Fishery Data Series No. 06-61

Salmon Studies in the Chena, Chatanika, Delta Clearwater, and Salcha Rivers, 2004 and 2005

by

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and

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November 2006

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

FISHERY DATA REPORT NO. 06-61

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ABSTRACT

Escapements of Chinook salmon *Oncorhynchus tshawytscha* in the Chena, Chatanika, and Salcha rivers near Fairbanks, Alaska are typically estimated using tower-count methodology. The summer of 2004 was one of the driest in recent years and although these conditions resulted in major forest fires throughout Alaska's interior, they also led to excellent Chinook salmon counting conditions on all three monitored rivers. In contrast, counting on the Chena and Chatanika rivers in July 2005 was hampered by high amounts of rain and heavy silt loads in both rivers causing reduced visibility. These conditions led to incomplete Chinook salmon abundance estimates from those counting tower projects. Viewing conditions on the Salcha River were good throughout the summer due to a new counting tower location and low rainfall in the drainage. This report summarizes the 2004 and 2005 results from the Chinook salmon counting tower projects on the Chena, Chatanika, and Salcha rivers, and the coho enumeration project on the Delta Clearwater River.

Chena River: During 2004, tower counts were conducted from 23 June to 1 August. During that period counting tower technicians could not work for 5 days (29 June – 3 July) due to the poor air quality caused by wildfires in the area. The estimated Chinook salmon escapement was 9,645 fish (SE=532) and the incomplete chum salmon *Oncorhynchus keta* escapement estimate was 15,162 fish (SE=648).

In 2005 tower counts were attempted from 29 June through 4 August. Due to several high water events and excessive silt loads in the river, complete counts were conducted for only 40% of those days, none of which were during the peak of the Chinook salmon run. Due to this low percentage of successful counts, no Chinook or chum salmon escapement estimates were generated for the Chena River.

Age and sex compositions of the Chena River Chinook escapement were determined after carcass surveys. In 2004 258 carcasses were collected. The proportion of females in the sample (after correction for gender bias) was 0.47 (SE = 0.06). Males were most represented by age 1.4 (36%). The majority of females were age 1.4 (88%). In 2005 620 carcasses were collected, the proportion of females in the sample (after correction for gender bias) was 0.32 (SE = 0.04). The majority of males examined were age 1.3 (57%), and the majority of females were age 1.4 (53%).

Chatanika River: During 2004, counts were conducted on the Chatanika River from 24 June to 30 July; with no counts being conducted during the periods of poor air quality (29 June – 3 July). Estimates of escapement were 2,444 Chinook salmon (SE=250) and a minimum of 1,538 chum salmon (SE=113).

In 2005, similar to the Chena River, no Chinook or chum salmon escapement estimates were produced for the Chatanika River due to the low number of days when successful counting occurred.

Salcha River: Chinook salmon enumeration and carcass surveys were conducted by staff from the Bering Sea Fishermen's Association (BSFA) in 2004 and 2005. During 2004, counts occurred from 25 June through 14 September. Escapement estimates were 15,761 Chinook salmon (SE=612) and 47,861 chum salmon (SE=671).

During 2005, the Salcha River tower operated from 30 June through 25 August. Estimated escapements were 6,000 Chinook salmon (SE=163) and a minimum of 194,933 chum salmon (SE=1,600).

Age and sex compositions of the Salcha River Chinook escapement were determined after carcass surveys. In 2004 240 carcasses were collected. The proportion of females in the sample (after correction for gender bias) was 0.47 (SE=0.12). Males were most represented by age 1.4 (58%). The majority of females were also age 1.4 (96%). In 2005 652 carcasses were collected, the proportion of females in the sample (after correction for gender bias) was 0.41 (SE=0.11). The majority of males examined were age 1.3 (52%), and the majority of females were age 1.4 (63%).

Delta Clearwater River: Escapements of coho salmon *Oncorhynchus kisutch* were enumerated during boat surveys. Counts of coho salmon in the mainstem river, which were expanded by a factor based on 5 years of aerial survey data of river tributaries that were not boat accessible, produced total escapement estimates of 47,651 and 43,059 coho salmon for 2004 and 2005, respectively.

Key words: aerial survey, age-sex-length composition, boat survey, carcass survey, Chatanika River, Chena River, Chinook salmon, chum salmon, coho salmon, counting towers, Delta Clearwater River, escapement, *Oncorhynchus keta*, *Oncorhynchus kisutch*, *Oncorhynchus tshawytscha*, Salcha River.

REPORT OVERVIEW

Some of the most important Yukon River Chinook salmon *Oncorhynchus tshawytscha* and coho salmon *O. kisutch* spawning rivers are located in the vicinity of Fairbanks, Alaska. The Chena and Salcha rivers support the largest spawning populations of Chinook salmon in the Tanana River drainage, while the Delta Clearwater River (DCR) supports the largest spawning population of coho salmon in the entire Yukon River drainage. Other nearby river systems that support important spawning populations of salmon includes the Chatanika, Goodpaster, and Nenana rivers.

Chinook and coho salmon are harvested during commercial, subsistence and personal use fisheries throughout the Yukon and Tanana rivers (Figure 1), and both species are targeted in inriver sport fisheries. Sport anglers value the opportunity to catch these large salmon, even though they are only available for a limited time each year. The recent 10 year (1994-2003) average sport catch of Chinook salmon in the Chena River was 1,873 fish, and the corresponding harvest was 646 fish (Table 1; Brase and Doxey *In prep*). The recent 5 year (2000-04) average sport catch of coho salmon in the Delta Clearwater River was 6,264 fish, and the corresponding average harvest was 674 fish (Parker *In prep*). Most sport anglers target Interior Alaska salmon for catch and release fishing as the flesh is relatively deteriorated by the time the fish have traveled the ~1,000 miles from the mouth of the Yukon River to their natal stream.

The Alaska Department of Fish and Game (ADF&G) has established biological escapement goal (BEG) ranges for Chinook salmon in the Chena and Salcha rivers and a sustainable escapement goal (SEG) range for coho salmon in the Delta Clearwater River (DCR). The BEGs are based on spawner-recruit analyses of run reconstruction data. BEGs are set as ranges which provide for maximum sustained yield. In 2001 the Alaska Board of Fisheries (BOF) adopted policy directing ADF&G to manage harvest so that escapements fall within the BEG ranges (*Policy for Statewide Salmon Escapement Goals*; 5 AAC 39.223, 2001). Escapement goals are evaluated and modified as needed on a 3-year cycle in synchrony with the 3 year BOF meeting cycle for addressing fisheries issues within the Yukon drainage. The Chinook salmon BEG range for the Chena River is 2,800 – 5,700 fish, and for the Salcha River is 3,300 – 6,500. The DCR coho salmon SEG point goal of >9,000 fish was revised to an SEG range of 5,200 – 17,000 fish at the 2003 BOF meeting (ADF&G 2004). There is currently no escapement goal for Chatanika River Chinook salmon.

The monitoring studies described in this report enable fisheries managers to collect and evaluate "real-time" data of run magnitude and fish passage. Counting towers are used to monitor Chinook salmon escapement to the Chena and Chatanika rivers and coho salmon escapement to the DCR is monitored through boat surveys.

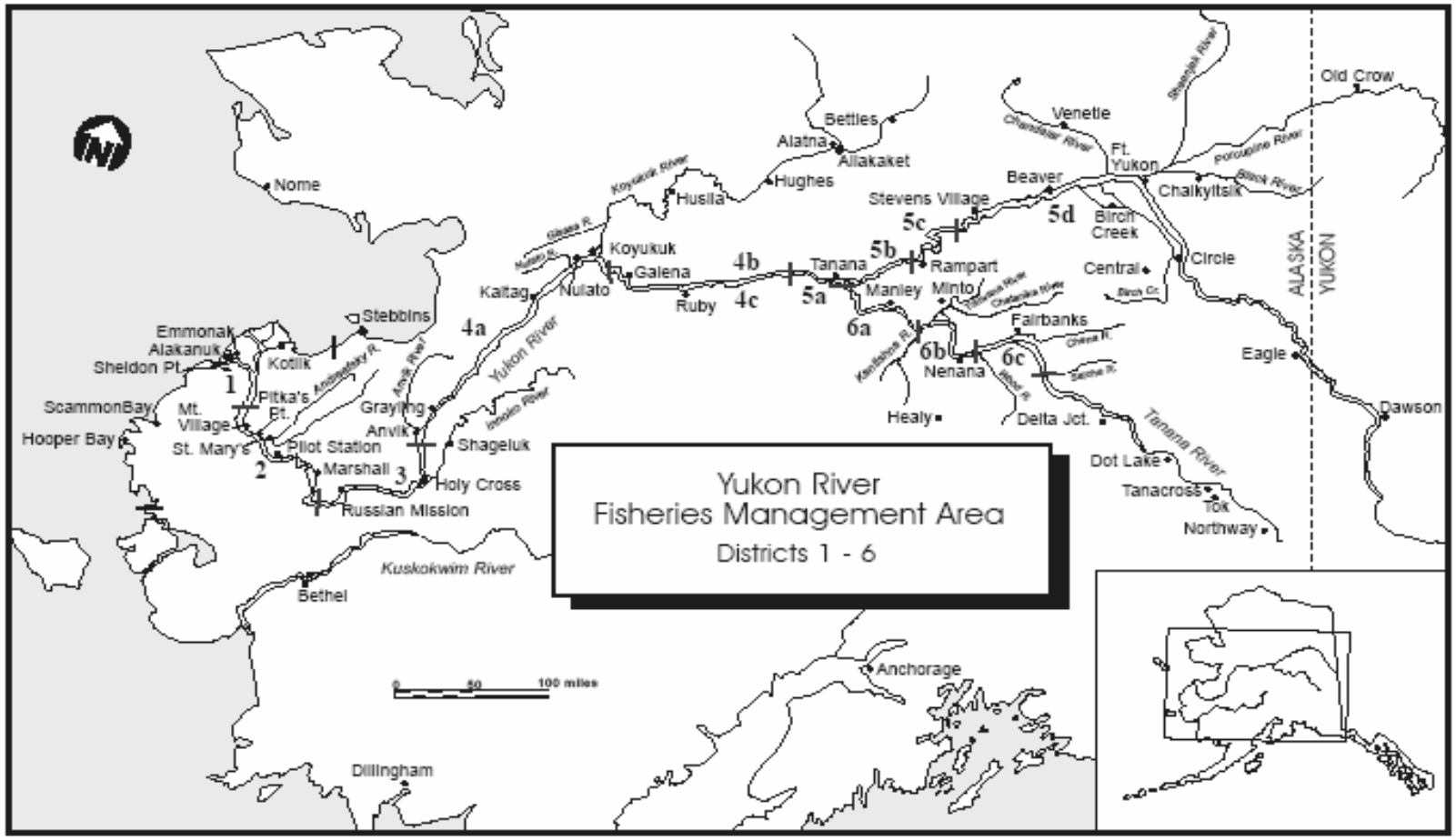

Figure 1.–Commercial fishing districts and subdistricts in the Yukon River drainage.

Table 1.–Estimated sport, commercial, and subsistence harvests of Chinook salmon in the Tanana River drainage, 1990 - 2005.[f]

	Sport Harvest										
	Creel Survey[a]		Statewide Survey[b]					Total	Commercial	Subsistence and Personal Use	Total Estimated
Year	Chena River	Salcha River	Chena River	Salcha River	Chatanika River	Nenana River	Other Streams	Tanana Drainage	Harvest[c]	Harvest [c,e]	Harvest
									Tanana Drainage		
1990	24	200	64	291	37	0	0	420	2,989	3,069	6,478
1991	-	362	110	373	82	11	54	630	1,163	2,515	4,308
1992	-	4	39	47	16	0	0	118	785	2,438	3,341
1993	-	54	733	601	192	0	137	1,691	1,445	2,098	5,234
1994	-	776	993	714	105	0	20	1,832	2,606	2,370	6,808
1995	-	811	662	1,448	58	0	213	2,381	2,747	2,178	7,306
1996	-	-	1,270	1,136	348	53	118	3,085	447	1,392	4,924
1997	-	-	1,029	719	155	10	0	1,943	2,728	3,025	7,696
1998	-	-	299	121	6	15	0	441	963	2,276	3,680
1999	-	-	442	445	63	11	0	1,006	690	1,955	3,651
2000	-	-	71	72	0	24	11	178	0	1,058	1,236
2001	-	-	536	108	23	0	0	667	0	2,571	3,238
2002	-	-	178	269	0	0	0	466	836	1,193	2,495
2003	-	-	976	1,127	13	11	0	2,136	1,813	2,349	6,298
2004	-	-	762	481	37	0	27	1,315	2,057	6,757[d]	10,129
2005	-	-	57	351	0	0	25	483	1,922	9,249[d]	11,654

a Creel census estimates from Hallberg and Bingham (1991-1996).

b Sport fishery harvest estimates from Mills (1991-1994) Howe et al. (1995, 1996, 2001 a-d), Walker et al. (2003), and Jennings et al. (2004, *In prep a, b*).

c Commercial, subsistence, and personal use estimates from: Schultz et al. 1994; Borba and Hamner 1998, 2000, 2001; Brase and Hamner 2002, 2003; Busher et al. *In prep*; Busher and Hamazaki 2005; ADF&G 2002.

d Preliminary data and subject to change.

e The personal use designation was established in 1988 to account for fishermen analogous to subsistence users fishing in the Tanana River within the Fairbanks Non-Subsistence Area.

f Totals do not include Chinook salmon harvests from stocked lakes in the Tanana River area.

The Salcha River was monitored by ADF&G prior to 1998. Results of ADF&G Commercial Fisheries Division (CFD) aerial surveys of the Salcha and Chena rivers from 1986 – 1993 indicated a correlation between Chinook salmon escapement index counts in the two rivers (ADF&G 2002). In addition, approximately 77% of past escapements to both rivers showed correlations with respect to achieving escapement objectives between 1987 and 1999. These facts, in conjunction with reduced funding levels, caused ADF&G to discontinue monitoring operations on the Salcha River. The Bering Sea Fishermen's Association (BSFA) has obtained US-Canada Treaty funds to operate a counting tower and perform a carcass survey on the Salcha River. The results of the Salcha River tower counts are provided to ADF&G throughout the season.

This report is broken into three sections with each section including the results from the 2004 and 2005 seasons. The sections are as follows:

1) the Chena and Chatanika rivers counting towers and Chinook salmon ASL (age-sex-length) results;
2) the Salcha River counting tower and Chinook salmon ASL results; and,
3) the Delta Clearwater River coho salmon survey.

SALMON COUNTING TOWERS ON THE CHENA AND CHATANIKA RIVERS

INTRODUCTION

Prior to 1986, aerial survey index counts conducted by ADF&G-CFD were the only Chinook salmon escapement data available for the Chena River. Aerial survey counts likely underestimated total escapement, but the amount and consistency of underestimation was unknown. From 1986 to 1988 CFD estimated abundance of Chinook salmon in the Chena River using mark-recapture (M-R) techniques to examine the relationship between aerial survey counts and actual abundance (Barton 1987a, 1988; Barton and Conrad 1989). Beginning in 1989 Sport Fish Division took over operations of the annual Chena River Chinook salmon M-R study. The relationship between the Chena River aerial survey counts and M-R abundance estimates from 1986 – 1992 was examined. The percentage of the total Chinook salmon abundance observed during aerial surveys ranged from 16 to 58% in the Chena River, with the data showing no clear linear trends, demonstrating that aerial survey counts did not provide a reliable index of escapement (Evenson 1993).

