor River from approximately 13 May through 11 September.
3) Estimate the age and sex composition of the escapement of Chinook salmon.
4) Estimate the age and sex composition of the escapement of coho salmon.
5) Conduct an aerial survey to estimate the Chinook salmon escapement upstream of RKM 2.8 of the Anchor River on approximately 28 July.

TASKS

1) Estimate length-at-age and sex of the Chinook and coho salmon escapements.
2) Examine all Chinook salmon and coho salmon sampled for age, sex, and length (ASL) data for an adipose fin.
3) Examine between-reader and within-reader variation of DIDSON recordings used to estimate escapement.
4) Determine diel[2] timing of Chinook and coho salmon passage at the Anchor River mainstem DIDSON-weir site during DIDSON operation and determine diurnal[3] timing of Chinook and coho salmon passage at the same site from weir counts.

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[2] "Diel" is defined as "of or pertaining to a 24-h period." Source: Dictionary.com website. Available at http://dictionary.reference.com (March 2010).

[3] "Diurnal" is defined as "occurring daily during the daytime rather than at night." Source: The American Heritage dictionary of the English Language, fourth edition. Boston: Houghton Mifflin Harcourt, 2009.

METHODS

OPERATION DATES AND EQUIPMENT

In 2007, Chinook salmon escapement was estimated from 14 May through 7 June using the DIDSON system (Table 7, Figure 4). Censuses of Chinook and coho salmon escapements were collected from 7 June to 12 September from fish counts through a resistance board weir (Figure 5). In 2008, Chinook salmon escapement was estimated from 13 May through 16 June using the DIDSON system. Censuses of Chinook and coho salmon escapements were collected from 16 June to 11 September from fish counts through a resistance board weir. In both years, during the period of DIDSON operation, beach seines were used to capture Chinook salmon for ASL samples from the North and South forks tributaries. During the resistance board weir operation, live boxes were used to capture Chinook and coho salmon for ASL samples.

DIDSON and Partial Picket Weirs

DIDSON, a high-definition imaging sonar manufactured by Sound Metrics Corporation (SMC)[4], gives near video-quality images of fish and is well suited for counting migrating salmon in the Anchor River. The highest image resolution is achieved when the DIDSON system is operated at shorter ranges using the higher of 2 available frequencies. Further details on factors influencing DIDSON resolution can be found in Appendix B1 and Burwen et al. (2007, 2010).

Because the width of the river at the monitoring site (approximately 31 m) is greater than the effective range of DIDSON in the Anchor River under turbid conditions (approximately 20 m), a partial weir was installed on each bank to narrow the ensonified corridor to 20 m or less (Figure 4). The weirs were typical tripod and picket structures that could be removed or extended as necessary due to changing water levels. When possible, the weirs were extended to narrow the ensonified corridor to 10 m, so that a smaller window length (10 m) could be used, resulting in better resolved images. All bottom irregularities at the base of the partial weir were sealed using sand bags, which prevented fish from migrating past the DIDSON system 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 (see Burwen et al. 2010). The communication cables from the DIDSON lead to topside electronics inside a “weatherport” tent. DIDSON data were stored and processed on a Dell desktop computer. All electronics were powered by a 2000 W generator.

The DIDSON system was positioned approximately 0.5 m upstream of the left-bank partial weir approximately 2–3 m from the end of the weir (Figure 4). The DIDSON transducer lens was positioned approximately 10–15 cm off the river bottom and angled downward approximately 3° from horizontal, which resulted in an ensonified cone along the river bottom that extended to the outside edge of the weir on the opposite bank. The DIDSON was aimed so that the terminal edge of the right bank weir was visible during data collection, ensuring full coverage of the migration corridor. During lower water levels, an artificial target (10 lb lead downrigger) was dragged

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

along the bottom between the weirs to ensure that the sonar beam was adequately covering the region where fish travel.

In 2007, DIDSON operations started on 14 May at 1600 hours and continued through 7 June at 1600 hours (Table 7). In 2007, low water levels allowed operation in high frequency mode using a window length of 10 m for the entire season.

In 2008, DIDSON operations started on 13 May at 1900 hours and continued through 16 June at 1100 hours (Table 7). Initial efforts to deploy the sonar on 12 May were unsuccessful because water levels were unusually high and swift and we were unable to extend the partial weirs such that the ensonified corridor was less than 20 m. After the river level dropped overnight, the partial weirs were extended and the ensonified corridor was narrowed to approximately 17 m. The right bank weir was again extended on 3 occasions to further narrow the ensonified corridor as follows: 1) on 18 May, the weir was extended by approximately 1 m at 1740 hours, 2) on 27 May, the weir was extended by approximately 5 m at 2200 hours, which narrowed the ensonified corridor to approximately 11 m, and 3) on 28 May, the weir was extended by 1 m, narrowing the ensonified zone to approximately 10 m.

Resistance Board Weir

The water level dropped sufficiently to install the resistance board weir on 7 June and 16 June in 2007 and 2008, respectively. In both years, the resistance board weir (length approximately 31 m) was installed approximately 6 m downstream from the DIDSON system. Picket spacing for the resistance board weir and live boxes were approximately 2.8 cm (1.5 in) to block the passage of all but the smallest ocean age-1 Chinook salmon. All bottom irregularities along the base of the resistance board weir were sealed using sand bags and a fencing skirt. Once the weir was fish tight, the partial weirs and DIDSON equipment were removed.

Two live boxes were incorporated into the weir, one in relatively shallow water near the left bank (defined as the left side of the river facing downstream) and a second in the midchannel. The left bank live box enabled the crew to pass fish through the weir during high water events when safe access to the midchannel live box was limited and/or when high turbidity compromised operation. The left bank live box was also used during periods of low water to provide an additional avenue for fish to move upstream. In 2008, a fish-counting chute was created near the right bank to allow fish passage during high water for fish migrating near the right bank. The fish-counting chute consisted of a modified weir panel designed to be closed during low water, and opened during high water. Because the modified panel did not have a live box attached, personnel were stationed at the chute whenever it was opened to identify and count fish.

During June in both years, a “steelhead chute” was formed near the thalweg by weighting the downstream end of a resistance board weir panel with a sand bag. The weight of the sand bag allowed a shallow stream of water that fish could use to swim downstream over the weir. The placement of the sand bag was used to adjust the water depth flowing over the weir panel so that it was deep enough to allow kelts to swim downstream, but shallow enough to prevent upstream migration.

ESCAPEMENT

DIDSON

For both years, upstream- and downstream-oriented fish images were counted for at least one 20-minute file for each hour the DIDSON was operated. The counts were then expanded to the hour. Details of the DIDSON equipment and counting protocols in 2007 and 2008 are given in Appendix B2.

The Chinook salmon component of the DIDSON counts was estimated by the following process:

Upstream-oriented images were assumed to be Chinook salmon. This assumption was tested, and adjustments made if necessary, using the species composition collected from beach seine sampling on the South and North forks of the Anchor River (Kerkvliet et al. 2008).

Downstream-oriented images were assumed to be Chinook salmon. This assumption was not verified and it is likely that a portion of the downstream counts included post-spawning steelhead trout. No adjustments were made to the downstream counts.

Weir

The weir was visually inspected on a daily basis for holes to ensure no fish could migrate past undetected. The gates to the left and midchannel live boxes were opened daily from approximately 0800 hours to approximately midnight or earlier, depending on darkness. Technicians periodically checked the live box and processed all fish as quickly as possible to prevent impeding the migration of fish. Technicians also recorded the hour that fish were counted through the live box. All fish were identified to species and counted. Daily counts of emigrating steelhead trout observed passing downstream through the “steelhead chute” or found upstream of the weir were opportunistically collected.

Aerial Index

Two surveyors flew helicopter surveys over the South Fork of the Anchor River to index Chinook salmon escapement on 27 July 2007 and 1 August 2008. Different pilots flew each survey. The index count was based on observations made by the surveyor sitting in the front seat of the helicopter. The front-seat surveyor in 2007 had trained as a back-seat surveyor from 2004 to 2006. The front-seat surveyor in 2008 had trained as a back-seat surveyor in 2007. The index area starts at an area referred to as “Orange Bluffs” (lat 59.775283, long −151.47550) and ends at the Old Sterling Highway Bridge (lat 59.771971, long −151.836604). The following variables were used to describe survey conditions: percent cloud cover, water clarity, and water glare. Index counts included the number of live and dead Chinook salmon observed. In 2007, an additional section of the river was flown upstream of the “Orange Bluffs” to lat 59.807999, long −151.401837 to determine if a substantial number of Chinook salmon spawned upstream of the index area.

BIOLOGICAL AND ENVIRONMENTAL SAMPLING

Beach Seine Samples

Age-sex-length data were collected from Chinook salmon captured by beach seine upstream of the sonar site on the North and South forks of the Anchor River. A 30.5-m long by 2-m deep beach seine with 5.1-cm stretched mesh size (abbreviated below as “net”) was drifted through deep pools (Kerkvliet et al. 2008).

In 2007, sampling was conducted twice on both the North Fork (25 May and 31 May) and the South Fork (23 May and 29 May). In 2008, sampling was conducted 3 times on the North Fork (30 May, 5 June, and 11 June) and the South Fork (27 May, 3 June, and 10 June).

All captured fish were identified to species, and the length from mid eye to tail fork (METF) was measured to the nearest 5 millimeters. Sex was visually determined through external characteristics and scales were collected for aging (determining age of fish; Welander 1940) from all Chinook salmon captured. The upper lobe of the caudal fin was also clipped on all Chinook salmon and steelhead trout before release to prevent double sampling. Scales were read using a microfiche reader and aged with methods described by Welander (1940) and Mosher (1969). Scales were aged without reference to size, sex, or other data. Scale samples were aged twice to estimate within-reader variability. All scale samples that had conflicting ages for the two estimates were re-aged to produce a resolved age that was used for composition and abundance estimates.

Mainstem Resistance Board Weir Samples

In 2007 and 2008, biological samples were generally collected from every 40th Chinook salmon and every 35th coho salmon that passed through the live boxes. Scales were collected, processed, and read as described above. The ASL procedure was modified on days when large numbers of fish passed the weir to improve the efficiency of sampling fish. For example, if 350 coho salmon were counted passing through the weir, then the next 10 coho salmon were sampled as a group for ASL data.

Coded Wire Tag Samples

Each Chinook salmon captured with a beach seine was inspected for the presence or absence of an adipose fin. Throughout the full weir operation, all Chinook and coho salmon sampled for ASL data were also inspected for the presence or absence of an adipose fin. Fish missing an adipose fin were sacrificed to identify the release site.

River Temperature and Stage

In 2007 and 2008, Cook Inlet Keeper (CIK) collected river temperatures using a data logger programmed to collect the average, minimum, and maximum water temperature in degrees Celsius every 15 minutes. The logger was installed approximately 0.1 RKM downstream of the sonar-weir site. Daily temperatures provided in this report were averaged from the temperature readings collected every 15 minutes (average, minimum, and maximum).

In 2007 and 2008, personnel from U.S. Geological Survey (USGS) collected hourly river stage readings from the gauge station (USGS 15239900) located on the South Fork at approximately 11.4 RKM. Daily average stage readings were supplied by Ben Balk with USGS (personal communication).

DATA ANALYSIS

Chinook Salmon

Escapement

DIDSON was used to estimate Chinook salmon passage during periods of high water until a resistance board weir could be installed that allowed a complete census of the Chinook salmon passage thereafter.

Net upstream passage for the period counted by DIDSON for the j^{th} hour (j = 1,…, 24) of the k^{th} day of the season was calculated as

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

where

u_{jk} = upstream counts for the period counted in hour j of day k and

d_{jk} = downstream counts for the period counted in hour j of day k.

Net upstream counts for each hour were estimated as

$$\hat{c}_{jk} = \frac{60}{t_{jk}} n_{jk} \tag{2}$$

where

t_{jk} = number of minutes sampled during the j^{th} hour on day k (target = 20 minutes).

In rare situations where entire hours were not counted due to computer malfunction, silting of sonar lens, etc., counts were linearly interpolated. The number of hours for which there is no count is very small and these adjustments are not thought to contribute any meaningful bias or variance to the season-end estimates.

Hourly count estimates ($\hat{c}_{jk}$) were summed to provide daily estimates of escapement (C_k) and an estimate of the total escapement passage (C_D) during DIDSON operation:

$$\hat{C}_k = \sum_{j=1}^{24} \hat{c}_{jk} \tag{3}$$

$$\hat{C}_D = \sum_{k=1}^{K} \hat{C}_k \tag{4}$$

where K is the number of days of operation of the DIDSON in the year in question. The variance of $\hat{C}_D$ was estimated as

$$\text{var}(\hat{C}_D) = \sum_{k=1}^{K} \text{var}(\hat{C}_k) = \sum_{k=1}^{K} \sum_{j=1}^{24} \text{var}(\hat{c}_{jk}) \tag{5}$$

where

$$\text{var}(\hat{c}_{jk}) = \left[\frac{60}{t_{jk}}\right]^2 \text{var}(n_{jk}) = \left[\frac{60}{t_{jk}}\right]^2 s^2 \left[1 - \frac{t_{jk}}{60}\right] \qquad (6)$$

and where s^2 is calculated as the successive difference estimate of variance for a systematic sample (Wolter 1985):

$$s^2 = \frac{\sum_{h=2}^{H}(n_h - n_{h-1})^2}{2(H-1)} \qquad (7)$$

where n_h is the h^{th} sample count (h = 1 corresponds to the first count of the season [j = 1, k = 1] and h = H corresponds to the last count of the season [j = 24, k = K]).

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

$$\hat{C}_T = \hat{C}_D + C_W \qquad (8)$$

where C_W is the count of Chinook salmon through the full weir; the variance of $\hat{C}_T$ was estimated as

$$\text{var}(\hat{C}_T) = \text{var}(\hat{C}_D) \qquad (9)$$

Count Diagnostics

Re-counted DIDSON files provided a measure of the reproducibility of the escapement count and a quality control measure. In 2007 and 2008, between- and within-reader variability was assessed for the 3 crewmembers primarily responsible for counting DIDSON files.

Between-reader variability was assessed by comparing three 20-minute counts made by 2 different crewmembers each day. Within-reader variability was assessed by comparing counts from two 20-minute DIDSON files made by each of the readers each day (i.e., each file was read twice by a reader). 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-reader analysis:

1. Kendall's Tau was calculated for each pair of readers counting 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 readers. It ranges from 0 to 1; it is high when there is little variation between the scores given to each file by the readers.
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 readers against the average of the scores of the readers.

A within-reader analysis analogous to statistics (1), (2) and (3) above was also conducted.

Run Timing

Run timing of Chinook salmon at the sonar-weir site was expressed as cumulative daily counts and associated percentiles. The number of days for the middle 80% of the run (between the 10th and 90th percentiles) to pass the weir was used to compare run timing between 2007 and 2008. The correlation of daily counts within the middle 80% of the run with daily river stage averages was examined with Pearson's correlation coefficient. Diel run timing was evaluated during the DIDSON period using 24-hour DIDSON counts. During the weir period, diurnal timing was calculated from the number of Chinook salmon that were passed through the weir live boxes during normal hours of operation (0800 through midnight). The hourly DIDSON and weir counts were expressed as the percentage of fish counted each hour.

Age and Sex Composition and Length-at-Age

Age and sex composition during the DIDSON operation was estimated from pooled samples obtained from beach seining in the North and South forks upstream of the sonar. While statistically significant, age composition differences between the forks in 2003 and 2004 were not substantial; in 2005 and 2006, few fish were found in the North Fork. We believe that pooling beach seine samples derived from equal effort from the North and South forks is the best way to obtain a representative sample of the migration upstream of 2.8 RKM occurring during sonar operation (Kerkvliet et al. 2008).

Age and sex composition during the mainstem weir operation was estimated from systematic sampling at the weir.

The estimated proportion of Chinook salmon of age or sex class k (or a combination thereof), in the escapement during a given period x ($x = W$ [Weir] or D [DIDSON]) was calculated by

$$\hat{p}_{xk} = \frac{n_{xk}}{n_x} \tag{10}$$

where

n_{xk} = the total number of salmon of age or sex class k in n_x and

n_x = the number of salmon sampled during period x.

The estimated proportion of Chinook salmon of age or sex class k (or a combination thereof) in the entire escapement to the Anchor River was calculated as

$$\hat{p}_k = \phi_D \hat{p}_{Dk} + (1 - \phi_D)\hat{p}_{Wk} \tag{11}$$

where

ϕ_D = the proportion of the entire escapement that migrates during the DIDSON operation (treated as a constant), and the estimated variance of proportion ($\hat{p}_k$) was calculated as

$$\mathrm{var}(\hat{p}_k) = \phi_D^2\left[\left(\frac{\hat{C}_D - n_D}{\hat{C}_D}\right)\frac{\hat{p}_{Dk}(1-\hat{p}_{Dk})}{n_D - 1}\right] + (1-\phi_D)^2\left(\frac{C_W - n_W}{C_W}\right)\frac{\hat{p}_{Wk}(1-\hat{p}_{Wk})}{n_W - 1}. \quad (12)$$

$\hat{C}_D$ is measured with high precision and is included in the finite population correction factor in Equation 12 as a constant.

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

$$\hat{N}_k = \hat{C}_T\ \hat{p}_k. \quad (13)$$

The estimated variance of $\hat{N}_k$ was calculated as (Goodman 1960)

$$\mathrm{var}(\hat{N}_k) = \hat{C}_T^{\ 2}\ \mathrm{var}(\hat{p}_k) + \hat{p}_k^2\ \mathrm{var}(\hat{C}_T) - \mathrm{var}(\hat{p}_k)\,\mathrm{var}(\hat{C}_T). \quad (14)$$

Mean length-at-age and its variance 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):

$$CV_j = 100\% x \frac{\sqrt{\sum_{i=1}^{R}\frac{(X_{ij} - X_j)^2}{R-1}}}{X_j} \quad (15)$$

where

X_{ij} = *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.

Coho Salmon

Escapement

Escapement of coho salmon was determined from counts of coho salmon through the resistance board weir.

Run Timing

Run timing of coho salmon was evaluated the same way as described above for Chinook salmon during the weir operation.

Age and Sex Composition and Length-at-Age

The age, sex, and length composition of the coho salmon escapement was based on a systematic sample collected at the mainstem weir only; the mainstem weir was installed before any coho salmon began their migration. The estimated proportion of coho salmon of age or sex class *k* ($\hat{p}_k$)

in the escapement (N) was calculated from the sample taken at the mainstem weir (n) using Equation 10. Its estimated variance was calculated as

$$\text{var}(\hat{p}_k) = \left(\frac{N - n}{N}\right)\frac{\hat{p}_k(1 - \hat{p}_k)}{n - 1}. \tag{16}$$

The estimated total number of coho salmon of age or sex class k was calculated as $\hat{N}_k = N\,\hat{p}_k$ with its variance estimated by

$$\text{var}(\hat{N}_k) = N^2\,\text{var}(\hat{p}_k). \tag{17}$$

Mean length-at-age and its variance were estimated using standard summary statistics.

The within-reader variability of coho scale age estimates was calculated the same way as described for Chinook salmon (Equation 15).

River Temperature and Stage

Correlation between the average daily river temperature and average river stage during the project operation was measured with Pearson's correlation coefficient (r).

RESULTS

CHINOOK SALMON

DIDSON and Weir Escapement

The 2007 Chinook salmon escapement was the third highest (9,622 fish, SE 238) and the 2008 escapement was the lowest (5,806 fish, SE 169) since 2004 when the entire run was first monitored (Table 5). The 2007 escapement estimate was based on expanded high frequency sonar counts (4,908 fish) from 14 May through 7 June, and the weir census (4,714 fish) from 7 June through 12 September (Appendices C1and D1, respectively). On 7 June 2007, the daily Chinook salmon count (322 fish) was based on sonar (261 fish) and weir counts (61 fish). The 2008 escapement estimate was derived from 13 May through 16 June counts using expanded low frequency sonar counts (363 fish) and high frequency sonar counts (3,060 fish) (Appendix C2), and from 16 June through 11 September using the weir census (2,383 fish) (Appendix D3). On 16 June 2008, the daily Chinook salmon count (79 fish) was based on sonar counts (63 fish) and weir counts (16 fish). Chinook salmon abundance estimates during the sonar period comprised roughly half of the escapement in both 2007 (51%) and 2008 (59%). The upstream to downstream count ratio of fish during the sonar periods was similar between 2007 (2.3:1) and 2008 (2.6:1) (Figures 6 and 7, Appendices C1 and C2). In 2008, there were 4 days (16–18 May and 11 June) when upstream counts were lower than downstream counts. Higher downstream counts resulted in negative daily counts for these days.

Steelhead trout were captured upstream of the sonar site during the sonar period. The percentage of steelhead trout out of all fish caught during netting on both forks of the Anchor River was roughly 24% in 2007 and 40% in 2008 (Table 8). In both 2007 and 2008, 14 steelhead trout were opportunistically counted through the steelhead chute to the downstream side of the weir.

Steelhead trout were observed passing through the steelhead chute from 10 June to 22 June in 2007, and from 17 June to 20 June in 2008.

Count Diagnostics

Selected DIDSON files created in both 2007 and 2008 were used to evaluate both between-reader (n = 209 files) and within-reader (n = 126 files) variability (Table 9). We found high intraclass correlations between DIDSON counts for 4 of the 5 pairs of between-reader combinations examined (2 [of 3] for 2007, $r > 0.98$; 2 [of 2] for 2008; $r > 0.93$); overall intraclass correlation was slightly higher in 2007 ($r = 0.96$) than in 2008 ($r = 0.94$) (Table 9). Plots of between-reader counts and Tukey difference plots for 2007 and 2008 are given in Figures 8 and 9. The only substantial disagreement was observed between readers 1 and 2 for 2 high counts in 2007 (Figure 8: plots A and D).

We also found high intraclass correlations ($r > 0.87$) of DIDSON counts for within-reader combinations. The overall correlation of first versus second count for within-reader data was similar in 2007 and 2008 ($r = 0.93$ and $r = 0.94$, respectively). Plots of within-reader counts and Tukey difference plots for 2007 and 2008 are given in Figures 10 and 11. The only substantial disagreement within readers was observed for reader 2 in 2007 (Figure 10: plots B and D).

Run Timing

The midpoint of the Chinook salmon run was 7 June in 2007and 12 June in 2008 (Figure 12, Appendices D1 and D3). The 2007 Chinook salmon run was more prolonged than the 2008 run (52 days versus 39 days, respectively).

The correlation between river stage and the middle 80^{th} percentile of the run explained approximately 20% of the variation (r^2) in Chinook salmon passage through the weir in 2007 ($r = 0.45$; df = 52; $P = 0.0007$; Figure 13) but not in 2008 ($r = 0.29$; df = 38; $P = 0.0751$; Figure 14). In 2007, river levels remained low from mid to late June. During this low water period, passage through the weir was low though large numbers of maturing fish were observed "holding" (staying within a local area) in deep pools and channels throughout the river downstream of the weir. Between 10 July and 13 July 2007, the river rose approximately 12 cm (Appendix E1). The final pulse of Chinook salmon (N = 1,082) passed through the weir from 10 July through 13 July 2007 (Appendix D1).

Diel patterns were similar in 2007 and 2008 with the highest DIDSON counts tallied during hours of darkness or suppressed light (Figures 15 and 16). In 2007 and 2008, most of the respective upstream-oriented (90% and 90%) and downstream-oriented (85% and 83%) images of fish were collected from 1400 hours to 0559 hours. For both years, the percentage of Chinook salmon passing through the weirs during hours of suppressed light was similar; 88% in 2007 and 87% in 2008 were counted between 1400 hours and 2359 hours (Figures 17 and 18).

Aerial Survey Escapement Index

The 2007 aerial survey was flown on 27 July and 678 Chinook salmon were counted within the index area. Water levels were low for the survey (Appendix E1). Clarity was described as good upstream of the New Sterling Highway Bridge, then turned fair downstream of the bridge because of a slight increase in turbidity (Appendix F1). The 2007 survey took approximately twice as long as the 2008 survey (approximately 2 hours versus 1 hour) and required the pilot to refuel the helicopter three quarters of the way through the survey. An additional 152 Chinook salmon were counted during a survey flown upstream of the index area.

The 2008 aerial survey was flown on 1 August and 528 Chinook salmon were counted in the index area. Visibility was described as good upstream of Engerbretsen Bridge, but turned poor downstream due to glare caused by the angle of the sun (Appendix F1). An additional 158 Chinook salmon were counted during a survey flown upstream of the index area.

Age and Sex Composition and Length-at-Age

In 2007 and 2008, Chinook salmon ASL samples from the North and South forks were pooled. Age compositions differed at significance level $\alpha = 0.1$ for both 2007 and 2008 ($\chi^2 = 7.7$, df = 2, $P = 0.022$, and $\chi^2 = 5.8$, df = 2, $P = 0.056$, respectively) between the netting and weir periods and estimates were weighted accordingly (see Methods).

Overall, ocean age 3 was the dominant age class in 2007 (53.4%, SE 3.7%) and 2008 (68.5%, SE 4.3%) for the Chinook salmon escapement (Tables 10 and 11). The second most common age class for females was ocean age 4 (15.4%, SE 2.7%) in 2007 and ocean age 2 (4.1%, SE 1.8) in 2008. In both years, ocean-age-2 males were the second highest age class (19.9%, SE 3.0 and 17.7%, SE 3.5%, respectively). The coefficient of variation of all Chinook salmon scales aged in 2007 and 2008 was 1.8% and 1.6%, respectively.

The male to female ratio for Chinook salmon sampled in 2007 and 2008 was approximately 1.3:1.0 for both years (Tables 10 and 11).

COHO SALMON

Escapement

The 2007 coho salmon escapement was the fourth highest (8,226 fish) and 2008 was the fifth highest (5,951 fish) of the 9 years of escapement counts for the Anchor River (Table 6). The 2007 coho salmon escapement was based on weir counts from 7 June through 12 September (Appendix D1). The 2008 coho salmon escapement was based on weir counts from 16 June through 11 September (Appendix D3).

Run Timing

The first coho salmon was counted through the weir on 14 July in 2007 and 17 July in 2008 (Appendices D1 and D3). The midpoint of the 2007 coho salmon run (8 September) was 17 days later than the 2008 run (22 August), and 6 days later than the midpoint of the 2004–2005 average run (2 September) (Figure 19).

The passage of coho salmon through the weir was strongly positively correlated with river stage in 2007, but not in 2008. In 2007, the correlation between river stage and the middle 80^{th} percentile of the run explained approximately 65% of the variation in the daily passage of coho salmon ($r = 0.80$; df = 17; $P < 0.001$; Figure 20). In contrast in 2008, river stage explained only 24% of the variation ($r = 0.49$; df = 20; $P = 0.023$; Figure 21).

For both years, the daily passage of coho salmon through the weirs was similar; most of the coho salmon were counted between 1300 hours and 2159 hours (2007: 83%, Figure 22; 2008: 79%, Figure 23).

