Fishery Data Series No. 14-56

Chinook Salmon Escapement in the Chena, Salcha, and Goodpaster Rivers and Coho Salmon Escapement in the Delta Clearwater River, 2013

by

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and

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December 2014

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)

Measures (fisheries)

fork length	FL
mideye-to-fork	MEF
mideye-to-tail-fork	METF
standard length	SL
total length	TL

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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December 2014

Development and publication of this manuscript were partially financed by the Federal Aid in Sport fish Restoration Act(16 U.S.C.777-777K) under Project F-10-17 and 18, Job No. S-3-1(a)

ADF&G Fishery Data Series was established in 1987 for the publication of Division of Sport Fish technically oriented results for a single project or group of closely related projects, and in 2004 became a joint divisional series with the Division of Commercial Fisheries. Fishery Data Series reports are intended for fishery and other technical professionals and are available through the Alaska State Library and on the Internet: http://www.adfg.alaska.gov/sf/publications/. This publication has undergone editorial and peer review.

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This document should be cited as:
Savereide, J. W., and J. Huang. 2014. Chinook salmon escapement in the Chena, Salcha, and Goodpaster rivers and coho salmon escapement in the Delta Clearwater River, 2013. Alaska Department of Fish and Game, Fishery Data Series No. 14-56, Anchorage.

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ABSTRACT

In 2013, salmon enumeration projects in the Tanana river drainage were conducted by the Alaska Department of Fish and Game (ADF&G) on the Chena and Delta Clearwater rivers. The enumeration projects on the Salcha and Goodpaster rivers were conducted by Bering Sea Fishermen's Association and Tanana Chiefs Corporation, respectively. Chinook salmon *Oncorhynchus tshawytscha* escapement for the Chena, Salcha, and Goodpaster rivers was estimated using tower-based counting techniques and coho salmon *O. kisutch* escapement in the Delta Clearwater River was estimated by visual boat survey at peak escapement. This report details work conducted by ADF&G on the Chena and Delta Clearwater rivers and serves as an archive for count data collected on the Salcha and Goodpaster rivers.

For the Chena River, the estimated escapements were 1,859 (SE=141) Chinook salmon and 21,372 (SE=547) chum salmon *O. keta*. Chinook salmon escapement was below the escapement goal of 2,800–5,700. The dominant age classes were age 1.2 (49%) for males and age 1.4 (82%) for females. The estimated proportion of females in the Chena River escapement was 0.39 (SE=0.03), and the proportion adjusted for gender-bias was 0.28 (SE=0.06). The mean length of females in the Chena River escapement was 811 mm (SE=10), and the mean length of males was 656 mm (SE=10).

For the Delta Clearwater River, the peak escapement count of coho salmon was 6,222. The count was within the range of the escapement goal of 5,200–17,000.

For the Salcha River, the estimated escapement of Chinook salmon was 5,465 (SE=282). Age, sex, and length compositions are provided. Escapement was within the range of the escapement goal of 3,300-6,500. The minimum estimate of chum salmon escapement was 60,980 (SE=952).

For the Goodpaster River**,** the estimated escapement of Chinook salmon was 723 (SE=44).

Key words: Chinook salmon, *Oncorhynchus tshawytscha,* chum salmon, *O. keta*, coho salmon, *O. kisutch*, Chena River, Delta Clearwater River, Salcha River, Goodpaster River, counting tower, escapement.

INTRODUCTION

The primary purpose of this report is to present findings from salmon escapement enumeration projects in the Tanana river drainage conducted by ADF&G-Sport Fish Division (ADF&G-SF) during 2013. These projects included a counting tower enumeration project on the Chena River to estimate total escapement of Chinook salmon *Oncorhynchus tshawytscha* and partial escapement of chum salmon *O. keta* and a roving boat survey count to estimate escapement of coho salmon *O. kisutch* in the Delta Clearwater River. The main body of this report details methodologies and results from these two assessment projects.

Secondarily, this report presents data summaries and estimates of escapement of Chinook salmon from counting tower projects conducted during 2013 by Bering Sea Fisherman's Association (BSFA) on the Salcha River and by Tanana Chiefs Conference (TCC) on the Goodpaster River. Information from these two projects is in this report at the request of BSFA and TCC as a means of archiving the count data and escapement estimates in a publication that is easily accessible by stakeholders and other researchers. Information pertinent to the Salcha and Goodpaster rivers enumeration studies are found in Appendix A and Appendix B, respectively.

The Chena and Salcha rivers support the largest spawning populations of Chinook salmon on the Alaskan side of the Yukon River drainage, while the Delta Clearwater River (DCR) supports the largest spawning population of coho salmon in the entire Yukon River drainage. The Goodpaster, Chatanika, and Nenana rivers also support important spawning populations of Chinook and coho salmon.

The *Policy for the Management of Sustainable Salmon Fisheries* (SSFP; 5 AAC 39.222, 2001) directs the Alaska Department of Fish and Game (ADF&G) to provide the Alaska Board of Fisheries (BOF) with reports on the status of salmon stocks and identify any salmon stocks that present a concern related to yield, management, or conservation. In 2000, the BOF classified Yukon Chinook salmon as a stock of yield concern. A stock of yield concern is defined as "a concern arising from a chronic inability, despite the use of specific management measures, to maintain expected yields, or harvestable surpluses, above a stock's escapement needs" (5 AAC 39.222(f)(42)).

Also in 2000, in response to the BOF's designation, a management plan (*Yukon River King Salmon Management Plan* 5AAC 05.360) and biological escapement goals (BEGs) of 2,800–5,700 Chinook salmon in the Chena River and 3,300–6,500 in the Salcha River were established by ADF&G in attempts to provide for maximum sustained yield. In contrast, a sustainable escapement goal (SEG) of 5,200–17,000 coho salmon in the Delta Clearwater River (DCR) was established because the spawner-recruit information required to establish a BEG was not available. There are currently no escapement goals for any salmon stocks in the Chatanika, Goodpaster, or Nenana rivers.

In 2001, the BOF directed ADF&G to manage Chinook and coho salmon harvests so that escapements fall within the BEGs and SEG. Currently the Yukon River Chinook salmon fisheries (commercial, subsistence, personal-use, and sport) are managed under the *Yukon River King Salmon Management Plan* (5 AAC 05.360), and the Chena and Salcha stocks are also managed under the *Chena and Salcha River King Salmon Sport Harvest Management Plan* (5 AAC 74.060). The combined plans manage the commercial, subsistence, personal-use, and sport fisheries through fishery gear, bag limit, and timing restrictions to achieve the established escapement goals first and then the amount necessary for subsistence (ANS) throughout the entire Alaskan portion of the Yukon River drainage.

Direct commercial gillnet (drift and set) fisheries for Chinook salmon have not taken place since 2007. Commercial harvests show a substantial decrease in average yield from 100,000 fish during the 10-year historical period of high production (1989–1998) to the recent 5-year (2008–2012) average of approximately 3,000 (Schmidt and Newland 2012). Currently, the commercial harvest of coho salmon takes place during commercial openings for fall chum salmon. The plan allows for commercial fishing of coho salmon when fall chum runs are in excess of 550,000 fish. The 5-year average (2004–2008) was 44,750 fish.

Subsistence and personal-use gillnet (drift and set) and fish wheel fisheries take place throughout the Yukon and Tanana River drainages. During 2007–2011, Chinook salmon harvests were within the established ANS (45,500–66,704) only 1 out of 5 years. Prior to 2008, annual subsistence harvest had remained relatively stable near 50,000 Chinook salmon (Schmidt and Newland 2012). The 5-year (2004-2008) average harvest of subsistence and personal-use coho salmon was 21,277 fish (Borba et al. 2009).

The Chena River Chinook salmon sport fishery takes place in the Chena River downstream from all spawning areas. The 5-year (2007–2011) average sport catch of Chinook salmon in the Chena River was 795 fish and the corresponding average harvest was 151 fish (Jennings et al. 2009a-b, 2010a-b, 2011a-b; Romberg et al. *In prepa-b*).The recent 5-year (2007–2011) average sport catch of Chinook salmon in the Salcha River was 947 fish and the corresponding average harvest was 268 fish (Jennings et al. 2009a-b, 2010a-b, 2011a-b; Romberg et al. *In prepa-b*).Sport fishing on the Goodpaster River was opened in 2007 but limited to catch and release only. In 2007-2008 and 2010, the reported sport catch was zero. In 2009, the sport catch was 104 fish (Jennings et al. 2009a-b, 2010a-b, 2011a-b; Romberg et al. *In prepa-b*). The 5-year (2007–2011) average sport catch of coho salmon in the Delta Clearwater River was 2,994 fish, and the corresponding average harvest was 195 fish (Jennings et al. 2009a-b, 2010a-b, 2011a-b; Romberg et al. *In prepa-b*).

To determine whether or not the established escapement goals were met, counting tower techniques were used to enumerate the Chinook salmon escapements in the Chena, Salcha, and Goodpaster rivers whereas visual boat surveys were used to estimate coho escapement in the Delta Clearwater River. The monitoring programs provide information on run magnitude and timing, which allows managers to modify fishing regulations to achieve the established escapement goals.

OBJECTIVES

The objectives in 2013 were as follows:

1. estimate the total escapement of Chinook salmon in the Chena River using tower-based counting techniques;
2. estimate age, sex, and length compositions of the escapement of Chinook salmon in the Chena River; and
3. count coho salmon in the Delta Clearwater River to obtain a count of the minimum escapement.

In addition to the objectives there was 1 task:

1. count chum salmon in the Chena River throughout the duration of the Chinook salmon run.

METHODS

CHENA RIVER CHINOOK SALMON

In 2013, daily escapements of Chinook and chum salmon were estimated by visually counting fish from a scaffolding tower on the north bank of the river just upstream from the Moose Creek dam (Figure 1). Lights were suspended over white fabric panels that were attached to the river bottom to provide illumination during periods of low ambient light. Counting began on or about 25 June and continued into August until there wer 3 continuous days with no net upstream passage of Chinook salmon. Virtually all Chinook salmon spawning occurs upstream of this site and no harvest of salmon is allowed upstream of the dam, so final estimates represent the total escapement.

Five technicians were assigned to enumerate the salmon escapement in the Chena River. Each day was divided into three 8-hour shifts. Shift I began at 0000 hours (midnight) and ended at 0759 hours; Shift II began at 0800 hours and ended at 1559 hours; Shift III began at 1600 hours and ended at 2359 hours. The start time for all counts began between the top of the hour and 10 minutes past.

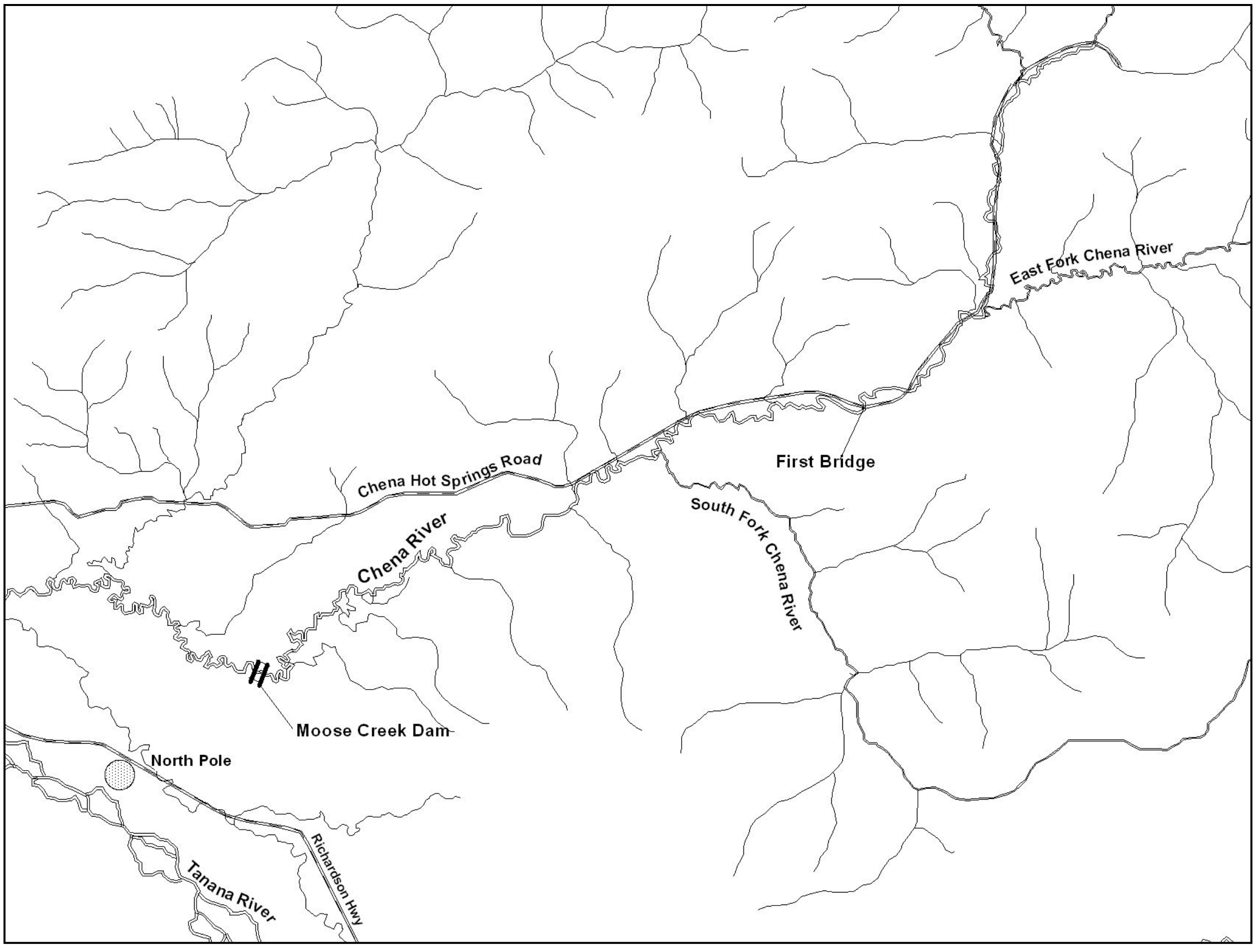

Figure 1.–Map of the Chena River demarcating the Moose Creek Dam and the first bridge on Chena Hot Springs Road.