Beginning in 1993, tower counting techniques were initiated to estimate escapements of Chinook salmon in the Chena River. Because some spawning occurred upstream of the M-R study section, it was believed that the M-R estimates did not represent total escapement, whereas tower-counts enumerate all migrants. In 1997 a paired M-R and complete tower-count estimate was obtained for the Chena River. A z-test of the two estimates and their associated variances failed to reject the hypothesis that the escapement from tower-counts was equal to that from mark-recapture studies (Stuby and Evenson 1998). Although tower-counts are the preferred method for estimating salmon escapement, M-R techniques may be the only method available to estimate escapement during years of high rainfall and high river stages.

The Chatanika River supports a small run of Chinook salmon. Recent estimates of sport harvests have indicated that relative exploitation may be large. Escapements have been monitored semi-annually in past years through aerial surveys conducted by CFD. No escapement objective exists for this river, and it is assumed that aerial surveys are a poor method of indexing escapement. During 1995 and 1996, boat counts were conducted successfully for a portion of the Chatanika River. Mark-recapture techniques were utilized during 1997. However, a very low recapture rate coupled with the need to stratify the data by sex produced a standard error that was 40% of the estimate (Stuby and Evenson 1998). During 1998 and 1999, escapement was estimated based on tower counts (Stuby 1999, 2000). In 2000 an extremely poor return coupled with high river stages precluded collection of useful passage data (Stuby 2001). In 2001 a minimal estimate of escapement was developed before high river stages ended counts as the run was tailing off. In 2002 and 2003 similar minimum estimates were obtained (Doxey et al. 2005).

The run timing of Chinook salmon and chum salmon *O. keta* overlaps on the Chena and Chatanika rivers, therefore chum salmon were also counted from the counting towers. The chum salmon run overlap is not complete with Chinook salmon; chum salmon arrive slightly later and persist for about three weeks after the Chinook salmon have completed their run. Chinook salmon counts were completed before the end of the chum salmon run so counts of chum salmon were terminated before all chum salmon had passed. Therefore chum salmon escapement estimates provided in this report are biased low, and are considered minimum estimates of chum salmon escapement.

2004 – 2005 OBJECTIVES

1. Estimate the total escapement of Chinook salmon in the Chena and Chatanika rivers using tower-counting techniques such that:
    a. the expected 95% confidence interval for the Chena River is within 15% of the point estimate of escapement; and,
    b. the expected 95% confidence interval for the Chatanika River is within 25% of the point estimate of escapement.
2. Estimate age and sex composition of the escapement of Chinook salmon in the Chena River by means of a carcass sample such that all estimated proportions are within 5 percentage points of the actual proportions 95% of the time and the estimated proportion of females in the escapement from either electrofishing samples or correcting the carcass survey estimate is within 10 percentage points of the actual proportion 95% of the time; and,
3. if the tower-counts become unreliable due to poor viewing conditions and an estimate is required to maintain the integrity of the biological escapement goal analysis program, estimate the total escapement of Chinook salmon in the Chena River such that the estimates are within 25% of the actual value 95% of the time using mark-recapture techniques.

In addition to the objectives there were three tasks:

1. collect length data from all Chinook salmon carcasses sampled for age and sex, and provide these data to CFD to support a Chinook salmon disease study being performed in the Yukon River;
2. as time and circumstances allow, provide logistical support (boat transportation during planned carcass surveys) and sampling assistance to researchers from other agencies conducting Chinook salmon research on the Chena and Chatanika rivers; and,
3. count chum salmon in the Chena and Chatanika rivers throughout the duration of the Chinook salmon run.

METHODS

Daily escapements of Chinook and chum salmon were estimated by visually counting fish as they passed through the Moose Creek Dam on the Chena River (Figure 2) and in front of a scaffolding tower on the riverbank of the Chatanika River immediately downstream from the Alaska Oil Pipeline crosses the river (Figure 3). Virtually all Chinook salmon spawning activity occurs upstream of these sites. No harvest of salmon is allowed upstream from the dam on the Chena River, so completed estimates from tower-counts represent total escapement above the dam. Most sport fishing for salmon in the Chatanika River occurs upstream from the tower, so complete tower-count estimates represent the total in-river return for the Chatanika River.

Construction of the tower infrastructures were completed prior to the beginning of counts. White fabric panels (8218 LTA manufactured by Seaman Corp., Canal Fulton, Ohio) were placed across the bottom of the river channels adjacent to the counting structures in order to highlight crossing salmon. Lights were suspended over the panels to provide illumination during periods of low ambient light. Since salmon often avoid areas with unusual substrate or those illuminated with artificial lighting, once the lights were turned on they were not shut off until salmon were again visible in ambient light. Counting was scheduled to begin on or about 26 June for the Chena River and 1 July for the Chatanika River. Counts were scheduled to end on or about July 31 for the Chena River and 8 August for the Chatanika River. Based on previous tower-counting studies in these systems, passages of Chinook salmon outside of these counting periods were considered negligible.

Three technicians were assigned to the Chatanika River and four to the Chena River. Counts were scheduled throughout the entire day in order to monitor 24-h migration patterns. For analysis, each day was divided into three 8-h shifts: however, a technicians' work-shift was 7.5 h. Each technician was scheduled for a maximum of five shifts per week (Monday–Sunday).

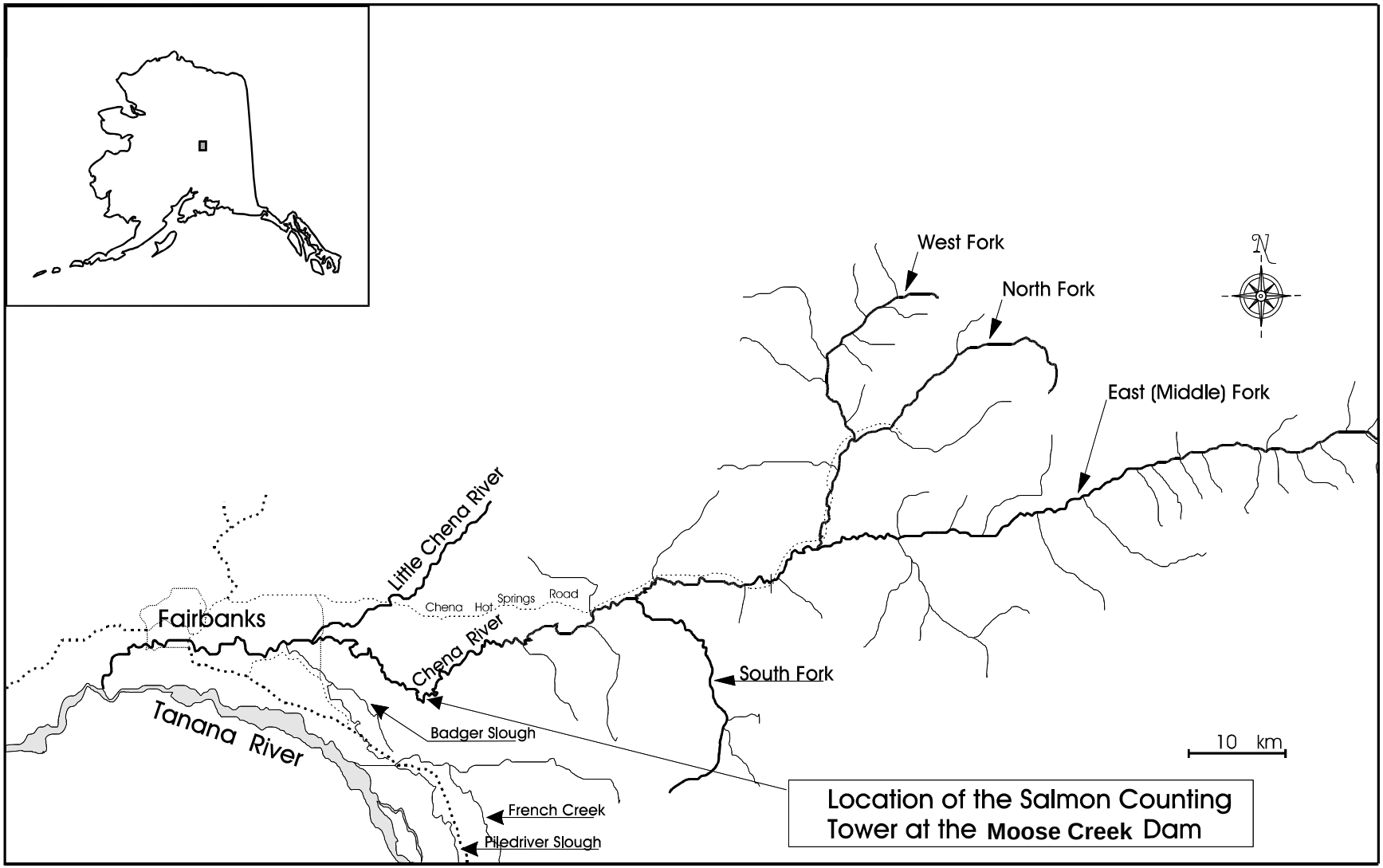

Figure 2.–Chena River drainage with location of counting tower**.**

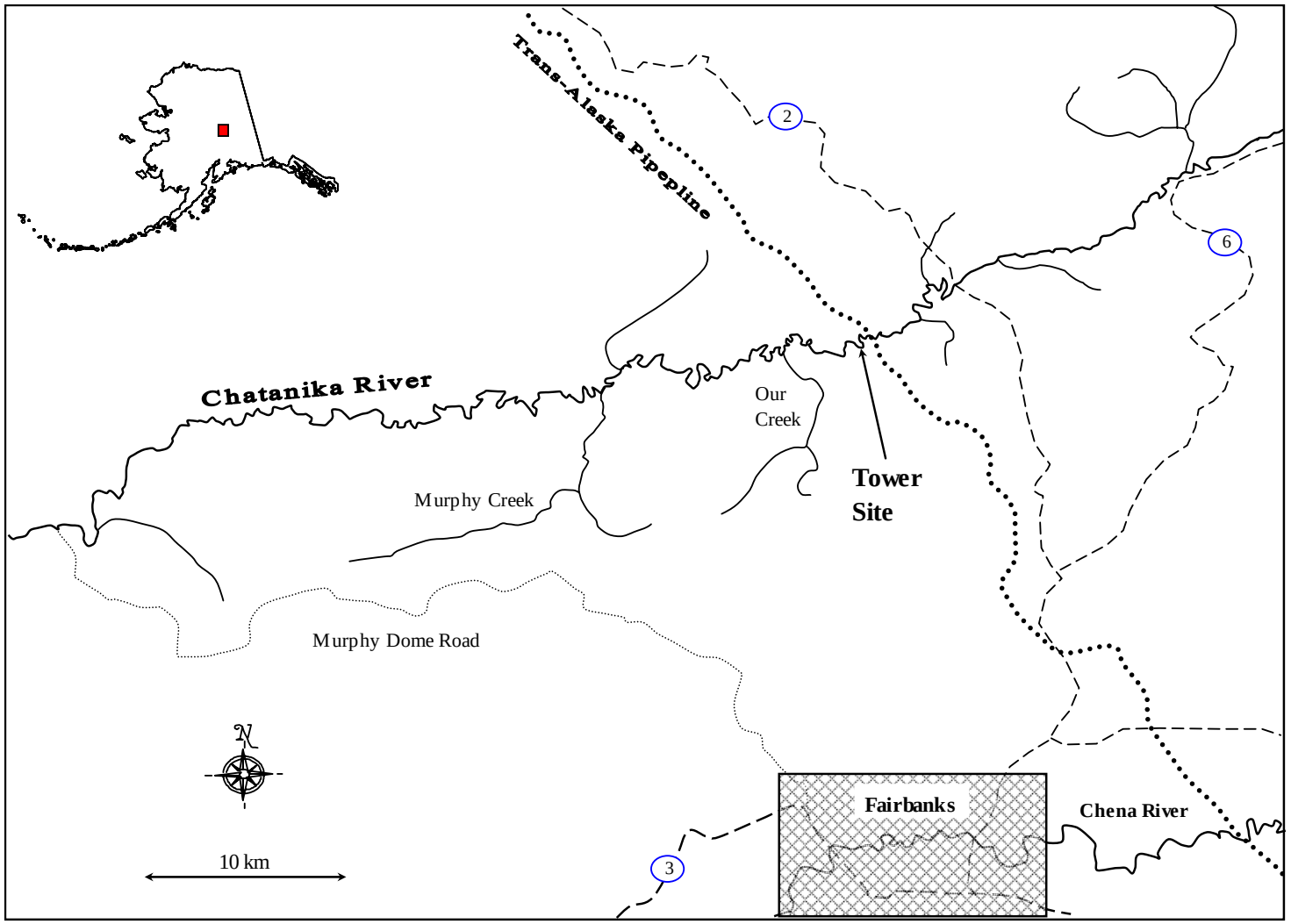

Figure 3.–Portion of the Chatanika River drainage with location of counting tower site.

Almost all shifts were staffed on the Chena River with counts scheduled 20 of 21 shifts per week after June 26. Sixteen shifts per week were staffed on the Chatanika River except during the first five days when counts were scheduled during 13 shifts per week (two shifts per day). Shift I began at 0000 hour (midnight) and ended at 0730 hour; Shift II began at 0800 hour and ended at 1530 hour; Shift III began at 1600 hour and ended at 2330 hour. Salmon were counted during 20 min of every hour. The start time for all counts during each shift began between the top of the hour and 10 min past. The width of the Chena River made it possible for fish to pass unseen by a single observer, so the river were bisected by placing a red strip across the panels near the center of the channel, and 10 min counts were conducted on each side. The count on the left side of the river (facing upstream) was conducted during the first 10 min of the hour, with the count of the right side immediately following. In contrast, the Chatanika River channel was sufficiently narrow to permit a single 20 min count over the entire width.

If viewing conditions prevented sampling during consecutively scheduled shifts, the counting schedule were adjusted to the extent possible to prevent scheduled non-counting shifts from following the shifts where counting failed due to viewing conditions. An example of a counting schedule is shown in Appendix A.

Numbers of Chinook salmon and chum salmon counted were recorded on field forms (Appendix B) at the end of each hourly count. At the end of each shift the counting technician phoned in their counts to a 24-hour answering machine at the project leader's office and the data sheets were returned to the office at the end of each day. The recorded messages were transcribed each morning and were subsequently entered into an excel spreadsheet. Recorded data included river, name of counter, date and time of counting shift, and numbers of each species counted (total upstream and total downstream) for each side of the river during 10 min counts for the Chena River and for 20 min counts for the entire width of the Chatanika River.

Carcasses of spawned-out Chinook salmon were collected on the Chena River from river mile 45 to 90 in order to estimate age, sex, and length (ASL) composition of the escapement. The survey was scheduled to occur during the first week in August subject to variability in the timing of the salmon run, weather, and river conditions. Chinook salmon carcasses were collected and inspected during one or two complete surveys of the study area. Two riverboats were used with crews consisting of three people in each boat with one person driving and the other two people collecting carcasses. 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 in order 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 landed on a gravel bar and the carcasses were laid out in rows of 10 with their left sides facing up. Each carcass was measured to the nearest 5 mm MEF. Sex was determined from external characteristics or from internal inspection. Three scales were removed from the left side of the carcass approximately two 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 carcass or if necessary, from any location other than along the lateral line where there were any scales remaining and placed directly on gum cards. After sampling, all carcasses were cut in a distinctive manner through the left orbit to avoid

resampling and returned to the river. Ages were determined from scale patterns as described by Mosher (1969).