Age and Sex Composition and Length-at-Age

Age 2.1 was the dominant age class in 2007 (84.2%, SE 2.8%) and in 2008 (80.0%, SE 3.6%) (Tables 12 and 13). The male to female ratio was lower in 2007 (1.2:1.0) compared to 2008 (1.9:1.0). The coefficient of variation of all coho salmon scales aged in 2007 and 2008 was 2.2% and 6.3%, respectively.

STRAYS

In 2007, no strays were detected from the 284 Chinook salmon and 230 coho salmon examined for ASL. In 2008, of the 140 Chinook salmon and 230 coho salmon examined, 1 Chinook salmon was sacrificed because of a missing adipose fin. No coded wire tag was found in the head of the sacrificed fish.

RIVER TEMPERATURE AND STAGE

River temperatures averaged approximately 10°C (range = 4.5°C to 16°C) in 2007 (Appendix G1) and 10°C (range = 3°C to 14°C) in 2008 (Appendix G2). River stages averaged approximately 42 cm (range = 34 to 64 cm) in 2007 (Appendix E1), and 52 cm (range = 32 to 103 cm) in 2008 (Appendix E2). Daily river stage and temperature averages were significantly correlated in 2007 ($r = 0.74$; df = 119; $P < 0.0001$) and 2008 ($r = 0.89$; df = 119; $P < 0.0001$; Figures 24 and 25). For the 2007 and 2008 project operations, approximately 55% and 80% (respectively) of the variation in temperature was explained by river stage.

DISCUSSION

CHINOOK SALMON

Since the inception of the sonar-weir project in 2003, the 2007 and 2008 Chinook salmon escapement estimates are the fifth and sixth in the data series (Kerkvliet and Burwen 2010; Kerkvliet et al. 2008). These estimates are thought to be biased and underestimate escapement because all downstream sonar counts were assumed to be Chinook salmon when we know (based on netting) that at least some were due to post-spawned emigrating steelhead trout (kelts). Chinook salmon and steelhead trout images could not be differentiated due to substantial overlapping size compositions. Escapement goals were met in 2007 and 2008, based on the current lower bound SEG. Aerial index counts have not consistently tracked with escapement estimates since 2003. The inconsistency is likely due to the inherent biases associated with aerial survey indices and we recommend discontinuing the area surveys in the future.

The within- and between-reader variation for counting fish images using DIDSON can be attributed to variation in the innate abilities of readers to identify fish, fish milling behavior, and the rate at which a file is reviewed. Fast moving fish can be difficult to see when the file is played at a high frame rate, while a fish can also be missed when a file is played too slowly because fish movement becomes less obvious. These factors were considered in the decision to stratify the ensonified range in 2008 when river levels were high. During this time, the 20-m range stratum was divided into 2 consecutively sampled 10-m range strata (Appendix B2). Although twice as many stratified files (40-min total) were collected for each hour during this period, the two 10-m range files could be reviewed at a faster rate and with less fatigue than the 20-minute files collected over the full range. Cronkite (2006) also used this method and found agreement between simultaneous DIDSON counts based on stratified ranges and visual counts made by observers standing at the end of a weir.

The percentages of steelhead trout in netting catches in 2007 (approximately 24%) and 2008 (approximately 40%) were higher than for 2005 and 2006 (approximately 6% and approximately 18%, respectively; Kerkvliet and Burwen 2010). The increase was likely attributed to the combination of increased netting efficiency and shifts in relative abundance between Chinook salmon and steelhead trout. Netting efficiency was improved in 2006 through 2008 by the use of dry suits that allowed fishing of deeper pools and channels where more kelts may have been holding. The relative abundance of Chinook salmon and steelhead trout likely varies from year to year. For example, in 2005, when the Chinook salmon escapement was high (11,156 fish), a low percentage of steelhead trout were captured. In contrast, when Chinook salmon escapement was lower (5,806 fish) in 2008, a high percentage of steelhead trout were captured.

To evaluate the bias caused by emigrating kelts, we culled the downstream counts in 2007 and 2008 by the percentage of kelts caught during netting using the method described in Kerkvliet et al. (2008) to apportion upstream counts. By applying this method, the 2007 and 2008 Chinook salmon escapement estimates would increase by roughly 2,940 and 1,267 fish, respectively. At this time, culling the downstream count does not pose a satisfactory solution for addressing the biases because even though kelts are caught upstream of the DIDSON during netting, many of these fish may not be emigrating downstream during the DIDSON period. Furthermore, if the downstream counts were culled, this would suggest that the number of emigrating kelts in 2007 was 2,940 and in 2008 it was 1,267, which is unlikely based on the number of immigrating steelhead trout counted through the weir in 1988 (878), 1989 (769), and 1992 (1,261) (Table 4). These weir counts do not include the mortality associated with overwintering or spawning.

The 2007 Chinook salmon run timing at the sonar-weir site was characterized as being more prolonged than average (52 days versus the 2004–2006 average of 38 days). The prolonged run timing in 2007 was likely caused by low river conditions (Figure 13). In mid-June and early July, large numbers of Chinook salmon were observed "holding" in the lower river, supporting the contention that the run was held up by low river levels. In future years, if the Chinook salmon escapement is low, the run timing is more prolonged than average, and there is a buildup of Chinook salmon in the lower river, management action to restrict the inriver sport fishery below the sonar-weir site should be considered. Even if the fishery were closed to Chinook salmon under such conditions, Chinook salmon could still be caught and released with an unknown level of mortality.

The 2008 inriver sport harvest of Chinook salmon was lower than 2007 by about 600 fish despite increased inriver fishing time (20 days versus 15 days, respectively; Table 5). The lower harvest in 2008 is attributed to the lower run size and the poor fishing conditions that were caused by high river levels, which occurred during the first 3 weeks of the fishery.

COHO SALMON

The 2007 and 2008 coho salmon escapement censuses are the third and fourth completed at the sonar-weir site in the data series (Kerkvliet and Burwen 2010; Kerkvliet et al. 2008). The 2007 and 2008 coho salmon escapements were within historical averages (Table 6). Differences in exploitation between years can be explained by run size and run timing of coho salmon in the Anchor River. Typically, exploitation is higher in years with lower escapement (e.g., 2004 and 2008). For the 2 years when escapement has been highest (2005 and 2006), most (>72%) of the coho salmon escapement has surged upstream of the fishery in under 6 days, when river levels were high and caused poor fishing conditions.

FUTURE ESCAPEMENT MONITORING

ADF&G will continue estimating the Anchor River Chinook and coho salmon escapements using sonar and weir counts from mid-May through mid-September. Ultimately, we plan to define a SEG range for Chinook salmon as additional years of escapement data are collected.

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TABLES AND FIGURES

Table 1.–Drainage characteristics of the North Fork and South Fork of the Anchor River.

	Anchor River		
Drainage characteristics	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: Baird, S., Kachemak Bay Research Reserve in Homer, AK, *unpublished data*, 2006.
Note: “RKM” = river kilometers.

Table 2.–Angler participation and harvest of Chinook, coho, pink, and sockeye salmon, Dolly Varden, and rainbow or steelhead trout, Anchor River, 1977–2008.

Year	Effort (days fished)	Harvest: Chinook salmon	Coho salmon	Pink salmon	Sockeye salmon	Dolly Varden	Rainbow or steelhead trout	Catch: Rainbow or steelhead trout[a]
1977	31,515	1,077	1,339	27	ND	9,222	2,099	ND
1978	42,671	2,109	1,559	139	ND	17,357	2,305	ND
1979	44,220	1,913	4,006	18	ND	21,364	1,782	ND
1980	33,272	605	2,649	339	ND	10,948	1,186	ND
1981	34,257	1,069	2,949	11	ND	15,271	928	ND
1982	24,709	718	2,379	161	ND	10,375	698	ND
1983	28,881	1,269	1,395	252	ND	17,277	1,605	ND
1984	26,919	998	1,135	249	167	5,599	985	ND
1985	31,715	672	2,239	124	224	7,716	475	ND
1986	34,938	1,098	1,021	136	39	3,914	520	ND
1987	39,045	761	2,010	54	1,263	2,735	643	ND
1988	24,356	976	2,219	109	109	2,746	200	ND
1989	19,145	578	2,635	115	136	1,476	0	2,066 [b]
1990	28,829	1,479	2,782	163	136	2,821	0	1,978
1991	22,187	1,047	3,169	125	152	1,409	0	2,349
1992	24,028	1,685	2,267	92	66	2,532	0	2,720
1993	29,338	2,787	4,003	98	45	1,031	0	4,156
1994	27,856	2,478	3,360	79	82	1,574	0	4,035
1995	25,888	1,475	3,080	47	94	1,537	0	2,232
1996	16,016	1,483	1,762	78	218	963	0	7,570
1997	17,020	1,563	1,636	321	165	1,575	0	3,103
1998	14,310	783	2,386	7	174	2,105	0	3,878
1999	21,184	1,409	1,780	54	174	1,061	0	3,920
2000	22,971	1,730	2,604	123	127	1,903	0	8,693
2001	19,195	889	2,960	11	61	1,652	0	3,045
2002	19,245	1,047	3,830	124	52	662	0	3,501
2003	17,482	1,011	3,999	68	504	1,124	0	3,409
2004	20,452	1,561	4,383	146	11	736	0	3,710
2005	20,079	1,432	5,314	69	156	675	0	2,524
2006	17,065	1,394	3,920	112	54	897	0	4,513
2007	34,390	2,081	3,962	298	53	1,327	0	8,365
2008	26,182	1,486	4,790	179	652	822	0	8,733
Averages								
2003–2008	22,608	1,494	4,395	145	238	930	0	5,209
1989–2008	22,143	1,470	3,231	115	156	1,394	0	4,225
1977–1988	33,042	1,105	2,075	135	360	10,377	1,119	ND
1977–2002	27,066	1,296	2,429	118	183	5,647	516	3,803
1977–2008	26,230	1,333	2,798	123	197	4,763	420	4,225

Source: Statewide Harvest Survey estimates (Mills 1979-1994; Howe et al. 1995-1996, 2001a-d; Walker et al. 2003; Jennings et al. 2004, 2006a-b, 2007, 2009a-b, 2010a-b).

Note:"harvest" = fish kept; "catch" = fish harvested plus fish released; "ND" = no data. Scientific names of species not previously identified: pink salmon (*Oncorhynchus gorbuscha*) and sockeye salmon (*O. nerka*).

[a] From 1989 to present, rainbow trout/steelhead trout fishery restricted to catch and release only.

[b] 1989 catch estimate from Gretchen Jennings (project manager, SWHS, ADF&G, SF, Anchorage, unpublished data).

Table 3.–Anchor River Chinook salmon aerial and ground survey indices, escapement estimates, and escapement goals, 1976–2008.

	Index counts			Escapement survey			Escapement goal	
Year	Date	Aerial [a]	Ground [b]	Type	Estimate	SE	Type	Number
1976	2 Aug	2,125	797	expanded aerial [c]	3,080	ND	None	
1977	27 Jul	3,585	1676	expanded aerial [c]	4,170	ND	None	
1978	4 Aug	2,209	834	expanded aerial [c]	2,410	ND	None	
1979	29 Jul	1,335	940	expanded aerial [c]	2,000	ND	None	
1980 [d]				expanded aerial [c]	660	ND	None	
1981 [d]	30 Jul	1,066	379	expanded aerial [c]	1,230	ND	None	
1982	28 Jul	1,493	433	expanded aerial [c]	1,540	ND	None	
1983	29 Jul	1,033	298	expanded aerial [c]	1,490	ND	None	
1984	5 Aug	1,087	181	expanded aerial [c]	1,170	ND	None	
1985	9 Aug	1,328	167	expanded aerial [c]	1,330	ND	None	
1986	29 Jul	2,287	237	expanded aerial [c]	2,390	ND	None	
1987	28 Jul	2,524	353	expanded aerial [c]	4,350	ND	None	
1988	30 Jul	1,458	229	expanded aerial [c]	2,550	ND	None	
1989	26 Jul	940	140	expanded aerial [c]	1,060	ND	None	
1990	21 Jul	967	108	expanded aerial [c]	2,630	ND	None	
1991	27 Jul	589	120	expanded aerial [c]	730	ND	None	
1992	10 Aug	99	ND	expanded aerial [c]	–	–	None	
1993	21 Jul	1,110	386	expanded aerial [c]	2,260	ND	BEG [e]	1,790
1994	30 Jul	837	150	expanded aerial [c]	1,051	ND	BEG [e]	1,790
1995 [d]				expanded aerial [c]	ND	ND	BEG [e]	1,790
1996	2 Aug	277	ND	expanded aerial [c]	–	–	BEG [e]	1,790
1997	30 Jul	477	ND	expanded aerial [c]	–	–	BEG [e]	1,790
1998	28 Jul	789	ND	aerial	ND	ND	BEG [f]	1,050–2,200
1999	28 Jul	685	ND	aerial	ND	ND	BEG [f]	1,050–2,200
2000	27 Jul	752	ND	aerial	ND	ND	SEG [g]	750–1,500
2001	27 Jul	414	ND	aerial	ND	ND	SEG [g]	750–1,500
2002	30 Jul	748	243	aerial	ND	ND	SEG [g]	750–1,500
2003	28 Jul	647	463	DIDSON, aerial	9,238	0	SEG [g]	750–1,500
2004	31 Jul	834	ND	DIDSON-weir, aerial	12,016	283	SEG [g]	750–1,500
2005	25 Jul	651	ND	DIDSON-weir, aerial	11,156	229	None [h]	
2006	27 Jul	899	ND	DIDSON-weir, aerial	8,945	289	None [h]	
2007	27 Jul	678	ND	DIDSON-weir, aerial	9,622	238	None [h]	
2008	1 Aug	528	ND	DIDSON-weir, aerial	5,806	169	SEG [i]	5,000

-continued-

Table 3.–Part 2 of 2.

	Index counts			Escapement survey			Escapement goal	
Year	Date	Aerial [a]	Ground [b]	Type	Estimate	SE	Type	Number
Averages								
2003–2008		706	ND		9,464	201		
1991–2003		619	272		9,238	0		
1976–1992		1,508	459		ND			
1976–2008		1,111	428		3,870	201		

Note: "ND" = no data, "–" = value cannot be computed due to limitations of the data.

[a] Aerial survey conducted over the South Fork from first fish observed in the headwaters downstream to the North Fork confluence (where most spawning was thought to occur).

[b] Ground index counts from a standard section of the South Fork within a subsection of the aerial survey area and varied between years: 1976–1982 the survey was conducted from Glanville Lumber to the North Fork confluence, and 1983–2008 the survey was conducted from a Sterling Highway bridge to the North and South forks confluence.

[c] "Expanded aerial" = total aerial count + [ground survey subsection count – aerial subsection count].

[d] Index counts were not conducted or were considered minimal due to highly turbid water during the aerial escapement survey.

[e] "BEG" = biological escapement goal, based on expanded aerial counts.

[f] BEG based on only aerial counts.

[g] "SEG" = sustainable escapement goal, based on aerial counts.

[h] SEG removed in November 2004.

[i] Lower bound SEG (threshold) established in 2007 based on full probability model using DIDSON and weir estimates, age composition, and historic aerial index counts.

Table 4.-Anchor River DIDSON-weir fish counts by species, 1987–1995 and 2003–2008.

				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 or steelhead trout [e]
1987 [f]	4 Jul–10 Sep	1.6	fixed picket weir	204	19,062	2,084	19	33	2,409	136
1988 [f]	3 Jul–5 Oct	1.6	fixed picket weir	245	14,935	777	24	30	2,805	878
1989 [f]	6 Jul–5 Nov	1.6	resistance board weir	95	11,384	4,729	165	212	20,187	769
1990 [f]	4 Jul–15 Aug	1.6	resistance board weir	144	10,427	355	17	39	190	3
1991 [f]	4 Jul–15 Aug	1.6	resistance board weir	39	18,002	1,757	9	46	13	5
1992 [f]	4 Jul–1 Oct	1.6	resistance board weir	129	10,051	992	39	174	4,596	1,261
1993 [f]	3 Jul–16 Aug	1.6	resistance board weir	90	8,262	1,019	12	71	290	1
1994 [f]	3 Jul–16 Aug	1.6	resistance board weir	111	17,259	723	2	61	420	1
1995 [f]	4 Jul–12 Aug	1.6	resistance board weir	112	10,994	1,094	4	73	725	10
2003 [g]	30 May–9 Jul	2.8	DIDSON	9,238 [h]	–	–	–	–	–	–
2004 [g]	16 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–9 Sep	2.8	DIDSON, resistance board weir	11,156 [h, i]	5,719	4,916	146	319	18,977	107
2006 [g]	15 May–24 Aug	2.8	DIDSON, resistance board weir	8,945 [h, i]	234	954	45	38	10,181 [j]	4
2007	14 May–12 Sep	2.8	DIDSON, resistance board weir	9,622 [h, i]	1,309	3,916	156	200	8,226	344
2008	13 May–11 Sep	2.8	DIDSON, resistance board weir	5,806 [h, i]	1,344	2,017	66	52	5,951	262

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

[b] Escapement is only partially counted due to weir operation dates and weir location (1987–1995) and to weir operation dates (2003).

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

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

[e] Incomplete counts due to project operation dates and/or weir location (1987, 1990–1991, 1993–1995, and 2004–2008).

[f] Sources: Larson and Balland (1989), Larson (1990-1995, 1997) when escapement weir was located approximately 1.6 RKM from mouth.

[g] Sources: Kerkvliet et al. (2008) for years 2003–2004, Kerkvliet and Burwen (2010) for years 2005–2006.

[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 Aug; the weir washed out due to flooding. The DIDSON operated again from 22 to 24 Aug; an estimated 3,292 coho salmon were counted.

Table 5.–Anchor River Chinook salmon escapement, freshwater harvest, total run, and exploitation estimates, 2003–2008.

		Chinook salmon						
						Total run [a]		
		Escapement		Freshwater harvest			Exploitation	Fishing
Year	Project dates	Estimate	SE	Estimate	SE	Estimate	rate (%) [b]	days
2003	30 May–9 Jul	9,238	0 [c]	1,011	157	10,249	9.9	12
2004	15 May–15 Sep	12,016	283 [d]	1,561	198	13,577	11.5	15
2005	13 May–9 Sep	11,156	229 [d]	1,432	233	12,588	11.4	15
2006	15 May–24 Aug	8,945	289 [d]	1,394	197	10,339	13.5	15
2007	14 May–12 Sep	9,622	238 [d]	2,081	326	11,703	17.8	15
2008	13 May–11 Sep	5,806	169 [d]	1,486	241	7,418	21.7	20
Averages								
2007–2008		7,714		1,847		9,561	19	18
2004–2007		10,435		1,617		12,052	13.4	15
2003–2008		9,464		1,515		10,979	13.8	15

Source: Harvest estimates from statewide harvest survey (Jennings et al. 2006a-b, 2007, 2009a-b, 2010a-b).

Note: Estimates of escapement for 2003–2008 may be low because of DIDSON bias.

[a] Total run = escapement + freshwater harvest; total does not account for the marine harvest.

[b] Percent harvest per total run.

[c] The estimate is based on a census of all DIDSON files.

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

Table 6.–Anchor River coho salmon escapement, freshwater harvest, total run, and exploitation estimates, 1987–1989, 1992, 2004–2008.

		Coho salmon				
					Total run [a]	
		Escapement	Freshwater harvest			Exploitation
Year	Project dates	estimate [b]	Estimate	SE	Estimate	rate (%) [c]
1987	5 Jul–11 Sep	2,409	2,010	ND	4,419 [d]	45.5
1988	3 Jul–6 Oct	2,805	2,219	ND	5,024 [d]	44.2
1989	6 Jul–7 Nov	20,187	2,635	ND	22,822 [d]	11.5
1992	4 Jul–2 Oct	4,596	2,267	ND	6,863 [d]	33.0
2004	15 May–15 Sep	5,728	4,383	722	10,111	43.3
2005	13 May–9 Sep	18,977 [e]	5,314	949	24,291	21.9
2006	15 May–24 Aug	10,181 [e]	3,920	975	14,101	27.8
2007	14 May–12 Sep	8,226	3,962	679	12,188	32.5
2008	13 May–11 Sep	5,951	4,790	821	10,741	44.6
Averages						
1987–1992		7,499	2,283		9,782	23.3
2004–2008		9,813	4,474		14,286	31.3
1987–2009		8,784	3,500		12,284	28.5

Source: Harvest estimates from statewide harvest survey (Mills 1998-1990, 1993;Jennings et al. 2007, 2009a-b, 2010a-b).

Note: "ND" = no data.

[a] Total run = escapement + freshwater harvest; does not account for the marine harvest.

[b] Escapement weir location approximately1.6 RKM from Anchor River mouth for years 1987–1989 and 1992, and approximately 2.8 RKM from mouth for years 2004–2009.

[c] Percent harvest per total run.

[d] Estimates are biased and may be high because an unknown number of fish in the escapement estimate were harvested after they were counted passing through the weir.

[e] Minimum escapement estimate for 2005 and 2006 because weir washed out; 2009 is minimum because counts were high when weir was removed.

Table 7.–Project dates for estimating Anchor River Chinook and coho salmon escapement in 2007 and 2008 using a combination of DIDSON and resistance board weir.

Year	DIDSON [a]	Mainstem weir	South Fork netting	North Fork netting
2007	14 May–7 Jun	7 Jun–12 Sep	Periodic sampling (*n* = 2) 25–31 May	Periodic sampling (*n* = 2) 23–29 May
2008	13 May–16 Jun	16 Jun–11 Sep	Periodic sampling (*n* = 3) 30 May–11 Jun	Periodic sampling (*n* = 3) 27 May–10 Jun

[a] DIDSON used with 2 partial picket weirs to funnel fish into ensonified corridor.

Table 8.–Species composition in beach seine catches on the North and South forks of the Anchor River, 2007–2008.

	South Fork					North Fork				
Year	Sample date	Chinook salmon	Dolly Varden	Steelhead trout	Pink salmon	Sample date	Chinook salmon	Dolly Varden	Steelhead trout	Pink salmon
2007	25 May	31	0	12	0	23 May	20	0	11	0
	31 May	92	0	21	0	29 May	37	0	12	0
	Totals	123	0	33	0	Totals	57	0	23	0
2008	30 May	6	0	13	0	27 May	3	0	1	0
	5 Jun	21	0	18	0	3 Jun	11	0	3	0
	11 Jun	33	0	17	0	10 Jun	17	0	9	0
	Totals	60	0	48	0	Totals	31	0	13	0

Table 9.–Between- and within-reader analyses of DIDSON counts, Anchor River, 2007–2008.

Year	Reader combination		No. files	Accumulated counts First reader	Accumulated counts Second reader	Kendall's Tau	Intraclass Corr (*r*)	95% CI intraclass
2007	Between reader	1-2	13	77	55	0.79	0.65	0.29, 0.85
		1-3	37	296	317	0.91	0.99	0.98, 0.99
		2-3	31	271	297	0.91	0.98	0.96, 0.99
		Overall	81	644	669	0.87	0.96	0.95, 0.97
	Within reader	1-1	26	201	191	0.73	0.97	0.94, 0.98
		2-2	15	160	142	0.84	0.90	0.77, 0.96
		Overall	41	361	333	0.79	0.93	0.89, 0.96
2008	Between reader	1-3	56	180	182	0.71	0.93	0.9, 0.96
		2-3	72	177	191	0.81	0.95	0.93, 0.97
		Overall	128	357	373	0.77	0.94	0.92, 0.96
	Within reader	1-1	37	95	116	0.79	0.95	0.92, 0.97
		2-2	48	96	120	0.78	0.87	0.81, 0.92
		Overall	85	191	236	0.77	0.94	0.91, 0.96

Table 10.–The estimated ocean age, sex, and length composition of the Anchor River Chinook salmon escapement, 2007.

	Composition by ocean age [a]					Composition
	1	2	3	4	5	by sex [b]
Female samples [c]	0	4	49	27	0	122
Percent	0.0	2.0	26.3	15.4	0.0	42.5
SE percent	0.0	1.0	3.3	2.7	0.0	2.9
Estimated abundance	0	192	2,531	1,482	0	4,089
SE abundance	0.0	96.3	323.6	262.4	0.0	296.8
Length samples	0	4	48	27	0	117
Mean length	NA	609	767	838	NA	780
SE mean length	NA	NA	8.2	7.0	NA	7.3
Male samples [c]	1	38	51	14	1	162
Percent	0.5	19.9	27.1	8.1	0.6	57.5
SE percent	0.5	3.0	3.3	2.1	0.6	2.9
Estimated abundance	48	1,915	2,608	779	58	5,533
SE abundance	48.1	292.5	324.0	203.0	57.7	310.8
Length samples	1	37	51	14	1	155
Mean length	355	595	746	876	1,010	701
SE mean length	NA	15.8	14.7	15.9	NA	10.2
Female and male samples [c]	1	42	100	41	1	284
Percent	0.5	22.0	53.4	23.5	0.6	100.0
SE percent	0.5	3.1	3.7	3.2	0.6	0.0
Estimated abundance	48	2,117	5,138	2,261	58	9,622
SE abundance	48.1	302.8	378.0	312.9	57.7	272.0
Length samples	1	41	99	41	1	272
Mean length	355	596	756	851	1,010	733
SE mean length	NA	15.1	8.5	7.4	NA	7.1

Note: "NA" = not applicable.

[a] Age and length-at-age compositions are based on weighted samples collected from nets on the South and North forks and the mainstem weir.

[b] Sex composition is based on weighted samples collected from nets on the South and North forks and the mainstem weir.

[c] Unweighted sample sizes by age class and sex of Chinook salmon collected from nets on the South and North forks and the mainstem weir.

Table 11.–The estimated ocean age, sex, and length composition of the Anchor River Chinook salmon escapement, 2008.

	Composition by ocean age [a]					Composition
	1	2	3	4	5	by sex [b]
Female samples [c]	0	5	42	2	0	62
Percent	0.0	4.1	36.4	1.7	0.0	44.3
SE percent	0.0	1.8	4.5	1.2	0.0	4.2
Estimated abundance	0	238	2,113	99	0	2,572
SE abundance	0.0	104.7	268.5	69.7	0.0	255.1
Length samples	0	5	41	2	0	61
Mean length	NA	652	780	866	0	777
SE mean length	NA	0.0	6.5	7.0	0.0	7.3
Male Samples [c]	5	21	37	4	0	78
Percent	4.4	17.7	32.1	3.5	0.0	55.7
SE percent	1.9	3.5	4.4	1.7	0.0	4.2
Estimated abundance	255	1,028	1,864	203	0	3,234
SE abundance	110.6	205.4	261.2	98.9	0.0	261.5
Length samples	5	20	36	4	0	76
Mean length	395	637	778	891	0	732
SE mean length	NA	13.4	7.8	NA	0.0	15.6
Female and male samples [c]	5	26	79	6	0	140
Percent	4.4	21.8	68.5	5.2	0.0	100
SE percent	1.9	3.7	4.3	2.1	0.0	0.0
Estimated abundance	255	1,266	3,977	302	0	5,806
SE abundance	110.6	218.0	275.3	122.2	0.0	137.0
Length samples	5	25	77	6	0	137
Mean length	395	640	779	884	0	752
SE mean length	NA	12.6	5.0	10.2	0.0	9.4

Note: "NA" = not applicable.