The project was designed to count all salmon passing upstream and downstream throughout the whole river for 20 minutes every hour over the course of the run. The numbers of Chinook and chum salmon were recorded on field forms at the end of each 20-minute count. In addition, the technician would evaluate and record the water clarity conditions (Table 1), as well as the river height from a staff gauge mounted on the dam. Only counts with a rank of 3 or higher were used in the estimate of escapement. A count with a rank of 4 or 5 was considered as no count. Each day, the data sheets from the previous day were returned to the project leader at the end of Shift I.

In 2007, a Dual-frequency Identification Sonar system (DIDSON; Model 300 Sound Metrics Corp., Lake Forest Park, WA) was deployed at the tower site, and a mixture model based on length was used to allocate the total count of salmon passing the sonar into numbers of Chinook and chum salmon. Results were compared to actual tower counts and suggested this methodology was an appropriate means to estimate passage when conditions prohibited tower counts.

In 2011, the sonar system was downstream of the Moose Creek Dam on both sides of the river to estimate the number of migrating salmon during periods of high-water (> 2 consecutive days) when tower counts could be completed. In 2013, two DIDSON sonar units were deployed just upstream of the counting panels and used to enumerate migrating fish. The objective was to position each sonar so it could record images from each half of the river, 24 hours a day, 7 days a week. Previous tower counts have shown that the majority of Chinook salmon migrate up the north side of the river at the tower site, but that is likely due to a deeper channel located on that side of the river. Both DIDSON sonar units were mounted to a portable aluminum tripod that was moved manually to adjust for water depth. Small weir structures were deployed at each site to ensure migrating salmon passed through the sonar beam.

In addition to the tower counts, carcasses of spawned-out Chinook salmon were collected during the first 2 weeks of August from the dam upriver to the second bridge (Figure 1) to estimate age, sex, and length composition of the escapement. Ages were determined from scale patterns as described by Mosher (1969). Three scales were removed from the left side of the fish approximately 2 rows above the lateral line along a diagonal line downward from the posterior insertion of the dorsal fin to the anterior insertion of the anal fin (Welander 1940). If no scales were present in the preferred area due to decomposition, scales were removed from the same area on the right side of the fish or, if necessary, from any location where there were scales remaining other than along the lateral line.

Two riverboats with a minimum of 3 people in each boat (1 operator and 2 people collecting carcasses) were used to collect Chinook salmon carcasses. Chinook salmon carcasses were speared from the boats and collected along banks and gravel bars. All deep pools and eddies that could be safely explored were inspected to find and sample as many Chinook salmon carcasses as possible. After collection, the carcasses were placed in a large tub onboard the boat. Once the tub was full, the boat would land on a gravel bar and the carcasses were laid out in rows of 10 with their left sides facing up. After sampling, all carcasses were cut in a distinctive manner through the left side of the fish to avoid resampling and returned to the river.

Delta Clearwater River Coho Salmon

Previous aerial surveys of the Delta Clearwater river drainage have shown that an average of 20% of the coho escapement is found in areas inaccessible to a boat survey; therefore, counts of adult coho salmon were conducted to obtain a minimum estimate of escapement. This estimate was used to evaluate whether or not the SEG was met.

Two persons (a boat operator and a counter) conducted the survey from a drifting river boat equipped with a 5-foot elevated platform. The survey was typically done during peak spawning times over the course of 1 to 2 days. The survey was conducted along the lower 18 miles of the Delta Clearwater River to within 1 mile of the Clearwater Lake outlet (Figure 2). The total number of coho salmon observed (both dead and

Table 1.–Water clarity classification.

Rank	Description	Salmon Viewing	Water Condition
1	Excellent	All passing salmon are observable	Virtually no turbidity or glare, “drinking water” clarity; all routes of passage observable
2	Good	All passing salmon are observable	Minimal to moderate levels of turbidity or glare; all routes of passage observable
3	Fair	Possible, but not likely, that some passing salmon may be missed	Moderate to high levels of turbidity or glare; a few likely routes of passage are partially obscured
4	Poor	Likely that some passing salmon may be missed	Moderate to high levels of turbidity or glare; some-many likely routes of passage are obscured
5	Un-observable	Passing fish are not observable	High level of turbidity or glare; ALL routes of passage obscured

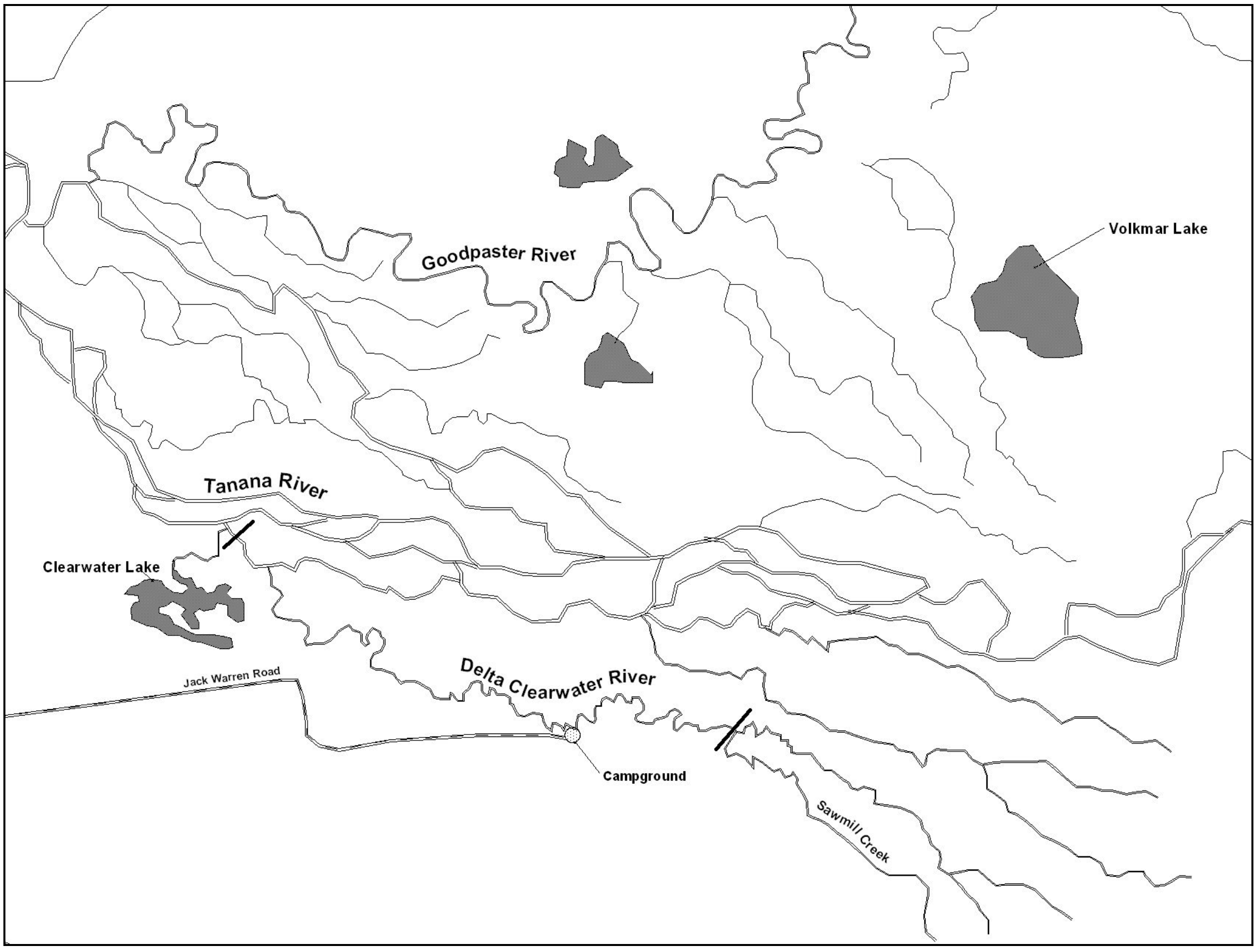

Figure 2.–Map of the Delta Clearwater River demarcating the survey area (bold lines).

alive) were recorded every mile at mile markers posted on the river bank. The sum of the section counts equals the estimate of minimum escapement.

DATA ANALYSIS (CHENA RIVER CHINOOK SALMON)

Estimates of Chinook salmon escapement were stratified by day. Daily estimates of escapement were considered a 2-stage direct expansion where the first stage was 8-hour shifts within a day and the second stage was counting periods within a shift. The second stage was considered systematic sampling because the counting periods were not chosen randomly.

The formulas necessary to calculate escapement from counting tower data were taken directly or modified from those provided in Cochran (1977). The expanded shift escapement on day *d* and shift *i* was calculated as follows:

$$Y_{di} = \frac{M_{di}}{m_{di}} \sum_{j=1}^{m_{di}} y_{dij} . \tag{1}$$

The average shift escapement for day *d* would be

$$\overline{Y}_d = \frac{\sum_{i=1}^{h_d} Y_{di}}{h_d} . \tag{2}$$

The following criteria were established to determine the methods used to estimate the daily escapement and its variance:

1. when 2 or more shifts were considered complete, escapement and variance was estimated using Equations 3-8;
2. when counts were only conducted during 1 shift but all 8 counting periods were sampled, escapement was estimated using Equation 3 and variance was estimated by back-calculating using Equation 11; and,
3. when no shifts were considered complete, interpolation techniques described in Equations 12 and 13 were used to estimate escapement and back-calculating using Equation 11 was used to estimate variance.

A minimum of 4 counting periods per shift was required for a complete shift. Counts were conducted during all scheduled counting periods unless water clarity conditions prohibited counts.

The expanded daily escapement was

$$\hat{N}_d = \overline{Y}_d H_d . \tag{3}$$

The period sampled was systematic because a period was sampled every hour in a shift. The sample variance associated with periods would be approximate using the successive difference approach:

$$s_{2di}^2 = \frac{1}{2(m_{di} - 1)} \sum_{j=2}^{m_{di}} \left(y_{dij} - y_{di(j-1)} \right)^2 . \tag{4}$$

Shift sampling was random. The between-shift sample variance was calculated as follows:

$$s_{1d}^2 = \frac{1}{h_d - 1} \sum_{i=1}^{h_d} \left(Y_{di} - \overline{Y}_d \right)^2 . \tag{5}$$

The variance for the expanded daily escapement was estimated as follows:

$$\hat{V}\left(\hat{N}_d\right) = \left[\left(1 - f_{1d}\right) H_d^2 \frac{s_{1d}^2}{h_d} \right] + \left[\frac{1}{f_{1d}} \sum_{i=1}^{h_d} \left(\left(1 - f_{2di}\right) M_{di}^2 \frac{s_{2di}^2}{m_{di}} \right) \right] \tag{6}$$

where:

$$f_{1d} = \frac{h_d}{H_d} \text{; and,} \tag{7}$$

$$f_{2di} = \frac{m_{di}}{M_{di}} \tag{8}$$

and

d = day;

i = 8-hour shift;

j = 20-minute counting period;

y_{dij} = the observed 20-minute period count;

Y_{di} = expanded shift escapement;

m_{di} = number of 20-minute counting periods sampled within a shift;

M_{di} = total number of possible 20-minute counting periods within a day (24 would indicate a full day);

h_d = number of 8-hour shifts sampled within a day;

H_d = total number of possible 8-hour shifts within a day; and,

D = total number of possible days.