Objective criteria for age and sex compositions were established based on sample sizes that could be attained through reasonable amounts of effort (cost) and historic success. Approximately 14% of the scales collected during past carcass surveys were either regenerated or not readable for other reasons. Therefore, three scales from each of at least 592 male and female Chinook salmon in the Chena River needed to be collected to ensure that ages could be determined for 509 fish (Thompson 1987). During past carcass sampling events, this target sample size was achieved in six of 15 years on the Chena River.

To estimate sex compositions from carcasses with the desired level of precision and accuracy stated in the objectives, 384 Chinook salmon carcasses needed to be examined in the Chena River (Cochran 1977). These 384 Chinook salmon were not in addition to the 592 fish needed for aging. During past carcass sampling events, this target sample size was achieved in nine of 15 years on the Chena River.

DATA ANALYSIS

Estimates of Chinook salmon abundance for the Chena River were stratified by day. Daily estimates of abundance were considered a two-stage direct expansion where the first stage were the 8-h shifts within a day and the second stage were the 10 min counting periods within a shift. The second stage was considered systematic sampling because the 10 min counting periods were not chosen randomly. Except where noted, the formulas (1-10) in this section for parameter estimates and variances necessary to calculate escapement from counting tower data were taken directly or modified from those provided in Cochran (1977). The expanded shift passage on day *d* and shift *i* was calculated by:

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

The average shift passage for day *d* was:

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

The expanded daily passage was:

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

The period sampled was a systematic sample, because a period was sampled every hour in a shift. The sample variance associated with periods was approximated using the successive difference approach (Wolter 1985):

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

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

$$s_{1d}^2 = \frac{1}{h_d - 1}\sum_{i=1}^{h_{sd}}\left(Y_{di} - \bar{Y}_d\right)^2 \quad (5)$$

The variance for the expanded daily passage was estimated by:

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

where:

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

$$f_{2di} = \frac{m_{di}}{M_{di}} \quad (8)$$

and

d = day;

i = 8-h shift;

j = 10-min (Chena) or 20-min (Chatanika) counting period;

y_{dij} = observed 20-min period count (Chatanika) or sum of 10-min period counts (Chena);

Y_{di} = expanded shift passage;

m_{di} = number of 10-min or 20-min counting periods sampled;

M_{di} = total number of possible 10-min or 20-min counting periods;

h_d = number of 8-h shifts sampled;

H_d = total number of possible 8-h shifts; and,

D = total number of possible days.

Passage for the entire run and variance was estimated by:

$$\hat{N} = \sum_{d=1}^{D}\hat{N}_d\text{ ; and} \quad (9)$$

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

For the Chena River, the daily-expanded shift passage and the associated variance were calculated using data from 10 min counting periods after summing counts within period from each side of the river to arrive at total estimates for the river. For the Chatanika River, the same estimator and variance equations were used except that data from 20 min counting periods were used.

In the event that water conditions and/or personnel constraints did not permit at least two shifts during a day, the sample variance across shifts (equation 5) could not be calculated from data and an approximation was substituted. The approximation was based on shift to shift variation observed at that counting site during days when more than one shift was worked. The coefficient of variation (*CV*) was used because it is independent of the magnitude of the estimate and is relatively constant throughout the run (Evenson 1995). The daily *CV* was calculated for each river and species as:

$$CV = \sqrt{s_{1d}^2} \Big/ \hat{N}_d \quad . \tag{11}$$

For a day when equation (5) could not be used, the mean of the daily known *CV*'s and the estimate of passage for that day were substituted in equation (11) to solve for an approximate sample variance across shifts for that day.

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

$$\hat{N}_i = \frac{\sum_{j=i-k}^{i+k} I(day\ j\ \ was\ sampled)\hat{N}_j}{\sum_{j=i-k}^{i+k} I(day\ j\ was\ sampled)} \tag{12}$$

where:

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

was an indicator function.

The moving average procedure was only applied for data gaps that did not exceed 4 days (12 consecutive shifts).

In previous years of this study it was stipulated that if full tower counts could not be performed due to adverse river conditions for more than four consecutive days (12 consecutive shifts) between Day 9 and Day 30 of the Chinook salmon run, then a mark-recapture experiment would be conducted. As escapement estimates and passage data have accumulated over the years and a BEG has been developed, the need for an unbroken series of escapement estimates has become less critical. This is important because electrofishing during the Chinook spawning run should be avoided if possible due to the probability of exposing salmon adults and eggs, as well as all other organisms in the 25+ foot wide path of the boat, to potentially damaging levels of electricity as described by Roach (1996).

The current Chena River Chinook salmon BEG is based on 11 pairs of spawner-return estimates (for brood years 1986-1996) with a spawning contrast of 4.59 (estimates range from 2,666-13,390; Evenson 2002). Estimates of abundance that fall within the middle of the range of previous estimates have little effect on the estimate of optimal spawning escapement (escapement that produces maximum sustained yield that is used to estimate the BEG range). However, extremely large or small escapements (outside the observed range) will improve the spawning contrast in the spawner-recruit relationship and provide for more certainty in the estimate of optimal spawning escapement.

Therefore, it was decided prior to the Chinook salmon season that a mark-recapture experiment would only be undertaken on the Chena River when tower counting failed and:

1. escapement was projected to be less than 3,000 or greater than 13,000 Chinook salmon;
2. abundance estimates were not obtained during the preceding two consecutive years (regardless of projected run size in the current year); or,
3. escapements less than 3,000 or more than 13,000 Chinook salmon were observed 5 or 6 years (dominant age classes in the brood-year return) prior to the current year.

Gender bias has been noted when comparing sex ratios of Chinook salmon collected during carcass surveys with those collected by electrofishing (Stuby 2001). Correcting the estimated carcass survey based proportion of females in an escapement to the proportion we may observe by electrofishing requires analysis of data from previous years when both sampling procedures were conducted. Paired electrofishing and carcass survey data are available for 8 years from the Chena River (1989-92, 1995-97, and 2000).

If sufficient carcasses were sampled the abundance estimate was apportioned by sex prior to apportioning by age categories within each sex. Estimates of the proportion of females and males in the Chena River 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):

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

with variance:

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

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

The correction factor necessary to correct estimates of the proportion of females in the Chena River escapement from carcass surveys in years when no electrofishing is conducted is R_p = 0.76153 with $\hat{V}(R_p)$ = 0.00754092.

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

$$\tilde{p}_{fe} = \hat{p}_{fc} R_p \text{ with } \hat{V}(\tilde{p}_{fe}) = \hat{p}_{fc}^2 \hat{V}(R_p) + R_p^2 \hat{V}(\hat{p}_{fc}) - \hat{V}(R_p)\hat{V}(\hat{p}_{fc}) \tag{16}$$

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

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

Abundance of each sex is then estimated by:

$$\hat{N}_s = \tilde{p}_{se}\hat{N} \tag{17}$$

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

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

The proportion of fish at age by sex *s* for samples collected solely for age, sex, and length were 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:

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

Abundance of age or size class *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):

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

Aerial Counts

In both 2004 and 2005, aerial survey counts of Chinook salmon in the Chena River were attempted by CFD staff after peak escapement had passed the dam. Barton (1987b) described the methods used for this survey. The daily tower counts of Chinook salmon and weather conditions were considered when determining the optimum day for the survey. The count was made from a low flying, fixed-wing aircraft. The proportion of the total estimated escapement counted by the aerial survey was calculated.

RESULTS

Chena River Chinook and Chum Salmon Abundance

In 2004 Chinook salmon counting began on the Chena River on 23 June and the first fish were seen two days later (Tables 2 and 3). Counting continued until 29 June when the smoke from wildfires caused extremely poor air quality in the area. Counting tower technicians were requested to stop working during this time out of concern for their health. Counting tower operations resumed on 4 July after the smoke moved out of the area and air quality increased. Counting continued on the Chena River until 1 August. Because fish were known to have passed upriver during the high smoke conditions, and counting tower operations ceased before the end of the chum salmon run, the 2004 escapement estimates of 9,645 Chinook salmon (SE=532) and 15,162 chum salmon (SE=648) are biased low and considered minimums. Because more than 12 consecutive shifts were missed during the high smoke conditions; the days when counting could not occur were not interpolated for.

Table 2.–Daily Chinook salmon passage at the Chena River counting site, 2004. Shaded cells indicate days with missing or incomplete counts due to high and/or turbid water, or poor air quality due to wildfires in the area.

Date	Day Of Run	Number of 10 min Counts/Day	Left Side			Right Side			Total		
			Number Counted	Estimated Passage	SE	Number Counted	Estimated Passage	SE	Number Counted	Estimated Passage	SE
23-Jun-04		16	0	0	0	0	0	0	0	0	0
24-Jun-04		16	0	0	0	0	0	0	0	0	0
25-Jun-04	1	32	2	18	18	0	0	0	2	18	18
26-Jun-04	2	32	1	9	9	0	0	0	1	9	9
27-Jun-04	3	32	4	36	31	0	0	0	4	36	31
28-Jun-04	4	48	14	84	38	0	0	0	14	84	38
29-Jun-04	5	32	0	0	0	0	0	0	0	0	0
30-Jun-04	6	0	0	0	N/A	0	0	N/A	0	0	N/A
1-Jul-04	7	0	0	0	N/A	0	0	N/A	0	0	N/A
2 Jul-04	8	0	0	0	N/A	0	0	N/A	0	0	N/A
3-Jul-04	9	0	0	0	N/A	0	0	N/A	0	0	N/A
4-Jul-04	10	48	6	36	22	0	0	0	6	36	22
5-Jul-04	11	48	40	240	178	0	0	0	40	240	178
6-Jul-04	12	48	136	816	251	0	0	0	136	816	251
7-Jul-04	13	48	72	432	138	0	0	0	72	432	138
8-Jul-04	14	32	25	225	42	0	0	0	25	225	42
9-Jul-04	15	48	55	330	77	0	0	0	55	330	77
10-Jul-04	16	48	49	294	57	0	0	0	49	294	57
11-Jul-04	17	48	94	564	147	1	6	6	95	570	147
12-Jul-04	18	48	169	1,014	149	3	18	13	172	1,032	150
13-Jul-04	19	48	164	984	85	1	6	4	165	990	85
14-Jul-04	20	48	102	612	118	1	6	6	103	618	118
15-Jul-04	21	48	87	522	91	0	0	0	87	522	91
16-Jul-04	22	48	80	480	94	0	0	0	80	480	94
17-Jul-04	23	32	61	549	207	0	0	0	61	549	207

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Table 2.–Page 2 of 2.

Date	Day Of Run	Number of 10 min Counts/Day	Left Side			Right Side			Total		
			Number Counted	Estimated Passage	SE	Number Counted	Estimated Passage	SE	Number Counted	Estimated Passage	SE
18-Jul-04	24	48	61	366	68	0	0	0	61	366	68
19-Jul-04	25	48	80	480	89	0	0	0	80	480	89
20-Jul-04	26	40	23	207	80	0	0	0	23	207	80
21-Jul-04	27	48	39	234	42	0	0	0	39	234	42
22-Jul-04	28	47	45	270	44	-1	-6	6	44	264	45
23-Jul-04	29	48	36	216	46	0	0	0	36	216	46
24-Jul-04	30	47	14	88	33	0	0	0	14	88	33
25-Jul-04	31	48	20	120	29	1	6	6	21	126	29
26-Jul-04	32	48	5	30	15	2	12	8	7	42	18
27-Jul-04	33	48	16	96	20	2	12	14	18	108	24
28-Jul-04	34	46	11	69	20	2	14	10	13	82	22
29-Jul-04	35	48	7	42	14	0	0	0	7	42	14
30-Jul-04	36	48	9	54	14	0	0	0	9	54	14
31-Jul-04	37	48	6	36	18	0	0	0	6	36	18
1-Aug-04	38	48	0	0	14	3	18	4	3	18	14
Total	-	1,556	1,533	9,553	531	15	92	27	1,548	9,645	532

Table 3.–Daily chum salmon passage at the Chena River counting site, 2004. Shaded cells indicate days with missing or incomplete counts due to high and/or turbid water, or poor air quality due to wildfires in the area.

	Total	Left Side			Right Side			Total		
Date	10 min Counts/Day	Number Counted	Estimated Passage	SE	Number Counted	Estimated Passage	SE	Number Counted	Estimated Passage	SE
23-Jun-04	16	0	0	0	0	0	0	0	0	0
24-Jun-04	16	0	0	0	0	0	0	0	0	0
25-Jun-04	32	0	0	0	0	0	0	0	0	0
26-Jun-04	32	0	0	0	0	0	0	0	0	0
27-Jun-04	32	0	0	0	0	0	0	0	0	0
28-Jun-04	48	0	0	0	0	0	0	0	0	0
29-Jun-04	32	0	0	0	0	0	0	0	0	0
30-Jun-04	0	0	0	N/A	0	0	N/A	0	0	N/A
1-Jul-04	0	0	0	N/A	0	0	N/A	0	0	N/A
2-Jul-04	0	0	0	N/A	0	0	N/A	0	0	N/A
3-Jul-04	0	0	0	N/A	0	0	N/A	0	0	N/A
4-Jul-04	48	0	0	0	0	0	0	0	0	0
5-Jul-04	48	2	12	12	0	0	0	2	12	12
6-Jul-04	48	3	18	10	0	0	0	3	18	10
7-Jul-04	48	2	12	12	0	0	0	2	12	12
8-Jul-04	32	3	27	12	0	0	0	3	27	12
9-Jul-04	48	6	36	15	0	0	0	6	36	15
10-Jul-04	48	2	12	8	0	0	0	2	12	8
11-Jul-04	48	12	72	16	0	0	0	12	72	16
12-Jul-04	48	27	162	30	0	0	0	27	162	30
13-Jul-04	48	55	330	80	0	0	0	55	330	80
14-Jul-04	48	68	408	147	7	42	41	75	450	153
15-Jul-04	48	79	474	178	0	0	0	79	474	178
16-Jul-04	48	38	228	108	1	6	6	39	234	108
17-Jul-04	32	41	369	165	0	0	0	41	369	165
18-Jul-04	48	74	444	142	0	0	0	74	444	142
19-Jul-04	48	75	450	95	1	6	6	76	456	95
20-Jul-04	40	7	63	40	0	0	0	7	63	40
21-Jul-04	48	45	270	122	1	6	6	46	276	122
22-Jul-04	47	61	366	107	0	0	0	61	366	107
23-Jul-04	48	60	360	74	0	0	0	60	360	74
24-Jul-04	47	133	865	137	1	7	7	134	872	137
25-Jul-04	48	226	1,356	150	9	54	28	235	1,410	152
26-Jul-04	48	182	1,092	179	0	0	15	182	1,092	180
27-Jul-04	48	189	1,134	202	25	150	84	214	1,284	219
28-Jul-04	46	201	1,244	160	48	312	73	249	1,556	176
29-Jul-04	48	164	984	121	57	342	98	221	1,326	156
30-Jul-04	48	163	978	125	43	258	63	206	1,236	140
31-Jul-04	48	126	756	154	60	360	87	186	1,116	177
1-Aug-04	48	81	486	89	102	612	135	183	1,098	162
Total	1,548	2,125	13,008	605	355	2,155	233	2,480	15,162	648

In 2005 the Chena River counting tower began operations on 29 June and the first Chinook salmon were seen on 1 July (Tables 4 and 5). Almost immediately after the first fish were seen there were several high rainfall events in the upper reaches of the Chena River drainage that caused the river to rise dramatically and made viewing the migrating salmon impossible. Throughout the high water events technicians continued to monitor the Chena River so salmon counting could resume as soon as possible. Although counts were conducted sporadically throughout the next three weeks they were of poor quality and insufficient to develop an estimate of escapement. The high water events and subsequent failed counts were during days 2 – 16 and 20 – 25, which essentially covered the entire timing of the average Chena River Chinook salmon run (Figure 4).