[a] Age and length-at-age compositions are based on weighted samples collected from nets on the South and North forks and the mainstem weir.

[b] Sex composition is based on weighted samples collected from nets on the South and North forks and the mainstem weir.

[c] Unweighted sample sizes by age class and sex of Chinook salmon collected from nets on the South and North forks and the mainstem weir.

Table 12.–The estimated age, sex, and length composition of the Anchor River coho salmon escapement, 2007.

	Composition by age class[a]		Composition by sex[b]
	1.1	2.1	
Female samples	10	61	103
Percent	6.1	37.2	44.8
SE percent	1.9	3.8	3.3
Estimated abundance	502	3,060	3,685
SE abundance	156	313	271
Length samples	10	32	103
Mean length	567	588	586
SE mean length	16.0	4.6	3.8
Male samples	15	78	127
Percent	9.1	47.6	55.2
SE percent	2.3	3.9	3.3
Estimated abundance	749	3,916	4,541
SE abundance	189	321	271
Length samples	15	34	127
Mean length	568	576	570
SE mean length	12.7	6.5	5.1
Female and male samples	25	140	230
Percent	15.2	84.2	100.0
SE percent	2.8	2.8	0.0
Estimated abundance	1,250	6,926	8,226
SE abundance	230	230	0
Length samples	25	66	230
mean length	568	576	577
SE mean length	9.7	4.3	3.4

Note: "NA" = not applicable.

[a] Age and length-at-age compositions are based on weighted samples collected from a weir on the Anchor River mainstem.

[b] Sex and age components do not necessarily sum to sex pooled over age or age pooled over sex due to missing sex for age data and missing age for sex data.

Table 13.–The estimated age, sex, and length composition of the Anchor River coho salmon escapement, 2008.

	Composition by age class[a]		Composition
	1.1	2.1	by sex[b]
Female samples	6	38	60
Percent	4.8	30.4	0
SE percent	1.9	4.1	0
Estimated abundance	286	1,809	2,089
SE abundance	113	244	220
Length samples	6	38	60
Mean length	578	608	599
SE mean length	9.9	5.1	4
Male samples	19	62	111
Percent	15.2	49.6	64.9
SE percent	3.2	4.5	3.7
Estimated abundance	905	2,952	3,862
SE abundance	190	268	220
Length samples	19	62	111
Mean length	589	591	595
SE mean length	11.7	7.3	5.2
Female and male samples	25	100	171
Percent	20.0	80.0	100.0
SE percent	3.6	3.6	0.0
Estimated abundance	1,190	4,761	5,951
SE abundance	214	214	0
Length samples	25	100	171
Mean length	586	597	597
SE mean length	9.2	5.0	3.7

Note: "NA" = not applicable.

[a] Age and length-at-age compositions are based on weighted samples collected from a weir on the Anchor River mainstem.

[b] Sex and age component do not necessarily sum to sex pooled over age or age pooled over sex due to missing sex for age data and missing age for sex data.

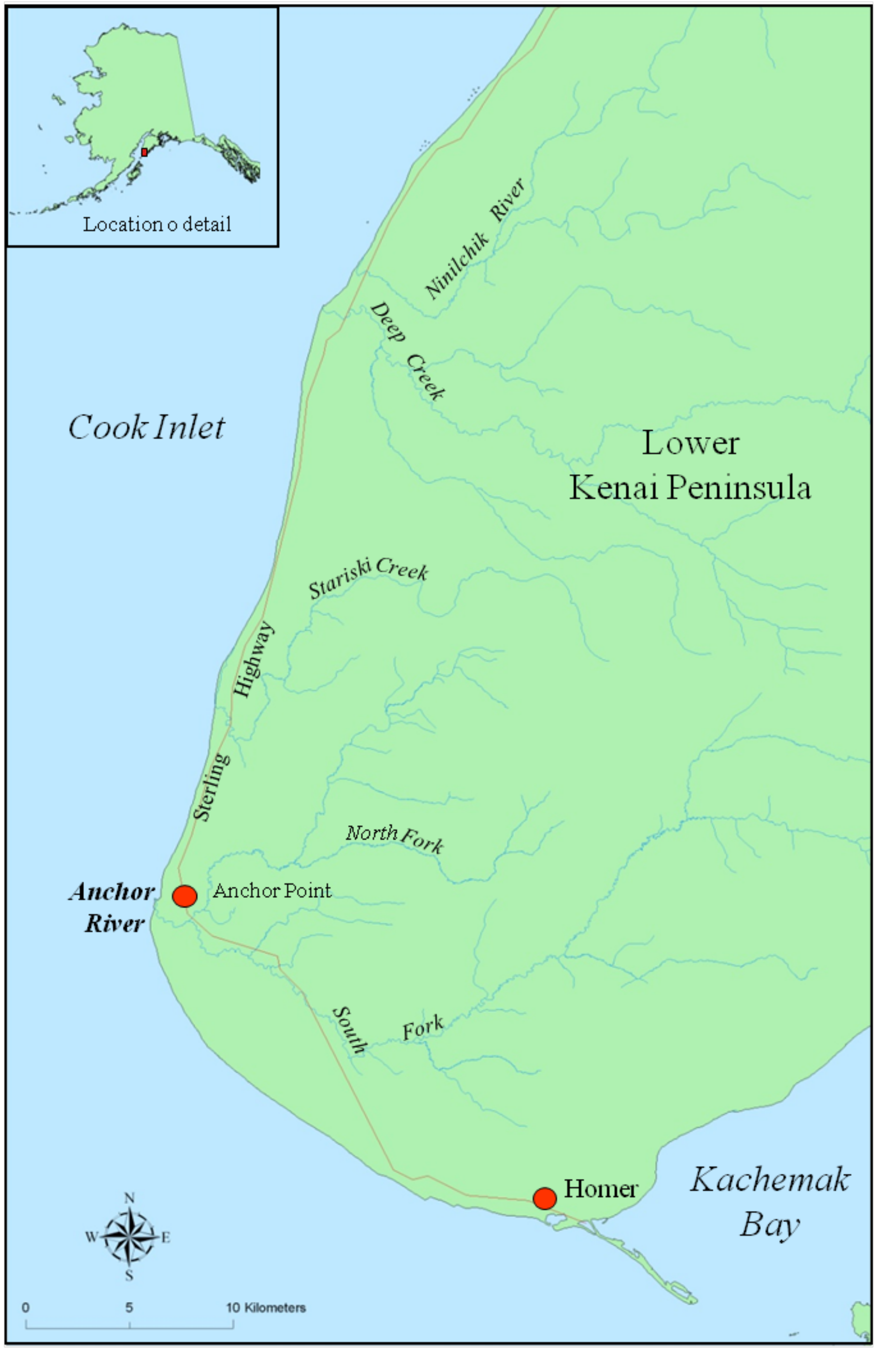

Figure 1.–Location of Anchor River and other roadside tributaries in the Lower Cook Inlet Management Area.

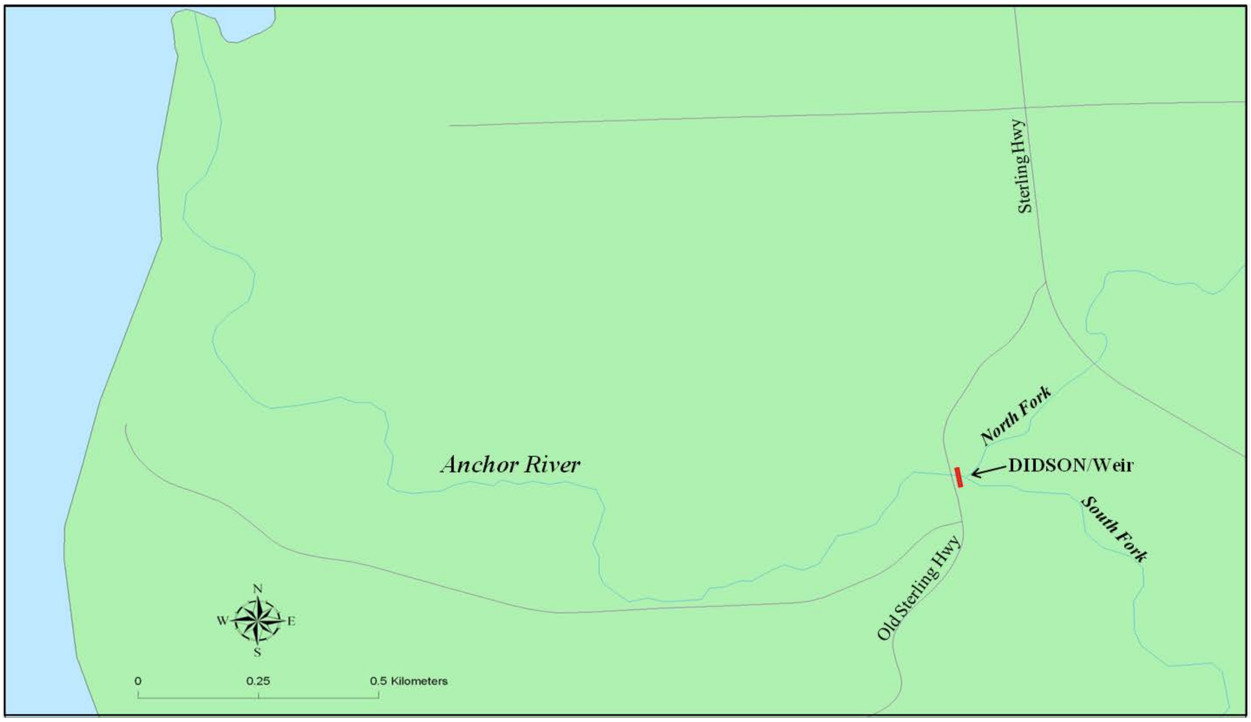

Figure 2.–Locations of the mainstem DIDSON-weir site on the Anchor River (lat 59.772233, long −151.835033).

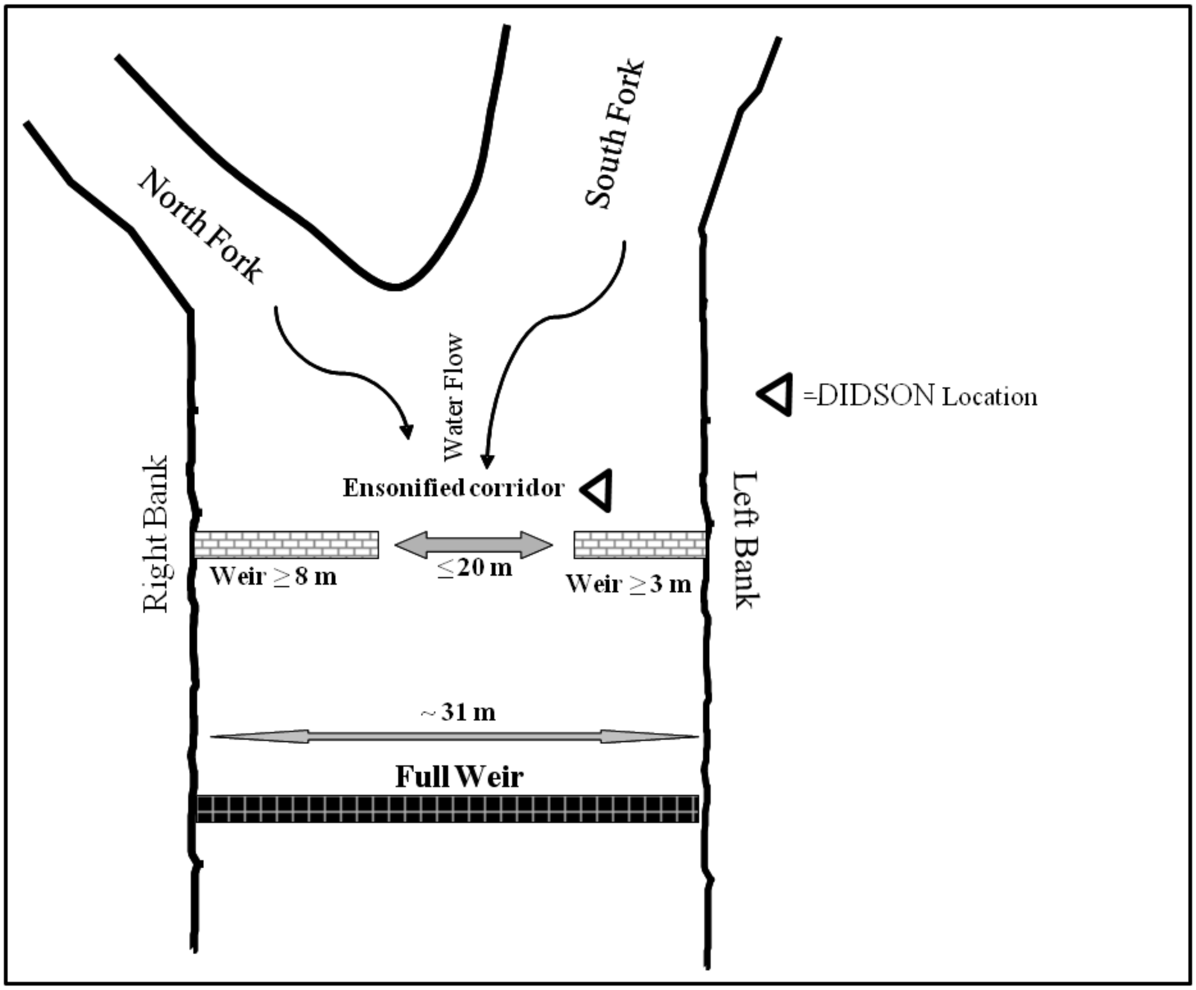

Figure 3.–Locations of DIDSON, partial picket weirs, and full weir on the mainstem of the Anchor River, 2007–2008.

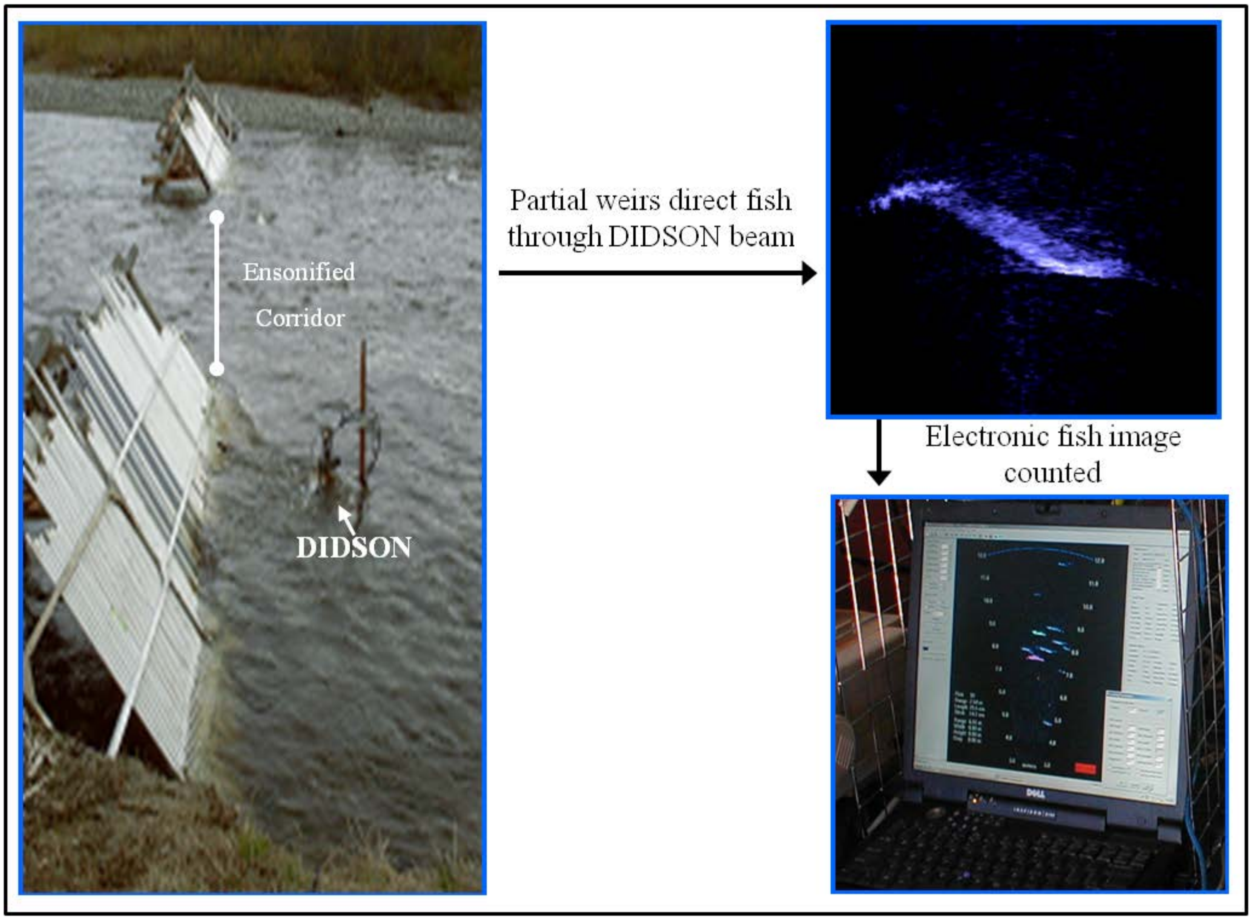

Figure 4.–DIDSON is used with partial weirs to funnel fish through the DIDSON beam.

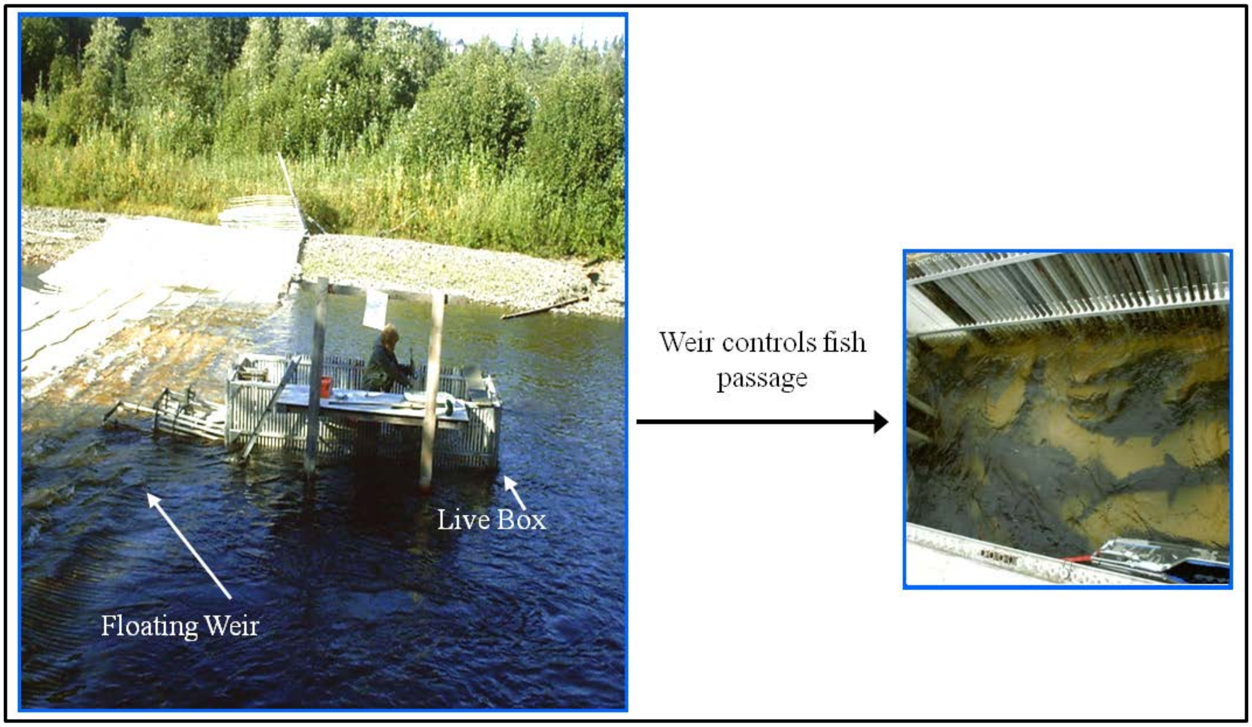

Figure 5.–Resistance board weir with midchannel live box on the Anchor River.

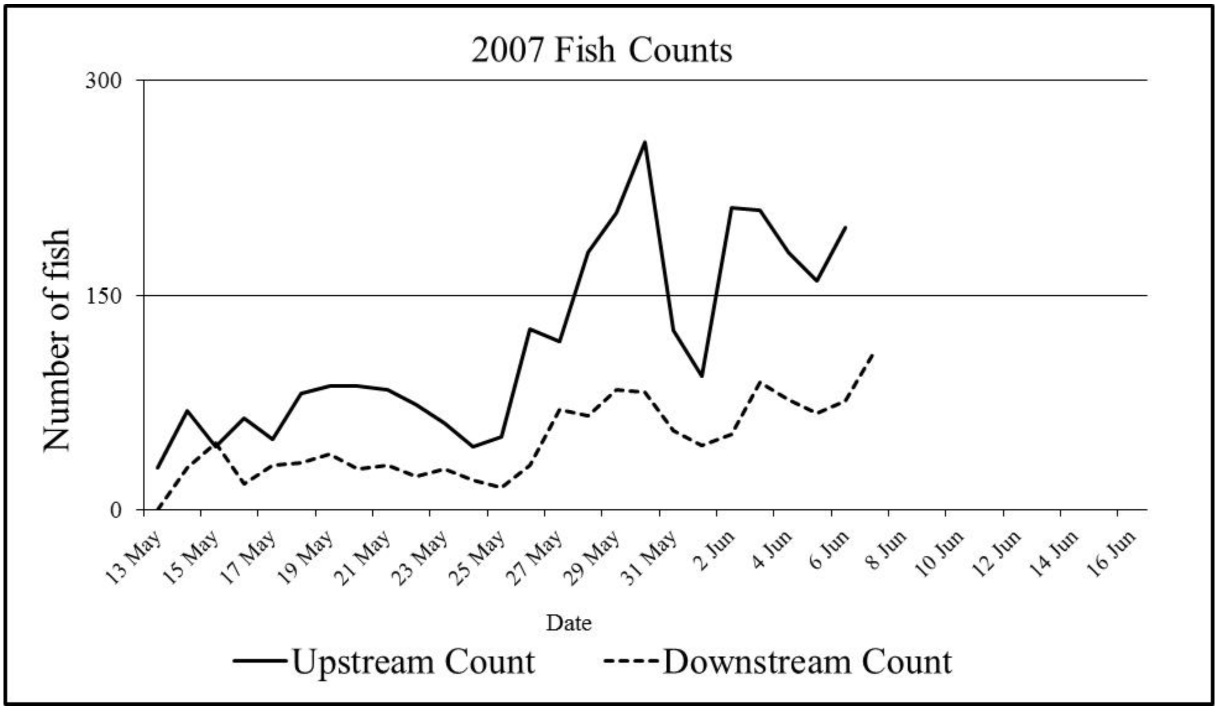

Figure 6.–Daily upstream and downstream fish counts based on DIDSON files, Anchor River, 2007.

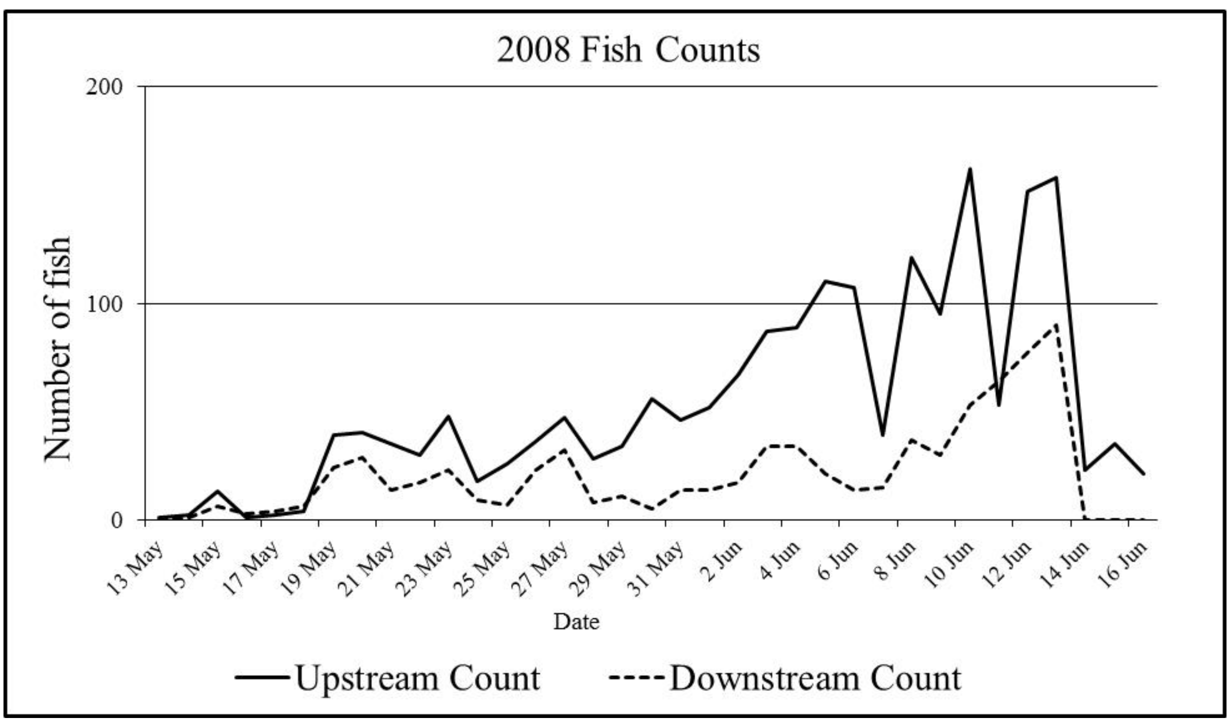

Figure 7.–Daily upstream and downstream fish counts based on DIDSON files, Anchor River, 2008.