Total escapement and variance was estimated as follows:

$$\hat{N} = \sum_{d=1}^{D} \hat{N}_d \text{ ; and,} \tag{9}$$

$$\hat{V}\left(\hat{N}\right) = \sum_{d=1}^{D} \hat{V}(\hat{N}_d)\,. \tag{10}$$

Equation 5, the sample variance across shifts, required data from more than 1 shift per day. In the event that water conditions and/or personnel constraints did not permit at least 2 shifts during a day, a coefficient of variation (*CV*) was calculated using all days when more than 1 shift was worked. The average *CV* was used to approximate the daily variation for those days when fewer than 2 shifts were worked. The *CV* was used because it was independent of the magnitude of the estimate and was relatively constant throughout the run (Evenson 1995). The daily *CV* was calculated as follows:

$$CV_d = SE_d \big/ \hat{N}_d\ . \tag{11}$$

When *k* consecutive days were not sampled due to adverse viewing conditions, the moving average estimate for the missing day *i* was calculated as follows:

(12)

where

$$I(\cdot) = \begin{cases} 1 & \text{when the condition is true} \\ 0 & \text{otherwise} \end{cases} \tag{13}$$

was an indicator function. The moving average procedure was only applied to data gaps that do not exceed 2 days (12 consecutive shifts).

Gender bias has been noted when comparing sex ratios of Chinook salmon collected during carcass surveys with those collected by electrofishing for a mark-recapture experiment (Stuby 2001). An analysis of data from previous years when both sampling procedures were used was completed to determine an adjustment to account for this bias. The adjustment was based on paired electrofishing and carcass survey data from the Chena River (1989-1992, 1995-1997, and 2000).

The escapement estimate was apportioned by sex prior to apportioning by age categories within each sex. Estimates of the proportion of females and males in the escapement based on carcass surveys were adjusted to estimate what would have been observed from an electrofishing sample. The estimated proportions of males and females from carcass surveys were calculated using (Cochran 1977) the following formula:

$$\hat{p}_{sc} = \frac{y_{sc}}{n_c}; \tag{14}$$

with variance

$$\hat{V}\left[\hat{p}_{sc}\right] = \frac{\hat{p}_{sc}\left(1-\hat{p}_{sc}\right)}{n_c - 1}; \tag{15}$$

where y_{sc} was the number of salmon of sex s observed during carcass surveys and n_c was the total number of salmon of either sex observed during carcass surveys for $s = m$ or f.

The adjustment necessary to compensate for the gender bias when no electrofishing was conducted was $\hat{R}_p$ = 0.708 with $\hat{V}(\hat{R}_p)$ = 0.018.

The bias-adjusted estimate and variance (Goodman 1960) of the proportion of females, $\tilde{p}_{fe}$, was

$\tilde{p}_{fe} = \hat{p}_{fc}\hat{R}_p$ with variance

$$\hat{V}(\tilde{p}_{fe}) = \hat{p}_{fc}^2\hat{V}(\hat{R}_p) + \hat{R}_p^2\hat{V}(\hat{p}_{fc}) - \hat{V}(\hat{R}_p)\hat{V}(\hat{p}_{fc}). \quad (16)$$

The estimate and variance of the proportion of males observable during electrofishing were

$\tilde{p}_{me} = 1 - \tilde{p}_{fe}$ and $\hat{V}(\tilde{p}_{me}) = \hat{V}(\tilde{p}_{fe})$.

Escapement of each sex was then estimated by

$$\hat{N}_s = \tilde{p}_{se}\hat{N} \quad (17)$$

The variance for $\hat{N}_s$ in this case was (Goodman 1960)

$$\hat{V}\left(\hat{N}_s\right) = \hat{V}\left(\tilde{p}_{se}\right)\hat{N}^2 + \hat{V}\left(\hat{N}\right)\tilde{p}_{se}^2 - \hat{V}\left(\tilde{p}_{se}\right)\hat{V}\left(\hat{N}\right). \quad (18)$$

Typically, the aging system for salmon includes the number of freshwater and ocean years of residence. For example, age 1.2 symbolizes 1 year of freshwater residence and 2 years in the ocean.

The proportion of fish at age *k* by sex *s* for samples collected solely for age, sex, and length was calculated as

$$\hat{p}_{sk} = \frac{y_{sk}}{n_s} \quad (19)$$

where $\hat{p}_{sk}$ = the estimated proportion of Chinook salmon that were age *k*; y_{sk} = the number of Chinook salmon sampled that were age *k*; and, n_s = the total number of Chinook salmon sampled.

The variance of this proportion was estimated as

$$\hat{V}\left[\hat{p}_{sk}\right] = \frac{\hat{p}_{sk}\left(1 - \hat{p}_{sk}\right)}{n_s - 1} \quad (20)$$

Escapement at age *k* for each sex was then estimated by

$$\hat{N}_{sk} = \hat{p}_{sk}\hat{N}_s \quad (21)$$

The variance for $\hat{N}_{sk}$ in this case was (Goodman 1960)

$$\hat{V}\left(\hat{N}_{sk}\right) = \hat{V}\left(\hat{p}_{sk}\right)\hat{N}_s^{\,2} + \hat{V}\left(\hat{N}_s\right)\hat{p}_{sk}^2 - \hat{V}\left(\hat{p}_{sk}\right)\hat{V}\left(\hat{N}_s\right). \quad (22)$$

RESULTS

CHENA RIVER CHINOOK SALMON

The Chena River counting tower was in operation from 8 July through 4 August. The estimated escapement of Chinook salmon was 1,859 (SE=141), which is lower than the established BEG and the lowest recorded since 1986 (Tables 2 and 3, Figure 3). The estimated chum salmon escapement was 21,372 (SE=547), which was considered a minimum estimate because tower counts were terminated before the chum salmon run was completed (Table 4).

Run timing patterns past the counting tower (Figure 4) were described by the day of the run to facilitate comparison among years (i.e., Day 1 equals the first Chinook salmon passing upriver during a scheduled count). The pattern observed over all available years (1997–1999, 2001, 2003–2004, 2006–2010, 2012–2013) illustrates the average magnitude and span of the run.

Recorded DIDSON images of migrating salmon were collected from 8 July through 4 August. A high water event from 22 July through 23 July prevented tower counts, but this data gap was less than 2 days, and the moving average estimator was used to estimate the daily escapements.

Carcass surveys began on 6 August and ended on 14 August. A total of 211 Chinook salmon carcasses were sampled for ASL data. Of the 211 carcasses sampled, 3 could not be sexed and 35 could not be aged (Table 5).

The sex composition of the escapement was 0.39 (SE=0.03) for females and 0.61 (SE=0.03) for males (Table 5). The sex composition adjusted for gender bias was 0.28 (SE=0.06) for females and 0.72 (SE=0.06) for males.

The age and length composition of the escapement was determined for each sex (Tables 6 and 7). The dominant age classes were age 1.2

Table 2.–Daily estimates of Chena River Chinook salmon escapement, 2013.

Date	Number of 20-minute counts	Number of salmon counted	Daily escapement[a]	Daily SE
8-Jul	8	0	0	0.0
9-Jul	24	0	0	0.0
10-Jul	24	0	0	0.0
11-Jul	0	0	0	0.0
12-Jul	0	0	0	0.0
13-Jul	0	0	0	0.0
14-Jul	0	0	0	0.0
15-Jul	14	1	6	2.4
16-Jul	24	31	93	21.8
17-Jul	24	27	81	16.5
18-Jul	24	33	99	21.8
19-Jul	24	103	309	37.5
20-Jul	24	36	108	17.6
21-Jul	16	27	122	53.8
22-Jul	0	0	150	61.0
23-Jul	0	0	191	77.7
24-Jul	16	49	221	38.4
25-Jul	24	77	231	45.1
26-Jul	24	26	78	16.8
27-Jul	24	8	24	6.1
28-Jul	24	6	18	6.9
29-Jul	24	24	72	18
30-Jul	24	12	36	10
31-Jul	24	1	3	3
1-Aug	24	4	12	5
2-Aug	24	-1	-3	4
3-Aug	24	1	3	3
4-Aug	24	2	6	4
Total		467	1,859	141

[a] Shaded cells indicate days estimated using the moving average estimator due to water clarity.

Table 3.–Estimates of the Chena River Chinook salmon escapement, 1986–2013.

	Escapement		
Year	Estimate	SE	Method
1986	9,065	1,080	Mark-Recapture
1987	6,404	557	Mark-Recapture
1988	3,346	556	Mark-Recapture
1989	2,730	249	Mark-Recapture
1990	5,603	1,164	Mark-Recapture
1991	3,172	282	Mark-Recapture
1992	5,580	478	Mark-Recapture
1993	12,241	387	Counting Tower
1994	11,877	479	Counting Tower
1995	11,394	1,210	Mark-Recapture
1996	7,153	913	Mark-Recapture
1997	13,390	699	Counting Tower
1998	4,745	503	Counting Tower
1999	6,485	427	Counting Tower
2000	4,694	1,184	Mark-Recapture
2001	9,696	565	Counting Tower
2002	6,967	2,466	Mark-Recapture
2003	11,100	653	Counting Tower
2004	9,645	532	Counting Tower
2005	-	-	-
2006	2,936	163	Counting Tower
2007	3,806	226	Counting Tower
2008	3,208	198	Counting Tower
2009	5,253	231	Counting Tower
2010	2,382	152	Counting Tower
2011	-	-	-
2012	2,220	127	Counting Tower
2013	1,859	141	Counting Tower

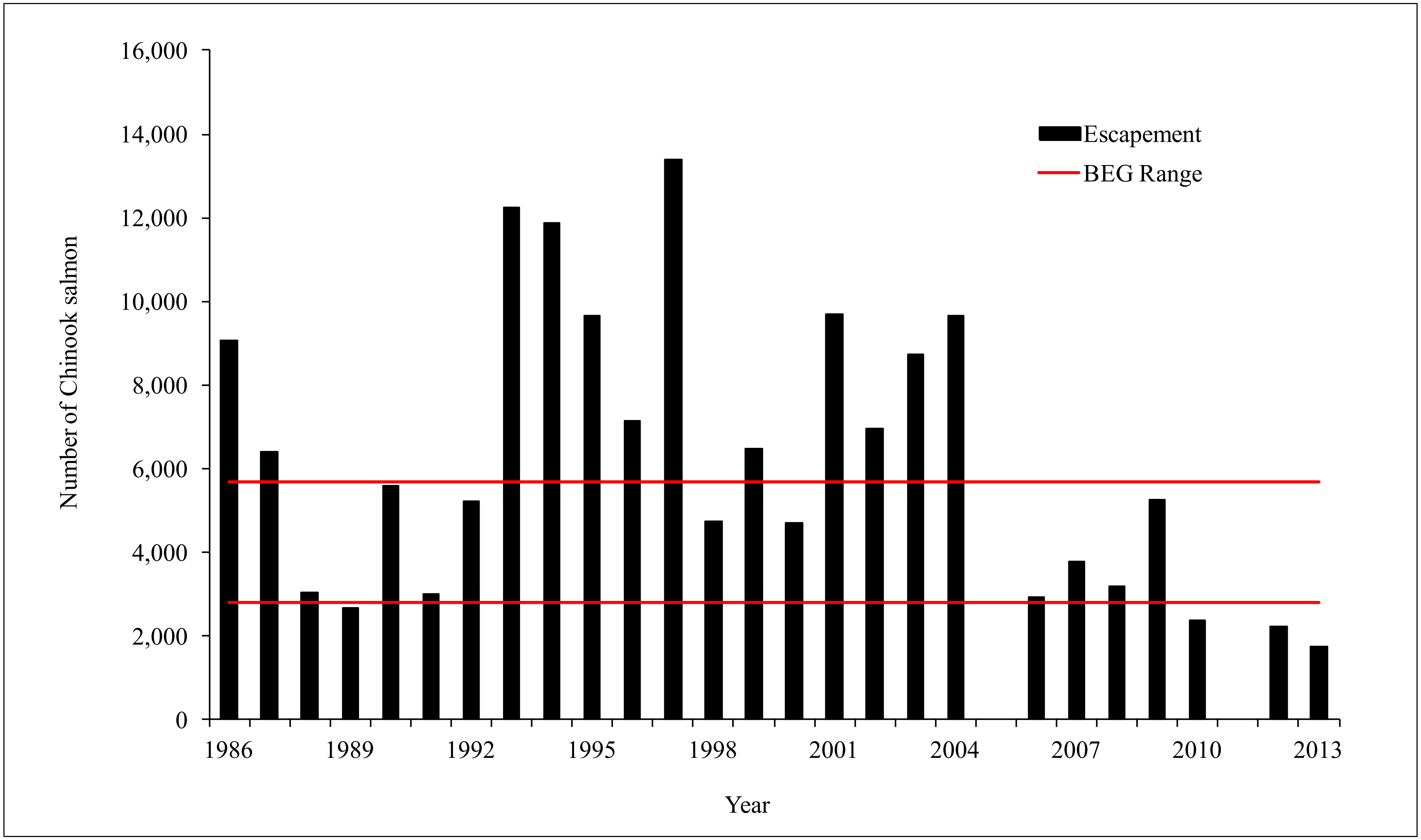

Figure 3.–Estimates of Chinook salmon escapements to the Chena River and the respective BEG, 1986-2013.