No mark-recapture experiment was performed in 2005 because although the tower count was a failure, none of the criteria for performing a mark-recapture experiment as described in the methods were met. Condition 1 did not apply because Chinook salmon escapements to the Salcha River appeared to be in the middle of the BEG range and escapements to the Chena and Salcha rivers typically correlate well (Figure 5). Condition 2 did not apply because a good abundance estimate was produced in 2004, and a minimum estimate was produced in 2003 (Doxey et al. 2005). Condition 3 did not apply in 2005 because the parent year spawners that produced the majority of returning fish were from the 1999 and 2000 escapements. Both these years' escapements were less than 3,000 or more than 13,000 fish. The 2000 escapement was 4,694 fish and the 2001 escapement was 9,696 fish.

Chena River Age-Sex-Length (ASL) Compositions

Chinook salmon carcasses were collected from the Chena River in 2004 for a total of nine days during the period of 23 July through 9 August. During the survey 258 Chinook salmon carcasses were sampled for ASL data. The uncorrected sex composition for this sample, including those fish not aged, was 0.38 males and 0.62 females (Table 6). The average (uncorrected for gender bias) male to female ratio of all sampled fish during 1989-2003 was 0.59 to 0.41 (Table 7). The estimated proportion of females in the 2004 escapement, based on carcass survey data corrected to the electrofishing standard, was 0.47 (SE=0.59).

Ages were determined for 93% of the samples collected in 2004. Age class abundances were not calculated, but carcass age composition is considered representative of the entire escapement. The dominant age class for males was 1.4 (36%; Table 6). Ages 1.2, 1.3 and 1.5 were also present. The dominant age class for females was 1.4 (88%). Females at ages 1.3, and 1.5 were also present. Mean lengths and length ranges for age classes of males and females are listed in Table 6.

Table 4.–Daily Chinook salmon passage at the Chena River counting site, 2005. Shaded cells indicate days with missing or incomplete counts due to high and/or turbid water.

Date	Day Of Run	Number of 10 min Counts/Day	Left Side			Right Side			Total		
			Number Counted	Estimated Passage	SE	Number Counted	Estimated Passage	SE	Number Counted	Estimated Passage	SE
29-Jun-05		32	0	0	0	0	0	0	0	0	0
30-Jun-05		36	0	0	0	0	0	0	0	0	0
1-Jul-05	1	48	4	24	14	0	0	0	4	24	14
2 Jul-05	2	0	0	0	N/A	0	0	N/A	0	0	N/A
3-Jul-05	3	0	0	0	N/A	0	0	N/A	0	0	N/A
4-Jul-05	4	0	0	0	N/A	0	0	N/A	0	0	N/A
5-Jul-05	5	16	0	0	0	0	0	0	0	0	0
6-Jul-05	6	8	0	0	N/A	0	0	0	0	0	N/A
7-Jul-05	7	0	0	0	N/A	0	0	N/A	0	0	N/A
8-Jul-05	8	0	0	0	N/A	0	0	N/A	0	0	N/A
9-Jul-05	9	0	0	0	N/A	0	0	N/A	0	0	N/A
10-Jul-05	10	0	0	0	N/A	0	0	N/A	0	0	N/A
11-Jul-05	11	0	0	0	N/A	0	0	N/A	0	0	N/A
12-Jul-05	12	0	0	0	N/A	0	0	N/A	0	0	N/A
13-Jul-05	13	8	0	0	N/A	0	0	0	0	0	N/A
14-Jul-05	14	22	0	0	N/A	1	7	5	1	7	N/A
15-Jul-05	15	36	7	67	12	-2	-14	13	5	53	18
16-Jul-05	16	30	9	90	27	1	9	10	10	99	29
17-Jul-05	17	40	5	45	29	2	12	14	7	57	32
18-Jul-05	18	44	5	36	14	3	18	12	8	54	19
19-Jul-05	19	1	0	0	N/A	0	0	0	0	0	N/A

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Table 4.–Page 2 of 2.

Date	Day Of Run	Number of 10 min Counts/Day	Left Side			Right Side			Total		
			Number Counted	Estimated Passage	SE	Number Counted	Estimated Passage	SE	Number Counted	Estimated Passage	SE
20-Jul-05	20	0	0	0	N/A	0	0	N/A	0	0	N/A
21-Jul-05	21	0	0	0	N/A	0	0	N/A	0	0	N/A
22-Jul-05	22	6	0	0	N/A	0	0	0	0	0	N/A
23-Jul-05	23	23	0	0	0	0	0	0	0	0	0
24-Jul-05	24	23	1	6	6	0	0	0	1	6	0
25-Jul-05	25	26	0	0	0	0	0	0	0	0	0
26-Jul-05	26	48	11	66	21	2	12	12	13	78	24
27-Jul-05	27	48	9	54	26	3	18	9	12	72	27
28-Jul-05	28	48	7	42	14	1	6	6	8	48	15
29-Jul-05	29	48	3	18	12	4	24	14	7	42	19
30-Jul-05	30	32	0	0	0	0	0	0	0	0	0
31-Jul-05	31	46	0	0	0	0	0	0	0	0	0
1-Aug-05	32	48	0	0	0	0	0	0	0	0	0
2-Aug-05	33	48	2	12	0	0	0	0	2	12	0
3-Aug-05	34	48	0	0	0	0	0	0	0	0	0
4-Aug-05	35	48	2	12	7	1	6	0	3	18	7
Total	-	861	65	-	-	16	-	-	81	-	-

Table 5.–Daily chum salmon passage at the Chena River counting site, 2005. Shaded cells indicate days with missing or incomplete counts due to high and/or turbid water.

	Total	Left Side			Right Side			Total		
Date	10 min Counts/Day	Number Counted	Estimated Passage	SE	Number Counted	Estimated Passage	SE	Number Counted	Estimated Passage	SE
29-Jun-05	32	0	0	0	0	0	0	0	0	0
30-Jun-05	36	0	0	0	0	0	0	0	0	0
1-Jul-05	48	0	0	0	0	0	0	0	0	0
2-Jul-05	0	0	0	N/A	0	0	N/A	0	0	N/A
3-Jul-05	0	0	0	N/A	0	0	N/A	0	0	N/A
4-Jul-05	0	0	0	N/A	0	0	N/A	0	0	N/A
5-Jul-05	16	0	0	0	0	0	0	0	0	0
6-Jul-05	8	0	0	N/A	0	0	0	0	0	N/A
7-Jul-05	0	0	0	N/A	0	0	N/A	0	0	N/A
8-Jul-05	0	0	0	N/A	0	0	N/A	0	0	N/A
9-Jul-05	0	0	0	N/A	0	0	N/A	0	0	N/A
10-Jul-05	0	0	0	N/A	0	0	N/A	0	0	N/A
11-Jul-05	0	0	0	N/A	0	0	N/A	0	0	N/A
12-Jul-05	0	0	0	N/A	0	0	N/A	0	0	N/A
13-Jul-05	8	0	0	N/A	0	0	0	0	0	N/A
14-Jul-05	22	0	0	N/A	0	0	0	0	0	N/A
15-Jul-05	36	0	0	0	1	6	6	1	6	6
16-Jul-05	30	4	39	20	8	72	34	12	111	39
17-Jul-05	40	3	27	12	15	90	33	18	117	35
18-Jul-05	44	5	48	29	5	30	14	10	78	33
19-Jul-05	1	0	0	N/A	0	0	0	0	0	N/A
20-Jul-05	0	0	0	N/A	0	0	N/A	0	0	N/A
21-Jul-05	0	0	0	N/A	0	0	N/A	0	0	N/A
22-Jul-05	6	0	0	N/A	3	72	0	3	72	N/A
23-Jul-05	23	3	21	0	3	36	0	6	57	0
24-Jul-05	23	13	78	28	2	58	0	15	136	0
25-Jul-05	27	5	86	72	9	81	80	14	167	107
26-Jul-05	48	37	222	55	96	576	137	133	798	147
27-Jul-05	48	32	192	29	46	276	38	78	468	47
28-Jul-05	48	21	126	50	100	600	134	121	726	143
29-Jul-05	48	3	18	8	92	552	182	95	570	182
30-Jul-05	32	53	477	176	213	1,917	364	266	2,394	404
31-Jul-05	46	137	835	161	150	950	208	287	1,785	263
1-Aug-05	48	44	264	61	181	1,086	241	225	1,350	249
2-Aug-05	48	78	468	94	279	1,674	259	357	2,142	275
3-Aug-05	48	189	1,134	181	306	1,836	154	495	2,970	238
4-Aug-05	48	166	996	148	322	1,932	205	488	2,928	253
Total	862	793	-	-	1,831	-	-	2,624	-	-

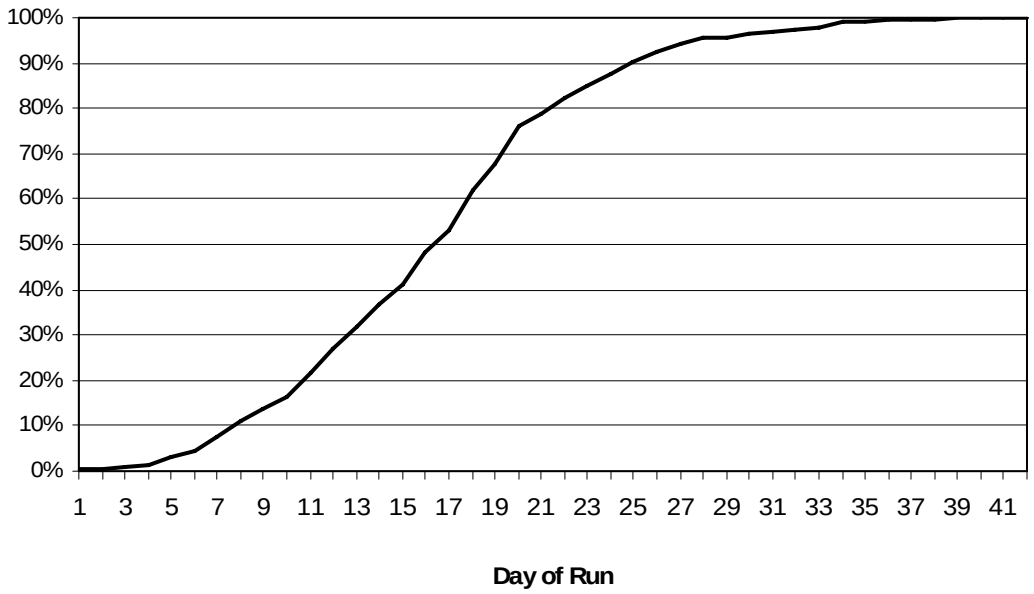

Figure 4.–Average cumulative percent passage by day of run of Chena River Chinook salmon using escapements from 1993-94, 1997-99 and 2003-04.

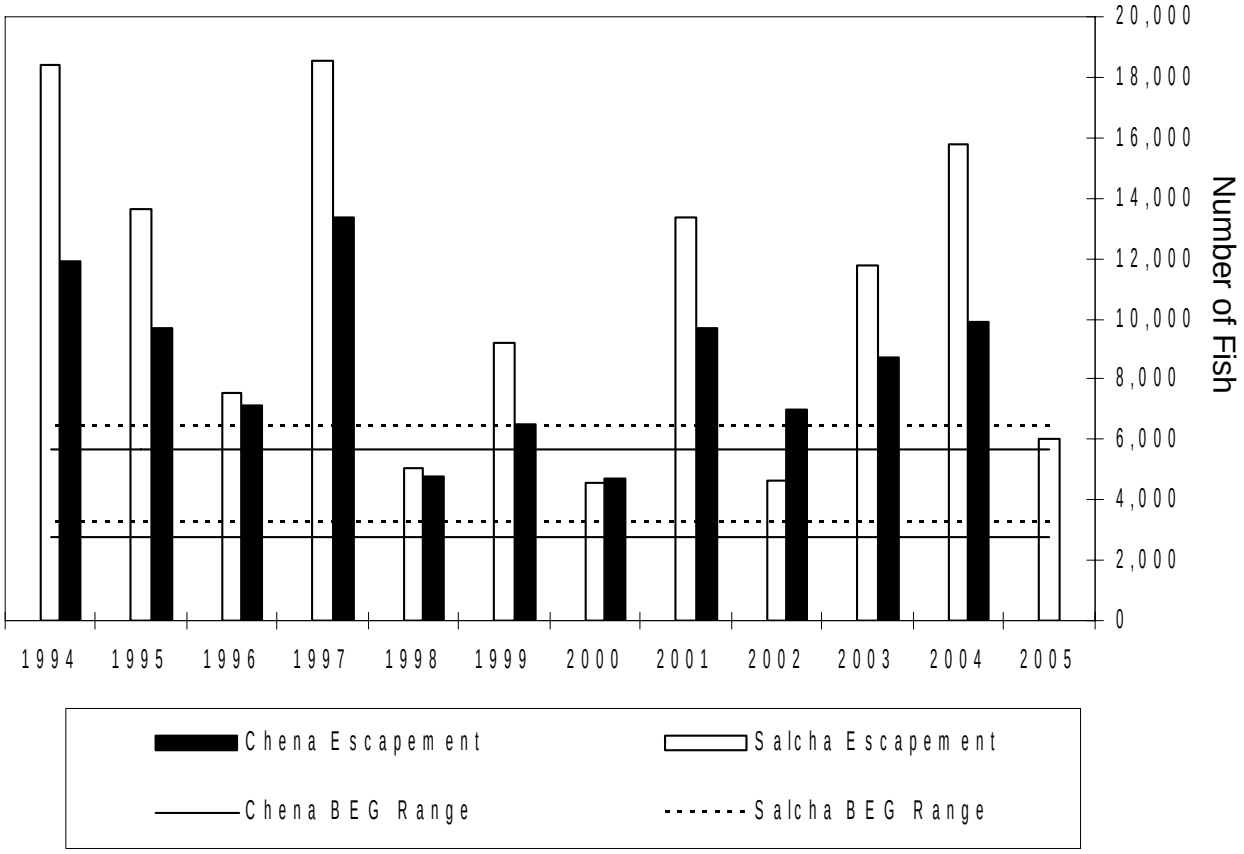

Figure 5.–Estimated Chinook salmon escapements to the Chena and Salcha rivers and the respective escapement goal ranges, 1994 – 2005.

Table 6.–Proportions and mean length by age and sex of Chinook salmon sampled during the Chena River carcass survey, 2004.