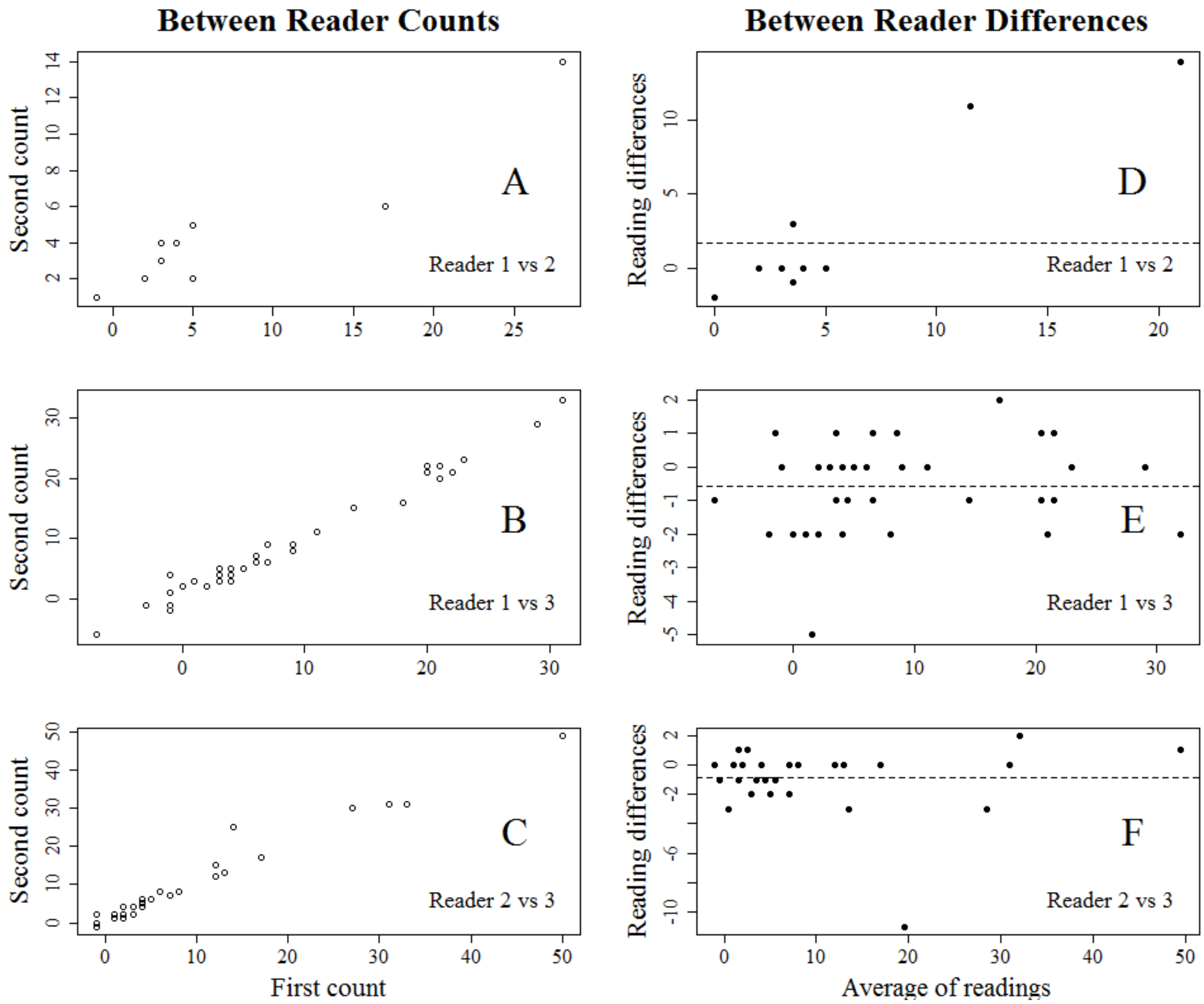

Figure 8.–Between-reader counts (A–C) and Tukey difference plots (D–F) for 3 combinations of 3 readers of selected DIDSON files, Anchor River, 2007.

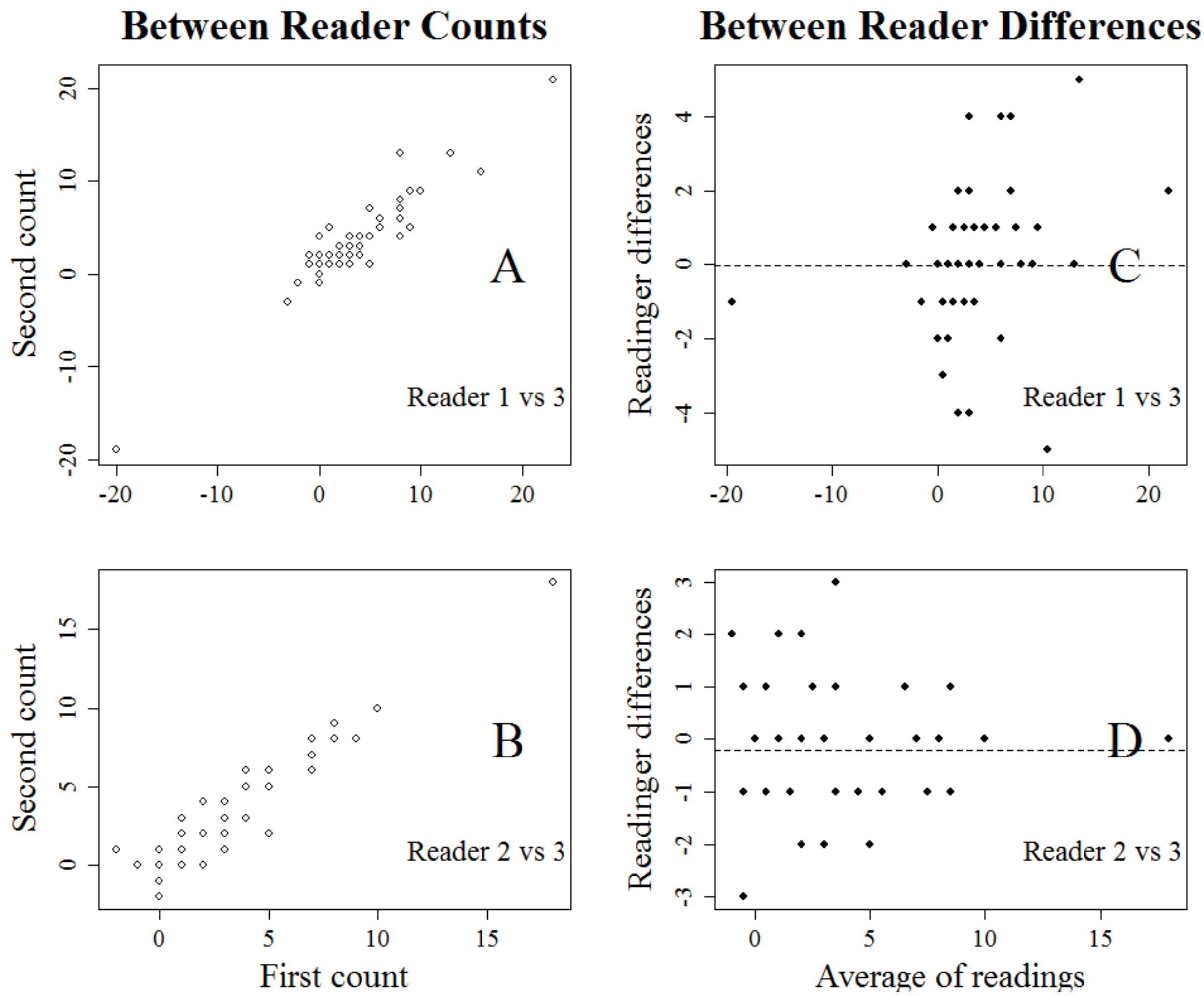

Figure 9.–Between-reader counts (A–B) and Tukey difference plots (C–D) for 2 combinations of 3 readers of selected DIDSON files, Anchor River, 2008.

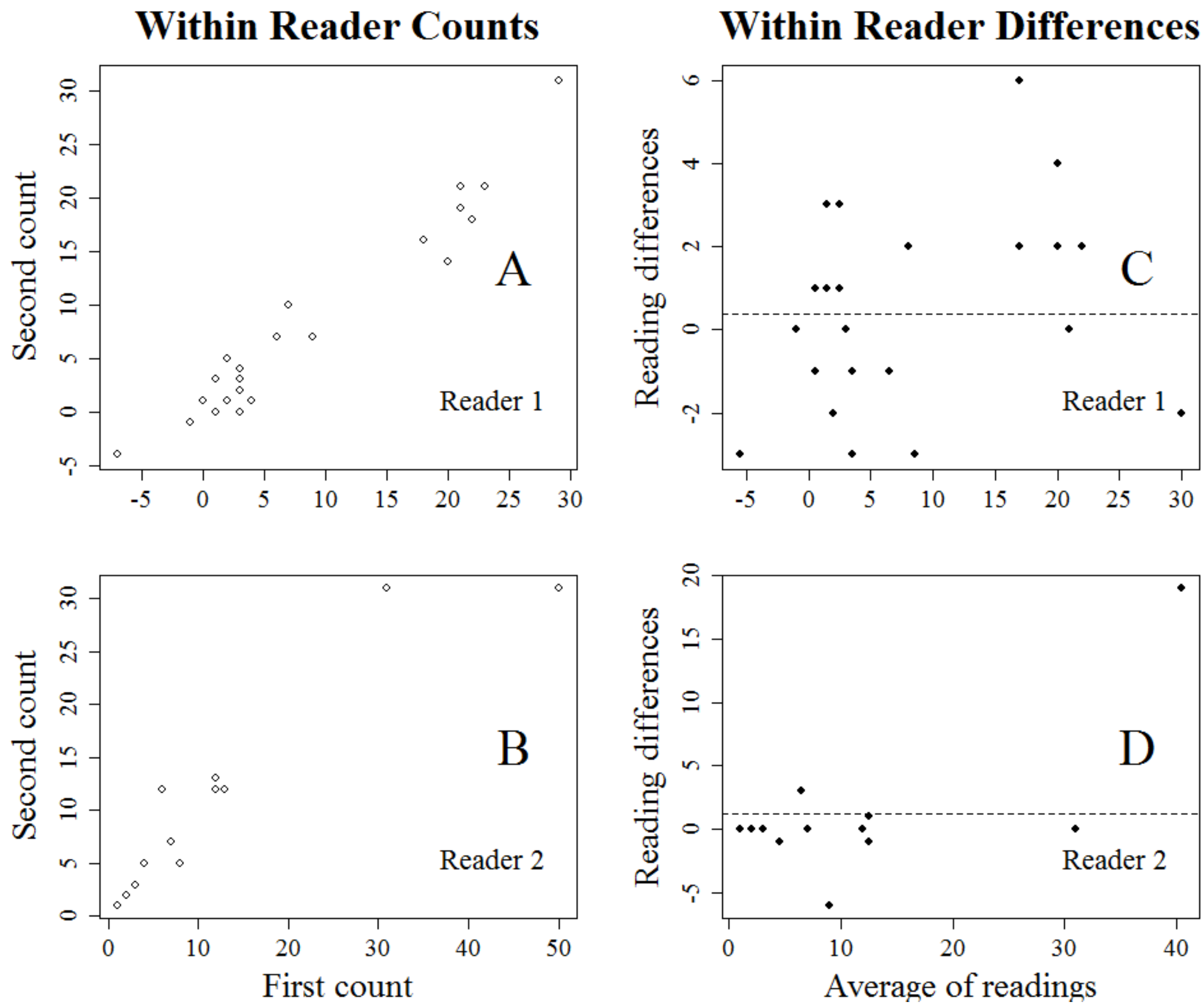

Figure 10.–Within-reader counts (A–B) and Tukey difference plots (C–D) for readers 1 and 2 of selected DIDSON files, Anchor River, 2007.

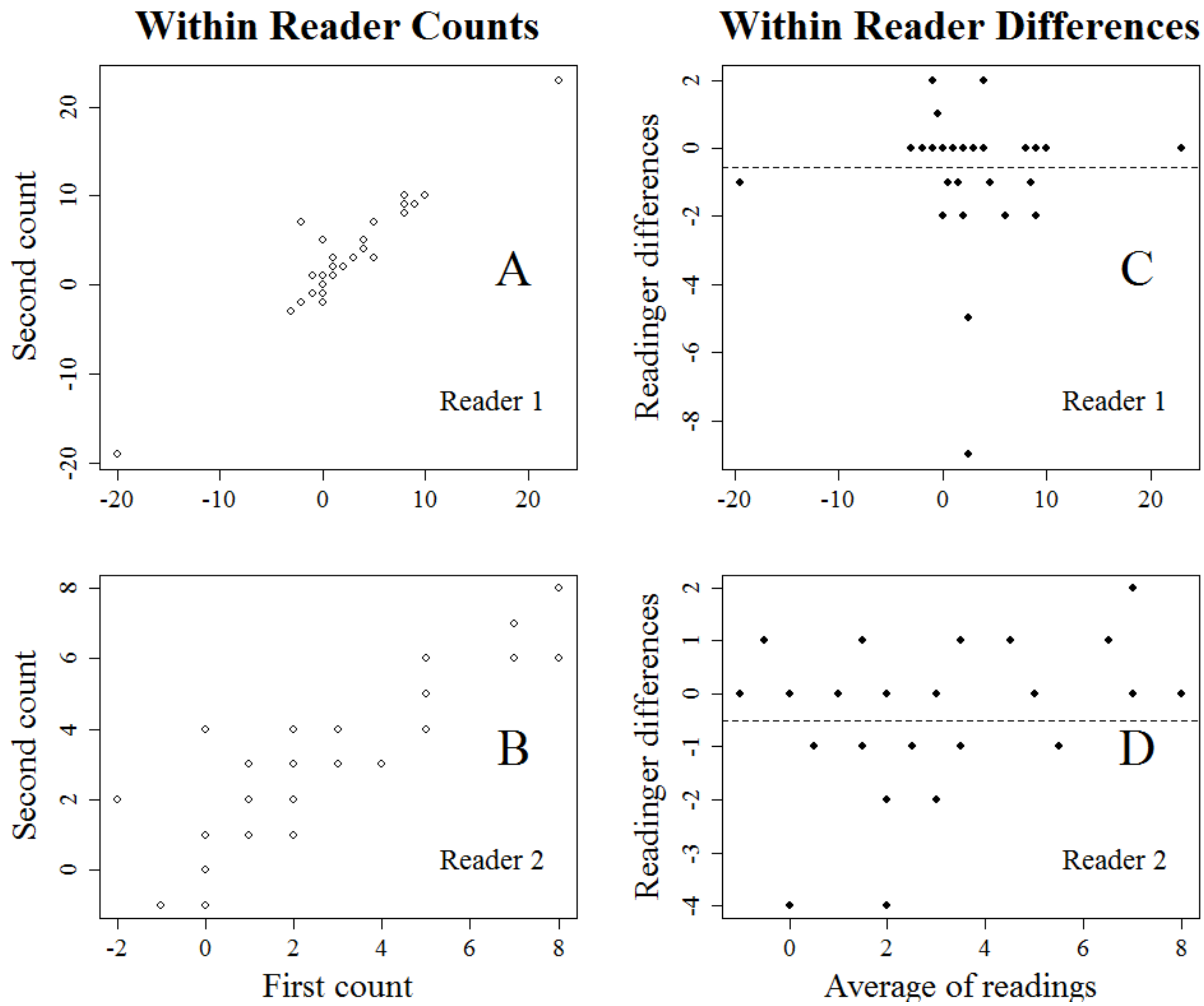

Figure 11.–Within-reader counts (A–B) and Tukey difference plots (C–D) for readers 1 and 2 of selected DIDSON files, Anchor River 2008.

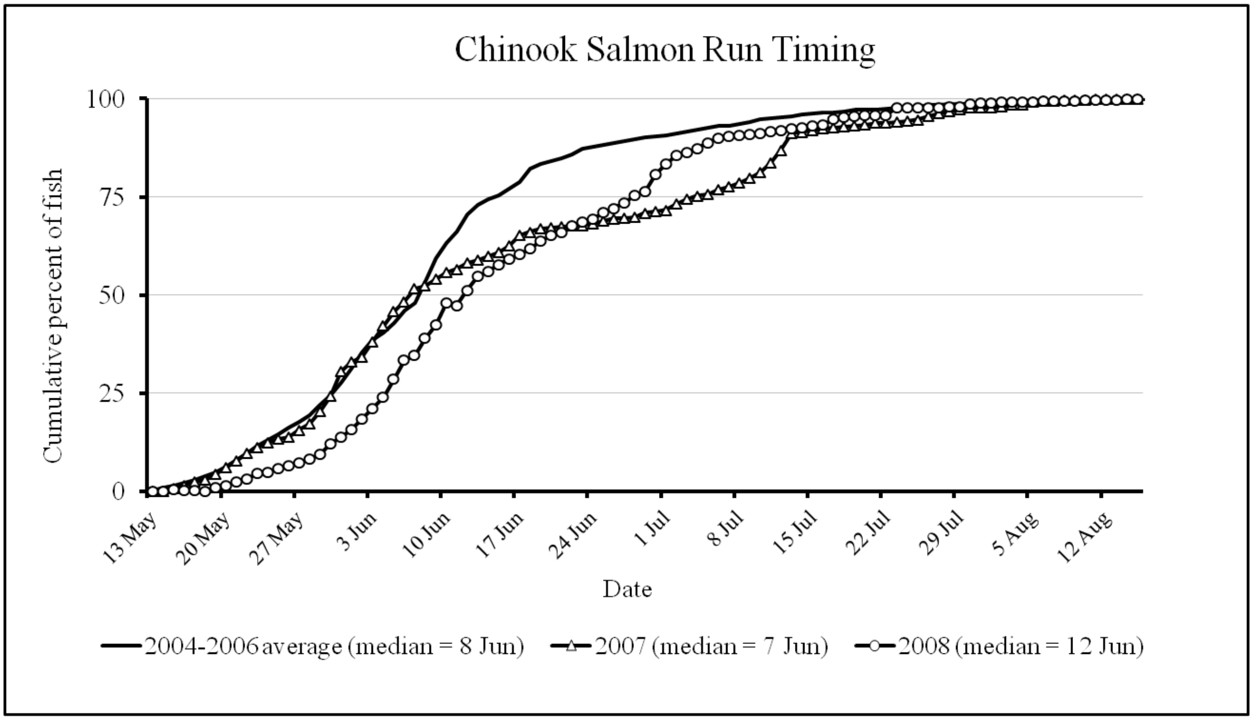

Figure 12.–Chinook salmon run timing of the 2007 and 2008 immigrations compared to the average (2004–2006) at the Anchor River sonar-weir site.

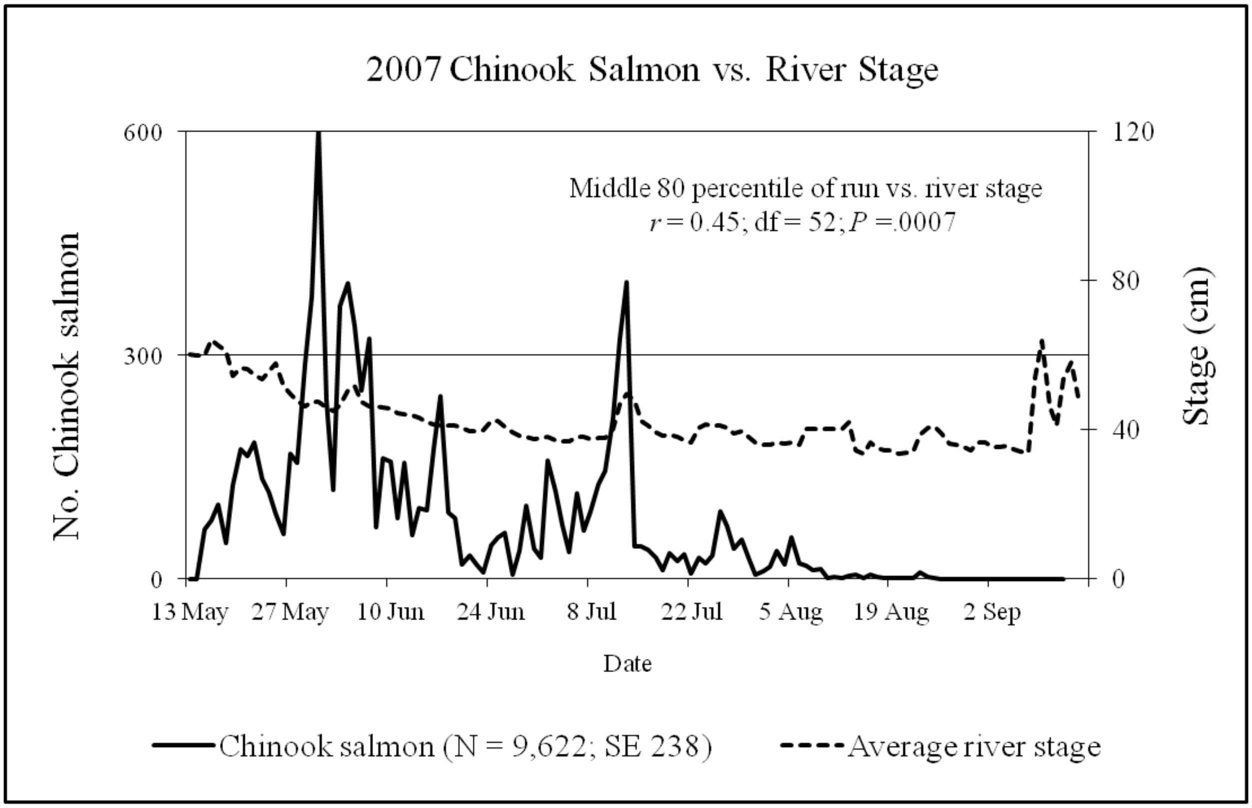

Figure 13.–Daily counts of Chinook salmon at the sonar-weir site plotted against daily river stage averages, Anchor River, 2007.

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

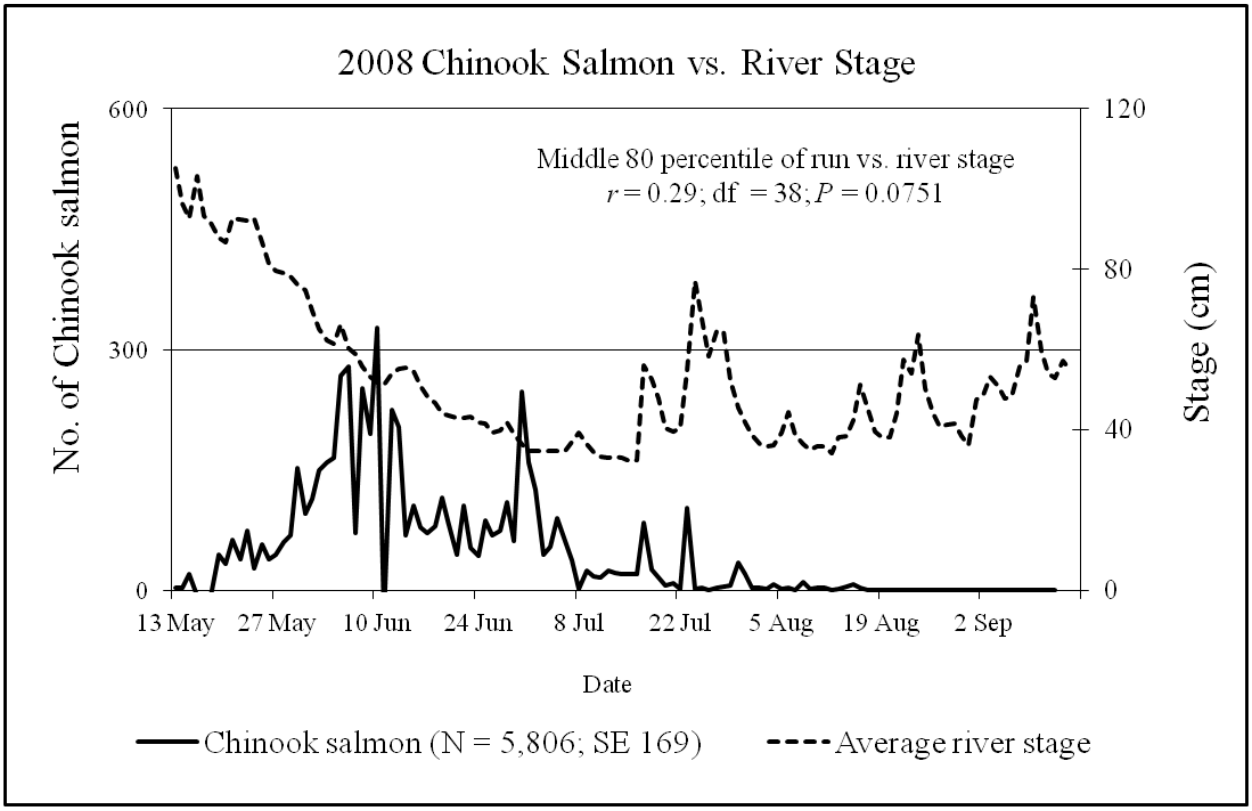

Figure 14.–Daily counts of Chinook salmon at the sonar-weir site plotted against daily river stage averages, Anchor River 2008.

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

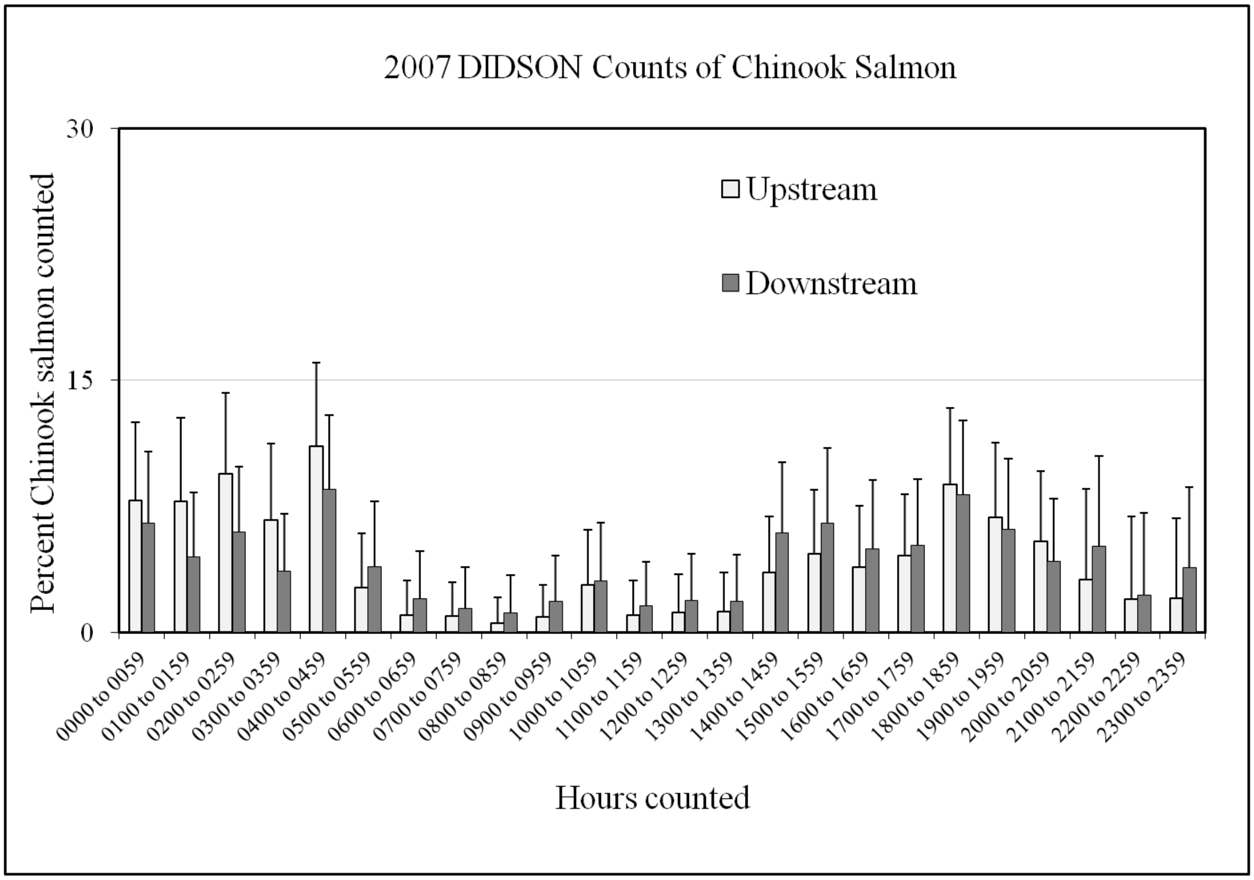

Figure 15.–Number of Chinook salmon estimated from 14 May to 7 June based on full 20-minute DIDSON counts expressed as the percentage of fish counted each hour and the standard error, 2007.