Table 4.–Daily estimates of Chena River chum salmon escapement, 2013.

Date	Number of 20-minute counts	Number of salmon counted	Daily escapement	Daily SE
8-Jul	8	0	0	0.0
9-Jul	24	0	0	0.0
10-Jul	24	0	0	0.0
11-Jul	0	0	0	0.0
12-Jul	0	0	0	0.0
13-Jul	0	0	0	0.0
14-Jul	0	0	0	0.0
15-Jul	14	0	0	0.0!
16-Jul	24	34	102	30.0
17-Jul	24	61	183	40.7
18-Jul	24	68	204	38.7
19-Jul	24	102	306	48.6
20-Jul	24	184	552	73.8
21-Jul	16	117	527	99.0
22-Jul	0	0	640	85.6
23-Jul	0	0	713	95.3
24-Jul	16	187	842	132.2
25-Jul	24	257	771	102.3
26-Jul	24	400	1,200	93.4
27-Jul	24	323	969	103.6
28-Jul	24	496	1,488	164.5
29-Jul	24	629	1,887	193.9
30-Jul	24	783	2,349	153.1
31-Jul	24	769	2,307	177.3
1-Aug	24	482	1,446	129.0
2-Aug	24	600	1,800	132.7
3-Aug	24	461	1,383	179.5
4-Aug	24	568	1,704	165.2
Total		6,521	21,372	547

[a] Shaded cells indicate days estimated using the moving average estimator due to water clarity.

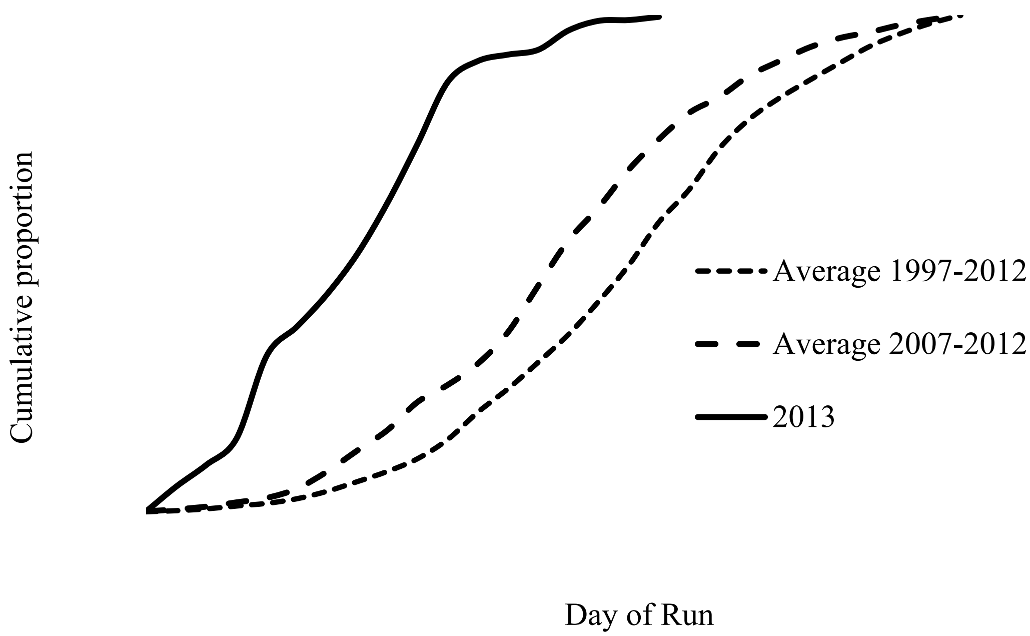

Figure 4.–Average run timing pattern for Chena River Chinook salmon past the counting tower by day of run over all years (1997–1999, 2001, 2003–2004, and 2006–2010, 2012), the last 5 years (2007–2010, 2012), and 2013.

Table 5.–Estimated proportions of male and female Chinook salmon sampled from carcass surveys on the Chena River, 1986–2013.

	Sexed				Sexed and Aged				Adjusted			
	Sample size		Sample proportion[a]		Sample size		Sample proportion[a]		Sample proportion[b]		Total	
Year	Males	Females	Males	Females	Males	Females	Males	Females	Males	Females	Escapement	Method[c]
1986	987	365	0.73	0.27	538	183	0.75	0.25	0.75	0.25	9,065	MR
1987	438	592	0.43	0.57	235	325	0.42	0.58	0.52	0.48	6,404	MR
1988	347	543	0.39	0.61	183	285	0.39	0.61	0.66	0.34	3,346	MR
1989	119	218	0.35	0.65	101	187	0.35	0.65	0.55	0.45	2,730	MR
1990	291	258	0.53	0.47	291	258	0.53	0.47	0.64	0.36	5,603	MR
1991	231	108	0.68	0.32	231	108	0.68	0.32	0.68	0.32	3,172	MR
1992	289	176	0.62	0.38	289	176	0.62	0.38	0.78	0.22	5,580	MR
1993	205	38	0.84	0.16	156	31	0.83	0.17	0.88	0.12	12,241	CT
1994	326	275	0.54	0.46	281	231	0.55	0.45	0.68	0.32	11,877	CT
1995	305	593	0.34	0.66	267	520	0.34	0.66	0.48	0.52	11,394	MR
1996	286	229	0.56	0.44	286	229	0.56	0.44	0.73	0.27	7,153	MR
1997	424	278	0.60	0.40	424	278	0.60	0.40	0.74	0.26	10,810	MR
1998	160	107	0.60	0.40	134	94	0.59	0.41	0.72	0.28	4,745	CT
1999	75	133	0.36	0.64	61	116	0.34	0.66	0.55	0.45	6,485	CT
2000	113	56	0.67	0.33	99	50	0.66	0.34	0.78	0.22	4,694	MR
2001	342	253	0.57	0.43	292	229	0.56	0.44	0.70	0.30	9,696	CT
2002	277	216	0.56	0.44	207	167	0.55	0.45	0.73	0.27	6,967	MR
2003	253	206	0.55	0.45	204	166	0.55	0.45	0.68	0.32	11,100[d]	CT
2004	98	160	0.38	0.62	88	151	0.37	0.63	0.56	0.44	9,645	CT
2005	352	268	0.57	0.43	319	234	0.58	0.42	0.69	0.31	-	CT
2006	221	183	0.55	0.45	196	166	0.54	0.46	0.68	0.32	2,936	CT
2007	51	32	0.61	0.39	36	26	0.58	0.42	0.74	0.26	3,806	CT
2008	26	18	0.59	0.41	20	16	0.56	0.44	0.71	0.29	3,208	CT
2009	209	272	0.43	0.57	198	244	0.45	0.55	0.60	0.40	5,253	CT
2010	132	54	0.71	0.29	56	25	0.69	0.31	0.79	0.21	2,382	CT
2011	331	156	0.68	0.32	292	135	0.68	0.32	0.77	0.23	-	-
2012	107	132	0.44	0.56	88	110	0.44	0.56	0.61	0.39	2,220	CT/S
2013	127	81	0.61	0.39	105	71	0.60	0.40	0.72	0.28	1,859	CT
Average	283	231	0.55	0.45	203	172	0.55	0.45	0.68	0.32	6,239	

[a] Estimated proportions were all derived from carcass samples.

[b] In years when counting tower assessments (CT) were conducted and only carcass surveys were conducted, proportions of males and females were adjusted using the methods shown in Appendix A. In years when mark-recapture experiments (MR) were conducted, proportions of males and females were estimated as the ratio of the abundance estimate of each gender to the abundance estimate of all fish.

[c] Escapement estimates were obtained from either a counting tower (CT) assessment, sonar images, or a mark-recapture (MR) project.

[d] Estimate includes an expansion for missed counting days. Minimum documented abundance with large gaps in counts due to flooding, was 8,739 (SE=653) fish.

Table 6.–Estimated proportions and mean length by age and sex of Chinook salmon sampled during the Chena River carcass survey, 2013.

	Sample	Sample	Length (mm)			
Age[a]	Size	Proportion	Mean	SE	Min	Max
Males						
1.1	2	0.02	390	40	350	430
1.2	51	0.49	533	6	450	610
1.3	27	0.26	722	9	620	790
2.2	0	0.00	-	-	-	-
1.4	24	0.23	821	24	500	960
1.5	1	0.01	970	-	-	-
Total Aged	105	0.60	649	14	350	970
Total Males[b]	127	0.61	656	10	350	970
Adjusted Total[c]		0.72				
Female						
1.3	12	0..17	730	16	620	805
1.4	57	0.81	825	6	730	915
2.3	1	0.01	725	-	-	-
1.5	1	0.01	980	-	-	-
Total Aged	71	0.40	819	6	620	940
Total Females[b]	81	0.39	819	5	620	940
Adjusted Total[c]		0.28				

[a] Age is represented by the number of annuli formed during river residence and ocean residence (i.e., an age of 1.4 represents one annulus formed during river residence and four annuli formed during ocean residence for a total age of 6 years).

[b] Totals include those Chinook salmon which could not be aged.

[c] Estimated proportion of females was corrected by a factor of 0.708.

Table 7.–Age composition and escapement estimates by gender and by all fish combined (unadjusted and adjusted) of Chena River Chinook salmon, 1986-2013. Escapement estimates were obtained from either a counting tower (CT) assessment, sonar (S), or mark-recapture (MR) project.

Males	Total Age (years)/European Age (freshwater years/ocean years)										Male	Male
	3	4	5		6		7		8		unadjusted[a]	adjusted[b]
Year	1.1	1.2	1.3	2.2	1.4	2.3	1.5	2.4	1.6	2.5	escapement	escapement
1986	0.002	0.126	0.636	0.000	0.197	0.019	0.020	0.000	0.000	0.000	6,618	6,764
1987	0.000	0.064	0.281	0.000	0.613	0.009	0.034	0.000	0.000	0.000	2,723	3,320
1988	0.016	0.268	0.355	0.000	0.279	0.000	0.082	0.000	0.000	0.000	1,305	2,212
1989	0.010	0.109	0.495	0.020	0.347	0.010	0.010	0.000	0.000	0.000	964	1,492
1990	0.000	0.423	0.309	0.003	0.254	0.000	0.010	0.000	0.000	0.000	2,970	3,569
1991	0.000	0.126	0.489	0.000	0.312	0.000	0.074	0.000	0.000	0.000	2,161	2,172
1992	0.031	0.682	0.208	0.000	0.080	0.000	0.000	0.000	0.000	0.000	3,468	4,373
1993	0.006	0.355	0.445	0.000	0.187	0.000	0.006	0.000	0.000	0.000	10,327	10,804
1994	0.000	0.053	0.644	0.000	0.292	0.004	0.007	0.000	0.000	0.000	6,442	8,029
1995	0.000	0.131	0.360	0.000	0.491	0.000	0.015	0.004	0.000	0.000	3,870	5,509
1996	0.038	0.108	0.629	0.000	0.136	0.000	0.087	0.000	0.000	0.000	3,972	5,239
1997	0.005	0.611	0.184	0.000	0.196	0.000	0.002	0.002	0.000	0.000	6,529	8,038
1998	0.000	0.075	0.858	0.000	0.045	0.000	0.022	0.000	0.000	0.000	2,843	3,399
1999	0.000	0.115	0.377	0.000	0.508	0.000	0.000	0.000	0.000	0.000	2,338	3,527
2000	0.000	0.303	0.444	0.000	0.222	0.000	0.030	0.000	0.000	0.000	3,139	3,675
2001	0.010	0.154	0.462	0.000	0.353	0.000	0.021	0.000	0.000	0.000	5,573	6,777
2002	0.000	0.001	0.004	0.000	0.001	0.000	0.001	0.000	0.000	0.000	3,915	5,063
2003	0.000	0.088	0.623	0.000	0.240	0.000	0.049	0.000	0.000	0.000	6,118	7,573
2004	0.000	0.295	0.318	0.000	0.364	0.000	0.023	0.000	0.000	0.000	3,664	5,410
2005	0.000	0.110	0.571	0.000	0.292	0.000	0.016	0.013	0.000	0.000	-	-
2006	0.000	0.235	0.592	0.005	0.148	0.005	0.015	0.000	0.000	0.000	1,606	1,994
2007	0.194	0.222	0.306	0.000	0.278	0.000	0.000	0.000	0.000	0.000	2,339	2,767
2008	0.000	0.150	0.750	0.000	0.100	0.000	0.000	0.000	0.000	0.000	1,896	2,279
2009	0.000	0.313	0.293	0.000	0.394	0.000	0.000	0.000	0.000	0.000	2,282	3,150
2010	0.000	0.196	0.518	0.018	0.250	0.000	0.018	0.000	0.000	0.000	1,690	1,892
2011	0.003	0.331	0.555	0.003	0.103	0.000	0.000	0.003	0.000	0.000	-	-
2012	0.011	0.114	0.636	0.000	0.239	0.000	0.000	0.000	0.000	0.000	994	1,352
2013	0.019	0.486	0.257	0.000	0.229	0.000	0.010	0.000	0.000	0.000	1,135	1,346
Average	0.008	0.245	0.463	0.002	0.261	0.002	0.019	0.001	0.000	0.000	3,592	4,416

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Table 7.–Page 2 of 4.