Age[a]	Sample Size	Sample Proportion	Length			
			Mean	SE	Min	Max
		Male				
1.2	26	0.30	614	8	545	720
1.3	28	0.32	717	12	580	800
1.4	32	0.36	835	16	645	1,020
1.5	2	0.02	975	75	900	1,050
Total Aged	88	-	735	13	545	1,050
Total Males[b]	98	0.38	730	12	545	1,050
Corrected Total[c]	-	0.53	-	-	-	-
		Female				
1.3	13	0.09	811	9	735	870
1.4	133	0.88	874	3	790	980
1.5	5	0.03	931	17	870	965
Total Aged	151	-	870	4	735	980
Total Females[b]	160	0.62	870	4	525	980
Corrected Total[c]	-	0.47	-	-	-	-

[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 0.7615.

Table 7.–Proportions of male and female Chinook salmon sampled from the Chena and Chatanika rivers, 1989-2005.

	Sample Size			Collection	Sample Proportion		Corrected Proportion[c]	
	Males	Females	Total	Method	Males	Females	Males	Females
Chena River								
1989	119	218	337	C	0.35	0.65	0.62	0.38
1990	291	258	549	C	0.53	0.47	0.64	0.36
1991	632	294	926	C, EF	0.68	0.32	-	-
1992	369	212	581	C	0.64	0.36	0.72	0.28
1993	205	38	243	C	0.84	0.16	0.88	0.12
1994	326	275	601	C	0.54	0.46	0.65	0.35
1995	305	593	898	C	0.34	0.66	0.50	0.50
1996	268	346	614	EF	0.44	0.56	-	-
1997	524	150	674	C	0.78	0.22	0.83	0.17
1998	160	107	267	C	0.60	0.40	0.69	0.31
1999	83	75	158	EF	0.52	0.47	-	-
2000	286	72	358	EF	0.80	0.20	-	-
2001	342	253	595	C	0.57	0.43	0.68	0.32
2002	N/A	N/A	N/A	EF	0.73	0.27	-	-
2003	253	209	462	C	0.55	0.45	0.66	0.34
2004	98	160	259	C	0.38	0.62	0.53	0.47
2005	352	268	620	C	0.57	0.43	0.68	0.32
Average 1989-2005	288	221	509		0.58	0.42	0.69	0.31
Chatanika River[b]								
1995	21	49	70	C	0.30	0.70	-	-
1996	60	48	108	C	0.56	0.44	-	-
1997	231	71	302	C	0.76	0.24	-	-
1998	40	20	60	EF	0.67	0.33	-	-
1999	7	19	26	C	0.27	0.73	-	-
2000	26	11	37	C	0.70	0.30	-	-
2001	20	24	44	C	0.45	0.55	-	-
2002	15	16	31	C	0.48	0.52	-	-
Average 1995-2001	53	32	85		0.52	0.48	-	-

a C=carcass survey proportions corrected to EF standard, EF=electrofishing (raw proportions used)

b Carcass (ASL) surveys were discontinued in the Chatanika River after 2002

c When sample was collected in carcass surveys, proportions were corrected to electrofishing standard for the Chena River.

The 2005 carcass survey was the most extensive ever undertaken on the Chena River. Carcasses were sampled by CFD from 13 July through 12 August. During this period 620 Chinook salmon carcasses were sampled for ASL data. The uncorrected sex composition for this sample, including those fish not aged, was 0.57 males and 0.43 females (Table 8). The average (uncorrected for gender bias) male to female ratio of all sampled fish during 1989-2004 was 0.58 to 0.43 (Table 7). The estimated proportion of females in the 2005 escapement, based on carcass survey data corrected to the electrofishing standard, was 0.32 (SE=0.04).

Ages were determined for 89% of the sample collected in 2005. Because no escapement estimate was produced in 2005, no age class abundances were calculated. However, carcass age composition is considered representative of the entire escapement. The dominant age class for males was 1.3 (57%; Table 8). Ages 1.2, 1.4, 2.4 and 1.5 were also present. The dominant age class for females was 1.4 (53%). Females at ages 1.2, 1.3, 2.3, 1.5 and 2.4 were also present. Mean lengths and length ranges for age classes of males and females are listed in Table 8.

Chena River Aerial Survey

In 2004, aerial surveys were not attempted on the Chena River due to heavy smoke in the Fairbanks area. In 2005 two aerial surveys were performed for the Chena River drainage. The first survey was attempted on 24 July and was rated as poor visibility and incomplete. The second survey was performed on 27 July and was rated as poor to good as the surveyor traveled upriver; approximately 1,567 live and 41 dead Chinook salmon were observed (K. Boeck, Commercial Fish Biologist, ADF&G, Fairbanks; personal communication). Since 1986, the proportion of the Chinook salmon population observed during aerial surveys has ranged from 0.02 to 0.59 of the tower/mark-recapture estimates and averaged 0.25 (Table 9).

Chatanika River Chinook Salmon Abundance

During 2004 and 2005, the Chatanika River experienced virtually identical weather and counting conditions to those seen on the Chena River, i.e., ideal counting conditions in 2004 (other than high smoke) and high water that hampered counting efforts for the majority of the 2005 salmon run (Tables 10 and 11).

In 2004 the Chatanika counting tower was operational on 24 June; however counting was not conducted during 29 June through 3 July due to poor air quality. The first Chinook salmon were observed on 4 July immediately after counting resumed and counting continued through 30 July. This was one of the few years that the Chatanika tower was in operation for virtually the entire Chinook salmon run (Table 12); however some salmon may have passed unobserved prior to 4 July. The estimated escapement of 2,444 Chinook salmon (SE=250) may be biased low; however it is unlikely that the bias is larger than 100 salmon. The estimate of 1,538 chum salmon (SE=113) is biased low and is considered a minimum estimate, because the chum salmon run continues into August.

In 2005 no estimates of escapements were produced for the Chatanika River due to the small number of days that complete counts were performed.

Table 8.–Proportions and mean length by age and sex of Chinook salmon sampled during the Chena River carcass survey, 2005.

Age[a]	Sample Size	Sample Proportion	Length			
			Mean	SE	Min	Max
		Male				
1.2	35	0.11	541	6	450	620
1.3	182	0.57	732	6	300	890
1.4	93	0.29	819	8	665	980
1.5	5	0.015	911	30	820	945
2.4	4	0.017	805	24	710	870
Total Aged	319	-	741	6	300	980
Total Males[b]	352	0.57	738	6	300	980
Corrected Total[c]	-	0.68	-	-	-	-
		Female				
1.2	1	0.0042	465	-	-	-
1.3	94	0.40	779	4	690	870
1.4	124	0.53	832	5	625	950
2.3	1	0.0042	760	-	-	-
1.5	10	0.042	882	17	820	990
2.4	4	0.017	824	13	775	870
Total Aged	234	-	811	4	465	990
Total Females[b]	268	0.43	812	4	465	990
Corrected Total[c]	-	0.32	-	-	-	-

[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 0.7615.

Table 9.–Estimated Chinook salmon abundance compared to the highest counts observed during aerial surveys, aerial survey conditions, and the proportion of the population observed during aerial surveys of the Chena River, 1986 - 2005.

Year	Estimated Abundance[a]	SE	Enumeration Method[c]	Aerial Survey Count	Aerial Survey Condition[b]	Proportion of Total Escapement
1986	9,065	1,080	M-R	2,031	Fair	0.22
1987	6,404	557	M-R	1,312	Fair	0.20
1988	3,346[d]	556	M-R	1,966	Fair-Poor	0.59
1989	2,666	249	M-R	1,180	Fair-Good	0.44
1990	5,603	1,164	M-R	1,436	Fair-Poor	0.26
1991	3,025	282	M-R	1,276	Poor	0.42
1992	5,230	478	M-R	825	Fair-Poor	0.16
1993	12,241	387	Tower	2,943	Fair	0.24
1994	11,877	479	Tower	1,570	Fair-Poor	0.13
1995	9,680	958	M-R	3,567	Fair	0.37
1996	7,153	913	M-R	2,233	Poor-Good	0.31
1997	13,390	699	Tower	3,495	Fair-Good	0.26
1998	4,745	503	Tower	386	Incomplete	0.08
1999	6,485	427	Tower	2,412	Fair	0.37
2000	4,694	1,184	M-R	906	Poor - Incomplete	0.19
2001	9,696	565	Tower	1,487	Good	0.15
2002	6,967	2,466	M-R	181	Poor - Incomplete	0.03
2003	8,739[e]	653	Tower	139	Poor - Incomplete	0.02
2004	9,645	532	Tower	No surveys due to fires in the area.		–
2005	No estimate produced, although likely w/in BEG range (2,800 – 5,700)			1,608	Poor – Good as proceeded upriver	–
					1986 – 2003 Average	0.25

[a] Details of estimates can be found in Barton (1987a and 1988); Barton and Conrad (1989); Burkholder (1991); Evenson (1991-1993; 1995-1996); Evenson and Stuby (1997), Skaugstad (1988, 1989, 1990b, 1992, 1993, and 1994), Stuby and Evenson (1998), Stuby (1999-2001), Doxey (2004), and Doxey et al. (2005).

[b] During these surveys, conditions were judged on a scale of "poor, fair, good, excellent" unless otherwise noted.

[c] Estimate was obtained from either mark-recapture (M-R) or tower-counting (Tower) techniques.

[d] Original estimate was 3,045 fish (SE=561) for a portion of the river. The estimate was expanded based on the distribution of spawners observed during an aerial survey.

[e] Minimum documented abundance with large gaps in counts due to flooding, escapement likely 11,100 fish.

Table 10.–Daily Chinook and chum salmon passage at the Chatanika River counting site, 2004. Shaded cells indicate days with missing or incomplete counts due to high and/or turbid water or poor air quality due to wildfires in the area.

	Total	Chinook			Chum		
Date	20 minute Counts/Day	Number Counted	Estimated Passage	SE	Number Counted	Estimated Passage	SE
24-Jun-04	3	0	0	0	0	0	0
25-Jun-04	8	0	0	0	0	0	0
26-Jun-04	0	0	0	N/A	0	0	N/A
27-Jun-04	0	0	0	N/A	0	0	N/A
28-Jun-04	8	0	0	0	0	0	0
29-Jun-04	8	0	0	0	0	0	0
30-Jun-04	0	0	0	N/A	0	0	N/A
1-Jul-04	0	0	0	N/A	0	0	N/A
2-Jul-04	0	0	0	N/A	0	0	N/A
3-Jul-04	0	0	0	N/A	0	0	N/A
4-Jul-04	16	4	18	17	0	0	0
5-Jul-04	16	5	23	15	0	0	0
6-Jul-04	24	5	15	9	0	0	0
7-Jul-04	24	23	69	40	0	0	0
8-Jul-04	24	12	36	16	0	0	0
9-Jul-04	16	0	0	0	0	0	0
10-Jul-04	8	8	72	0	0	0	0
11-Jul-04	16	84	126	144	0	0	0
12-Jul-04	16	58	261	51	5	23	11
13-Jul-04	24	43	129	52	1	3	3
14-Jul-04	24	87	261	45	9	27	11
15-Jul-04	16	37	167	49	6	27	13
16-Jul-04	16	89	401	126	9	41	15
17-Jul-04	16	40	180	41	10	45	39
18-Jul-04	16	46	207	98	21	95	30
19-Jul-04	24	22	66	15	28	84	16
20-Jul-04	16	16	72	17	20	90	35
21-Jul-04	16	17	77	19	17	77	12
22-Jul-04	16	15	68	12	38	171	37
23-Jul-04	16	1	5	16	7	32	9
24-Jul-04	16	5	23	11	24	108	24
25-Jul-04	16	11	50	28	18	81	23
26-Jul-04	24	20	60	15	13	39	9
27-Jul-04	16	3	14	8	18	81	20
28-Jul-04	24	7	21	15	62	186	57
29-Jul-04	24	3	9	7	45	135	27
30-Jul-04	22	5	18	4	62	195	31
Total	529	666	2,444	250	413	1,538	113

[a] N/A – Standard errors are not calculated for days in which only one shift or less than one shift are staffed.

Table 11.–Daily Chinook and chum salmon passage at the Chatanika River counting site, 2005. Shaded cells indicate days with missing or incomplete counts due to high and/or turbid water.

	Total	Chinook			Chum		
Date	20 minute Counts/Day	Number Counted	Estimated Passage	SE	Number Counted	Estimated Passage	SE
29-Jun-05	16	0	0	0	0	0	0
30-Jun-05	16	0	0	0	0	0	0
1-Jul-05	22	0	0	0	0	0	0
2-Jul-05	0	0	0	N/A	0	0	N/A
3-Jul-05	0	0	0	N/A	0	0	N/A
4-Jul-05	0	0	0	N/A	0	0	N/A
5-Jul-05	0	0	0	N/A	0	0	N/A
6-Jul-05	0	0	0	N/A	0	0	N/A
7-Jul-05	0	0	0	N/A	0	0	N/A
8-Jul-05	0	0	0	N/A	0	0	N/A
9-Jul-05	0	0	0	N/A	0	0	N/A
10-Jul-05	0	0	0	N/A	0	0	N/A
11-Jul-05	0	0	0	N/A	0	0	N/A
12-Jul-05	0	0	0	N/A	0	0	N/A
13-Jul-05	0	0	0	N/A	0	0	N/A
14-Jul-05	0	0	0	N/A	0	0	N/A
15-Jul-05	0	0	0	N/A	0	0	N/A
16-Jul-05	0	0	0	N/A	0	0	N/A
17-Jul-05	0	0	0	N/A	0	0	N/A
18-Jul-05	0	0	0	N/A	0	0	N/A
19-Jul-05	0	0	0	N/A	0	0	N/A
20-Jul-05	0	0	0	N/A	0	0	N/A
21-Jul-05	0	0	0	N/A	0	0	N/A
22-Jul-05	0	0	0	N/A	0	0	N/A
23-Jul-05	0	0	0	N/A	0	0	N/A
24-Jul-05	0	0	0	N/A	0	0	N/A
25-Jul-05	0	0	0	N/A	0	0	N/A
26-Jul-05	8	19	171	0	3	27	0
27-Jul-05	16	11	50	19	6	27	18
28-Jul-05	24	8	24	8	35	105	16
29-Jul-05	19	5	26	15	18	73	19
30-Jul-05	20	4	15	7	37	126	24
31-Jul-05	8	0	0	0	18	162	0
1-Aug-05	8	3	27	0	10	90	0
2-Aug-05	15	-1	-4	12	42	207	60
3-Aug-05	16	0	0	13	39	176	0
4-Aug-05	15	-2	-8	0	45	298	0
5-Aug-05	14	1	5	4	39	203	26
6-Aug-05	16	1	5	4	56	252	55
7-Aug-05	14	0	0	0	28	135	43
Total	247	49	-	-	376	-	-

Table 12.–Abundance estimates for Chinook salmon in the Chatanika River, 1980-2005.

Year	Estimated Abundance[a]	Method	Survey Condition
1980	37	Aerial	Fair
1981	NS	-	-
1982	159	Aerial	Fair-Good
1983	NS	-	-
1984	9	Aerial	Poor
1985	NS	-	-
1986	79	Aerial	Fair
1987	NS	-	-
1988	NS	-	-
1989	75	Aerial	Fair
1990	61	Aerial	Fair-Poor
1991	104	Aerial	Fair
1992	78	Aerial	Fair
1993	75	Aerial	Fair
1993	253[b]	Boat	Good
1994	372	Aerial	Fair
1995	444[b]	Boat	Fair-Good
1996	198[b]	Boat	Fair-Good
1997	3,809	M-R	-
1998	864	Tower	-
1999	503	Tower	-
2000	398[c]	Tower	-
2001	964 [c]	Tower	-
2002	719[c]	Tower	-
2003	1,088[c]	Tower	-
2004	2,444	Tower	-
2005	No estimate	Tower	-

a NS = No survey was performed.

b Incomplete survey.

c Incomplete tower estimate.