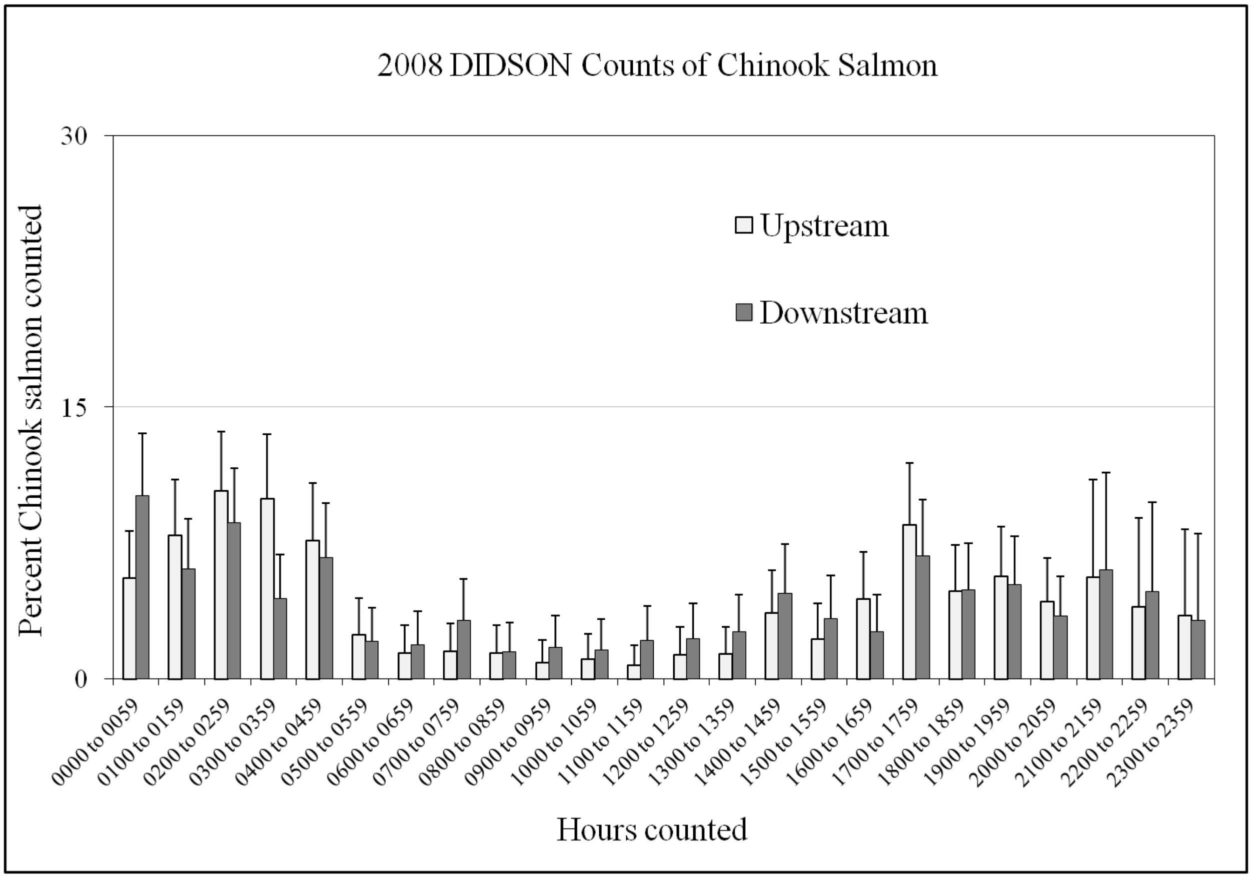

Figure 16.–Number of Chinook salmon estimated from 13 May to 16 June based on full 20-minute DIDSON counts expressed as the percentage of fish counted each hour and the standard error, 2008.

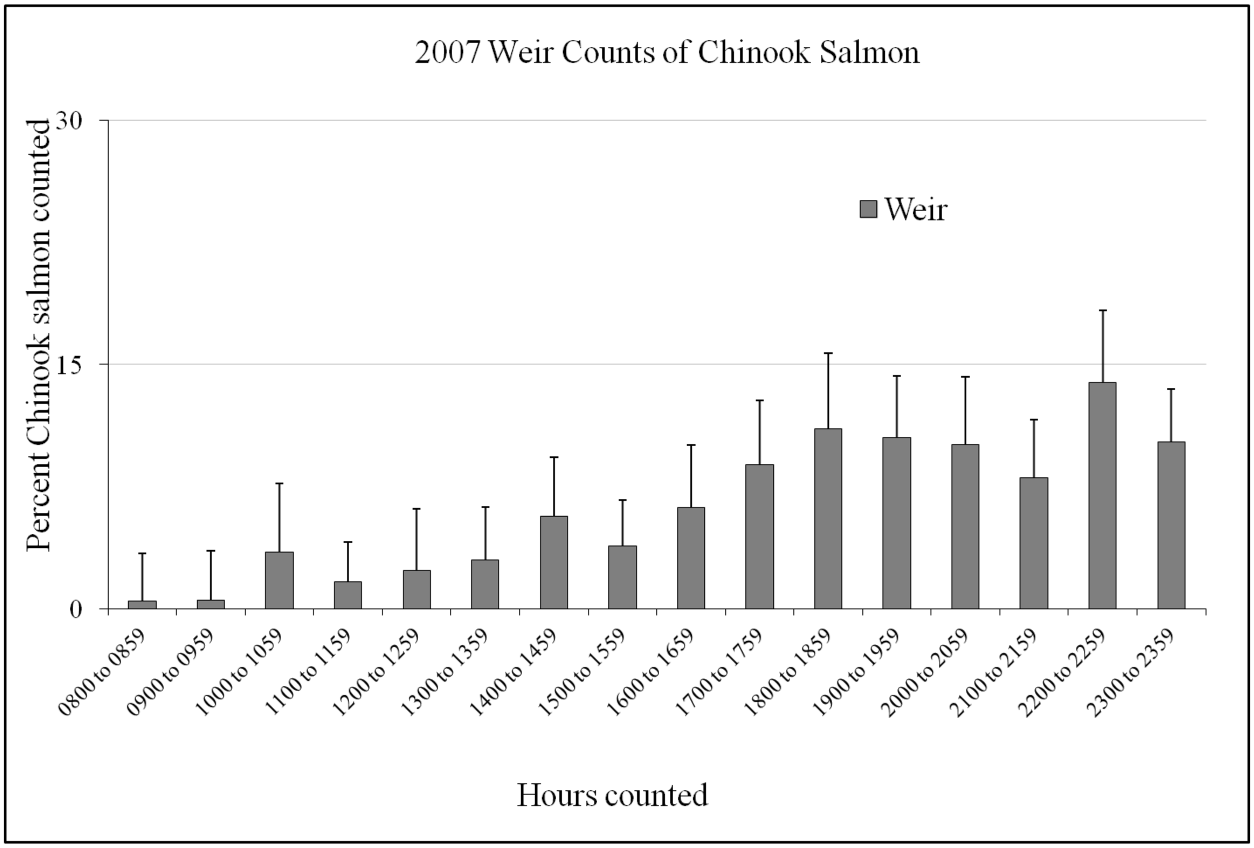

Figure 17.–Number of Chinook salmon counted through the weir from 7 June to 12 September between 0800 hours and midnight expressed as the percentage of fish counted each hour and the standard error, 2007.

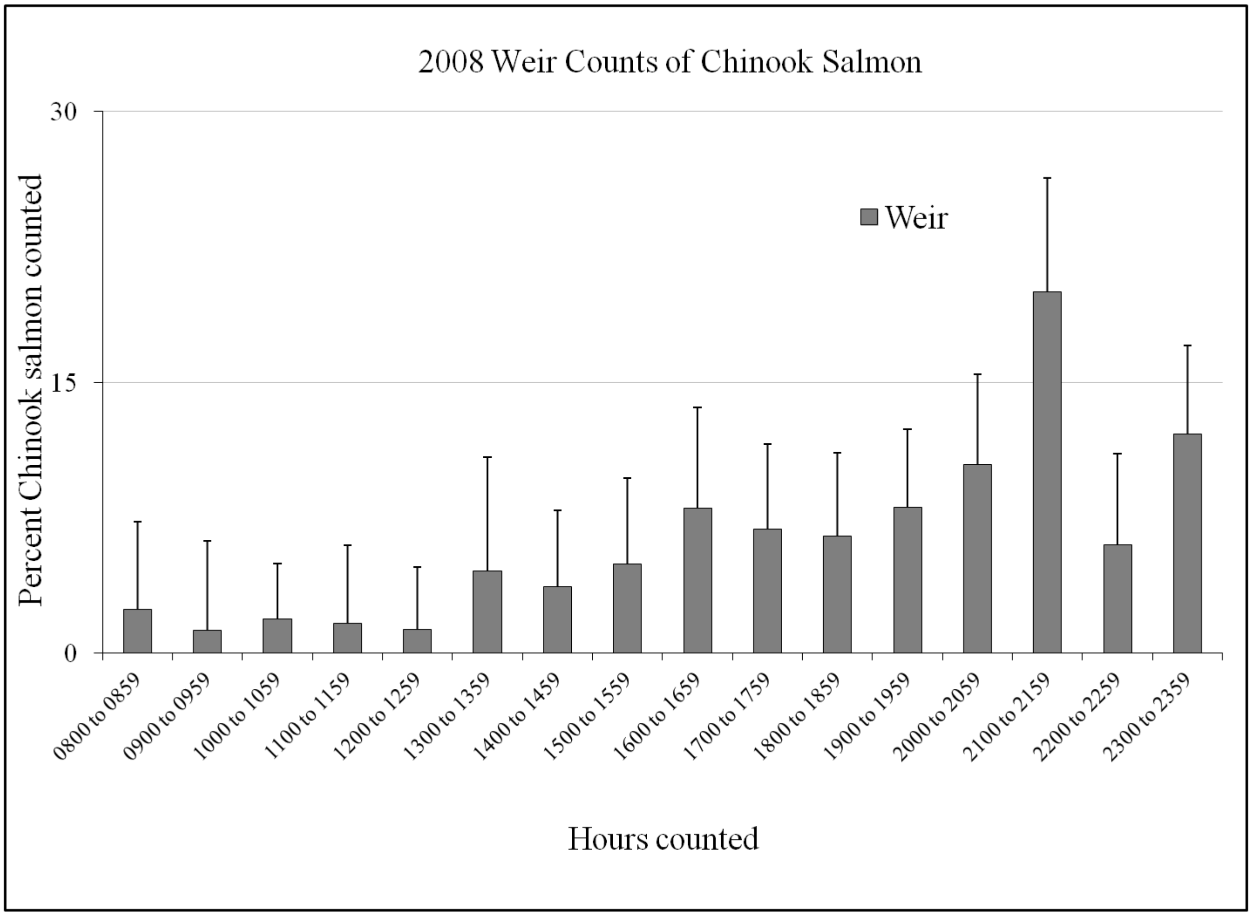

Figure 18.–Number of Chinook salmon counted through the weir from 16 June to 11 September between 0800 hours and midnight expressed as the percentage of fish counted each hour and the standard error, 2008.

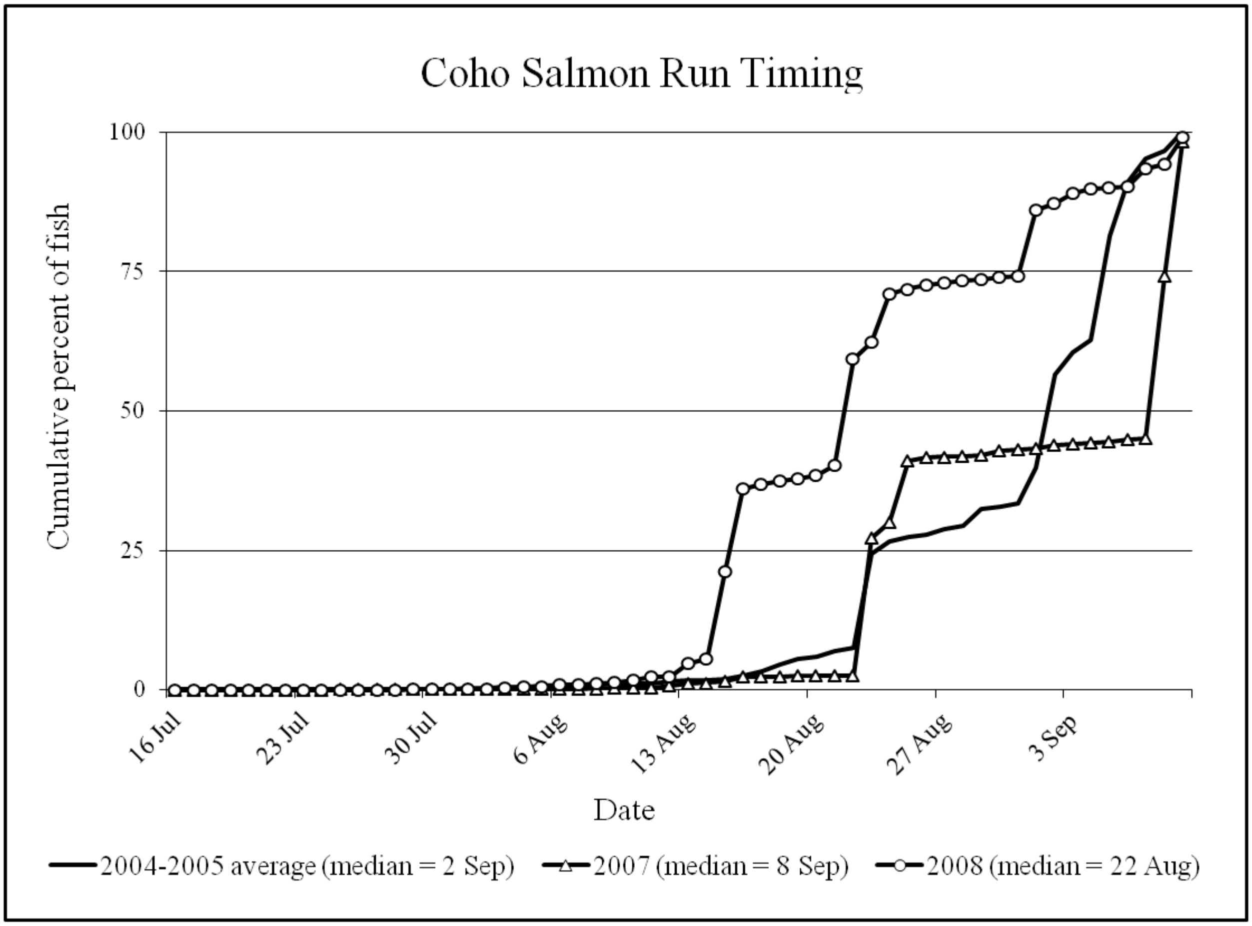

Figure 19.–Run timing of coho salmon in 2007 and 2008 compared to the 2004–2005 average run, Anchor River.

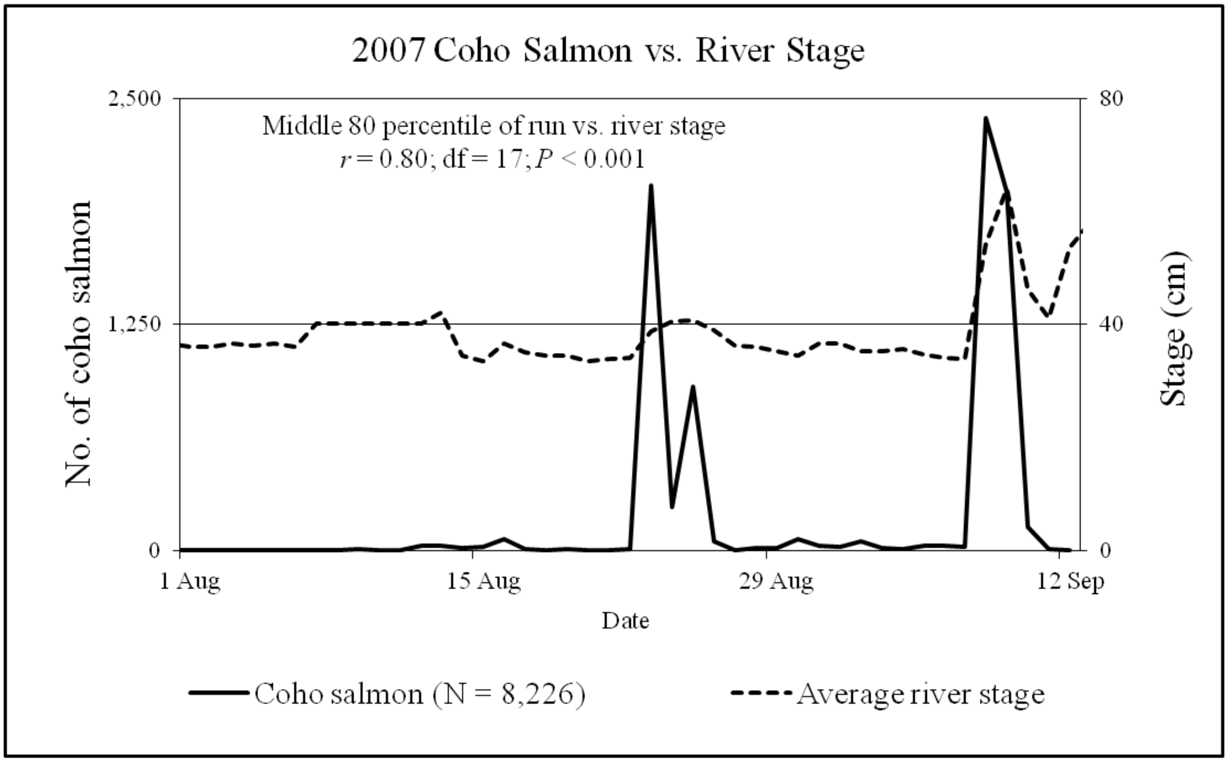

Figure 20.–Daily counts of coho salmon at the sonar-weir site plotted against daily river stage averages, Anchor River, 2007.

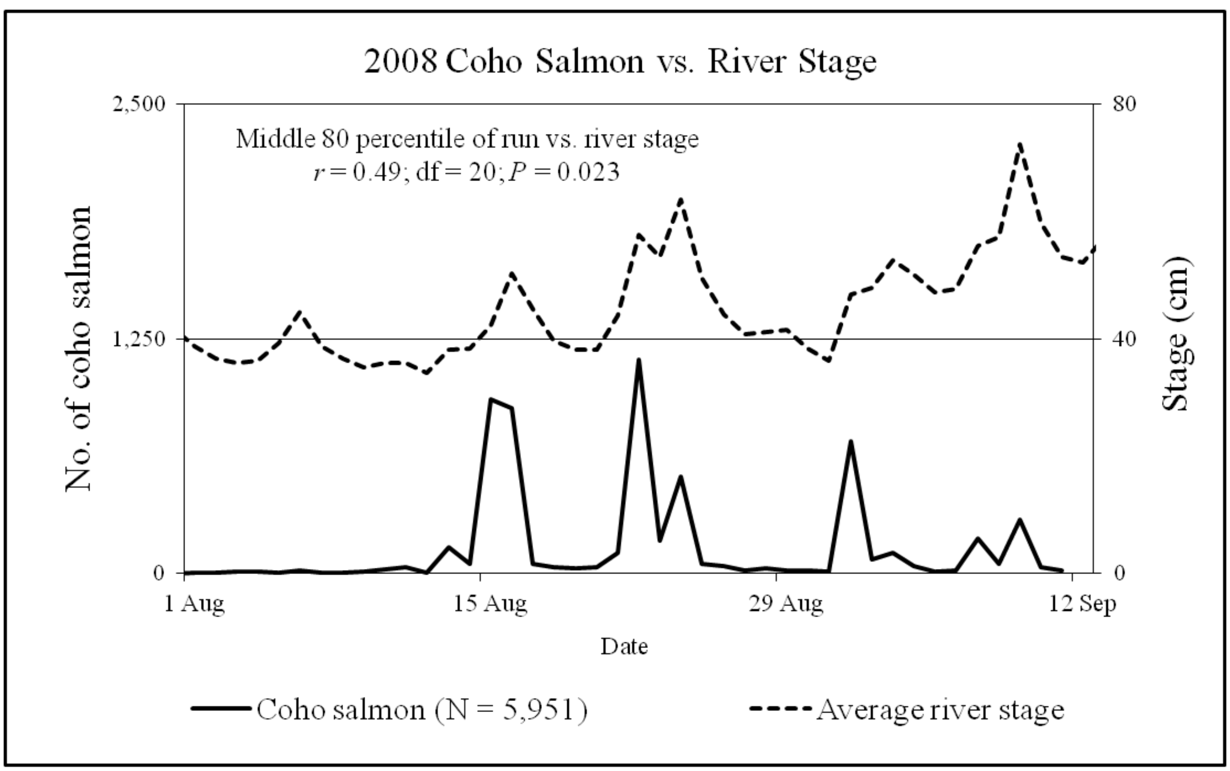

Figure 21.–Daily counts of coho salmon at the sonar-weir site plotted against daily river stage averages, Anchor River 2008.

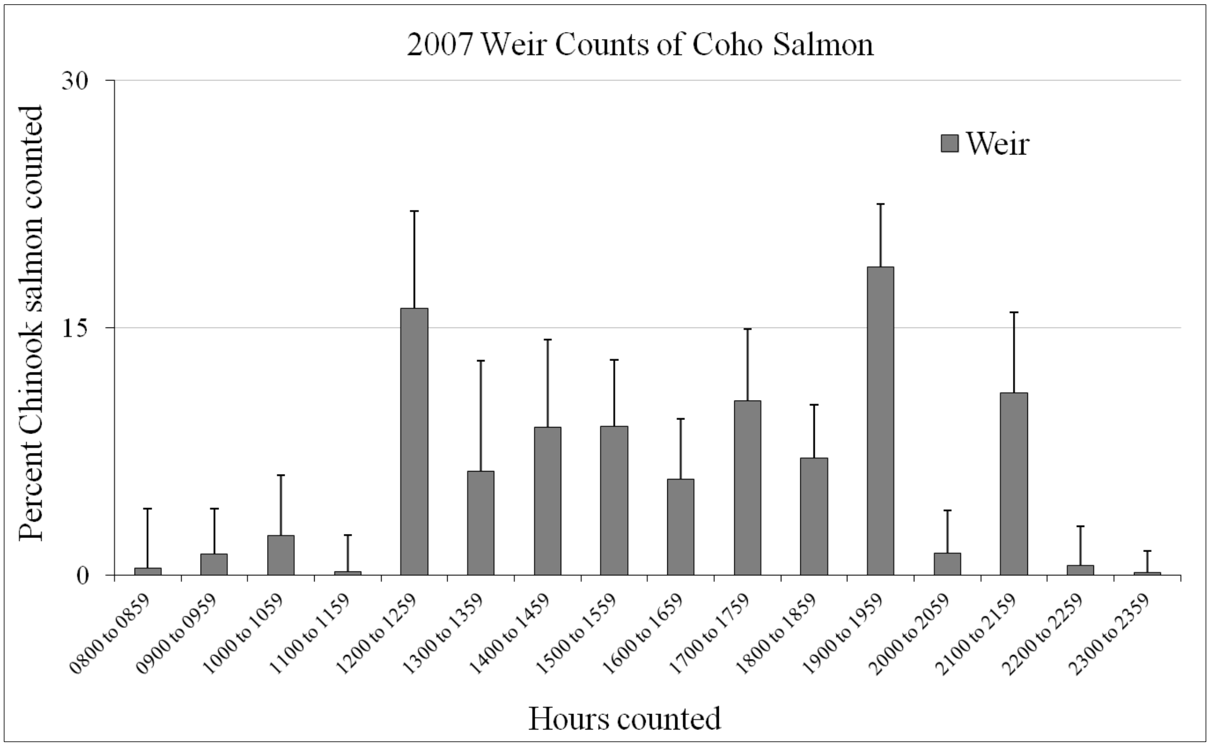

Figure 22.–Number of coho salmon counted through the weir from 7 June to 12 September between 0800 hours and midnight expressed as the percentage of fish counted each hour and the standard error, 2007.