Females	Total Age (years)/European Age (freshwater years/ocean years)										Female	Female
	3	4	5		6		7		8		unadjusted[a]	adjusted[b]
Year	1.1	1.2	1.3	2.2	1.4	2.3	1.5	2.4	1.6	2.5	escapement	escapement
1986	0.000	0.000	0.131	0.000	0.552	0.000	0.306	0.005	0.000	0.005	2,447	2,301
1987	0.000	0.003	0.022	0.000	0.855	0.000	0.114	0.006	0.000	0.000	3,681	3,084
1988	0.000	0.000	0.060	0.000	0.582	0.000	0.351	0.000	0.000	0.007	2,041	1,134
1989	0.000	0.005	0.187	0.000	0.652	0.000	0.155	0.000	0.000	0.000	1,766	1,238
1990	0.000	0.008	0.194	0.000	0.733	0.000	0.066	0.000	0.000	0.000	2,633	2,034
1991	0.000	0.000	0.120	0.000	0.620	0.000	0.231	0.009	0.009	0.009	1,011	1,000
1992	0.000	0.000	0.284	0.000	0.710	0.000	0.006	0.000	0.000	0.000	2,112	1,207
1993	0.000	0.000	0.258	0.000	0.710	0.000	0.032	0.000	0.000	0.000	1,914	1,437
1994	0.000	0.000	0.182	0.000	0.771	0.004	0.043	0.000	0.000	0.000	5,435	3,848
1995	0.000	0.000	0.131	0.000	0.821	0.000	0.044	0.004	0.000	0.000	7,524	5,885
1996	0.000	0.004	0.210	0.000	0.358	0.000	0.428	0.000	0.000	0.000	3,181	1,914
1997	0.000	0.007	0.058	0.000	0.914	0.000	0.022	0.000	0.000	0.000	4,281	2,772
1998	0.000	0.000	0.532	0.000	0.383	0.000	0.085	0.000	0.000	0.000	1,902	1,346
1999	0.000	0.009	0.181	0.000	0.810	0.000	0.000	0.000	0.000	0.000	4,147	2,958
2000	0.000	0.000	0.180	0.000	0.620	0.000	0.200	0.000	0.000	0.000	1,555	1,019
2001	0.000	0.022	0.175	0.000	0.716	0.000	0.087	0.000	0.000	0.000	4,123	2,919
2002	0.000	0.000	0.003	0.000	0.005	0.000	0.006	0.000	0.000	0.000	3,052	1,904
2003	0.000	0.006	0.271	0.000	0.633	0.000	0.090	0.000	0.000	0.000	4,982	3,527
2004	0.000	0.000	0.086	0.000	0.881	0.000	0.033	0.000	0.000	0.000	5,981	4,235
2005	0.000	0.004	0.402	0.000	0.530	0.004	0.043	0.017	0.000	0.000	1,761	1,247
2006	0.000	0.000	0.289	0.000	0.705	0.000	0.006	0.000	0.000	0.000	1,330	942
2007	0.038	0.154	0.423	0.000	0.385	0.000	0.000	0.000	0.000	0.000	1,467	1,039
2008	0.000	0.000	0.438	0.000	0.438	0.000	0.125	0.000	0.000	0.000	1,312	929
2009	0.000	0.008	0.070	0.000	0.910	0.000	0.012	0.000	0.000	0.000	2,971	2,103
2010	0.000	0.000	0.480	0.000	0.480	0.000	0.040	0.000	0.000	0.000	692	490
2011	0.000	0.000	0.274	0.000	0.681	0.000	0.030	0.015	0.000	0.000	-	-
2012	0.000	0.000	0.309	0.000	0.691	0.000	0.000	0.000	0.000	0.000	1,226	868
2013	0.000	0.000	0.169	0.000	0.817	0.014	0.000	0.000	0.000	0.000	724	513
Average	0.000	0.008	0.223	0.000	0.676	0.001	0.089	0.002	0.000	0.001	2,909	2,084

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Table 7.–Page 3 of 4.

Unadjusted[a]	Total Age (years)/European Age (freshwater years/ocean years)											
All Fish	3	4	5		6		7		8		Total	
Year	1.1	1.2	1.3	2.2	1.4	2.3	1.5	2.4	1.6	2.5	escapement	Method
1986	0.001	0.094	0.508	0.000	0.287	0.014	0.093	0.001	0.000	0.001	9,065	MR
1987	0.000	0.029	0.130	0.000	0.754	0.004	0.080	0.004	0.000	0.000	6,404	MR
1988	0.006	0.105	0.175	0.000	0.464	0.000	0.246	0.000	0.000	0.004	3,346	MR
1989	0.003	0.042	0.295	0.007	0.545	0.003	0.104	0.000	0.000	0.000	2,730	MR
1990	0.000	0.228	0.255	0.002	0.479	0.000	0.036	0.000	0.000	0.000	5,603	MR
1991	0.000	0.086	0.372	0.000	0.410	0.000	0.124	0.003	0.003	0.003	3,172	MR
1992	0.019	0.424	0.234	0.002	0.316	0.002	0.002	0.000	0.000	0.000	5,580	MR
1993	0.005	0.294	0.412	0.000	0.278	0.000	0.011	0.000	0.000	0.000	12,241	CT
1994	0.000	0.029	0.436	0.000	0.508	0.004	0.023	0.000	0.000	0.000	11,877	CT
1995	0.000	0.044	0.208	0.000	0.709	0.000	0.034	0.004	0.000	0.000	11,394	MR
1996	0.021	0.062	0.443	0.000	0.235	0.000	0.239	0.000	0.000	0.000	7,153	MR
1997	0.003	0.372	0.134	0.000	0.480	0.000	0.010	0.001	0.000	0.000	10,810	MR
1998	0.000	0.044	0.724	0.000	0.184	0.000	0.048	0.000	0.000	0.000	4,745	CT
1999	0.000	0.045	0.249	0.000	0.706	0.000	0.000	0.000	0.000	0.000	6,485	CT
2000	0.003	0.302	0.390	0.000	0.283	0.000	0.022	0.000	0.000	0.000	4,694	MR
2001	0.006	0.096	0.336	0.000	0.512	0.000	0.050	0.000	0.000	0.000	9,696	CT
2002	0.000	0.238	0.278	0.000	0.444	0.000	0.040	0.000	0.000	0.000	6,967	MR
2003	0.000	0.051	0.465	0.000	0.416	0.000	0.068	0.000	0.000	0.000	11,100[c]	CT
2004	0.000	0.109	0.172	0.000	0.690	0.000	0.029	0.000	0.000	0.000	9,645	CT
2005	0.000	0.065	0.499	0.000	0.392	0.002	0.027	0.014	0.000	0.000	4,075	CT
2006	0.000	0.127	0.453	0.003	0.403	0.003	0.011	0.000	0.000	0.000	2,936	CT
2007	0.129	0.194	0.355	0.000	0.323	0.000	0.000	0.000	0.000	0.000	3,806	CT
2008	0.000	0.083	0.611	0.000	0.250	0.000	0.056	0.000	0.000	0.000	3,208	CT
2009	0.000	0.145	0.170	0.000	0.679	0.000	0.007	0.000	0.000	0.000	5,253	CT
2010	0.000	0.136	0.506	0.012	0.321	0.000	0.025	0.000	0.000	0.000	2,382	CT
2011	0.002	0.226	0.466	0.002	0.287	0.000	0.009	0.007	0.000	0.000	-	-
2012	0.005	0.051	0.455	0.000	0.490	0.000	0.000	0.000	0.000	0.000	2,220	CT/S
2013	0.011	0.290	0.222	0.000	0.466	0.006	0.006	0.000	0.000	0.000	1,859	CT
Average	0.004	0.142	0.354	0.001	0.443	0.001	0.052	0.001	0.000	0.000	6,322	

-continued-

Table 7.–Page 4 of 4.

Adjusted[b]	Total Age (years)/European Age (freshwater years/ocean years)											
All Fish	3	4	5		6		7		8		Total	
Year	1.1	1.2	1.3	2.2	1.4	2.3	1.5	2.4	1.6	2.5	escapement	Method
1986	0.001	0.094	0.508	0.000	0.287	0.014	0.093	0.001	0.000	0.001	9,065	MR
1987	0.000	0.035	0.156	0.000	0.730	0.004	0.072	0.003	0.000	0.000	6,404	MR
1988	0.011	0.177	0.255	0.000	0.382	0.000	0.173	0.000	0.000	0.002	3,346	MR
1989	0.005	0.062	0.355	0.011	0.485	0.005	0.076	0.000	0.000	0.000	2,730	MR
1990	0.000	0.272	0.267	0.002	0.428	0.000	0.030	0.000	0.000	0.000	5,603	MR
1991	0.000	0.086	0.373	0.000	0.409	0.000	0.123	0.003	0.003	0.003	3,172	MR
1992	0.027	0.574	0.194	0.000	0.204	0.000	0.001	0.000	0.000	0.000	5,580	MR
1993	0.006	0.311	0.421	0.000	0.253	0.000	0.009	0.000	0.000	0.000	12,241	CT
1994	0.000	0.036	0.494	0.000	0.447	0.004	0.019	0.000	0.000	0.000	11,877	CT
1995	0.000	0.063	0.241	0.000	0.661	0.000	0.030	0.004	0.000	0.000	11,394	MR
1996	0.028	0.081	0.517	0.000	0.196	0.000	0.179	0.000	0.000	0.000	7,153	MR
1997	0.004	0.456	0.152	0.000	0.380	0.000	0.007	0.002	0.000	0.000	10,810	MR
1998	0.000	0.053	0.766	0.000	0.141	0.000	0.040	0.000	0.000	0.000	4,745	CT
1999	0.000	0.066	0.288	0.000	0.646	0.000	0.000	0.000	0.000	0.000	6,485	CT
2000	0.003	0.302	0.390	0.000	0.283	0.000	0.022	0.000	0.000	0.000	4,694	MR
2001	0.007	0.114	0.376	0.000	0.462	0.000	0.041	0.000	0.000	0.000	9,696	CT
2002	0.002	0.307	0.302	0.000	0.369	0.000	0.020	0.000	0.000	0.000	6,967	MR
2003	0.000	0.062	0.511	0.000	0.365	0.000	0.062	0.000	0.000	0.000	11,100[c]	CT
2004	0.000	0.166	0.216	0.000	0.591	0.000	0.027	0.000	0.000	0.000	9,645	CT
2005	0.000	0.077	0.519	0.000	0.364	0.001	0.024	0.014	0.000	0.000	-	-
2006	0.000	0.159	0.495	0.003	0.327	0.003	0.012	0.000	0.000	0.000	2,936	CT
2007	0.152	0.204	0.338	0.000	0.307	0.000	0.000	0.000	0.000	0.000	3,806	CT
2008	0.000	0.107	0.659	0.000	0.198	0.000	0.036	0.000	0.000	0.000	3,208	CT
2009	0.000	0.191	0.204	0.000	0.600	0.000	0.005	0.000	0.000	0.000	5,253	CT
2010	0.000	0.156	0.510	0.014	0.297	0.000	0.022	0.000	0.000	0.000	2,382	CT
2011	0.003	0.256	0.491	0.003	0.235	0.000	0.007	0.006	0.000	0.000	-	-
2012	0.007	0.069	0.508	0.000	0.415	0.000	0.000	0.000	0.000	0.000	2,220	CT/S
2013	0.014	0.352	0.233	0.000	0.391	0.004	0.007	0.000	0.000	0.000	1,859	CT
Average	0.010	0.170	0.368	0.001	0.405	0.001	0.044	0.001	0.000	0.000	6,239	

a Unadjusted escapement and composition estimates were derived from the observed sample proportions of males and females from carcass surveys.

b Adjusted escapement and composition estimates were derived either from mark-recapture estimates (MR) or in years when counting tower (CT) assessments were conducted, from carcass surveys that were adjusted using the methods described in Appendix A and do not necessarily reflect actual sample proportions.

c Estimate includes an expansion for missed counting days. CV is a minimum estimate and does not include uncertainty associated with expansion for missed days. Minimum documented abundance with large gaps in counts due to flooding, was 8,739 (SE=653) fish.