DISCUSSION

There are two primary objectives driving the annual Chena River Chinook salmon enumeration project. For management purposes, escapement status relative to the BEG (2,800 - 5,700 fish) must be tracked. Inseason documented and projected escapement estimates provide the foundation for in-season management of the Chinook salmon sport fishery in the Chena River and add to the body of information used to manage the Chinook salmon subsistence, personal use, and commercial fisheries in the Tanana River downstream from the Chena River. For research purposes, the total abundance and age-sex composition information is used to build brood tables that, over time, will be used to further refine the BEG.

In 2004, the inseason data collected from assessments during June and early July in the Lower Yukon River indicated that the Chinook salmon run was stronger than expected. On July 14 the cumulative Chinook salmon escapement on the Chena River was 5,667 fish, this was within 100 fish of exceeding the upper BEG range of 5,700 fish. Therefore the bag and possession limit for Chinook salmon 20 inches or greater in length was increased to three fish/ day for the remainder of the salmon season (the standard limit is one fish/ day).

In 2005, assessment projects along the Yukon River indicated that the Chinook salmon run was generally stronger than expected. Because the Chena River counting tower project was inoperable for the majority of the run, the Salcha River was used as an indicator of Chinook salmon run strength on the Chena River. Although the Salcha River assessment seemed to indicate that Chinook salmon escapement would be within the BEG range for both rivers; there were not enough fish to warrant a liberalization of bag and possession limits. The high water events that led to poor counting conditions on the Chena River likely resulted in a smaller than average sport harvest.

Details of management actions may be found in the 2001 – 2005 Fishery Management Report for the Lower Tanana Management Area (Brase and Doxey *In prep*).

Estimates of total escapement from tower counts may not always be needed for management of the sport fishery. Even when periods of high, turbid water create breaks in the counts that are too lengthy (>4 days) to be bridged by interpolated estimates, the cumulative abundance from uninterrupted counts (documented escapement) may be sufficient to evaluate whether the BEG was achieved. If total documented escapement is within or exceeding the BEG range there would be no reason to restrict fisheries.

In this report, run timing, proportional escapement, and cumulative escapement on a given day are described by day-of-run instead of by calendar dates (i.e., Day 1 is the day of first passage of a Chinook salmon during a scheduled counting period). Anchoring escapement curves on Day 1 of the run (rather than a range of calendar dates) and aligning cumulative escapement curves by day of run facilitates comparison of passage rates between years and comparisons of proportional passage compared to the long-term average (Figure 6). It also facilitates inseason escapement projections.

Table 13.–Estimated abundance, highest counts during aerial surveys, aerial survey conditions, and proportion of the population observed during aerial surveys for Chinook salmon escapement in the Salcha River, 1987 - 2005.

Year	Estimated Abundance[a]	SE	Estimation Method[c]	Aerial Survey Count	Aerial Survey Condition[b]	% of Total Escapement
1987	4,771	504	MR	1,898	Fair	0.40
1988	4,562	556	MR	2,761	Good	0.61
1989	3,924	630	MR	2,333	Good	0.71
1990	10,728	1,404	MR	3,744	Good	0.35
1991	5,608	664	MR	2,212	Poor	0.39
1992	7,862	975	MR	1,484	Fair-Poor	0.19
1993	10,007	360	Tower	3,636	Fair	0.36
1994	18,399	549	Tower	11,823	Good	0.64
1995	13,643	471	Tower	3,978	Fair-Good	0.29
1996	7,570	1,238	MR	4,866	Fair-Good	0.64
1997	18,514	1,043	Tower	3,458	Poor	0.19
1998	5,027	331	Tower	1,985	Poor	0.39
1999	9,198	290	Tower	3,570	Fair	0.39
2000	4,595	802	Tower	2,478	Poor	0.53
2001	13,328[e]	2,163	Tower	2,990	Good	N/A
2002	4,644[f]	160	Tower	2,416	Fair	N/A
2003	11,758[g]	747	Tower	N/A	N/A	N/A
2004	15,761	612	Tower	No survey		N/A
2005	5,988	163	Tower	5,295	Good	0.88
						1987-2000 Avg. = 0.43

[a] Details of estimates can be found in Barton (1987a and 1988); Barton and Conrad (1989); Burkholder (1991); Evenson (1991-1993; 1995-1996); Evenson and Stuby (1997), Skaugstad (1988, 1989, 1990a, 1992, 1993, and 1994), Stuby and Evenson (1998), Stuby (1999, 2000, and 2001), Doxey (2004), Doxey et al. (2005).

[b] During these surveys, conditions were judged on a scale of "poor, fair, good, excellent" unless otherwise noted.

[c] MR indicates that estimate was obtained from mark-recapture techniques, Tower indicates tower-counts.

[e] Estimate was obtained from expansion of interrupted tower-count based on day-of-run average proportion (counts effectively ended on Day 19 of run, when 6 year average proportional passage was 67.38%).

[f] Minimum estimate based only on counts when visibility was good or questionable. During the 32 days of the run when the majority of the Chinooks passed, there were no counts on 11 days and visibility precluded complete counts on 7 additional days. Best guess is that escapement was 6,000 – 12,000 Chinook salmon.

[g] Minimum documented abundance with large gaps in counts due to flooding, escapement likely 15,500 fish.

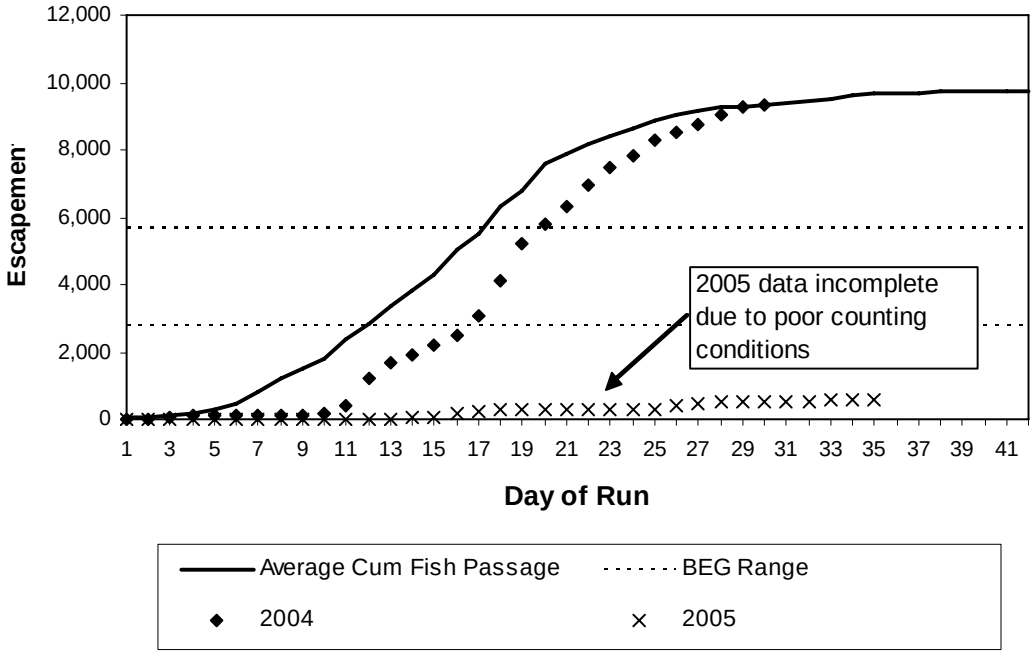

Figure 6.–Cumulative passage by day of run of Chena River Chinook salmon in 2004 and 2005 compared to the average (1993-94, 1997-99 and 2003).

The 2005 carcass survey was the most thorough temporal survey that the ADF&G has ever performed on the Chena River, and it is questionable if "correcting" the estimated male/female proportions to an electrofishing standard is appropriate for these survey data. The electrofishing standard is based on years where mark-recapture experiments using electrofishing are conducted, providing data for which size and gender bias can be evaluated and biases in composition estimates can be removed by the choice of estimation model. We speculate that discrepancies between composition estimates based on electrofishing and on carcass surveys, which are usually conducted during or after the peak of spawning, are usually the result of smaller fish (more predominantly male) having a lower probability of being sampled during carcass surveys. The lower probability may be a result of lower detectibility of small carcasses present in the survey area or due to smaller carcasses "washing out" and not being available for sampling. The potential for bias from these sources was lower during the 2005 carcass survey because surveys were conducted regularly throughout the spawning period. However, the raw and "corrected" survey proportions were estimated for this report because there has not been an analysis to determine under what circumstances the correction factor is necessary. It is suggested that an analysis be performed as part of the spawner-recruit analysis planned for the 2010 escapement goal review.

The Chatanika River is a system that responds very quickly and dramatically to rainfall events. The only complete Chatanika River Chinook salmon escapement estimate was obtained in 2004 although has been monitored since 1998. Because several annual attempts to estimate Chinook salmon escapement to the Chatanika River have failed due to repeatedly poor counting conditions or resulted in estimates that were, at best, biased low, the project biologist recommended that 2005 be the final year operating the salmon counting tower.

SALCHA RIVER CHINOOK SALMON STUDIES

INTRODUCTION

The Salcha River, like the Chena River, has some of the largest Chinook salmon escapements in the Yukon drainage and supports a popular Chinook salmon sport fishery. ADF&G Sport Fish Division conducted mark-recapture abundance estimates on the Salcha River from 1987 to 1992 (Table 13), then conducted tower-count estimates from 1993 to 1998. After developing evidence that the Chena and Salcha rivers Chinook escapement magnitudes paralleled each other and that Chinook salmon sport fisheries could be adequately managed with escapement data from one of the two rivers, Sport Fish Division discontinued a Chinook salmon abundance estimation project in the Salcha River. Starting in 1999, Bering Sea Fishermen's Association (BSFA) employees began to conduct tower counts. Funding was provided by a grant administered by the US Fish and Wildlife Service (USFWS). The BSFA's infrastructure, counting methodology, and data management is essentially identical to the methods previously used by ADF&G on the Salcha River and presently used on the Chena River. This provides a consistently comparable set of escapement estimates over the years for the Salcha River Chinook salmon stock (within the constraints created by river conditions) and allows continued comparison of Chena and Salcha rivers Chinook salmon escapements. Throughout the season, the counts of Salcha River Chinook salmon are provided to ADF&G after each 8-hour shift, and results are presented in this report. Further details regarding this project can be obtained by contacting the USFWS – Fairbanks Fish and Wildlife Field Office referencing study number USRM-07-05.

METHODS

In 2004, one 12 foot tall tower was erected on the left bank (looking upriver) of the Salcha River approximately 0.25 mile downstream from the Richardson Highway Bridge (Figure 7). In 2005 that site was abandoned due to a deepening channel and increased sport fishing activity. The tower was moved approximately 0.50 mile upstream of the Richardson Highway Bridge and switched to the right bank (looking upriver). Project mobilization, escapement enumeration, and data analysis procedures for the Salcha River counting tower were virtually identical to those used for the Chena and Chatanika rivers.

RESULTS

In 2004 the Salcha River counting tower was in operation on 25 June and the first Chinook salmon were observed that day, indicating that some fish may have passed before the tower was fully operational. Counts continued through 14 September, although the Chinook salmon run was essentially over by early August (~Day 35; Table 14) as is typically the case (Figure 8). High water hindered operations 6-8 July and caused marginal viewing conditions for five other days throughout the summer, however the 2004 viewing conditions were good overall. Estimates of escapement were 15,761 Chinook salmon (SE=612) and 47,861 chum salmon (SE=671). Chinook salmon escapements were well above the upper end of the BEG range of 3,300 – 6,500 fish (Figure 9).

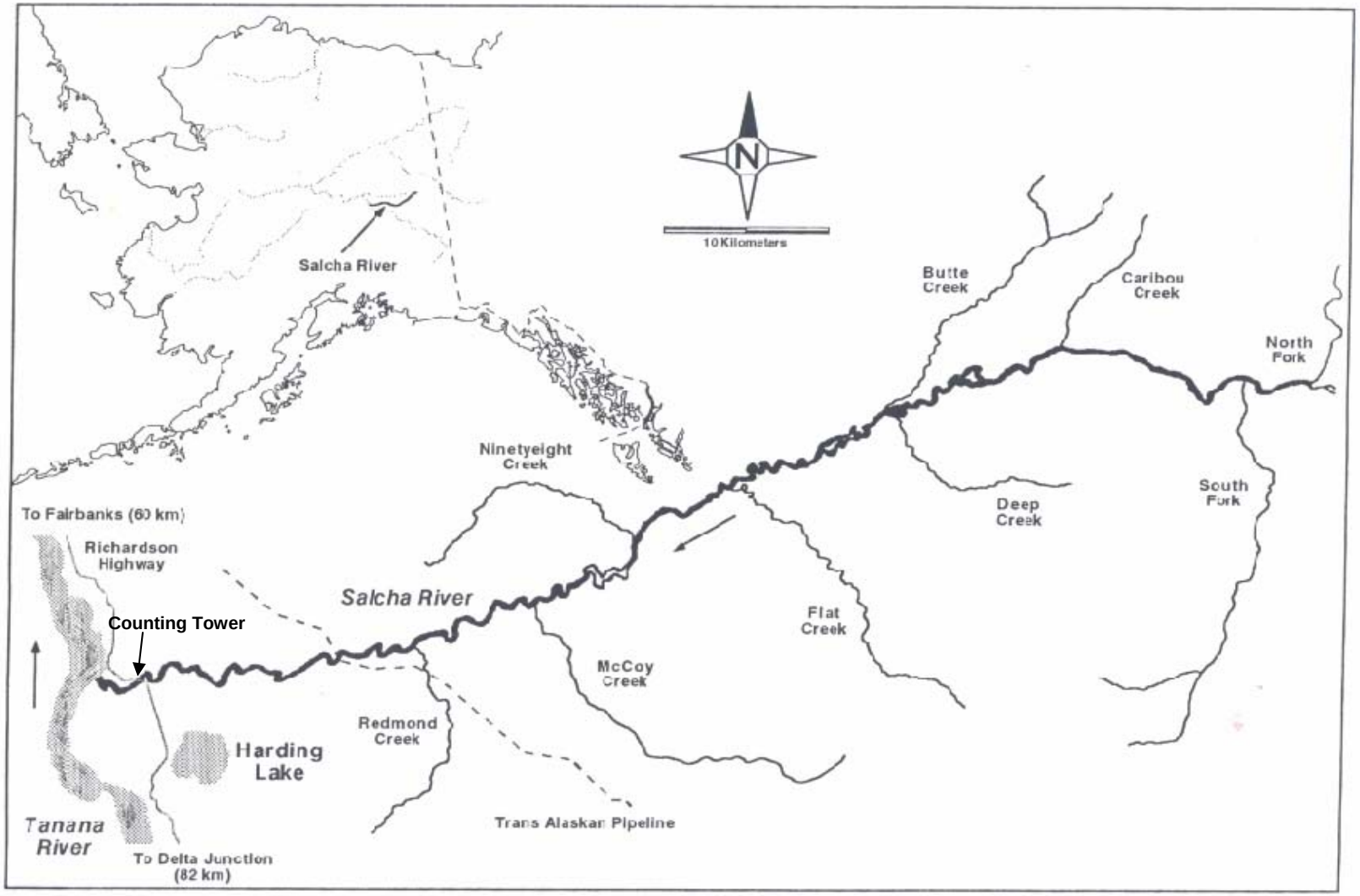

Figure 7.–Salcha River drainage, with location of counting tower site.