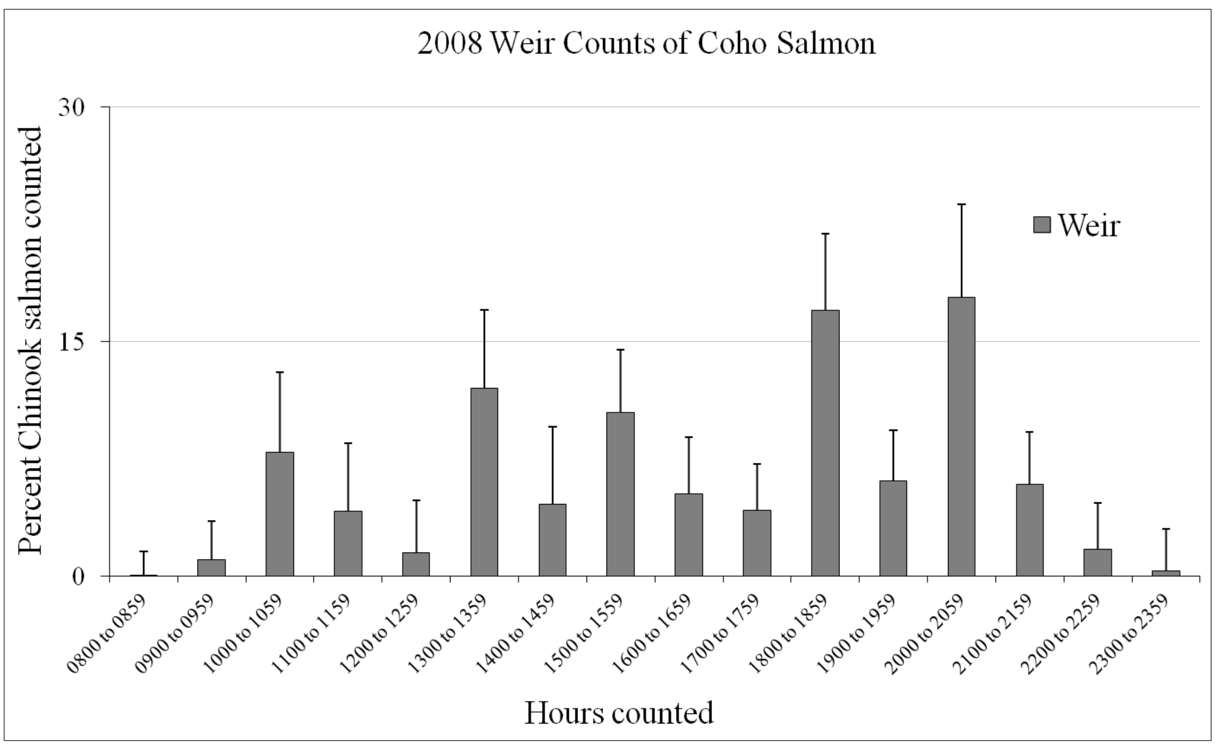

Figure 23.–Number of coho salmon counted through the weir from 16 June to 11 September between 0800 hours and midnight expressed as the percentage of fish counted each hour and the standard error, 2008.

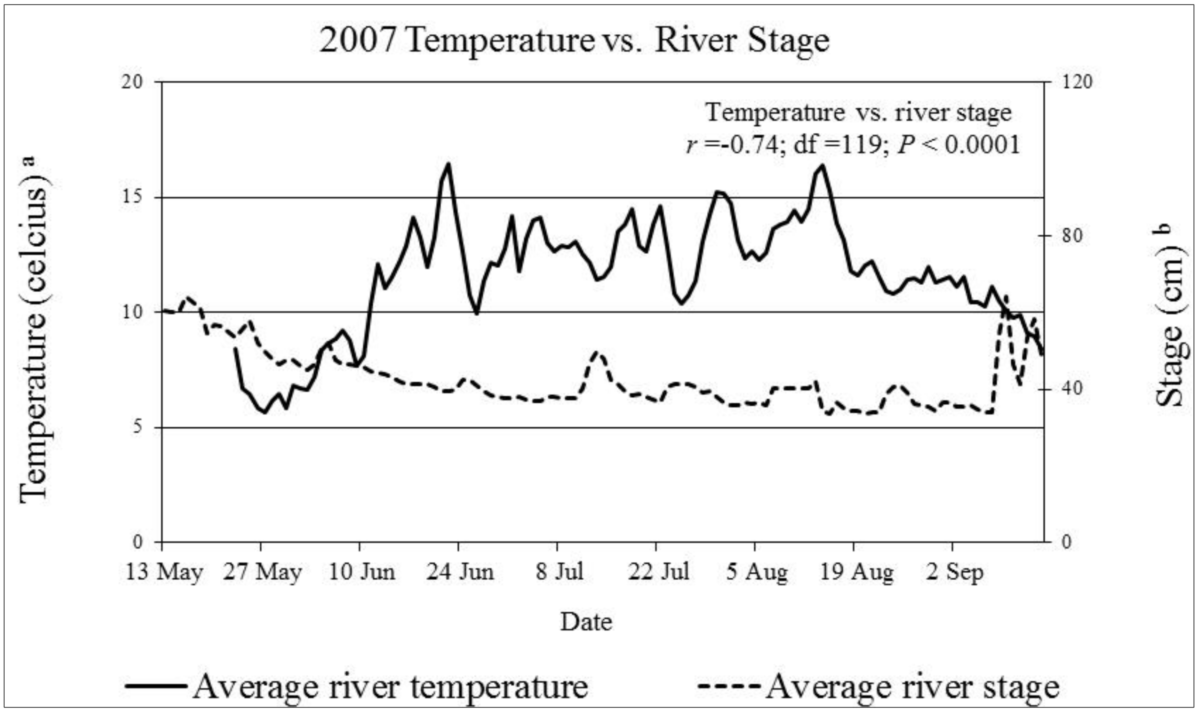

Figure 24.–The average daily river temperature (˚C) and stage, Anchor River, 2007.

[a] Temperature data were collected at approximately 2.7 RKM on the Anchor River mainstem.

[b] Stage data were collected at gauge station USGS 15239900 located at approximately 11.4 RKM on the South Fork, Anchor River.

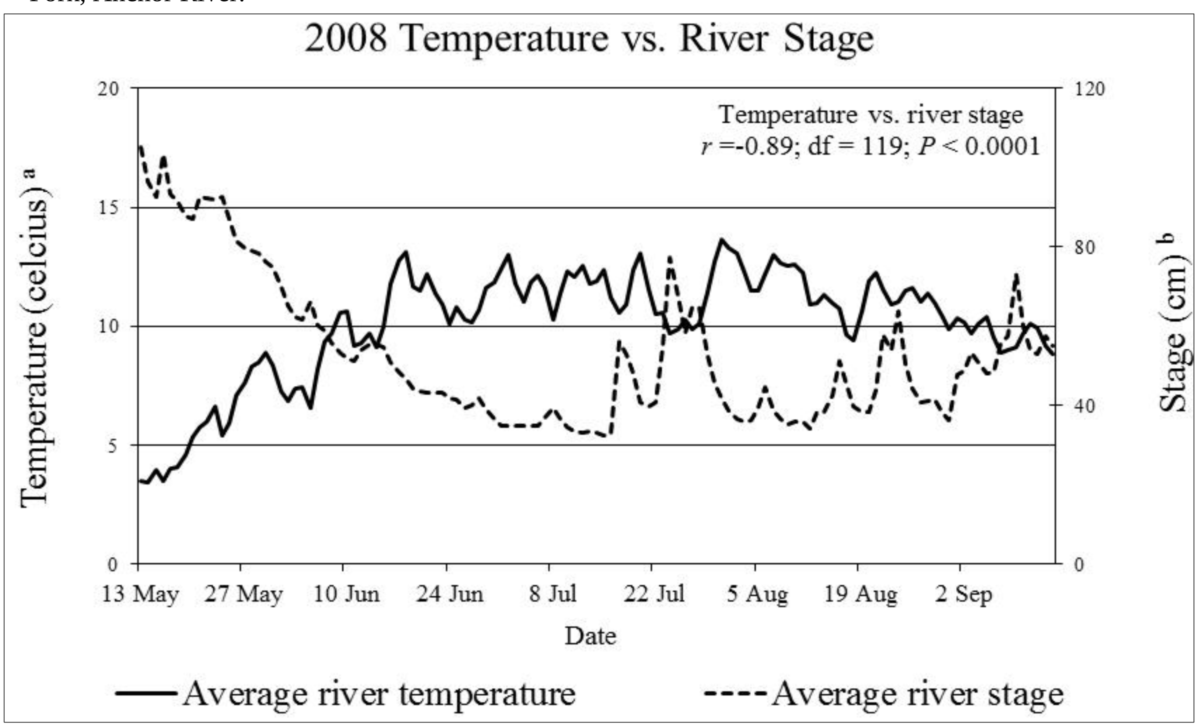

Figure 25.–The average daily river temperature (˚C) and stage, Anchor River, 2008.

[a] Temperature data were collected at approximately 2.7 RKM on the Anchor River mainstem.

[b] Stage data were collected at gauge station USGS 15239900 located at approximately 11.4 RKM on the South Fork, Anchor River.

APPENDIX A: MONITORING TIMELINES FOR ANCHOR RIVER CHINOOK SALMON.

Appendix A1.–Timeline of escapement monitoring for Chinook salmon on the Anchor River, 1950–2008.

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.
Year(s)	Escapement monitoring
2003	In addition to the aerial survey, the feasibility of using DIDSON[5] 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 2.8 RKM. 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 levels, and resistance board weir, during periods of low water levels. 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 area 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 levels, and resistance board weir during periods of low water levels. Aerial surveys were continued through 2008 to compare index to total run estimates. In 2009, 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).

[5] Dual frequency IDentification SONar (DIDSON)

Appendix A2.–Timeline of sport harvest monitoring and escapement goals for Chinook salmon on the Anchor River, 1950–2008.

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/or 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 to 2,200 Chinook salmon and was based on historic aerial survey counts and their relationship to the 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 2004b, 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 2004b, 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 2004b, 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. 2007a).
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 DIDSON/weir project from 2003 to 2007 (Szarzi et al. 2007b)

Appendix A3.–Timeline of the freshwater fishing regulations and emergency orders for Chinook salmon on the Anchor River, 1960–2008.

Year(s)	**Chinook salmon fishing regulations**
	Closed areas for Chinook salmon
1960–2008	Salmon fishing closed upstream of the junction of North and South forks.
1996–2008	The area above forks was closed to all fishing until 1 August to protect spawning salmon.
	Recording requirements
1966–1980	A Chinook salmon punch card was required by all anglers, including those under 16 years of age.
1981–2008	Anglers recorded Chinook salmon harvest on the back of a sport fishing license or harvest card.
	Open season for Chinook salmon
1960	7 May–31 December.
1961	7 May–1 July only.
1962–1963	7 May–8 July only.
1964–1965	Closed
1966	28 May–26 June and limited to weekends and holidays or until 500 Chinook salmon 20 in or longer were attained among the Anchor River, Deep Creek, Ninilchik, and Kenai rivers.
1967	27 May–11 June opened continuously or until 500 Chinook salmon 20 in or longer were attained among the Anchor River, Deep Creek, Ninilchik and Kenai rivers.
1968	25 May–9 June opened continuously or until 500 Chinook salmon 20 in or longer were attained among the Anchor River, Deep Creek, Ninilchik and Kenai rivers.
1969	24 May–8 June opened continuously or until 200 Chinook salmon 20 in or longer were attained among the Anchor River, Deep Creek, Ninilchik and Kenai rivers.
1970	30 May–14 June opened continuously or until 200 Chinook salmon 20 in or longer were attained among the Anchor River, Deep Creek, Ninilchik and Kenai rivers.
1971	Beginning on Memorial Day weekend for 2 consecutive 2-day weekends (Saturday and Sunday). Quota eliminated.
1972	Beginning on Memorial Day weekend for 2 consecutive 2-day weekends.
1973–1975	Beginning on Memorial Day weekend for 3 consecutive 2-day weekends.
1976–1977	Beginning on Memorial Day weekend for 4 consecutive 2-day weekends.

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Appendix A3.–Part 2 of 3.

1978–1988	Beginning on Memorial Day weekend for 4 consecutive 3-day weekends (weekends include Monday).
1989–2001	Beginning on Memorial Day weekend for 5 consecutive 3-day weekends (weekends include Monday).
2002–2003	Beginning on the Memorial Day weekend for 4 consecutive 3-day weekends (weekends include Monday) (Szarzi and Begich 2004b).
2004–2007	In 2004, the fishery was open for a fifth 3-day weekend by emergency order (EO) based on weir count. The fishery was open by regulation for five 3-day consecutive weekends beginning on the weekend prior to Memorial Day weekend 2005–2007 (Szarzi et al. 2007a-b).
2008	The fishery was open the 3-day weekend before Memorial Day weekend, 4 consecutive 3-day weekends following, and also the Wednesdays following each weekend opening.
Bag, possession, and season limits	
1960	Bag and possession limit: 3 salmon over a length of 16 in, of which not more than 2 could be Chinook salmon 20 in or more in length.
1961–1962	Bag and possession limit: 3 salmon over a length of 20 in, of which not more than 1 could be Chinook salmon 20 in or more in length.
1963	Bag and possession limit: salmon 16 in 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 in or more in length. Bag and possession limit: 10 Chinook salmon less than 20 in long. Season limit: 2 Chinook salmon 20 in or more in length.
1979–1985	Bag and possession limit: 1 Chinook salmon 20 in or more in length. Bag and possession limit: 10 Chinook salmon less than 20 in long. Season limit: 5 Chinook salmon 20 in or more in length.
1986–1995	Bag limit: 1 Chinook salmon 16 in or more in length. Bag and possession limit: 10 Chinook salmon less than 16 in long. Season limit: 5 Chinook salmon 16 in or more in length.
1996–1998	Bag limit: 1 Chinook salmon 16 in or more in length. Bag and possession limit: 10 Chinook salmon less than 16 in long. Season limit: 2 Chinook salmon 16 in or more in length from Deep Creek or the Anchor River combined. After harvesting a Chinook salmon 16 in 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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Appendix A3. Part 3 of 3.

1999–2007	Bag limit: 1 Chinook salmon 20 in or more in length. Bag and possession limit: 10 Chinook salmon less than 20 in long. Season limit: 2 Chinook salmon 20 in or more in length from Deep Creek or the Anchor River combined. After harvesting a Chinook salmon 20 in 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	Bag limit: 1 Chinook salmon 20 in or more in length. Bag and possession limit: 10 Chinook salmon less than 20 in length. Season limit: 5 Chinook salmon 20 in or more in length.

Emergency orders (EOs)

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 (Nelson *unpublished*)[6].
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.

[6] 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: DIDSON SPECIFICATIONS AND SETTINGS

Appendix B1.–DIDSON specifications for 2007–2008.

DIDSON operates at 2 discrete frequencies: a higher frequency that produces higher resolution images, and a lower frequency that can detect targets at farther ranges but at a reduced image resolution. The standard model DIDSON used on the Anchor River operates at 1.8 MHz for close range observations (less than 15 m) and 1.0 MHz for observations from 15 m up to 30 m. Overall beam dimensions are 29° in the horizontal axis and 12° in the vertical axis. At high frequency (1.8 MHz), image resolution is enhanced because the image is formed using 96 beams, each 0.3° wide, compared to low frequency (1.0 MHz) that forms the image using only 48 beams that are 0.6° wide. Image resolution is also influenced by the data collection "window length" i.e. range interval sampled, which is implemented in discrete lengths of 2.5, 5.0, 10.0, 20.0, and 40.0 m. Because the DIDSON image is composed of 512 samples (pixels) in range, images with shorter window lengths are better resolved (down-range resolution = window length/512). Consequently, images collected at smaller window lengths (2.5, 5.0, and 10.0 m) and high frequency (1.8 MHz) are preferable to their counterparts (20m and 40m, 1.0 MHz).

Appendix B2.–DIDSON settings used to collect escapement data for 2007–2008.

In 2007, the DIDSON system was operated in high frequency mode for the entire period of operation. The DIDSON software (version V5.13.02; provided by the manufacture, Sound Metrics Corporation) was programmed to collect data in three 20-minute files for each hour. A total of 577 hours of DIDSON recordings were collected. Fish counts were generally based on the first 20-minute file. If the first 20-minute count was missing, the second or third 20-minute file was used.

In 2008, data were collected using DIDSON software (version V5.18.05, provided by the manufacturer, Sound Metrics Corporation). During high water-level conditions from 13 May through 27 May, the corridor was about 17 m wide and the DIDSON system was operated in low frequency mode to accommodate the longer sampling range. During this period, image quality was generally poor due to increased current noise and by noise generated by the weir pickets on the opposite bank, which appeared as bright flashing streaks across the DIDSON image. To improve image quality during high flow conditions, the DIDSON software was programmed to collect data at two10-m range strata in addition to a single 20-m range stratum as follows:

1. Lower quality images were collected during the first 20-minute time period of each hour from 0 m to 20 m (full range; 0 m represents the sonar lens surface). Images recorded with a 20 m window length have half the resolution of those collected with a 10 m window length. Data were collected using the following software parameters: total frames = 8,372; receiver gain = 40; window start = 0.83 m; window length = 20 m; and focus = auto.
2. Higher quality images were collected during the second 20-minute time period at high frequency from 0 m to 10 m (near range). Images recorded for the near range appear better resolved due to the shorter window length. Data were collected using the following software parameters: total frames = 8,328; receiver gain = 40; window start = 0.83 m; window length = 10.0 m; and focus = 5.85.
3. Higher quality images were collected during the third 20-minute time period at low frequency from 10 m to 20 m (long range). Images recorded for the long range appear large because the window length is small. Data were collected using the following software parameters: total frames = 8,368; receiver gain = 40; window start = 10.0 m; window length = 10.0 m; and focus = 15.13.

From 13 May through 27 May, the count from Range 2 (0–10 m) and Range 3 (10–20 m) were summed to provide a surrogate for a full 20-minute count of the entire span of the river. If one of the Range 2 or Range 3 counts was incomplete or missing then the count for Range 1 (0–20 m) was used.

On 27 May 2008, the open area between the picket weirs was constricted to approximately 11 m and the DIDSON collection software was reprogrammed to record a file at high frequency every 20 minutes over the entire range. The DIDSON system operated in this way until 16 June and the 20-minute files were processed the same way as described for 2007. Data were collected using the following software parameters: total frames = 7,497; receiver gain = 40; window start = 2.08 m; window length = 10.0 m; and focus = 0.71.

Overall, in 2008 1,125 hours of DIDSON recordings were collected and 4 hours of recordings were lost because of a computer malfunction. The recordings from the short and long ranges from 13 May through 27 May contained 317 hours of short range recordings and 333 hours of long range recordings. A total of 475 hours of recordings were collected at high frequency.

APPENDIX C: DIDSON COUNTS FOR 2007 AND 2008

Appendix C1.–Daily upstream, downstream, net, and expanded counts of fish based on DIDSON files, Anchor River, 2007.

Date	Upstream	Downstream	Net count [a]	Expanded [b]
14 May	29	29	0	0
15 May	69	47	22	66
16 May	44	18	26	78
17 May	64	31	33	99
18 May	49	33	16	48
19 May	81	39	42	126
20 May	86	28	58	174
21 May	86	31	55	165
22 May	84	23	61	183
23 May	73	28	45	135
24 May	60	21	39	117
25 May	44	15	29	87
26 May	51	31	20	60
27 May	126	70	56	168
28 May	118	66	52	156
29 May	180	84	96	288
30 May	208	82	126	378
31 May	257	55	202	606
1 Jun	125	45	80	240
2 Jun	93	53	40	120
3 Jun	211	89	122	366
4 Jun	209	77	132	396
5 Jun	180	67	113	339
6 Jun	160	76	84	252
7 Jun	197	110	87	261
Total	2,884	1,248	1,636	4,908

[a] Net count = upstream – downstream.

[b] Expanded to the hour.

Appendix C2.–Daily upstream, downstream, net, and expanded counts of fish based on DIDSON files, Anchor River, 2008.

Date	Upstream	Downstream	Net count [a]	Expanded [b]
13 May	1	0	1	3
14 May	2	1	1	3
15 May	13	6	7	21
16 May	1	3	-2	-6
17 May	2	4	-2	-6
18 May	4	6	-2	-6
19 May	39	24	15	45
20 May	40	29	11	33
21 May	35	14	21	63
22 May	30	17	13	39
23 May	48	23	25	75
24 May	18	9	9	27
25 May	26	7	19	57
26 May	36	23	13	39
27 May	47	32	15	45
28 May	28	8	20	60
29 May	34	11	23	69
30 May	56	5	51	153
31 May	46	14	32	96
1 Jun	52	14	38	114
2 Jun	67	17	50	150
3 Jun	87	34	53	159
4 Jun	89	34	55	165
5 Jun	110	21	89	267
6 Jun	107	14	93	279
7 Jun	39	15	24	72
8 Jun	121	37	84	252
9 Jun	95	30	65	195
10 Jun	162	53	109	327
11 Jun	53	64	-11	-33
12 Jun	152	77	75	225
13 Jun	158	90	68	204
14 Jun	23	0	23	69
15 Jun	35	0	35	105
16 Jun	21	0	21	63
Total	1,877	736	1,141	3,423

[a] Net count = upstream – downstream.

[b] Expanded to the hour.

APPENDIX D: ESCAPEMENT COUNTS FOR 2007 AND 2008

Appendix D1.–Daily escapement of Chinook salmon, coho salmon, and steelhead trout counted at the Anchor River sonar-weir site, 2007.

	Chinook salmon [a]			Coho salmon			Steelhead trout		
	Count			Count			Count		
Date	Daily	Cum	Cum %	Daily	Cum	Cum %	Daily	Cum	Cum %
14 May [b]	0	0	0	–	–	–	–	–	–
15 May [b]	66	66	1	–	–	–	–	–	–
16 May [b]	78	144	1	–	–	–	–	–	–
17 May [b]	99	243	3	–	–	–	–	–	–
18 May [b]	48	291	3	–	–	–	–	–	–
19 May [b]	126	417	4	–	–	–	–	–	–
20 May [b]	174	591	6	–	–	–	–	–	–
21 May [b]	165	756	8	–	–	–	–	–	–
22 May [b]	183	939	10	–	–	–	–	–	–
23 May [b]	135	1,074	11	–	–	–	–	–	–
24 May [b]	117	1,191	12	–	–	–	–	–	–
25 May [b]	87	1,278	13	–	–	–	–	–	–
26 May [b]	60	1,338	14	–	–	–	–	–	–
27 May [b]	168	1,506	16	–	–	–	–	–	–
28 May [b]	156	1,662	17	–	–	–	–	–	–
29 May [b]	288	1,950	20	–	–	–	–	–	–
30 May [b]	378	2,328	24	–	–	–	–	–	–
31 May [b]	606	2,934	30	–	–	–	–	–	–
1 Jun [b]	240	3,174	33	–	–	–	–	–	–
2 Jun [b]	120	3,294	34	–	–	–	–	–	–
3 Jun [b]	366	3,660	38	–	–	–	–	–	–
4 Jun [b]	396	4,056	42	–	–	–	–	–	–
5 Jun [b]	339	4,395	46	–	–	–	–	–	–
6 Jun [b]	252	4,647	48	–	–	–	–	–	–
7 Jun [c]	322	4,969	52	0	0	0	1	1	0
8 Jun [d]	70	5,039	52	0	0	0	1	2	1
9 Jun [d]	162	5,201	54	0	0	0	2	4	1
10 Jun [d]	157	5,358	56	0	0	0	0	4	1
11 Jun [d]	82	5,440	57	0	0	0	0	4	1
12 Jun [d]	155	5,595	58	0	0	0	0	4	1
13 Jun [d]	58	5,653	59	0	0	0	1	5	1
14 Jun [d]	95	5,748	60	0	0	0	0	5	1
15 Jun [d]	92	5,840	61	0	0	0	3	8	2
16 Jun [d]	174	6,014	63	0	0	0	2	10	3
17 Jun [d]	245	6,259	65	0	0	0	4	14	4
18 Jun [d]	89	6,348	66	0	0	0	3	17	5

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Appendix D1.–Part 2 of 4.

	Chinook salmon [a]			Coho salmon			Steelhead trout		
	Count			Count			Count		
Date	Daily	Cum	Cum %	Daily	Cum	Cum %	Daily	Cum	Cum %
19 Jun[d]	81	6,429	67	0	0	0	0	17	5
20 Jun[d]	20	6,449	67	0	0	0	1	18	5
21 Jun[d]	31	6,480	67	0	0	0	1	19	6
22 Jun[d]	20	6,500	68	0	0	0	0	19	6
23 Jun[d]	9	6,509	68	0	0	0	0	19	6
24 Jun[d]	45	6,554	68	0	0	0	0	19	6
25 Jun[d]	55	6,609	69	0	0	0	0	19	6
26 Jun[d]	62	6,671	69	0	0	0	0	19	6
27 Jun[d]	6	6,677	69	0	0	0	0	19	6
28 Jun[d]	37	6,714	70	0	0	0	0	19	6
29 Jun[d]	98	6,812	71	0	0	0	0	19	6
30 Jun[d]	40	6,852	71	0	0	0	0	19	6
1 Jul[d]	28	6,880	72	0	0	0	0	19	6
2 Jul[d]	159	7,039	73	0	0	0	1	20	6
3 Jul[d]	118	7,157	74	0	0	0	0	20	6
4 Jul[d]	73	7,230	75	0	0	0	0	20	6
5 Jul[d]	36	7,266	76	0	0	0	0	20	6
6 Jul[d]	115	7,381	77	0	0	0	0	20	6
7 Jul[d]	65	7,446	77	0	0	0	0	20	6
8 Jul[d]	91	7,537	78	0	0	0	0	20	6
9 Jul[d]	127	7,664	80	0	0	0	1	21	6
10 Jul[d]	145	7,809	81	0	0	0	0	21	6
11 Jul[d]	217	8,026	83	0	0	0	0	21	6
12 Jul[d]	322	8,348	87	0	0	0	0	21	6
13 Jul[d]	398	8,746	91	0	0	0	0	21	6
14 Jul[d]	44	8,790	91	2	2	0	0	21	6
15 Jul[d]	44	8,834	92	0	2	0	0	21	6
16 Jul[d]	39	8,873	92	0	2	0	0	21	6
17 Jul[d]	28	8,901	93	0	2	0	0	21	6
18 Jul[d]	12	8,913	93	0	2	0	0	21	6
19 Jul[d]	34	8,947	93	0	2	0	0	21	6
20 Jul[d]	24	8,971	93	1	3	0	0	21	6
21 Jul[d]	33	9,004	94	0	3	0	0	21	6
22 Jul[d]	7	9,011	94	0	3	0	0	21	6
23 Jul[d]	29	9,040	94	0	3	0	0	21	6
24 Jul[d]	21	9,061	94	0	3	0	0	21	6
25 Jul[d]	32	9,093	95	1	4	0	0	21	6

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Appendix D1.–Part 3 of 4.