(49%) for males and age 1.4 and 2.3 (82%) for females (Tables 6 and 7).

Delta Clearwater River Coho Salmon

In 2013, the boat survey was conducted on 24 October, and the minimum estimate of escapement was 6,222 (Table 8) coho salmon.

DISCUSSION

To evaluate whether the BEG was met, a precise estimate of escapement is required. In 2013, the majority of the Chinook salmon run was enumerated under good viewing conditions, but the escapement goal was not met. In fact, it was the lowest escapement recorded since ADF&G began enumerating salmon in these systems in 1986. Although an estimate for 2011 could not be derived, itis likely the escapement goal has not been achieved since 2010.

In 2013, the Chena River Chinook salmon fishery was closed because the run was not projected to meet minimum escapement, and lower river indicators suggested that the Chinook salmon run was weak (Brase and Baker *In prep*). Restrictions had been placed on subsistence, commercial, and sport users in the Yukon River, and closing the Chena River to sport fishing of Chinook salmon seemed prudent based on recent years' production (Brase and Baker *In prep*). This proved to be the appropriate management action, as the run did not meet minimum escapement (Table 3).

The female sex composition estimate in 2013 (0.28) escapement was different than 2012 (0.39; $z = -7.75$; $P\text{-}val < 0.01$) and 2011 (0.23; $z = 4.27$; $P\text{-}val < 0.01$). There are typically more males in the Chena River escapement than females, but composition estimates similar to 2012 would be preferred because a trend in this direction could be detrimental to future returns.

The age composition estimates of the 2013 escapement were similar ($\chi^2 = 0.175$; df=4; $P\text{-}val = 0.99$) to estimates over the last 5 years (2008–2012). However, the proportion of salmon ages 4 and 5, and ages 5 and 6, complemented one another, and this relationship is lost when averaging over time. In other words, when there is a large proportion of age 4 salmon in a particular year there is typically a smaller proportion of age 5 and vice versa.

The Delta Clearwater River boat count was conducted in 2013 over 1 day in good conditions, which produced minimum estimates of escapement within the established SEG. Previous studies have expanded the boat count to account for the escapement to inaccessible tributaries in the Delta Clearwater River drainage. This expansion was done to conduct a spawner-recruit analysis and was not used to evaluate whether the SEG was met. For this reason, the minimum escapement estimate that is used to evaluate the SEG is the only one reported.

In 2013, the fishery was restricted to catch-and-release fishing because the run was not projected to meet the SEG. The fishery was not closed because commercial fishery harvests and assessment projects in the Lower Tanana River indicated that the coho salmon run was slightly late, and there were thought to be fish still holding downriver. The final escapement estimate for 2013 was 6,222 coho salmon, which surpassed the lower bound of the SEG (5,200 fish; Brase and Baker *In prep*).

CONCLUSION

Continued assessment of the Chena, Salcha, and Delta Clearwater rivers is required to determine whether or not the established escapement goals for the largest Chinook and coho salmon spawning tributaries in the Alaskan portion of the Yukon River drainage are met. Consistently poor returns to the Chena River are concerning, and numerous projects are being proposed to look at early life history of juvenile salmon. Currently, the Alaska Sustainable Salmon Fund (AKSSF) is funding the Chena River counting tower through 2015. The coho salmon counts are annually funded through ADF&G General Funds, and the Salcha and Goodpaster river projects are funded through 2014 from Research and Management (R&M) funds for the Yukon River, distributed by USFWS.

Table 8.–Minimum estimates of escapement for Delta Clearwater River coho salmon, 1980-2013.

Year	Survey date	Minimum escapement
1980	28 Oct	3,946
1981	21 Oct	8,563
1982	3 Nov	8,365
1983	25 Oct	8,019
1984	6 Nov	11,061
1985	13 Nov	6,842
1986	21 Oct	10,857
1987	27 Oct	22,300
1988	28 Oct	21,600
1989	25 Oct	12,600
1990	26 Oct	8,325
1991	23 Oct	23,900
1992	26 Oct	3,963
1993	21 Oct	10,875
1994	24 Oct	62,675
1995	23 Oct	20,100
1996	29 Oct	14,075
1997	24 Oct	11,525
1998	20 Oct	11,100
1999	28 Oct	10,975
2000	24 Oct	9,225
2001	19 Oct	46,875
2002	31 Oct	38,625
2003	21 Oct	105,850
2004	27 Oct	37,950
2005	25 Oct	34,293
2006	24 Oct	16,748
2007	31 Oct-1 Nov	14,650
2008	30 Oct	7,500
2009	26 Oct	16,850
2010	30 Oct	5,867
2011	28 Oct	16,544
2012	19 Oct	5,230
2013	24 Oct	6,222
Average		19,238

ACKNOWLEDGEMENTS

The author would like to thank the following ADF&G Sport Fish staff who made the 2013 Chena River counting tower a success: the crew leader Virgil Davis, and the counting crew of Allison Martin, Chad Bear, Loren St. Amand, Sydney Pace, and Chloe Johnson. Thanks to the Assistant Area Manager, Brandy Baker, and Area Manager Audra Brase for performing the annual Delta Clearwater River coho salmon counts. Anchorage Commercial Fisheries staff aged the Chinook salmon scale samples. Jiaqi Huang provided assistance with project planning, design, and analysis. Matt Evenson edited and Rachael Kvapil prepared the final report. The U.S. Army Corps of Engineers provided access to the Moose Creek Dam. Thanks to Chris Stark and the technicians from the Bering Sea Fishermen's Association and Tanana Chiefs Conference, who colelcted and supplied the Salcha and Goodpaster river counting tower data to the author.

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APPENDIX A: SALCHA RIVER CHINOOK SALMON COUNTING TOWER DATA

INTRODUCTION

Bering Sea Fishermen's Association (BSFA) began tower counts on the Salcha River in 1999. Further details regarding this project can be obtained by contacting the project leader with BSFA.

METHODS

Project mobilization, escapement enumeration, and data analysis procedures for the Salcha River counting tower are virtually identical to those used for the Chena River.

RESULTS

In 2013, the Salcha River counting tower (Figure A1) was in operation from 9 July to 14 August; the estimated Chinook salmon escapement during that time was 5,465 fish (SE=282, Tables A1 and A2). The estimated chum salmon escapement during that time was 60,980 fish (SE=952, Table A3).

AGE-SEX-LENGTH COMPOSITIONS

In 2013, a total of 200 Chinook salmon carcasses were collected along the Salcha River from 7 through 18 August. The estimated proportion of females in the escapement from the carcass survey was 0.50 (SE=0.04) and the gender-bias corrected estimate was 0.44 (SE=0.09). The largest age class for males (54%) was age 1.4, and the largest for females (84%) was also age 1.4 (Tables A4 and A5).

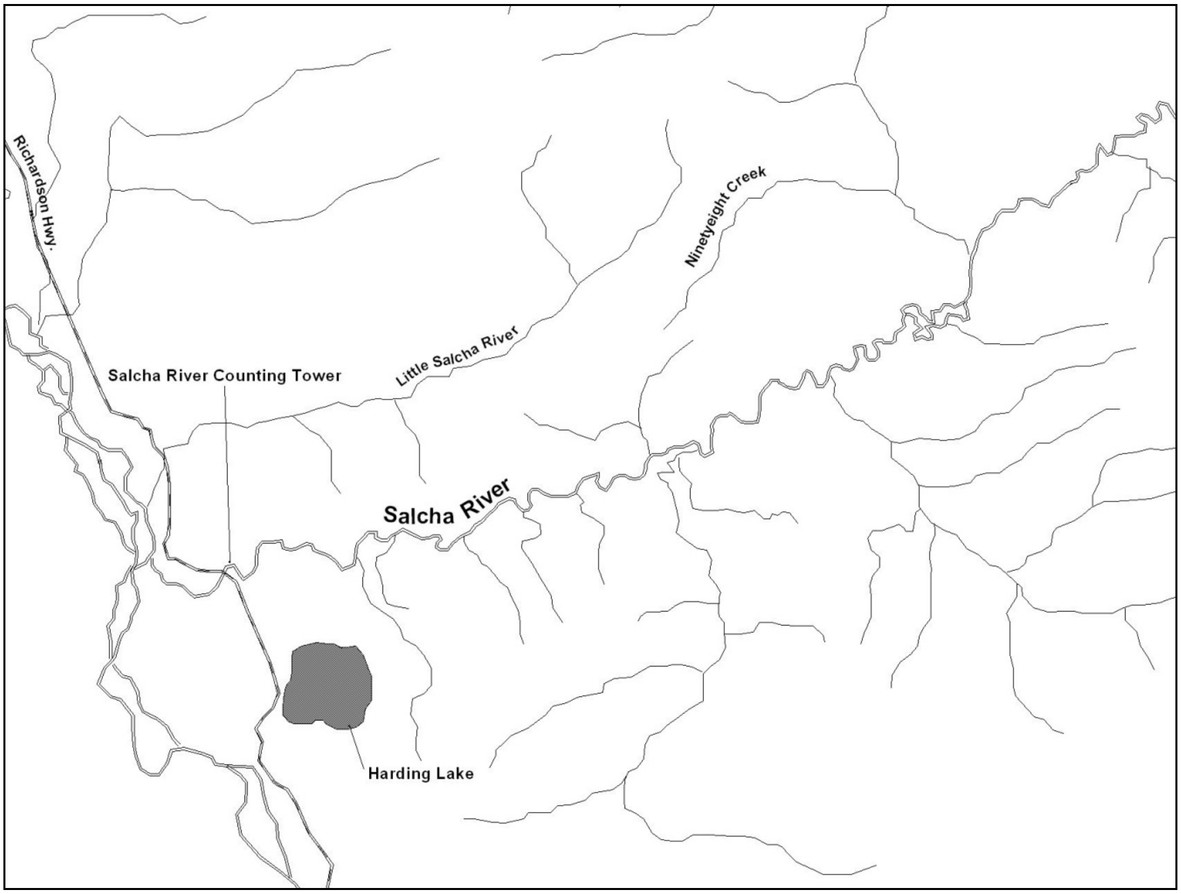

Figure A1.–Map of the Salcha River demarcating the counting tower.

Table A1.–Estimates of the Salcha River Chinook salmon escapement, 1987–2013.

Year	Escapement Estimate	Escapement SE	Method[b]
1987	4,771	504	M-R
1988	4,322	556	M-R
1989	3,294	630	M-R
1990	10,728	1,404	M-R
1991	5,608	664	M-R
1992	7,862	975	M-R
1993	10,007	360	CT
1994	18,399	549	CT
1995	13,643	471	CT
1996	7,570	1,238	M-R
1997	18,514	1,043	CT
1998	5,027	331	CT
1999	9,198	290	CT
2000	4,595	802	CT
2001	13,328	2,163	CT
2002	9,000[a]	160	CT
2003	15,500[a]	747	CT
2004	15,761	612	CT
2005	5,988	163	CT
2006	10,679	315	CT
2007	6,425	225	CT
2008	5,415[a]	169	CT
2009	12,774	405	CT
2010	6,135	170	CT
2011	7,200[a]	-[c]	CT
2012	7,165	163	CT
2013	5,465	282	CT

[a] Estimate was obtained from an expansion of the interrupted tower-count.

[b] Escapement estimates were obtained from either a counting tower (CT) assessment or a mark-recapture (MR) project.

[c] Standard error not reported by BSFA.

Table A2.–Daily estimates of Salcha River Chinook salmon escapement, 2013.