Table 14.–Daily Chinook and chum salmon[a] passage at the counting site on the Salcha River, 2004. Shaded cells indicate days with missing or incomplete counts due to high and/or turbid water.

Date	Day of Run (Chinook)	Number Of Counts	Chinook Salmon			Chum Salmon		
			Number Counted	Estimated Passage	SE	Number Counted	Estimated Passage	SE
25-Jun-04	1[a]	11	2	9	7	0	0	0
26-Jun-04	2	24	5	15	5	0	0	0
27-Jun-04	3	24	3	9	6	0	0	0
28-Jun-04	4	24	1	3	3	0	0	0
29-Jun-04	5	24	11	33	11	0	0	0
30-Jun-04	6	24	14	42	12	1	3	3
1-Jul-04	7	24	4	12	7	0	0	0
2-Jul-04	8	24	6	18	6	0	0	0
3-Jul-04	9	24	1	3	2	0	0	0
4-Jul-04	10	24	10	30	10	0	0	0
5-Jul-04	11	24	68	204	91	0	0	0
6-Jul-04	12	8	41	369	0	0	0	0
7-Jul-04	13	0	0	0	N/A	0	0	N/A
8-Jul-04	14	11	3	14	10	0	0	0
9-Jul-04	15	24	65	195	45	2	6	4
10-Jul-04	16	24	213	639	154	5	15	8
11-Jul-04	17	24	304	912	208	0	0	0
12-Jul-04	18	24	500	1,500	108	3	9	6
13-Jul-04	19	24	292	876	149	23	69	24
14-Jul-04	20	24	698	2,094	379	151	453	70
15-Jul-04	21	24	252	756	82	213	639	135
16-Jul-04	22	24	186	558	13	118	354	66
17-Jul-04	23	24	208	624	160	109	327	62
18-Jul-04	24	24	366	1,098	202	346	1,038	195
19-Jul-04	25	24	295	885	65	204	612	52
20-Jul-04	26	24	232	696	97	236	708	59
21-Jul-04	27	24	224	672	99	243	729	76
22-Jul-04	28	24	338	1,014	79	201	603	80
23-Jul-04	29	24	387	1,161	111	230	690	97
24-Jul-04	30	24	79	237	29	203	609	79
25-Jul-04	31	24	83	249	27	346	1,038	99
26-Jul-04	32	24	89	267	36	538	1,614	134
27-Jul-04	33	24	38	114	16	691	2,073	161
28-Jul-04	34	24	39	117	23	867	2,601	208
29-Jul-04	35	24	22	66	11	747	2,241	180
30-Jul-04	36	24	28	84	12	670	2,010	144
31-Jul-04	37	24	14	42	12	637	1,911	122

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Table 14.-Page 2 of 3.

Date	Day of Run (Chinook)	Number Of Counts	Chinook Salmon			Chum Salmon		
			Number Counted	Estimated Passage	SE	Number Counted	Estimated Passage	SE
1-Aug-04	38	24	12	36	12	810	2,430	167
2-Aug-04	39	24	5	15	6	546	1,638	87
3-Aug-04	40	24	1	3	2	295	885	142
4-Aug-04	41	24	10	30	11	469	1,407	109
5-Aug-04	42	24	4	12	6	513	1,539	87
6-Aug-04	43	24	3	9	4	374	1,122	93
7-Aug-04	44	24	2	6	3	507	1,521	98
8-Aug-04	45	24	0	3	2	400	1,200	77
9-Aug-04	46	24	0	0	0	426	1,278	86
10-Aug-04	47	24	3	9	6	569	1,707	74
11-Aug-04	48	24	1	3	3	379	1,137	104
12-Aug-04	49	24	0	0	0	354	1,062	93
13-Aug-04	50	24	1	3	3	378	1,134	81
14-Aug-04	51	24	2	6	3	299	897	66
15-Aug-04	52	24	0	0	0	254	762	71
16-Aug-04	53	24	1	3	3	338	1,014	82
17-Aug-04	54	24	1	3	3	261	783	56
18-Aug-04	55	24	0	0	0	209	627	38
19-Aug-04	56	24	0	0	0	207	621	44
20-Aug-04	57	24	0	0	0	203	609	51
21-Aug-04	58	24	1	3	3	132	421	50
22-Aug-04		24	0	0	0	60	180	28
23-Aug-04		24	0	0	0	108	324	46
24-Aug-04		24	0	0	0	109	327	30
25-Aug-04		24	0	0	0	57	171	21
26-Aug-04		24	0	0	0	52	156	21
27-Aug-04		24	0	0	0	59	177	30
28-Aug-04		24	0	0	0	60	180	30
29-Aug-04		24	0	0	0	62	186	24
30-Aug-04		24	0	0	0	58	174	27
31-Aug-04		24	0	0	0	47	141	0
1-Sep-04		24	0	0	0	62	186	26
2-Sep-04		24	0	0	0	45	135	17
3-Sep-04		24	0	0	0	39	117	18
4-Sep-04		16	0	0	0	21	95	16
5-Sep-04		24	0	0	0	27	81	11
6-Sep-04		24	0	0	0	27	81	16
7-Sep-04		24	0	0	0	48	144	17
8-Sep-04		24	0	0	0	59	177	29

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Table 14.-Page 3 of 3.

Date	Day of Run (Chinook)	Number Of Counts	Chinook Salmon			Chum Salmon		
			Number Counted	Estimated Passage	SE	Number Counted	Estimated Passage	SE
9-Sep-04		24	0	0	0	38	114	19
10-Sep-04		24	0	0	0	47	141	36
11-Sep-04		24	0	0	0	48	144	18
12-Sep-04		24	0	0	0	34	102	25
13-Sep-04		24	0	0	0	27	81	20
14-Sep-04		4	0	0	0	7	101	0
Total	-	1,874	5,168	15,761	612	15,908	47,861	671

[a] Day 1 of documented passage. Because a Chinook salmon was seen during the first shift of the project, Day 1 may have occurred earlier.

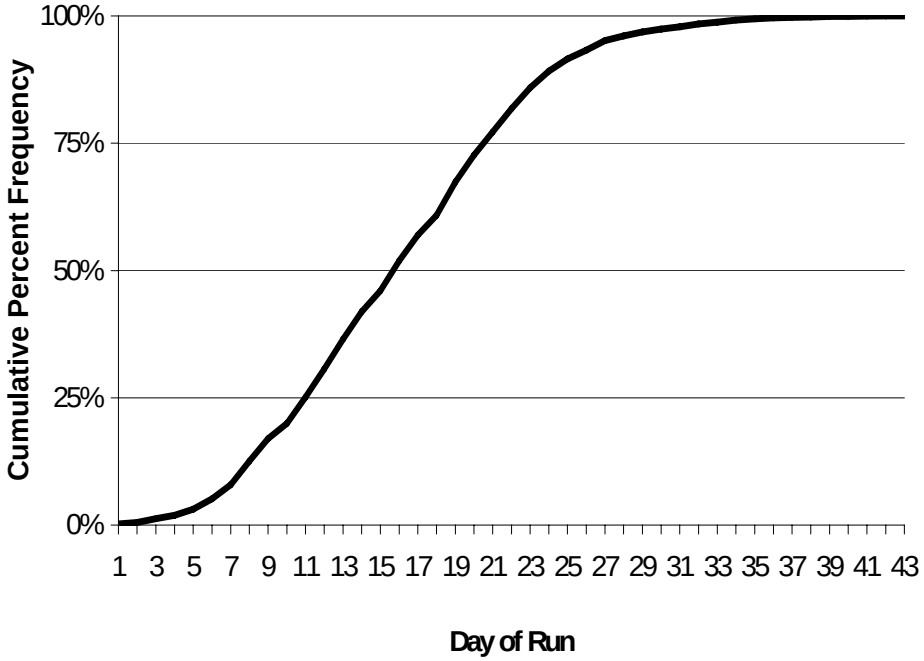

Figure 8.–Average proportional cumulative passage by day of run of Salcha River Chinook salmon, 1993-95, 1997-99. Data for other years is incomplete and not included.

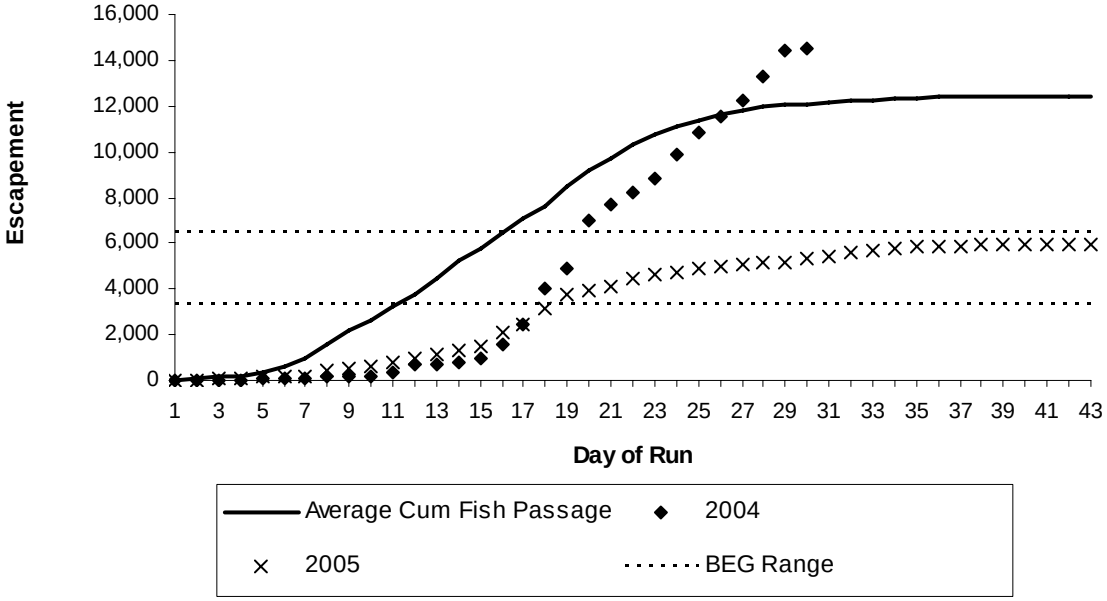

Figure 9.–Expanded cumulative passage by day of run for Salcha River Chinook salmon comparing 2004 and 2005 with the 1993-95, 1997-99 average.

In 2005, conditions for accurately counting salmon in the Salcha River were very different from those at the Chena and Chatanika rivers counting sites. This was due to low rainfall in the drainage, the new tower location, and the lack of fire damage in the upper reaches of the drainage. The Salcha tower was in operation through the entire Chinook salmon run from 30 June through 25 August (Table 15). Escapements were estimated at 6,000 Chinook salmon (SE=163) and 194,933 chum salmon (SE=1,600). The Chinook salmon escapement approached the upper end of the BEG range (Figure 9).

Age-Sex-Length Compositions

In 2004 Chinook salmon carcasses were collected along the Salcha River from 21 July through 8 August. A total of 240 Chinook salmon carcasses were collected (Table 16). The sex composition for this sample, including those fish not aged, was 0.37 males and 0.63 females. The Salcha River gender bias correction factor has been estimated at 0.75. The estimated proportion of females in the 2004 escapement, based on carcass survey data corrected to the electrofishing standard, was 0.47 (SE=0.12). The correction factor for the Salcha River is very imprecise due to large annual variation in selectivity between years. Similar to the Chena River, the authors suggest that the Salcha River "correction factor" be assessed as part of the spawner-recruit analysis planned for the 2010 escapement goal review.

Ages were determined for 229 (95%) of the fish collected in 2004. The largest age class for males sampled and aged in 2004 was age 1.4 (58%; Table 16). Males were also represented by ages 1.2 and 1.3. Age 1.4 dominated among aged females (96%; Table 16). Females were also represented by ages 1.3 and 1.5. Mean lengths and length ranges for age classes of males and females are also listed in Table 16.

During 2005, an extensive carcasses collecting event occurred on the Salcha River, with Chinook salmon carcasses being sampled from 11 July through 12 August. A total of 652 Chinook salmon carcasses were sampled (Table 17). Sex composition was 0.45 males and 0.55 females. The estimated proportion of females in the 2005 escapement, based on carcass survey data corrected for gender bias was 0.41 (SE = 0.11).

Ages were determined for 602 fish (92%) of the 2005 sample. Age 1.3 predominated among males (52%), followed by ages 1.4, 1.2, 1.5 and 2.4 (Table 17). Among females the majority were age 1.4 (63%), followed by ages 1.3 and 1.5. Mean lengths and length ranges for age classes of males and females are listed in Table 17.

Table 15.–Daily Chinook and chum salmon passage at the counting site on the Salcha River, 2005.

Date	Day of Run (Chinook)	Number of Counts	Chinook Salmon			Chum Salmon		
			Number Counted	Estimated Passage	SE	Number Counted	Estimated Passage	SE
30-Jun-05		3	0	0	0	0	0	0
1-Jul-05	1	24	2	6	4	0	0	0
2-Jul-05	2	24	4	12	4	0	0	0
3-Jul-05	3	24	11	33	9	0	0	0
4-Jul-05	4	24	18	54	17	0	0	0
5-Jul-05	5	16	11	33	14	0	0	0
6-Jul-05	6	24	13	39	10	0	0	0
7-Jul-05	7	24	13	39	10	0	0	0
8-Jul-05	8	24	73	219	37	0	0	0
9-Jul-05	9	24	16	48	11	0	0	0
10-Jul-05	10	24	48	144	27	0	0	0
11-Jul-05	11	24	48	144	17	0	0	0
12-Jul-05	12	24	50	150	18	0	0	0
13-Jul-05	13	24	71	213	25	0	0	0
14-Jul-05	14	24	60	180	21	11	33	15
15-Jul-05	15	24	66	198	30	33	99	14
16-Jul-05	16	24	200	600	68	105	315	37
17-Jul-05	17	25	112	336	48	50	150	16
18-Jul-05	18	24	233	699	44	85	255	31
19-Jul-05	19	24	207	621	44	149	447	61
20-Jul-05	20	24	57	171	20	22	66	18
21-Jul-05	21	24	67	201	21	83	249	26
22-Jul-05	22	24	92	276	60	218	654	83
23-Jul-05	23	24	67	201	34	460	1,380	139
24-Jul-05	24	24	32	96	16	708	2,124	129
25-Jul-05	25	24	70	210	37	857	2,571	273
26-Jul-05	26	24	23	69	10	1,153	3,459	203
27-Jul-05	27	24	24	72	14	1,329	3,987	221
28-Jul-05	28	24	21	63	11	1,191	3,573	188
29-Jul-05	29	24	14	45	8	1,234	3,702	182
30-Jul-05	30	24	44	132	21	1,287	3,861	166
31-Jul-05	31	24	48	144	22	1,119	3,357	163
1-Aug-05	32	24	46	138	22	1,255	3,765	308
2-Aug-05	33	24	43	129	16	1,708	5,124	245
3-Aug-05	34	24	30	90	22	2,515	7,545	434
4-Aug-05	35	23	11	33	9	4,064	12,192	336
5-Aug-05	36	24	6	18	6	4,881	14,643	420
6-Aug-05	37	24	17	51	12	3,798	11,394	332

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Table 15.-Page 2 of 2.