	Chinook salmon [a]			Coho salmon			Steelhead trout		
	Count			Count			Count		
Date	Daily	Cum	Cum %	Daily	Cum	Cum %	Daily	Cum	Cum %
26 Jul [d]	90	9,183	95	1	5	0	0	21	6
27 Jul [d]	71	9,254	96	0	5	0	0	21	6
28 Jul [d]	41	9,295	97	0	5	0	0	21	6
29 Jul [d]	52	9,347	97	1	6	0	0	21	6
30 Jul [d]	28	9,375	97	0	6	0	0	21	6
31 Jul [d]	6	9,381	97	0	6	0	0	21	6
1 Aug [d]	10	9,391	98	0	6	0	0	21	6
2 Aug [d]	16	9,407	98	0	6	0	0	21	6
3 Aug [d]	37	9,444	98	3	9	0	0	21	6
4 Aug [d]	20	9,464	98	1	10	0	0	21	6
5 Aug [d]	55	9,519	99	0	10	0	1	22	6
6 Aug [d]	21	9,540	99	4	14	0	0	22	6
7 Aug [d]	17	9,557	99	3	17	0	0	22	6
8 Aug [d]	11	9,568	99	2	19	0	0	22	6
9 Aug [d]	13	9,581	100	8	27	0	0	22	6
10 Aug [d]	1	9,582	100	4	31	0	1	23	7
11 Aug [d]	2	9,584	100	3	34	0	0	23	7
12 Aug [d]	1	9,585	100	25	59	1	1	24	7
13 Aug [d]	4	9,589	100	27	86	1	0	24	7
14 Aug [d]	6	9,595	100	16	102	1	0	24	7
15 Aug [d]	1	9,596	100	19	121	1	1	25	7
16 Aug [d]	6	9,602	100	65	186	2	2	27	8
17 Aug [d]	2	9,604	100	9	195	2	0	27	8
18 Aug [d]	1	9,605	100	0	195	2	0	27	8
19 Aug [d]	1	9,606	100	7	202	2	0	27	8
20 Aug [d]	1	9,607	100	1	203	2	0	27	8
21 Aug [d]	1	9,608	100	4	207	3	0	27	8
22 Aug [d]	1	9,609	100	7	214	3	0	27	8
23 Aug [d]	9	9,618	100	2,021	2,235	27	15	42	12
24 Aug [d]	3	9,621	100	240	2,475	30	8	50	15
25 Aug [d]	1	9,622	100	909	3,384	41	13	63	18
26 Aug [d]	0	9,622	100	49	3,433	42	3	66	19
27 Aug [d]	0	9,622	100	3	3,436	42	0	66	19
28 Aug [d]	0	9,622	100	14	3,450	42	0	66	19
29 Aug [d]	0	9,622	100	12	3,462	42	0	66	19
30 Aug [d]	0	9,622	100	64	3,526	43	10	76	22
31 Aug [d]	0	9,622	100	23	3,549	43	5	81	24

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Appendix D1.–Part 4 of 4.

Date	Chinook salmon [a]			Coho salmon			Steelhead trout		
	Count			Count			Count		
	Daily	Cum	Cum %	Daily	Cum	Cum %	Daily	Cum	Cum %
1 Sep [d]	0	9,622	100	18	3,567	43	2	83	24
2 Sep [d]	0	9,622	100	49	3,616	44	8	91	26
3 Sep [d]	0	9,622	100	15	3,631	44	0	91	26
4 Sep [d]	0	9,622	100	8	3,639	44	1	92	27
5 Sep [d]	0	9,622	100	24	3,663	45	0	92	27
6 Sep [d]	0	9,622	100	27	3,690	45	3	95	28
7 Sep [d]	0	9,622	100	17	3,707	45	8	103	30
8 Sep [d]	0	9,622	100	2,393	6,100	74	75	178	52
9 Sep [d]	0	9,622	100	1,984	8,084	98	61	239	69
10 Sep [d]	0	9,622	100	132	8,216	100	91	330	96
11 Sep [d]	0	9,622	100	9	8,225	100	4	334	97
12 Sep [d]	0	9,622	100	1	8,226	100	10	344	100

Note: "–" = value cannot be computed due to limitations of the data.

[a] Escapement estimate of Chinook salmon is 9,622 (SE 238).

[b] Daily count estimated from 20-min DIDSON counts expanded to the hour of fish passage between partial picket weirs from 14 May through 7 June.

[c] Daily count estimated from 20-min DIDSON counts expanded to the hour (261) of fish passage between partial picket weirs from 0001 to 1600 and from fish identified to species in the weir live box from 1601 hours through midnight on 7 June.

[d] Daily count of fish identified to species in the weir live box.

Appendix D2.–Daily escapement of Dolly Varden, and pink, chum, and sockeye salmon counted at the Anchor River sonar-weir site, 2007.

	Dolly Varden			Pink salmon			Chum salmon			Sockeye salmon		
	Count		Cum	Count		Cum	Count		Cum	Count		Cum
Date	Daily	Cum	%	Daily	Cum	%	Daily	Cum	%	Daily	Cum	%
14 May[a]	–	–	–	–	–	–	–	–	–	–	–	–
15 May[a]	–	–	–	–	–	–	–	–	–	–	–	–
16 May[a]	–	–	–	–	–	–	–	–	–	–	–	–
17 May[a]	–	–	–	–	–	–	–	–	–	–	–	–
18 May[a]	–	–	–	–	–	–	–	–	–	–	–	–
19 May[a]	–	–	–	–	–	–	–	–	–	–	–	–
20 May[a]	–	–	–	–	–	–	–	–	–	–	–	–
21 May[a]	–	–	–	–	–	–	–	–	–	–	–	–
22 May[a]	–	–	–	–	–	–	–	–	–	–	–	–
23 May[a]	–	–	–	–	–	–	–	–	–	–	–	–
24 May[a]	–	–	–	–	–	–	–	–	–	–	–	–
25 May[a]	–	–	–	–	–	–	–	–	–	–	–	–
26 May[a]	–	–	–	–	–	–	–	–	–	–	–	–
27 May[a]	–	–	–	–	–	–	–	–	–	–	–	–
28 May[a]	–	–	–	–	–	–	–	–	–	–	–	–
29 May[a]	–	–	–	–	–	–	–	–	–	–	–	–
30 May[a]	–	–	–	–	–	–	–	–	–	–	–	–
31 May[a]	–	–	–	–	–	–	–	–	–	–	–	–
1 Jun[a]	–	–	–	–	–	–	–	–	–	–	–	–
2 Jun[a]	–	–	–	–	–	–	–	–	–	–	–	–
3 Jun[a]	–	–	–	–	–	–	–	–	–	–	–	–
4 Jun[a]	–	–	–	–	–	–	–	–	–	–	–	–
5 Jun[a]	–	–	–	–	–	–	–	–	–	–	–	–
6 Jun[a]	–	–	–	–	–	–	–	–	–	–	–	–
7 Jun[b]	0	0	0	0	0	0	0	0	0	0	0	0
8 Jun[c]	0	0	0	0	0	0	0	0	0	0	0	0
9 Jun[c]	0	0	0	0	0	0	0	0	0	0	0	0
10 Jun[c]	0	0	0	0	0	0	0	0	0	0	0	0
11 Jun[c]	0	0	0	0	0	0	0	0	0	0	0	0
12 Jun[c]	0	0	0	0	0	0	0	0	0	0	0	0
13 Jun[c]	0	0	0	0	0	0	0	0	0	0	0	0
14 Jun[c]	0	0	0	0	0	0	0	0	0	0	0	0
15 Jun[c]	0	0	0	0	0	0	0	0	0	0	0	0
16 Jun[c]	0	0	0	0	0	0	0	0	0	0	0	0
17 Jun[c]	0	0	0	0	0	0	0	0	0	0	0	0
18 Jun[c]	0	0	0	0	0	0	0	0	0	0	0	0

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Appendix D2.–Part 2 of 4.

Date	Dolly Varden Count Daily	Dolly Varden Count Cum	Dolly Varden Cum %	Pink salmon Count Daily	Pink salmon Count Cum	Pink salmon Cum %	Chum salmon Count Daily	Chum salmon Count Cum	Chum salmon Cum %	Sockeye salmon Count Daily	Sockeye salmon Count Cum	Sockeye salmon Cum %
19 Jun[c]	0	0	0	0	0	0	0	0	0	0	0	0
20 Jun[c]	0	0	0	0	0	0	0	0	0	0	0	0
21 Jun[c]	0	0	0	0	0	0	0	0	0	0	0	0
22 Jun[c]	0	0	0	0	0	0	0	0	0	0	0	0
23 Jun[c]	2	2	0	0	0	0	0	0	0	0	0	0
24 Jun[c]	0	2	0	0	0	0	0	0	0	0	0	0
25 Jun[c]	0	2	0	0	0	0	0	0	0	0	0	0
26 Jun[c]	4	6	0	0	0	0	0	0	0	0	0	0
27 Jun[c]	0	6	0	0	0	0	0	0	0	0	0	0
28 Jun[c]	1	7	1	0	0	0	0	0	0	0	0	0
29 Jun[c]	0	7	1	0	0	0	0	0	0	0	0	0
30 Jun[c]	3	10	1	0	0	0	0	0	0	0	0	0
1 Jul[c]	0	10	1	0	0	0	0	0	0	0	0	0
2 Jul[c]	3	13	1	1	1	0	0	0	0	1	1	1
3 Jul[c]	4	17	1	4	5	0	0	0	0	0	1	1
4 Jul[c]	7	24	2	4	9	0	0	0	0	0	1	1
5 Jul[c]	1	25	2	1	10	0	0	0	0	0	1	1
6 Jul[c]	8	33	3	1	11	0	0	0	0	0	1	1
7 Jul[c]	0	33	3	0	11	0	0	0	0	0	1	1
8 Jul[c]	4	37	3	3	14	0	0	0	0	0	1	1
9 Jul[c]	28	65	5	14	28	1	0	0	0	0	1	1
10 Jul[c]	53	118	9	14	42	1	1	1	1	0	1	1
11 Jul[c]	11	129	10	37	79	2	0	1	1	0	1	1
12 Jul[c]	21	150	11	26	105	3	1	2	1	0	1	1
13 Jul[c]	7	157	12	18	123	3	1	3	2	2	3	2
14 Jul[c]	*12*	169	13	6	129	3	0	3	2	0	3	2
15 Jul[c]	42	211	16	6	135	3	1	4	3	0	3	2
16 Jul[c]	49	260	20	20	155	4	0	4	3	0	3	2
17 Jul[c]	8	268	20	7	162	4	2	6	4	0	3	2
18 Jul[c]	40	308	24	9	171	4	1	7	4	1	4	2
19 Jul[c]	56	364	28	28	199	5	1	8	5	1	5	3
20 Jul[c]	277	641	49	80	279	7	8	16	10	0	5	3
21 Jul[c]	168	809	62	40	319	8	1	17	11	1	6	3
22 Jul[c]	44	853	65	13	332	8	2	19	12	0	6	3
23 Jul[c]	38	891	68	78	410	10	5	24	15	0	6	3
24 Jul[c]	31	922	70	34	444	11	0	24	15	0	6	3
25 Jul[c]	19	941	72	12	456	12	0	24	15	0	6	3
26 Jul[c]	57	998	76	44	500	13	5	29	19	1	7	4

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Appendix D2.–Part 3 of 4.

Date	Dolly Varden Count Daily	Dolly Varden Count Cum	Dolly Varden Cum %	Pink salmon Count Daily	Pink salmon Count Cum	Pink salmon Cum %	Chum salmon Count Daily	Chum salmon Count Cum	Chum salmon Cum %	Sockeye salmon Count Daily	Sockeye salmon Count Cum	Sockeye salmon Cum %
27 Jul [c]	27	1,025	78	48	548	14	6	35	22	4	11	6
28 Jul [c]	88	1,113	85	56	604	15	1	36	23	2	13	7
29 Jul [c]	45	1,158	88	106	710	18	1	37	24	3	16	8
30 Jul [c]	3	1,161	89	20	730	19	0	37	24	1	17	9
31 Jul [c]	6	1,167	89	8	738	19	0	37	24	0	17	9
1 Aug [c]	1	1,168	89	5	743	19	0	37	24	1	18	9
2 Aug [c]	6	1,174	90	9	752	19	1	38	24	0	18	9
3 Aug [c]	31	1,205	92	80	832	21	4	42	27	10	28	14
4 Aug [c]	7	1,212	93	30	862	22	1	43	28	1	29	15
5 Aug [c]	5	1,217	93	59	921	24	0	43	28	7	36	18
6 Aug [c]	4	1,221	93	31	952	24	1	44	28	4	40	20
7 Aug [c]	5	1,226	94	30	982	25	1	45	29	3	43	22
8 Aug [c]	3	1,229	94	13	995	25	3	48	31	4	47	24
9 Aug [c]	2	1,231	94	26	1,021	26	0	48	31	8	55	28
10 Aug [c]	0	1,231	94	7	1,028	26	0	48	31	3	58	29
11 Aug [c]	2	1,233	94	20	1,048	27	1	49	31	4	62	31
12 Aug [c]	3	1,236	94	29	1,077	28	1	50	32	7	69	35
13 Aug [c]	0	1,236	94	29	1,106	28	1	51	33	8	77	39
14 Aug [c]	0	1,236	94	22	1,128	29	2	53	34	5	82	41
15 Aug [c]	0	1,236	94	13	1,141	29	1	54	35	2	84	42
16 Aug [c]	1	1,237	94	68	1,209	31	3	57	37	9	93	47
17 Aug [c]	0	1,237	94	10	1,219	31	0	57	37	8	101	51
18 Aug [c]	0	1,237	94	20	1,239	32	1	58	37	5	106	53
19 Aug [c]	1	1,238	95	37	1,276	33	8	66	42	3	109	55
20 Aug [c]	0	1,238	95	50	1,326	34	9	75	48	2	111	56
21 Aug [c]	0	1,238	95	34	1,360	35	11	86	55	3	114	57
22 Aug [c]	0	1,238	95	90	1,450	37	6	92	59	2	116	58
23 Aug [c]	0	1,238	95	330	1,780	45	10	102	65	28	144	72
24 Aug [c]	0	1,238	95	150	1,930	49	1	103	66	14	158	79
25 Aug [c]	0	1,238	95	319	2,249	57	1	104	67	3	161	81
26 Aug [c]	0	1,238	95	201	2,450	63	6	110	71	1	162	81
27 Aug [c]	0	1,238	95	71	2,521	64	1	111	71	0	162	81
28 Aug [c]	0	1,238	95	71	2,592	66	7	118	76	0	162	81
29 Aug [c]	0	1,238	95	89	2,681	68	5	123	79	0	162	81
30 Aug [c]	0	1,238	95	152	2,833	72	5	128	82	3	165	83
31 Aug [c]	0	1,238	95	133	2,966	76	2	130	83	7	172	86

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Appendix D2.–Part 4 of 4.

	Dolly Varden			Pink salmon			Chum salmon			Sockeye salmon		
	Count		Cum	Count		Cum	Count		Cum	Count		Cum
Date	Daily	Cum	%	Daily	Cum	%	Daily	Cum	%	Daily	Cum	%
1 Sep [c]	1	1,239	95	115	3,081	79	3	133	85	3	175	88
2 Sep [c]	0	1,239	95	111	3,192	82	4	137	88	7	182	91
3 Sep [c]	0	1,239	95	73	3,265	83	3	140	90	0	182	91
4 Sep [c]	0	1,239	95	75	3,340	85	1	141	90	0	182	91
5 Sep [c]	0	1,239	95	61	3,401	87	2	143	92	1	183	92
6 Sep [c]	0	1,239	95	71	3,472	89	6	149	96	0	183	92
7 Sep [c]	0	1,239	95	33	3,505	90	1	150	96	3	186	93
8 Sep [c]	0	1,239	95	266	3,771	96	2	152	97	11	197	99
9 Sep [c]	69	1,308	100	90	3,861	99	3	155	99	3	200	100
10 Sep [c]	1	1,309	100	37	3,898	100	0	155	99	0	200	100
11 Sep [c]	0	1,309	100	11	3,909	100	1	156	100	0	200	100
12 Sep [c]	0	1,309	100	7	3,916	100	0	156	100	0	200	100

Note: "–" = value cannot be computed due to limitations of the data.

[a] Daily count estimated from 20-min DIDSON counts expanded to the hour of fish passage between partial picket weirs from 14 May through 6 June.

[b] Daily count estimated from 20-min DIDSON counts expanded to the hour (261) of fish passage between partial picket weirs from 0001 to 1600 and from fish identified to species in the weir live box from 1601 hours through midnight on 7 June.

[c] Daily count of fish identified to species in the weir live box.

Appendix D3.–Daily escapement of Chinook salmon, coho salmon, and steelhead trout counted at the Anchor River sonar-weir site, 2008.

	Chinook salmon [a]			Coho salmon			Steelhead trout		
	Count			Count			Count		
Date	Daily	Cum	Cum %	Daily	Cum	Cum %	Daily	Cum	Cum %
13 May [b]	3	3	0	–	–	–	–	–	–
14 May [b]	3	6	0	–	–	–	–	–	–
15 May [b]	21	27	0	–	–	–	–	–	–
16 May [b]	-6	21	0	–	–	–	–	–	–
17 May [b]	-6	15	0	–	–	–	–	–	–
18 May [b]	-6	9	0	–	–	–	–	–	–
19 May [b]	45	54	1	–	–	–	–	–	–
20 May [b]	33	87	1	–	–	–	–	–	–
21 May [b]	63	150	3	–	–	–	–	–	–
22 May [b]	39	189	3	–	–	–	–	–	–
23 May [b]	75	264	5	–	–	–	–	–	–
24 May [b]	27	291	5	–	–	–	–	–	–
25 May [b]	57	348	6	–	–	–	–	–	–
26 May [b]	39	387	7	–	–	–	–	–	–
27 May [b]	45	432	7	–	–	–	–	–	–
28 May [b]	60	492	8	–	–	–	–	–	–
29 May [b]	69	561	10	–	–	–	–	–	–
30 May [b]	153	714	12	–	–	–	–	–	–
31 May [b]	96	810	14	–	–	–	–	–	–
1 Jun [b]	114	924	16	–	–	–	–	–	–
2 Jun [b]	150	1,074	18	–	–	–	–	–	–
3 Jun [b]	159	1,233	21	–	–	–	–	–	–
4 Jun [b]	165	1,398	24	–	–	–	–	–	–
5 Jun [b]	267	1,665	29	–	–	–	–	–	–
6 Jun [b]	279	1,944	33	–	–	–	–	–	–
7 Jun [b]	72	2,016	35	–	–	–	–	–	–
8 Jun [b]	252	2,268	39	–	–	–	–	–	–
9 Jun [b]	195	2,463	42	–	–	–	–	–	–
10 Jun [b]	327	2,790	48	–	–	–	–	–	–
11 Jun [b]	-33	2,757	47	–	–	–	–	–	–
12 Jun [b]	225	2,982	51	–	–	–	–	–	–
13 Jun [b]	204	3,186	55	–	–	–	–	–	–
14 Jun [b]	69	3,255	56	–	–	–	–	–	–
15 Jun [c]	105	3,360	58	–	–	–	–	–	–

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Appendix D3.–Part 2 of 4.

	Chinook salmon [a]			Coho salmon			Steelhead trout		
	Count			Count			Count		
Date	Daily	Cum	Cum %	Daily	Cum	Cum %	Daily	Cum	Cum %
16 Jun [d]	79	3,439	59	0	0	0	0	0	0
17 Jun [d]	71	3,510	60	0	0	0	2	2	1
18 Jun [d]	80	3,590	62	0	0	0	1	3	1
19 Jun [d]	116	3,706	64	0	0	0	0	3	1
20 Jun [d]	81	3,787	65	0	0	0	0	3	1
21 Jun [d]	44	3,831	66	0	0	0	0	3	1
22 Jun [d]	106	3,937	68	0	0	0	1	4	2
23 Jun [d]	53	3,990	69	0	0	0	0	4	2
24 Jun [d]	43	4,033	69	0	0	0	0	4	2
25 Jun [d]	87	4,120	71	0	0	0	0	4	2
26 Jun [d]	68	4,188	72	0	0	0	0	4	2
27 Jun [d]	75	4,263	73	0	0	0	0	4	2
28 Jun [d]	110	4,373	75	0	0	0	0	4	2
29 Jun [d]	62	4,435	76	0	0	0	0	4	2
30 Jun [d]	247	4,682	81	0	0	0	0	4	2
1 Jul [d]	160	4,842	83	0	0	0	0	4	2
2 Jul [d]	125	4,967	86	0	0	0	1	5	2
3 Jul [d]	45	5,012	86	0	0	0	0	5	2
4 Jul [d]	55	5,067	87	0	0	0	0	5	2
5 Jul [d]	90	5,157	89	0	0	0	0	5	2
6 Jul [d]	61	5,218	90	0	0	0	0	5	2
7 Jul [d]	38	5,256	91	0	0	0	0	5	2
8 Jul [d]	2	5,258	91	0	0	0	0	5	2
9 Jul [d]	24	5,282	91	0	0	0	0	5	2
10 Jul [d]	17	5,299	91	0	0	0	1	6	2
11 Jul [d]	16	5,315	92	0	0	0	0	6	2
12 Jul [d]	24	5,339	92	0	0	0	0	6	2
13 Jul [d]	22	5,361	92	0	0	0	0	6	2
14 Jul [d]	21	5,382	93	0	0	0	0	6	2
15 Jul [d]	21	5,403	93	0	0	0	0	6	2
16 Jul [d]	20	5,423	93	0	0	0	0	6	2
17 Jul [d]	84	5,507	95	1	1	0	0	6	2
18 Jul [d]	26	5,533	95	0	1	0	1	7	3
19 Jul [d]	16	5,549	96	0	1	0	0	7	3
20 Jul [d]	6	5,555	96	0	1	0	0	7	3
21 Jul [d]	9	5,564	96	0	1	0	0	7	3
22 Jul [d]	2	5,566	96	0	1	0	0	7	3

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Appendix D3.–Part 3 of 4.

	Chinook salmon [a]			Coho salmon			Steelhead trout		
	Count			Count			Count		
Date	Daily	Cum	Cum %	Daily	Cum	Cum %	Daily	Cum	Cum %
23 Jul [d]	103	5,669	98	0	1	0	0	7	3
24 Jul [d]	2	5,671	98	0	1	0	0	7	3
25 Jul [d]	3	5,674	98	0	1	0	0	7	3
26 Jul [d]	1	5,675	98	0	1	0	0	7	3
27 Jul [d]	3	5,678	98	0	1	0	0	7	3
28 Jul [d]	5	5,683	98	0	1	0	0	7	3
29 Jul [d]	6	5,689	98	2	3	0	0	7	3
30 Jul [d]	34	5,723	99	0	3	0	1	8	3
31 Jul [d]	20	5,743	99	1	4	0	0	8	3
1 Aug [d]	3	5,746	99	2	6	0	0	8	3
2 Aug [d]	3	5,749	99	6	12	0	0	8	3
3 Aug [d]	2	5,751	99	11	23	0	0	8	3
4 Aug [d]	7	5,758	99	10	33	1	0	8	3
5 Aug [d]	2	5,760	99	2	35	1	0	8	3
6 Aug [d]	4	5,764	99	17	52	1	0	8	3
7 Aug [d]	1	5,765	99	7	59	1	0	8	3
8 Aug [d]	10	5,775	99	7	66	1	0	8	3
9 Aug [d]	2	5,777	100	12	78	1	0	8	3
10 Aug [d]	3	5,780	100	25	103	2	0	8	3
11 Aug [d]	4	5,784	100	34	137	2	2	10	4
12 Aug [d]	1	5,785	100	7	144	2	1	11	4
13 Aug [d]	2	5,787	100	138	282	5	3	14	6
14 Aug [d]	5	5,792	100	52	334	6	1	15	6
15 Aug [d]	8	5,800	100	926	1,260	21	4	19	8
16 Aug [d]	4	5,804	100	881	2,141	36	8	27	11
17 Aug [d]	0	5,804	100	51	2,192	37	0	27	11
18 Aug [d]	0	5,804	100	32	2,224	37	0	27	11
19 Aug [d]	0	5,804	100	28	2,252	38	3	30	12
20 Aug [d]	0	5,804	100	33	2,285	39	0	30	12
21 Aug [d]	1	5,805	100	110	2,395	40	2	32	13
22 Aug [d]	0	5,805	100	1,137	3,532	60	13	45	18
23 Aug [d]	0	5,805	100	177	3,709	63	5	50	20
24 Aug [d]	0	5,805	100	514	4,223	71	3	53	21
25 Aug [d]	0	5,805	100	54	4,277	72	8	61	24
26 Aug [d]	1	5,806	100	43	4,320	73	3	64	25
27 Aug [d]	0	5,806	100	18	4,338	73	3	67	27
28 Aug [d]	0	5,806	100	31	4,369	74	3	70	28

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Appendix D3.–Part 4 of 4.

	Chinook salmon [a]			Coho salmon			Steelhead trout		
	Count			Count			Count		
Date	Daily	Cum	Cum %	Daily	Cum	Cum %	Daily	Cum	Cum %
29 Aug [d]	0	5,806	100	15	4,384	74	2	72	29
30 Aug [d]	0	5,806	100	14	4,398	74	5	77	31
31 Aug [d]	0	5,806	100	13	4,411	74	3	80	32
1 Sep [d]	0	5,806	100	706	5,117	86	75	155	62
2 Sep [d]	0	5,806	100	74	5,191	88	16	171	68
3 Sep [d]	0	5,806	100	111	5,302	89	15	186	74
4 Sep [d]	0	5,806	100	43	5,345	90	6	192	76
5 Sep [d]	0	5,806	100	12	5,357	90	8	200	80
6 Sep [d]	0	5,806	100	16	5,373	91	9	209	83
7 Sep [d]	0	5,806	100	186	5,559	94	18	227	90
8 Sep [d]	0	5,806	100	52	5,611	95	5	232	92
9 Sep [d]	0	5,806	100	288	5,899	99	17	249	99
10 Sep [d]	0	5,806	100	33	5,932	100	2	251	100
11 Sep [d]	0	5,806	100	19	5,951	100	11	262	104

Note: "–" = value cannot be computed due to limitations of the data.

[a] Escapement estimate of Chinook salmon is 5,806 (SE 169).

[b] Daily count estimated from 20-min DIDSON counts expanded to the hour of fish passage between partial picket weirs from 13 May through 16 June.

[c] Daily count estimated from 20-min DIDSON counts expanded to the hour (63) of fish passage between partial picket weirs from 0001 to 1100 and from fish identified to species in the weir live box from 1101 hours through midnight on 16 June.

[d] Daily count of fish identified to species in the weir live box.

Appendix D4.–Daily escapement of Dolly Varden, and pink, chum, and sockeye salmon counted at the Anchor River sonar-weir site, 2007.