Date	Day of run	Number of 20-minute counts	Daily escapement
9-Jul	1	9	0
10-Jul	2	24	9
11-Jul	3	12	9
12-Jul	4	0	12
13-Jul	5	0	103
14-Jul	6	8	18
15-Jul	7	24	282
16-Jul	8	24	336
17-Jul	9	24	348
18-Jul	10	24	336
19-Jul	11	24	528
20-Jul	12	24	135
21-Jul	13	14	303
22-Jul	14	0	383
23-Jul	15	16	464
24-Jul	16	24	246
25-Jul	17	24	291
26-Jul	18	24	330
27-Jul	19	24	408
28-Jul	20	24	381
29-Jul	21	24	120
30-Jul	22	24	57
31-Jul	23	24	51
1-Aug	24	24	54
2-Aug	25	24	33
3-Aug	26	24	78
4-Aug	27	24	87
5-Aug	28	24	21
6-Aug	29	24	6
7-Aug	30	24	3
8-Aug	31	24	12
9-Aug	32	24	6
10-Aug	33	24	6
11-Aug	34	24	0
12-Aug	35	24	6
13-Aug	36	24	3
14-Aug	37	16	0
Total			5,465

Table A3.–Daily estimates of Salcha River chum salmon escapement, 2013.

Date	Day of run	Number of 20-minute counts	Daily escapement
9-Jul	1	9	0
10-Jul	2	24	0
11-Jul	3	12	0
12-Jul	4	0	0
13-Jul	5	0	0
14-Jul	6	8	0
15-Jul	7	24	15
16-Jul	8	24	60
17-Jul	9	24	126
18-Jul	10	24	321
19-Jul	11	24	693
20-Jul	12	24	1,155
21-Jul	13	14	972
22-Jul	14	0	889
23-Jul	15	16	806
24-Jul	16	24	1,494
25-Jul	17	24	1,749
26-Jul	18	24	2,430
27-Jul	19	24	2,100
28-Jul	20	24	2,526
29-Jul	21	24	2,967
30-Jul	22	24	3,300
31-Jul	23	24	3,204
1-Aug	24	24	2,934
2-Aug	25	24	3,183
3-Aug	26	24	3,489
4-Aug	27	24	2,754
5-Aug	28	24	3,162
6-Aug	29	24	3,396
7-Aug	30	24	3,540
8-Aug	31	24	2,880
9-Aug	32	24	2,718
10-Aug	33	24	2,154
11-Aug	34	24	1,671
12-Aug	35	24	1,557
13-Aug	36	24	1,341
14-Aug	37	16	1,395
Total			60,980

Table A4.–Estimated proportions and mean length by age and sex of Chinook salmon sampled during the Salcha River carcass survey, 2013.

	Sample	Sample	Length (mm)			
Age[a]	Size	Proportion	Mean	SE	Min	Max
Males						
1.1	2	0.02	363	13	350	375
1.2	20	0.22	550	14	440	625
1.3	18	0.20	713	14	605	810
1.4	48	0.54	845	9	745	985
1.5	1	0.01	965	-	-	-
Total Aged	89	0.50	742	16	350	985
Total Males[b]	99	0.50	750	15	350	1,000
Adjusted Total[c]	-	0.56	-	-	-	-
Female						
1.3	10	0.11	779	11	735	845
1.4	76	0.84	840	5	760	940
1.5	4	0.04	868	8	815	895
Total Aged	90	0.50	834	5	735	940
Total Females[b]	101	0.50	834	4	735	940
Adjusted Total[c]		0.44	-	-	-	-

a Age is represented by the number of annuli formed during river residence and ocean residence (i.e., an age of 1.4 represents 1 annulus formed during river residence and 4 annuli formed during ocean residence plus 1 year for year of spawning for a total age of 6 years).

b Estimated proportion of females was corrected by a factor of 0.867.

Table A5.–Age composition and escapement estimates by gender and by all fish combined (unadjusted and adjusted) of Salcha River Chinook salmon, 1987–2013. Escapement estimates were obtained from either a counting tower (CT) assessment or mark-recapture (MR) project.

Males	Total Age (years)/European Age (freshwater years/ocean years)										Male	Male
	3	4	5		6		7		8		unadjusted[a]	adjusted[b]
Year	1.1	1.2	1.3	2.2	1.4	2.3	1.5	2.4	1.6	2.5	escapement	escapement
1987	0.005	0.152	0.275	0.000	0.544	0.000	0.025	0.000	0.000	0.000	1,766	2,290
1988	0.007	0.333	0.330	0.000	0.243	0.000	0.083	0.003	0.000	0.000	2,223	2,363
1989	0.012	0.107	0.548	0.000	0.333	0.000	0.000	0.000	0.000	0.000	1,477	1,853
1990	0.004	0.333	0.352	0.000	0.268	0.000	0.042	0.000	0.000	0.000	5,832	6,845
1991	0.004	0.143	0.489	0.000	0.309	0.000	0.051	0.000	0.004	0.000	3,082	3,325
1992	0.019	0.543	0.338	0.007	0.084	0.005	0.005	0.000	0.000	0.000	5,020	5,031
1993	0.012	0.384	0.454	0.000	0.146	0.003	0.000	0.000	0.000	0.000	7,364	7,613
1994	0.010	0.035	0.561	0.000	0.366	0.000	0.028	0.000	0.000	0.000	9,825	11,251
1995	0.000	0.296	0.292	0.000	0.388	0.000	0.021	0.004	0.000	0.000	6,013	7,023
1996	0.054	0.118	0.567	0.000	0.177	0.000	0.084	0.000	0.000	0.000	3,777	5,588
1997	0.000	0.256	0.244	0.000	0.489	0.000	0.011	0.000	0.000	0.000	9,597	10,488
1998	0.035	0.070	0.756	0.000	0.128	0.000	0.012	0.000	0.000	0.000	3,532	3,716
1999	0.000	0.201	0.374	0.000	0.424	0.000	0.000	0.000	0.000	0.000	4,471	4,834
2000	0.000	0.304	0.565	0.000	0.130	0.000	0.000	0.000	0.000	0.000	2,776	2,846
2001	0.008	0.167	0.425	0.000	0.400	0.000	0.000	0.000	0.000	0.000	8,395	8,995
2002	0.000	0.554	0.190	0.000	0.179	0.000	0.076	0.000	0.000	0.000	5,907	6,288
2003	0.011	0.126	0.598	0.000	0.241	0.000	0.023	0.000	0.000	0.000	8,964	10,181
2004	0.000	0.247	0.176	0.000	0.576	0.000	0.000	0.000	0.000	0.000	5,910	7,168
2005	0.000	0.204	0.516	0.000	0.265	0.000	0.011	0.004	0.000	0.000	2,709	3,168
2006	0.000	0.101	0.715	0.000	0.174	0.000	0.010	0.000	0.000	0.000	5,989	6,659
2007	0.000	0.343	0.364	0.000	0.293	0.000	0.000	0.000	0.000	0.000	4,130	4,436
2008	0.011	0.163	0.658	0.000	0.168	0.000	0.000	0.000	0.000	0.000	3,307	3,571
2009	0.000	0.520	0.315	0.000	0.165	0.000	0.000	0.000	0.000	0.000	7,774	8,446
2010	0.007	0.352	0.571	0.007	0.052	0.010	0.000	0.000	0.000	0.000	4,250	4,501
2011	0.003	0.252	0.574	0.000	0.157	0.010	0.003	0.000	0.000	0.000	4,188	4,589
2012	0.006	0.148	0.509	0.000	0.337	0.000	0.000	0.000	0.000	0.000	2,957	3,517
2013	0.022	0.225	0.202	0.000	0.539	0.000	0.011	0.000	0.000	0.000	2,705	3,072
Average	0.009	0.247	0.443	0.001	0.281	0.001	0.018	0.000	0.000	0.000	4,961	5,543

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Table A5.–Page 2 of 4.

Females	Total Age (years)/European Age (freshwater years/ocean years)										Female	Female
	3	4	5		6		7		8		unadjusted[a]	adjusted[b]
Year	1.1	1.2	1.3	2.2	1.4	2.3	1.5	2.4	1.6	2.5	escapement	escapement
1987	0.000	0.003	0.038	0.000	0.849	0.000	0.110	0.000	0.000	0.000	3,005	2,481
1988	0.000	0.005	0.066	0.000	0.690	0.000	0.239	0.000	0.000	0.000	2,099	1,959
1989	0.000	0.000	0.131	0.000	0.730	0.000	0.139	0.000	0.000	0.000	1,817	1,441
1990	0.000	0.008	0.147	0.000	0.713	0.000	0.132	0.000	0.000	0.000	4,896	3,883
1991	0.000	0.000	0.133	0.000	0.680	0.000	0.183	0.000	0.004	0.000	2,526	2,283
1992	0.000	0.005	0.327	0.000	0.650	0.000	0.014	0.005	0.000	0.000	2,842	2,831
1993	0.000	0.008	0.224	0.000	0.736	0.000	0.032	0.000	0.000	0.000	2,643	2,394
1994	0.000	0.017	0.185	0.000	0.721	0.004	0.073	0.000	0.000	0.000	8,574	7,148
1995	0.000	0.010	0.138	0.000	0.816	0.000	0.030	0.007	0.000	0.000	7,630	6,620
1996	0.000	0.005	0.205	0.000	0.390	0.000	0.400	0.000	0.000	0.000	3,793	1,982
1997	0.000	0.033	0.044	0.000	0.900	0.000	0.022	0.000	0.000	0.000	8,917	8,026
1998	0.000	0.000	0.649	0.000	0.297	0.000	0.054	0.000	0.000	0.000	1,495	1,311
1999	0.000	0.000	0.131	0.000	0.863	0.000	0.006	0.000	0.000	0.000	4,727	4,364
2000	0.000	0.111	0.389	0.000	0.389	0.000	0.111	0.000	0.000	0.000	1,819	1,749
2001	0.000	0.000	0.194	0.000	0.722	0.000	0.083	0.000	0.000	0.000	4,933	4,333
2002	0.000	0.000	0.041	0.000	0.776	0.000	0.184	0.000	0.000	0.000	3,093	2,712
2003	0.000	0.000	0.211	0.000	0.754	0.000	0.035	0.000	0.000	0.000	6,536	5,319
2004	0.000	0.000	0.028	0.000	0.958	0.000	0.014	0.000	0.000	0.000	9,851	8,593
2005	0.000	0.000	0.330	0.000	0.627	0.000	0.043	0.000	0.000	0.000	3,279	2,820
2006	0.000	0.000	0.204	0.000	0.760	0.005	0.032	0.000	0.000	0.000	4,690	4,020
2007	0.000	0.009	0.100	0.000	0.882	0.000	0.009	0.000	0.000	0.000	2,295	1,989
2008	0.000	0.000	0.303	0.000	0.655	0.000	0.042	0.000	0.000	0.000	2,108	1,844
2009	0.000	0.000	0.056	0.000	0.939	0.000	0.006	0.000	0.000	0.000	5,000	4,328
2010	0.000	0.032	0.584	0.000	0.344	0.000	0.016	0.024	0.000	0.000	1,885	1,634
2011	0.000	0.000	0.054	0.000	0.914	0.000	0.032	0.000	0.000	0.000	3,012	2,611
2012	0.000	0.000	0.207	0.000	0.765	0.000	0.028	0.000	0.000	0.000	4,208	3,648
2013	0.000	0.000	0.111	0.000	0.844	0.000	0.044	0.000	0.000	0.000	2,760	2,393
Average	0.000	0.009	0.194	0.000	0.717	0.000	0.078	0.001	0.000	0.000	4,090	3,508

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Table A5.–Page 3 of 4.

Unadjusted[b]	Total Age (years)/European Age (freshwater years/ocean years)											
All Fish	3	4	5		6		7		8		Total	
Year	1.1	1.2	1.3	2.2	1.4	2.3	1.5	2.4	1.6	2.5	escapement	Method[c]
1987	0.002	0.058	0.126	0.000	0.736	0.000	0.078	0.000	0.000	0.000	4,771	MR
1988	0.004	0.203	0.225	0.000	0.421	0.000	0.145	0.002	0.000	0.000	4,322	MR
1989	0.005	0.041	0.290	0.000	0.579	0.000	0.086	0.000	0.000	0.000	3,294	MR
1990	0.002	0.169	0.249	0.000	0.492	0.000	0.087	0.000	0.000	0.000	10,728	MR
1991	0.002	0.076	0.322	0.000	0.483	0.000	0.113	0.000	0.004	0.000	5,608	MR
1992	0.012	0.361	0.334	0.005	0.276	0.003	0.008	0.002	0.000	0.000	7,862	MR
1993	0.009	0.280	0.391	0.000	0.309	0.002	0.009	0.000	0.000	0.000	10,007	CT
1994	0.006	0.027	0.392	0.000	0.525	0.002	0.048	0.000	0.000	0.000	18,399	CT
1995	0.000	0.136	0.206	0.000	0.628	0.000	0.026	0.006	0.000	0.000	13,643	CT
1996	0.027	0.061	0.383	0.000	0.286	0.000	0.245	0.000	0.000	0.000	7,570	MR
1997	0.000	0.144	0.144	0.000	0.694	0.000	0.017	0.000	0.000	0.000	18,514	CT
1998	0.024	0.049	0.724	0.000	0.179	0.000	0.024	0.000	0.000	0.000	5,027	CT
1999	0.000	0.091	0.241	0.000	0.664	0.000	0.003	0.000	0.000	0.000	9,198	CT
2000	0.000	0.220	0.488	0.000	0.244	0.000	0.049	0.000	0.000	0.000	4,595	CT
2001	0.005	0.104	0.339	0.000	0.521	0.000	0.031	0.000	0.000	0.000	13,328	CT
2002	0.000	0.362	0.138	0.000	0.387	0.000	0.113	0.000	0.000	0.000	9,000	CT
2003	0.007	0.076	0.444	0.000	0.444	0.000	0.028	0.000	0.000	0.000	15,500	CT
2004	0.000	0.092	0.083	0.000	0.817	0.000	0.009	0.000	0.000	0.000	15,761	CT
2005	0.000	0.093	0.415	0.000	0.462	0.000	0.028	0.002	0.000	0.000	5,988	CT
2006	0.000	0.057	0.493	0.000	0.428	0.002	0.020	0.000	0.000	0.000	10,679	CT
2007	0.000	0.224	0.269	0.000	0.503	0.000	0.003	0.000	0.000	0.000	6,425	CT
2008	0.007	0.099	0.518	0.000	0.360	0.000	0.017	0.000	0.000	0.000	5,415	CT
2009	0.000	0.317	0.214	0.000	0.467	0.000	0.002	0.000	0.000	0.000	12,774	CT
2010	0.005	0.255	0.575	0.005	0.141	0.007	0.005	0.007	0.000	0.000	6,135	CT
2011	0.002	0.146	0.355	0.000	0.476	0.006	0.015	0.000	0.000	0.000	7,200	CT
2012	0.002	0.060	0.329	0.000	0.593	0.000	0.017	0.000	0.000	0.000	7,165	CT
2013	0.011	0.112	0.156	0.000	0.693	0.000	0.028	0.000	0.000	0.000	5,465	CT
Average	0.005	0.145	0.328	0.000	0.474	0.001	0.046	0.001	0.000	0.000	9,051	

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Adjusted	Total Age (years)/European Age (freshwater years/ocean years)											
All Fish	3	4	5		6		7		8		Total	
Year	1.1	1.2	1.3	2.2	1.4	2.3	1.5	2.4	1.6	2.5	escapement	Method[c]
1987	0.002	0.074	0.151	0.000	0.703	0.000	0.069	0.000	0.000	0.000	4,771	MR
1988	0.004	0.185	0.210	0.000	0.446	0.000	0.154	0.002	0.000	0.000	4,322	MR
1989	0.007	0.060	0.366	0.000	0.507	0.000	0.061	0.000	0.000	0.000	3,294	MR
1990	0.002	0.215	0.278	0.000	0.429	0.000	0.075	0.000	0.000	0.000	10,728	MR
1991	0.002	0.085	0.344	0.000	0.460	0.000	0.105	0.000	0.004	0.000	5,608	MR
1992	0.012	0.349	0.334	0.004	0.288	0.003	0.008	0.002	0.000	0.000	7,862	MR
1993	0.009	0.298	0.402	0.000	0.281	0.002	0.007	0.000	0.000	0.000	10,007	CT
1994	0.006	0.028	0.409	0.000	0.509	0.002	0.046	0.000	0.000	0.000	18,399	CT
1995	0.000	0.158	0.217	0.000	0.595	0.000	0.025	0.005	0.000	0.000	13,643	CT
1996	0.040	0.089	0.472	0.000	0.233	0.000	0.167	0.000	0.000	0.000	7,570	MR
1997	0.000	0.163	0.161	0.000	0.661	0.000	0.016	0.000	0.000	0.000	18,514	CT
1998	0.026	0.052	0.728	0.000	0.172	0.000	0.023	0.000	0.000	0.000	5,027	CT
1999	0.000	0.112	0.266	0.000	0.620	0.000	0.003	0.000	0.000	0.000	9,198	CT
2000	0.000	0.238	0.505	0.000	0.219	0.000	0.038	0.000	0.000	0.000	4,595	CT
2001	0.006	0.113	0.351	0.000	0.503	0.000	0.027	0.000	0.000	0.000	13,328	CT
2002	0.000	0.389	0.146	0.000	0.357	0.000	0.108	0.000	0.000	0.000	9,000[c]	CT
2003	0.007	0.080	0.456	0.000	0.429	0.000	0.027	0.000	0.000	0.000	15,500[c]	CT
2004	0.000	0.113	0.096	0.000	0.783	0.000	0.008	0.000	0.000	0.000	15,761	CT
2005	0.000	0.107	0.428	0.000	0.437	0.000	0.026	0.002	0.000	0.000	5,988	CT
2006	0.000	0.062	0.520	0.000	0.397	0.002	0.019	0.000	0.000	0.000	10,679	CT
2007	0.000	0.240	0.282	0.000	0.475	0.000	0.003	0.000	0.000	0.000	6,425	CT
2008	0.007	0.108	0.538	0.000	0.333	0.000	0.014	0.000	0.000	0.000	5,415[c]	CT
2009	0.000	0.343	0.227	0.000	0.427	0.000	0.002	0.000	0.000	0.000	12,774	CT
2010	0.005	0.267	0.575	0.005	0.130	0.008	0.004	0.006	0.000	0.000	6,135	CT
2011	0.002	0.161	0.385	0.000	0.432	0.006	0.014	0.000	0.000	0.000	7,200	CT
2012	0.003	0.073	0.355	0.000	0.555	0.000	0.014	0.000	0.000	0.000	7,165	CT
2013	0.013	0.126	0.162	0.000	0.673	0.000	0.026	0.000	0.000	0.000	5,465	CT
Average	0.006	0.159	0.347	0.000	0.446	0.001	0.040	0.001	0.000	0.000	9,051	

[a] Unadjusted escapement and composition estimates were derived from the observed sample proportions of males and females from carcass surveys.

[b] Adjusted escapement and composition estimates were derived either from mark-recapture estimates (MR) or in years when counting tower (CT) assessments were conducted, from carcass surveys that were adjusted using the methods described in Appendix A and do not necessarily reflect actual sample proportions.

[c] Estimate includes an expansion for missed counting days. SE is a minimum estimate and does not include uncertainty associated with expansion for missed days.

APPENDIX B: GOODPASTER RIVER CHINOOK SALMON COUNTING TOWER DATA

INTRODUCTION

The Chinook salmon counting tower on the Goodpaster River began operations in 2004. It is operated by staff from Tanana Chiefs Conference (TCC) and the Bering Sea Fisherman's Association. Further details regarding this project can be obtained by contacting the TCC.

Unlike the Chena and Salcha rivers, the Goodpaster River does not have an escapement goal, and counts are not provided to the fisheries managers on a daily basis. In the future, as a longer time series is developed, an escapement goal may be developed and managed for.

METHODS

Project mobilization, escapement enumeration, and data analysis procedures for the Goodpaster River counting tower were similar to those used for the Chena River.

The Goodpaster River has not been sampled for Chinook salmon ASL composition, although samples have been taken for genetic identification.

RESULTS

In 2013, the Goodpaster River counting tower (Figure B1) was in operation from 16 July through 3 August; the estimated Chinook salmon escapement during that time was 723 (SE=44) (Tables B1 and B2).

It is unknown what proportion of the Goodpaster River Chinook salmon stock may spawn up the South Fork of the river, but various surveys have shown little if any spawning occurring on the South Fork as habitat is unsuitable for at least the vast majority of the drainage; therefore, the estimates of escapement produced by this project should not be considered totally inclusive but rather representative of the Goodpaster River until such time as the significance of the South Fork can be ascertained.

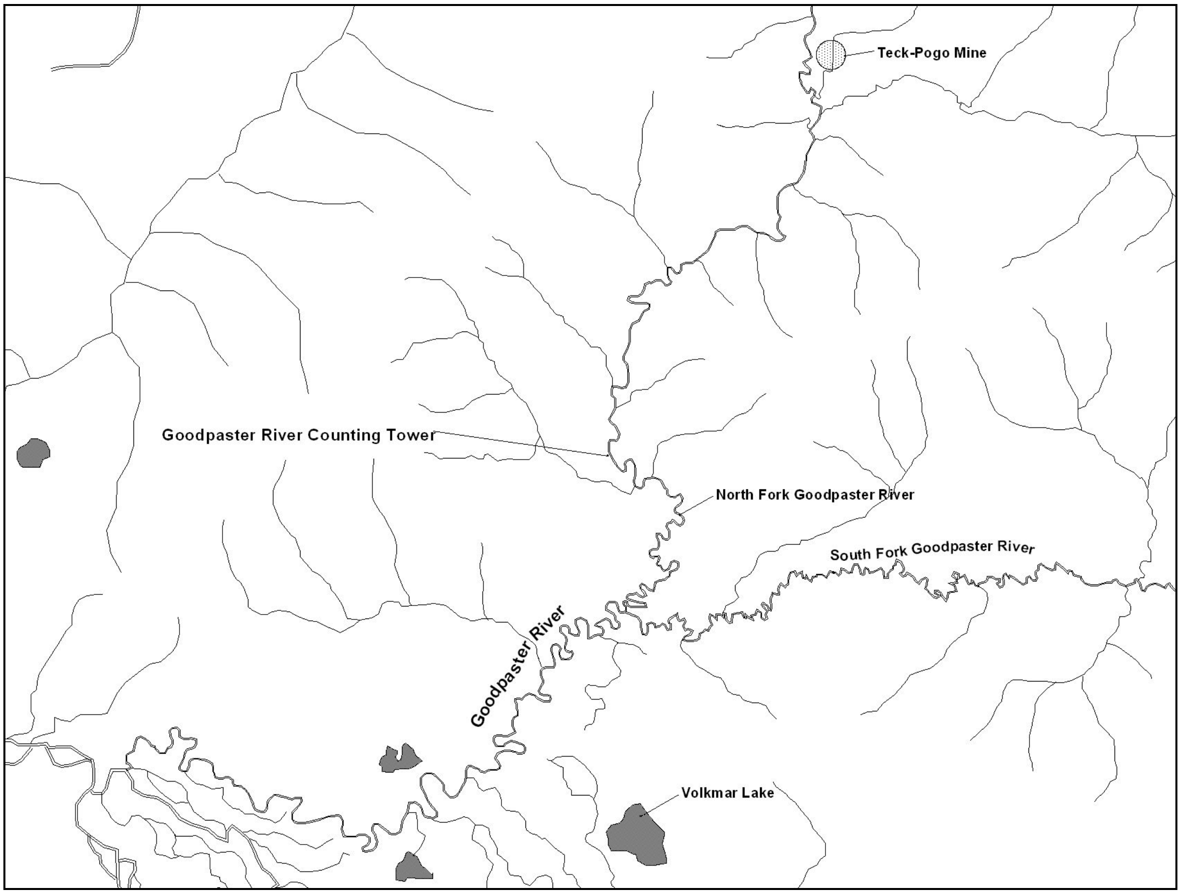

Figure B1.–Map of the Goodpaster River demarcating the counting tower.

Table B1.–Estimates of the Goodpaster River Chinook salmon escapement, 2004–2013.

Year	Escapement	
	Estimate	SE
2004	3,673	106
2005	1,184	70
2006	2,479	100
2007	1,581	82
2008	1,880	85
2009	4,280	167
2010	1,167	67
2011	1,325	Not Reported
2012	752	50
2013	723	44

Table B2.–Daily estimates of Goodpaster River Chinook salmon escapement, 2013.

Date	Number of 20-minute counts	Daily escapement
16-Jul	16	0
17-Jul	24	30
18-Jul	24	33
19-Jul	22	55
20-Jul	24	51
21-Jul	8	27
22-Jul	8	27
23-Jul	24	36
24-Jul	24	27
25-Jul	24	54
26-Jul	24	27
27-Jul	24	33
28-Jul	24	57
29-Jul	24	39
30-Jul	24	39
31-Jul	24	51
1-Aug	24	36
2-Aug	24	60
3-Aug	12	41
Total		723