	Dolly Varden			Pink salmon			Chum salmon			Sockeye salmon		
	Count		Cum	Count		Cum	Count		Cum	Count		Cum
Date	Daily	Cum	%	Daily	Cum	%	Daily	Cum	%	Daily	Cum	%
13 May [b]	–	–	–	–	–	–	–	–	–	–	–	–
14 May [b]	–	–	–	–	–	–	–	–	–	–	–	–
15 May [b]	–	–	–	–	–	–	–	–	–	–	–	–
16 May [b]	–	–	–	–	–	–	–	–	–	–	–	–
17 May [b]	–	–	–	–	–	–	–	–	–	–	–	–
18 May [b]	–	–	–	–	–	–	–	–	–	–	–	–
19 May [b]	–	–	–	–	–	–	–	–	–	–	–	–
20 May [b]	–	–	–	–	–	–	–	–	–	–	–	–
21 May [b]	–	–	–	–	–	–	–	–	–	–	–	–
22 May [b]	–	–	–	–	–	–	–	–	–	–	–	–
23 May [b]	–	–	–	–	–	–	–	–	–	–	–	–
24 May [b]	–	–	–	–	–	–	–	–	–	–	–	–
25 May [b]	–	–	–	–	–	–	–	–	–	–	–	–
26 May [b]	–	–	–	–	–	–	–	–	–	–	–	–
27 May [b]	–	–	–	–	–	–	–	–	–	–	–	–
28 May [b]	–	–	–	–	–	–	–	–	–	–	–	–
29 May [b]	–	–	–	–	–	–	–	–	–	–	–	–
30 May [b]	–	–	–	–	–	–	–	–	–	–	–	–
31 May [b]	–	–	–	–	–	–	–	–	–	–	–	–
1 Jun [b]	–	–	–	–	–	–	–	–	–	–	–	–
2 Jun [b]	–	–	–	–	–	–	–	–	–	–	–	–
3 Jun [b]	–	–	–	–	–	–	–	–	–	–	–	–
4 Jun [b]	–	–	–	–	–	–	–	–	–	–	–	–
5 Jun [b]	–	–	–	–	–	–	–	–	–	–	–	–
6 Jun [b]	–	–	–	–	–	–	–	–	–	–	–	–
7 Jun [b]	–	–	–	–	–	–	–	–	–	–	–	–
8 Jun [b]	–	–	–	–	–	–	–	–	–	–	–	–
9 Jun [b]	–	–	–	–	–	–	–	–	–	–	–	–
10 Jun [b]	–	–	–	–	–	–	–	–	–	–	–	–
11 Jun [b]	–	–	–	–	–	–	–	–	–	–	–	–
12 Jun [b]	–	–	–	–	–	–	–	–	–	–	–	–
13 Jun [b]	–	–	–	–	–	–	–	–	–	–	–	–
14 Jun [b]	–	–	–	–	–	–	–	–	–	–	–	–
15 Jun [c]	–	–	–	–	–	–	–	–	–	–	–	–

-continued-

Appendix D4.–Part 2 of 4.

	Dolly Varden			Pink salmon			Chum salmon			Sockeye salmon		
	Count		Cum	Count		Cum	Count		Cum	Count		Cum
Date	Daily	Cum	%	Daily	Cum	%	Daily	Cum	%	Daily	Cum	%
16 Jun [d]	0	0	0	0	0	0	0	0	0	0	0	0
17 Jun [d]	0	0	0	0	0	0	0	0	0	0	0	0
18 Jun [d]	0	0	0	0	0	0	0	0	0	0	0	0
19 Jun [d]	3	3	0	0	0	0	0	0	0	0	0	0
20 Jun [d]	0	3	0	0	0	0	0	0	0	0	0	0
21 Jun [d]	0	3	0	0	0	0	0	0	0	0	0	0
22 Jun [d]	0	3	0	0	0	0	0	0	0	0	0	0
23 Jun [d]	0	3	0	0	0	0	0	0	0	0	0	0
24 Jun [d]	0	3	0	0	0	0	0	0	0	0	0	0
25 Jun [d]	0	3	0	0	0	0	0	0	0	0	0	0
26 Jun [d]	1	4	0	0	0	0	0	0	0	0	0	0
27 Jun [d]	2	6	0	0	0	0	0	0	0	0	0	0
28 Jun [d]	0	6	0	0	0	0	0	0	0	0	0	0
29 Jun [d]	2	8	1	1	1	0	0	0	0	0	0	0
30 Jun [d]	3	11	1	2	3	0	0	0	0	0	0	0
1 Jul [d]	0	11	1	15	18	1	0	0	0	0	0	0
2 Jul [d]	1	12	1	4	22	1	0	0	0	0	0	0
3 Jul [d]	38	50	4	6	28	1	0	0	0	0	0	0
4 Jul [d]	64	114	8	4	32	2	0	0	0	0	0	0
5 Jul [d]	72	186	14	9	41	2	0	0	0	0	0	0
6 Jul [d]	17	203	15		41	2	0	0	0	0	0	0
7 Jul [d]	50	253	19	4	45	2	0	0	0	0	0	0
8 Jul [d]	38	291	22	2	47	2	0	0	0	0	0	0
9 Jul [d]	16	307	23	12	59	3	0	0	0	0	0	0
10 Jul [d]	211	518	39	17	76	4	0	0	0	0	0	0
11 Jul [d]	126	644	48	5	81	4	0	0	0	0	0	0
12 Jul [d]	64	708	53	3	84	4	1	1	2	0	0	0
13 Jul [d]	136	844	63	9	93	5	0	1	2	0	0	0
14 Jul [d]	47	891	66	10	103	5	0	1	2	0	0	0
15 Jul [d]	13	904	67	10	113	6	0	1	2	0	0	0
16 Jul [d]	29	933	69	14	127	6	2	3	5	1	1	2
17 Jul [d]	16	949	71	42	169	8	2	5	8	0	1	2
18 Jul [d]	42	991	74	4	173	9	0	5	8	0	1	2
19 Jul [d]	43	1,034	77	8	181	9	0	5	8	0	1	2
20 Jul [d]	151	1,185	88	11	192	10	1	6	9	0	1	2
21 Jul [d]	5	1,190	89	8	200	10	0	6	9	0	1	2
22 Jul [d]	11	1,201	89	6	206	10	1	7	11	0	1	2

-continued-

Appendix D4.–Part 3 of 4.

	Dolly Varden			Pink salmon			Chum salmon			Sockeye salmon		
	Count		Cum	Count		Cum	Count		Cum	Count		Cum
Date	Daily	Cum	%	Daily	Cum	%	Daily	Cum	%	Daily	Cum	%
23 Jul [d]	21	1,222	91	44	250	12	1	8	12	0	1	2
24 Jul [d]	0	1,222	91	1	251	12	0	8	12	0	1	2
25 Jul [d]	25	1,247	93	9	260	13	4	12	18	1	2	4
26 Jul [d]	7	1,254	93	3	263	13	0	12	18	0	2	4
27 Jul [d]	6	1,260	94	4	267	13	1	13	20	1	3	6
28 Jul [d]	29	1,289	96	9	276	14	1	14	21	0	3	6
29 Jul [d]	9	1,298	97	27	303	15	0	14	21	1	4	8
30 Jul [d]	8	1,306	97	28	331	16	1	15	23	1	5	10
31 Jul [d]	1	1,307	97	32	363	18	1	16	24	3	8	15
1 Aug [d]	0	1,307	97	14	377	19	1	17	26	0	8	15
2 Aug [d]	3	1,310	97	24	401	20	0	17	26	2	10	19
3 Aug [d]	2	1,312	98	34	435	22	0	17	26	4	14	27
4 Aug [d]	6	1,318	98	17	452	22	3	20	30	4	18	35
5 Aug [d]	4	1,322	98	21	473	23	6	26	39	3	21	40
6 Aug [d]	0	1,322	98	35	508	25	4	30	45	0	21	40
7 Aug [d]	1	1,323	98	10	518	26	0	30	45	1	22	42
8 Aug [d]	1	1,324	99	17	535	27	0	30	45	0	22	42
9 Aug [d]	0	1,324	99	20	555	28	1	31	47	0	22	42
10 Aug [d]	1	1,325	99	21	576	29	2	33	50	0	22	42
11 Aug [d]	0	1,325	99	32	608	30	1	34	52	0	22	42
12 Aug [d]	4	1,329	99	24	632	31	1	35	53	0	22	42
13 Aug [d]	1	1,330	99	62	694	34	3	38	58	1	23	44
14 Aug [d]	0	1,330	99	17	711	35	0	38	58	2	25	48
15 Aug [d]	0	1,330	99	195	906	45	0	38	58	2	27	52
16 Aug [d]	2	1,332	99	153	1,059	53	1	39	59	4	31	60
17 Aug [d]	1	1,333	99	31	1,090	54	1	40	61	0	31	60
18 Aug [d]	3	1,336	99	19	1,109	55	1	41	62	3	34	65
19 Aug [d]	1	1,337	99	15	1,124	56	0	41	62	0	34	65
20 Aug [d]	1	1,338	100	37	1,161	58	2	43	65	2	36	69
21 Aug [d]	0	1,338	100	49	1,210	60	5	48	73	0	36	69
22 Aug [d]	1	1,339	100	75	1,285	64	0	48	73	3	39	75
23 Aug [d]	0	1,339	100	61	1,346	67	1	49	74	1	40	77
24 Aug [d]	0	1,339	100	79	1,425	71	1	50	76	3	43	83
25 Aug [d]	3	1,342	100	40	1,465	73	1	51	77	0	43	83
26 Aug [d]	1	1,343	100	29	1,494	74	4	55	83	0	43	83
27 Aug [d]	0	1,343	100	34	1,528	76	4	59	89	1	44	85
28 Aug [d]	0	1,343	100	67	1,595	79	0	59	89	0	44	85

-continued-

Appendix D4.–Part 4 of 4.

Date		Dolly Varden			Pink salmon			Chum salmon			Sockeye salmon		
		Count		Cum	Count		Cum	Count		Cum	Count		Cum
		Daily	Cum	%	Daily	Cum	%	Daily	Cum	%	Daily	Cum	%
29 Aug	d	0	1,343	100	45	1,640	81	0	59	89	0	44	85
30 Aug	d	0	1,343	100	44	1,684	84	1	60	91	1	45	87
31 Aug	d	0	1,343	100	47	1,731	86	0	60	91	1	46	88
1 Sep	d	0	1,343	100	90	1,821	90	1	61	92	3	49	94
2 Sep	d	0	1,343	100	30	1,851	92	0	61	92	1	50	96
3 Sep	d	0	1,343	100	47	1,898	94	1	62	94	1	51	98
4 Sep	d	0	1,343	100	17	1,915	95	0	62	94	0	51	98
5 Sep	d	0	1,343	100	21	1,936	96	0	62	94	0	51	98
6 Sep	d	0	1,343	100	16	1,952	97	2	64	97	0	51	98
7 Sep	d	1	1,344	100	24	1,976	98	1	65	98	1	52	100
8 Sep	d	0	1,344	100	14	1,990	99	0	65	98	0	52	100
9 Sep	d	0	1,344	100	19	2,009	100	1	66	100	0	52	100
10 Sep	d	0	1,344	100	6	2,015	100	0	66	100	0	52	100
11 Sep	d	0	1,344	100	2	2,017	100	0	66	100	0	52	100

Note: "–" = value cannot be computed due to limitations of the data.

[a] Escapement estimate of Chinook salmon is 5,806 (SE 169).

[b] Daily count estimated from 20-min DIDSON counts expanded to the hour of fish passage between partial picket weirs from 12 May through 16 June.

[c] Daily count estimated from 20-min DIDSON counts expanded to the hour (63) of fish passage between partial picket weirs from 0001 to 1100 and from fish identified to species in the weir live box from 1101 hours through midnight on 16 June.

[d] Daily count of fish identified to species in the weir live box.

APPENDIX E: STAFF GAUGE READINGS FOR 2007 AND 2008

Appendix E1.–Daily river stage average for the South Fork, Anchor River, 2007.

Day	Daily staff gauge readings (cm) [a]				
	May	June	July	August	September
1	75.9	46.0	37.8	36.0	36.6
2	71.3	45.1	38.1	36.0	35.4
3	71.6	46.6	37.2	36.6	35.4
4	75.9	50.6	36.9	36.3	35.7
5	75.6	51.8	36.9	36.6	34.7
6	71.9	47.5	38.1	36.0	34.1
7	73.2	46.3	38.1	40.2	33.8
8	65.2	46.3	37.5	50.3	54.3
9	68.6	46.0	37.8	50.0	64.0
10	67.7	45.7	37.8	49.7	46.3
11	63.1	44.5	40.2	49.4	41.1
12	60.7	44.2	46.9	49.4	53.6
13	60.4	43.9	49.7	42.1	58.2
14	60.0	43.3	47.9	34.4	49.1
15	60.0	42.1	42.4	33.5	44.8
16	64.3	41.5	41.1	36.6	41.5
17	62.8	41.1	39.3	35.1	40.2
18	61.3	41.1	38.4	34.4	41.1
19	54.6	41.1	38.7	34.4	63.7
20	56.7	40.5	38.1	33.5	53.6
21	56.4	39.6	37.2	33.8	46.6
22	54.9	39.6	36.6	34.1	43.9
23	53.6	39.9	40.5	38.7	47.2
24	55.8	42.4	41.5	40.5	-58.8
25	57.9	42.4	41.1	40.8	52.1
26	51.8	40.8	41.1	39.0	48.5
27	49.7	39.3	40.5	36.3	44.5
28	47.9	38.4	39.0	36.0	43.6
29	46.3	38.1	39.6	35.4	43.3
30	47.5	37.5	38.1	34.4	42.7
31	47.5		36.6	36.6	

Source: Ben Balk (USGS) personal communication.

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

Appendix E2.–Daily river stage average for the South Fork, Anchor River, 2008.

Day	Daily staff gauge readings (cm) [a]				
	May	June	July	August	September
1	63.1	69.8	34.7	38.7	47.5
2	67.7	65.2	34.7	36.6	48.8
3	72.5	62.2	34.7	36.0	53.3
4	69.8	61.6	ND	36.3	50.9
5	74.4	66.1	ND	39.3	47.9
6	89.0	60.4	ND	44.5	48.5
7	82.0	58.8	36.9	38.7	55.8
8	84.4	55.8	39.3	36.6	57.3
9	82.3	53.3	36.6	35.1	73.2
10	92.4	51.8	34.4	36.0	59.7
11	95.1	51.2	33.2	36.0	53.9
12	117.3	53.9	32.9	34.1	53.0
13	105.2	55.2	33.2	38.1	57.3
14	96.3	55.5	32.9	38.4	54.9
15	92.7	54.6	32.3	42.4	55.2
16	103.3	50.9	32.6	51.2	67.1
17	93.3	48.5	56.1	45.1	90.2
18	91.4	46.6	52.7	39.6	73.2
19	87.8	44.2	47.9	38.1	69.5
20	86.9	43.6	40.5	ND	74.1
21	92.7	43.0	39.6	ND	65.2
22	92.4	43.0	40.5	57.6	60.0
23	92.0	43.3	54.6	53.9	57.3
24	92.7	41.8	77.1	63.7	71.6
25	86.9	41.5	67.7	50.3	67.7
26	81.4	39.3	58.2	44.2	62.5
27	79.6	39.9	64.6	40.8	60.7
28	78.9	41.8	64.6	41.1	55.5
29	78.3	39.0	52.4	41.5	52.4
30	76.2	36.6	45.4	38.4	50.3
31	74.7		41.8	36.3	

Source: Ben Balk (USGS) personal communication.

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

APPENDIX F: AERIAL SURVEY COUNTS FOR 2007 AND 2008

Appendix F1.–Helicopter index survey of the Chinook salmon escapement, Anchor River, 2007 and 2008.

	Date					
	27 Jul 2007 [a]			1 Aug 2008 [b]		
Location of survey	Live	Dead	Total	Live	Dead	Total
Upstream of index area						
lat 59.807999, long −151.401837 to Orange Bluff	149	3	152	158	0	158
Index area [c]						
Orange Bluff (59.775283, long −151.475500) to Beaver Creek confluence	27	1	28	34	0	34
Beaver Creek to North Fork Road Bridge (Englebretsen bridge)	258	3	261	357	3	360
North Fork Rd Bridge (Englebretsen) to Old Kurka gravel pit site	61	1	62	36	0	36
Old Kurka gravel pit to New Sterling Hwy Bridge (Blackwater Bend)	166	5	171	50	2	52
New Sterling Hwy Bridge (Blackwater Bend) to weir	155	1	156	46	0	46
Sum index count	667	11	678	523	5	528
Total count	816	14	830	681	5	686

[a] Cloud cover: overcast to broken clouds. Glare: shadowing was bad under cottonwoods. Clarity: light murky from Blackwater Bend to Old Sterling Hwy Bridge.

[b] Cloud cover: mostly clear. Glare: poor light conditions downstream from Engerbretson. Clarity: water clarity good.

[c] Index count locations.

APPENDIX G: WATER TEMPERATURE FOR 2007 AND 2008

Appendix G1.–Daily river temperate averages (˚C), Anchor River, 2007.

	Daily temperatures (˚C)																	
	May			June			July			August			September			October		
Day	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
1	ND	ND	ND	6.6	5.9	8.2	11.8	10.2	14.5	13.1	11.9	14.5	11.1	9.0	12.5	6.4	5.6	7.6
2	ND	ND	ND	7.2	5.6	9.0	13.2	10.2	17.1	12.3	11.3	13.1	11.6	10.2	13.3	5.1	4.1	6.2
3	ND	ND	ND	8.4	6.7	10.5	14.0	11.6	16.3	12.6	11.0	14.8	10.4	9.6	11.6	4.5	3.6	5.9
4	ND	ND	ND	8.7	7.3	11.0	14.1	12.2	16.3	12.3	11.6	13.1	10.4	8.7	12.2	3.0	2.7	3.6
5	ND	ND	ND	8.8	7.6	10.2	13.0	12.2	14.2	12.6	11.3	14.8	10.2	7.6	13.3	ND	ND	ND
6	ND	ND	ND	9.2	7.0	11.3	12.6	9.6	15.1	13.6	10.8	17.1	11.1	9.3	13.3	ND	ND	ND
7	ND	ND	ND	8.8	7.0	11.3	12.9	9.6	16.5	13.8	10.5	17.4	10.5	9.6	11.3	ND	ND	ND
8	ND	ND	ND	7.7	6.7	8.7	12.8	11.6	14.5	14.0	10.5	17.7	10.1	9.6	10.5	ND	ND	ND
9	ND	ND	ND	8.1	6.4	10.2	13.1	11.0	15.1	14.4	11.0	18.0	9.8	9.0	10.5	ND	ND	ND
10	ND	ND	ND	10.4	6.7	14.8	12.5	11.6	13.6	13.9	10.5	17.4	9.9	9.0	11.0	ND	ND	ND
11	ND	ND	ND	12.1	9.3	15.4	12.1	10.8	13.9	14.5	11.9	17.4	9.1	8.5	9.9	ND	ND	ND
12	ND	ND	ND	11.0	9.0	13.3	11.4	10.2	13.1	16.0	13.1	20.1	9.0	8.5	9.9	ND	ND	ND
13	ND	ND	ND	11.6	8.2	15.4	11.5	10.2	13.9	16.4	13.1	20.1	8.4	8.2	8.7	ND	ND	ND
14	ND	ND	ND	12.2	8.7	16.0	12.0	10.2	14.5	15.3	13.9	17.1	8.8	7.9	10.2	ND	ND	ND
15	ND	ND	ND	12.9	9.3	16.8	13.5	11.0	16.8	13.9	12.5	16.0	8.1	6.7	9.6	ND	ND	ND
16	ND	ND	ND	14.1	10.5	18.0	13.8	10.5	17.7	13.2	11.9	14.2	7.7	6.4	9.3	ND	ND	ND
17	ND	ND	ND	13.3	11.3	14.8	14.5	11.6	17.4	11.8	9.9	13.3	6.9	5.3	8.7	ND	ND	ND
18	ND	ND	ND	12.0	10.8	13.9	12.9	11.9	14.8	11.6	11.0	12.5	7.4	7.0	7.9	ND	ND	ND
19	ND	ND	ND	13.3	9.6	17.7	12.7	11.0	14.5	12.1	10.5	13.6	8.1	7.3	9.0	ND	ND	ND
20	ND	ND	ND	15.7	11.6	20.1	13.8	10.8	17.7	12.2	11.6	12.8	8.4	7.9	9.3	ND	ND	ND
21	ND	ND	ND	16.4	13.6	19.5	14.6	11.0	18.6	11.6	10.8	12.2	7.4	6.2	8.7	ND	ND	ND
22	8.4	7.6	8.7	14.4	12.5	16.3	12.8	11.6	15.1	10.9	10.5	11.6	6.1	5.0	7.0	ND	ND	ND
23	6.7	6.2	7.6	12.7	11.6	13.9	10.8	10.5	11.6	10.8	9.9	12.2	7.1	6.2	8.5	ND	ND	ND
24	6.5	5.6	7.6	10.7	10.2	11.6	10.4	9.6	11.3	11.0	8.7	13.6	7.6	6.7	8.7	ND	ND	ND
25	5.8	5.3	6.7	10.0	9.3	10.8	10.8	9.9	11.9	11.4	8.7	14.2	7.2	6.4	7.9	ND	ND	ND
26	5.6	4.4	6.7	11.4	8.5	15.4	11.4	10.2	12.8	11.5	9.6	13.9	6.7	5.9	7.6	ND	ND	ND
27	6.2	4.4	7.9	12.1	8.7	15.4	13.1	10.8	16.5	11.3	9.9	12.8	5.5	4.1	7.0	ND	ND	ND
28	6.5	4.7	8.5	12.0	9.9	14.2	14.2	11.0	18.0	12.0	10.5	14.5	5.9	5.3	6.4	ND	ND	ND
29	5.9	4.1	7.6	12.8	8.7	16.8	15.2	11.9	18.6	11.3	8.5	14.5	6.3	5.3	7.3	ND	ND	ND
30	6.8	5.9	7.9	14.2	11.0	18.0	15.2	13.3	16.8	11.4	8.5	14.8	6.4	5.9	7.3	ND	ND	ND
31	6.7	6.2	7.6				14.7	13.1	17.1	11.6	9.0	14.5				ND	ND	ND

Note: "ND" = no data.

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

Appendix G2.–Daily river temperature averages (˚C), Anchor River, 2008.

	Daily temperatures (˚C)																	
	May			June			July			August			September			October		
Day	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
1	1.8	0.8	2.9	7.3	6.4	8.1	12.4	9.2	16.0	13.3	11.3	15.2	10.3	8.8	12.2	3.5	2.2	4.9
2	2.2	1.1	3.8	6.9	6.1	7.8	13.0	9.9	16.4	13.0	11.5	15.2	10.1	9.6	10.9	3.5	2.3	4.7
3	1.7	0.2	2.9	7.4	6.1	9.0	11.8	11.1	13.8	12.3	11.4	13.4	9.7	9.0	10.6	3.2	2.3	4.0
4	1.8	0.8	2.9	7.4	6.7	8.4	11.0	10.1	12.0	11.5	10.9	12.1	10.1	8.9	11.6	3.2	2.4	4.2
5	2.4	1.4	3.5	6.5	5.5	7.5	11.9	10.2	13.9	11.5	10.1	13.7	10.4	9.0	12.2	3.3	2.5	4.2
6	2.0	1.1	2.9	8.2	6.1	11.0	12.1	10.6	13.8	12.2	10.4	14.8	9.5	9.1	10.7	2.4	1.7	3.5
7	2.0	0.8	3.5	9.3	7.2	11.0	11.6	10.5	13.0	13.0	10.5	16.0	8.9	8.6	9.1	2.4	1.4	3.4
8	2.3	1.7	2.9	9.7	8.4	11.6	10.3	9.8	11.6	12.6	9.9	15.7	9.0	8.6	9.5	2.1	1.3	3.1
9	2.9	1.7	4.3	10.5	8.4	13.3	11.4	9.2	14.3	12.5	9.7	15.5	9.1	8.6	9.7	0.9	0.4	1.8
10	3.4	2.0	4.9	10.6	8.4	13.5	12.3	10.6	14.7	12.6	10.6	14.9	9.7	9.1	10.6	2.9	1.8	3.9
11	2.9	2.3	4.1	9.2	8.0	10.7	12.1	10.7	14.0	12.2	10.0	14.2	10.1	9.3	11.2	3.3	3.0	3.7
12	3.1	2.0	4.3	9.3	6.6	12.5	12.6	10.8	14.4	10.9	9.7	12.1	9.9	9.5	10.4	3.4	3.0	3.6
13	3.5	2.0	5.2	9.7	8.7	10.8	11.8	11.1	12.8	11.0	10.2	11.8	9.1	8.8	9.7	2.3	1.9	3.0
14	3.4	2.3	4.6	9.1	7.9	11.0	11.9	10.4	13.7	11.3	10.4	12.4	8.8	8.4	9.3	2.0	1.7	2.5
15	3.9	2.9	5.2	10.0	8.2	12.8	12.4	11.5	13.3	10.9	10.4	11.5	8.8	8.3	9.3	2.6	2.3	3.0
16	3.5	2.3	4.9	11.8	9.0	15.1	11.2	10.7	12.3	10.7	10.0	11.9	8.4	8.0	8.7	2.5	2.2	2.8
17	4.0	1.7	6.4	12.8	9.9	15.9	10.6	9.9	11.9	9.6	8.6	10.5	7.6	7.0	8.0	1.7	1.2	2.3
18	4.0	2.9	5.5	13.1	10.7	16.0	10.9	8.9	13.2	9.4	8.3	10.5	7.9	7.4	8.5	1.0	0.6	1.5
19	4.6	2.9	6.7	11.7	10.5	13.0	12.4	10.4	14.9	10.6	9.1	12.8	7.8	7.0	8.8	1.1	0.6	1.8
20	5.4	2.9	8.1	11.5	9.8	13.9	13.0	11.0	15.6	11.9	9.9	14.5	7.4	6.7	8.4	1.1	0.3	1.7
21	5.7	3.2	8.1	12.2	10.3	14.7	11.6	10.7	12.8	12.2	10.9	13.8	6.6	5.6	7.6	0.9	0.3	1.4
22	6.0	3.5	8.1	11.4	10.2	12.9	10.5	9.6	11.2	11.5	10.6	12.4	5.8	4.6	7.1	ND	ND	ND
23	6.6	4.3	9.0	10.9	9.0	13.3	10.6	9.3	12.1	10.9	10.3	11.7	6.3	5.7	7.0	ND	ND	ND
24	5.4	4.1	7.5	10.1	8.2	11.4	9.7	9.1	10.8	11.0	9.4	13.4	6.7	6.3	7.0	ND	ND	ND
25	5.9	3.5	8.7	10.8	9.2	12.9	9.8	8.9	11.0	11.5	10.5	12.9	7.0	6.5	7.4	ND	ND	ND
26	7.0	4.3	9.6	10.3	9.6	11.4	10.2	9.8	10.7	11.6	9.9	13.7	7.1	6.6	8.0	ND	ND	ND
27	7.6	4.9	10.1	10.2	8.8	12.0	9.9	9.5	10.2	11.0	9.6	12.6	5.8	4.9	6.8	ND	ND	ND
28	8.3	5.5	11.0	10.7	9.2	12.3	10.1	8.0	12.1	11.4	10.1	13.4	4.7	3.6	5.9	ND	ND	ND
29	8.5	6.7	10.4	11.6	9.2	14.5	11.4	9.4	13.5	11.0	8.9	13.3	4.4	3.6	5.2	ND	ND	ND
30	8.9	6.7	11.3	11.8	8.5	15.3	12.7	11.0	15.1	10.4	8.4	12.5	4.1	3.1	5.4	ND	ND	ND
31	8.4	7.8	9.8				13.6	11.4	16.4	9.9	9.1	10.8				ND	ND	ND

Note: "ND" = no data.

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