Date	Day of Run (Chinook)	Number of Counts	Chinook Salmon			Chum Salmon		
			Number Counted	Estimated Passage	SE	Number Counted	Estimated Passage	SE
7-Aug-05	38	24	8	24	7	3,680	11,040	274
8-Aug-05	39	24	0	15	5	2,820	8,460	489
9-Aug-05	40	24	2	6	3	4,272	12,816	476
10-Aug-05	41	24	9	27	7	4,254	12,762	392
11-Aug-05	42	24	1	3	3	3,855	11,565	521
12-Aug-05	43	24	0	0	0	3,448	10,344	497
13-Aug-05	44	24	2	6	3	2,466	7,398	298
14-Aug-05	45	24	1	3	3	2,387	7,161	176
15-Aug-05	46	24	2	6	5	1,477	4,431	170
16-Aug-05	47	24	0	0	0	1,450	4,350	142
17-Aug-05		24	1	3	2	1,209	3,627	140
18-Aug-05		24	0	0	0	1,172	3,516	162
19-Aug-05		24	0	0	0	738	2,214	108
20-Aug-05		24	0	0	0	533	1,599	82
21-Aug-05		24	0	0	0	473	1,419	72
22-Aug-05		24	0	0	0	628	1,884	72
23-Aug-05		24	0	0	0	557	1,671	73
24-Aug-05		24	0	0	0	609	1,827	97
25-Aug-05		13	0	0	0	341	1,904	91
Total	-	1,327	1,995	6,000	163	64,684	194,933	1,600

Table 16.–Number sampled, estimated proportions, abundance[a] and mean length by sex and age class of Chinook salmon in the Salcha River, 2004.

	Sample	Sample	Length			
Age[a]	Size	Proportion	Mean	SE	Min	Max
		Male				
1.2	21	0.25	625	6	570	670
1.3	15	0.18	735	10	680	830
1.4	49	0.58	884	10	740	1,000
Total Aged	85	-	786	16	570	1,000
Total Males[b]	90	0.37	791	16	570	1,000
Corrected Total[c]	-	0.53	-	-	-	-
		Female				
1.3	4	0.027	866	30	820	880
1.4	138	0.96	882	3	780	1,020
1.5	2	0.014	935	65	870	1,000
Total Aged	144	-	881	3	780	1,020
Total Females[b]	150	0.63	881	3	780	1,020
Corrected Total[c]	-	0.47	-	-	-	-

[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).

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

[c] Estimated proportion of females was corrected by a factor of 0.75·

Table 17.–Number sampled proportions, and mean length by sex and age class of Chinook salmon in the Salcha River, 2005.

Age[a]	Sample Size	Sample Proportion	Length			
			Mean	SE	Min	Max
		Male				
1.2	56	0.20	552	5	410	640
1.3	142	0.52	753	6	525	910
1.4	73	0.27	840	10	655	990
1.5	3	0.011	980	60	920	1,070
2.4	1	0.0036	805	-	-	-
Total Aged	275	-	733	8	410	1,070
Total Males[b]	295	0.45	733	8	410	1,070
Corrected Total[c]	-	0.59	-	-	-	-
		Female				
1.3	108	0.33	798	3	675	875
1.4	205	0.63	846	3	745	995
1.5	14	0.043	899	14	780	975
Total Aged	327	-	832	3	675	995
Total Females[b]	357	0.55	832	3	675	995
Corrected Total[c]	-	0.41	-	-	-	-

[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).

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

[c] Estimated proportion of females was corrected by a factor of 0.75.

COHO SALMON COUNTS IN THE DELTA CLEARWATER RIVER

INTRODUCTION

The Delta Clearwater River (DCR) is a spring-fed tributary to the Tanana River, located near Delta Junction about 160 km southeast of Fairbanks (Figure 10). Length of the mainstem is about 32 km, the north fork is approximately 10 km in length, and there are a number of shallow spring areas adjacent to the main channel.

The DCR has the largest known coho salmon escapements in the Yukon River drainage (Parker 1991). Spawning occurs throughout the main channel and in the spring areas. Before reaching the spawning grounds of the DCR, coho salmon travel about 1,700 km from the ocean and pass through several different commercial fishing districts in the Yukon and Tanana rivers (Figure 1). Subsistence or personal use fishing also occurs in each district.

Coho salmon in the DCR support a popular fall sport fishery with a daily bag and possession limit of three fish. The average annual harvest exceeded 1,000 coho salmon from 1986-1991. In recent years, catch has been high but harvest relatively low (Table 18).

Historically, escapements of coho salmon into the DCR have been monitored by counting fish from a drifting riverboat (Parker 1991). From 1994-98 aerial surveys (using a helicopter) were also conducted to estimate escapement in non-boatable portions of the river (Evenson 1995, 1996; Evenson and Stuby 1997; Stuby and Evenson 1998; Stuby 1999-2001). Escapement information is used to evaluate management of the commercial, subsistence, and personal use fisheries, in addition to regulating the sport harvest of coho salmon by opening and closing the season and changing the bag limit. In 2003 the AK Board of Fisheries established a sustainable escapement goal (SEG) range of 5,200 – 17,000 coho salmon for the DCR (measured with boat counts; Parker *In prep*). When counts indicate that the goal may not be achieved, the bag limit may be reduced or the fishery closed. If the count exceeds the escapement goal, the bag limit may be liberalized. However, given the observed low harvest rates, such an increase would result in little reduction in escapement.

OBJECTIVE

Count coho salmon in the Delta Clearwater River from a drifting river boat at weekly intervals during the run to estimate total escapement.

METHODS

Study Design

Counts of adult coho salmon were conducted by two persons (a boat operator and a counter) from a drifting river boat equipped with a 5 ft elevated platform. Surveys were conducted once a week starting when coho salmon began entering the system (typically in late September), and continued until peak escapement was documented. Beginning at the upstream end of the DCR, surveys were conducted along the lower 18 miles of the river to within 0.5 mile of the Clearwater Lake outlet. Numbers of salmon observed were recorded every 1.0 mile at mile markers posted on the river bank.

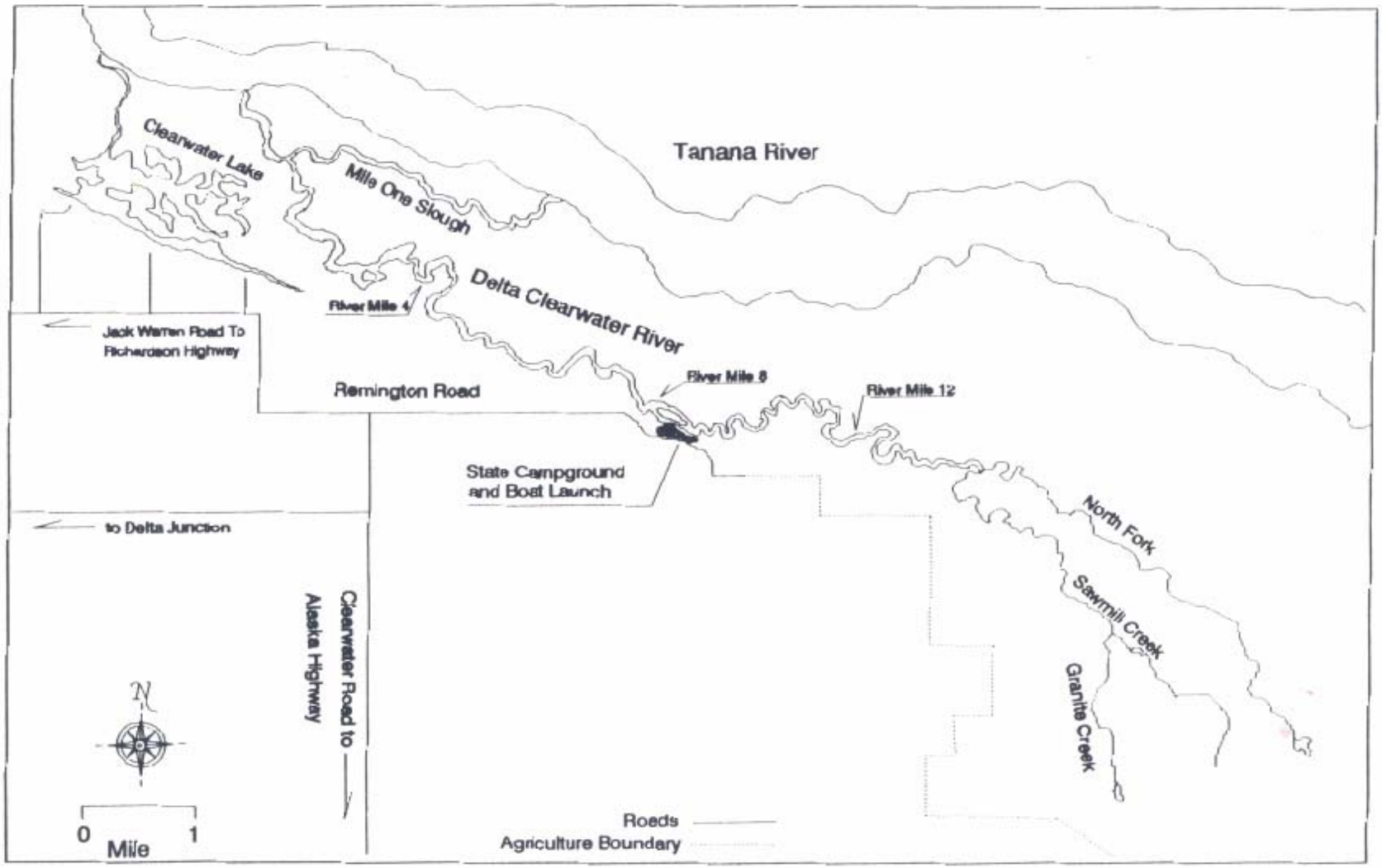

Figure 10.–Delta Clearwater River drainage.

Table 18.–Peak escapements, harvests, and catch of coho salmon in the Delta Clearwater River, 1980-2005.

Peak Escapement Counts								
Year	Survey Date	Mainstem	Non-Navigable Tributaries		Total[d]		Sport Harvest[e]	Sport Catch[e]
1980	28 Oct	3,946	-		3,946		25	NA
1981	21 Oct	8,563	-		8,563		45	NA
1982	3 Nov	8,365	-		8,365		21	NA
1983	25 Oct	8,019	-		8,019		63	NA
1984	6 Nov	11,061	-		11,061		571	NA
1985	13 Nov	6,842	-		6,842	c	722	NA
1986	21 Oct	10,857	-		10,857		1,005	NA
1987	27 Oct	22,300	-		22,300		1,068	NA
1988	28 Oct	21,600	-		21,600		1,291	NA
1989	25 Oct	12,600	-		12,600		1,049	NA
1990	26 Oct	8,325	-		8,325		1,375	3,271
1991	23 Oct	23,900	-		23,900		1,721	4,382
1992	26 Oct	3,963	-		3,963		615	1,555
1993	21 Oct	10,875	-		10,875		48	1,695
1994	24 Oct	62,675	17,565	a	80,240		509	3,009
1995	23 Oct	20,100	6,283	a	26,383		391	5,195
1996	29 Oct	14,075	3,300	a	17,375		937	2,435
1997	24 Oct	11,525	2,375	a	13,900		794	3,776
1998	20 Oct	11,100	2,775	a	13,875		479	1,932
1999	28 Oct	10,975	2,805	b	13,780		76	1,634
2000	24 Oct	9,225	2,358	b	11,583		252	1,890
2001	19 Oct	46,875	11,982	b	58,857		816	5,392
2002	31 Oct	38,625	9,873	b	48,498		517	5,311
2003	21 Oct	105,850	27,057	b	132,907		1,272	14,665
2004	27 Oct	37,950	9,701	b	47,651		511	4,061
2005	25 Oct	34,293	8,766	b	43,059		267	2,640
2000-2004 Average		47,705	12,194		60,572		674	6,264

[a] Escapement in non-navigable tributaries was estimated by helicopter survey ADF&G, Division of Sport Fish.

[b] Expansion for the non-navigable portion is based on the average proportion of the total escapement observed in these areas from 5-years of aerial survey data. The aerial counts ranged from 0.17-0.24 and averaged $\bar{\hat{p}}_{tr}$ = 0.204 as a proportion of the total escapement. The escapement in the inaccessible tributaries is estimated by multiplying the mainstem boat survey counts by $\bar{\hat{p}}_{tr} / \left(1 - \bar{\hat{p}}_{tr}\right)$.

[c] Survey by ADF&G, Commercial Fisheries Division.

[d] Boat survey by ADF&G, Sport Fish Division unless otherwise noted.

[e] Data were obtained from Mills (1981-1994); Howe et al. (1995, 1996, 2001a-d); Walker et al. 2003; Jennings et al. 2004, *In prep a-b.*

From 1994 to 1998, aerial surveys of the tributaries inaccessible by boat were conducted in order to determine the proportion of coho salmon that were counted in these areas relative to the proportion counted within the main river. An expansion factor based on five years of aerial surveys was developed which allows for estimation of total escapement without aerial surveys of inaccessible areas. The aerial counts ranged from 0.17-0.24 and averaged $\bar{\hat{p}}_{tr}$ = 0.204 as a proportion of the total escapement. The escapement in the inaccessible tributaries is estimated by multiplying the mainstem boat survey counts by $\bar{\hat{p}}_{tr} / \left(1 - \bar{\hat{p}}_{tr}\right)$. Those estimated tributary escapements added to the numbers of fish counted in the mainstem during the boat surveys are the estimate of total escapement.

Data Collection

The person performing the salmon counting stood on the front of the riverboat and counted fish along each section of river. The counter wore polarized glasses to facilitate viewing the brightly colored coho salmon and kept track of the number of fish on tally counters. The numbers of coho were recorded and the tally counters were zeroed out at the start of each new section.

RESULTS

In 2004 the peak boat survey of the river's mainstem was conducted on 27 October. Coho salmon were distributed throughout the entire mainstem at varying densities (Table 19) and a total of 37,950 fish were counted. The count was expanded by 0.204 (9,701 fish) to account for fish spawning in adjacent spring areas. Total calculated escapement was 47,651 coho salmon.

In 2005 the peak boat survey was conducted on 25 October. Coho salmon were distributed throughout the entire mainstem at varying densities (Table 20) and a total of 34,293 fish were counted. The count was expanded by 0.204 (8,766 fish) to account for fish spawning in adjacent spring areas. Total calculated escapement was 43,059 coho salmon.

DISCUSSION

In both 2004 and 2005 commercial fishing occurred in the mainstem Tanana River from mid-August through late-September. Although the fishery typically targets fall chum salmon, coho salmon are caught incidentally in the fish wheels and gillnets used by the fishermen. The 2005 Tanana River (District 6) commercial harvest of approximately 49,600 fall chum and 21,800 coho salmon was the largest harvest in recent years due to the commercial fishing restrictions that had been in place on the Yukon and Tanana rivers since 1998 (W. Busher, Fishery Biologist, ADF&G CFD, Fairbanks; personal communication) The commercial fishery likely reduced the numbers of coho salmon returning to the DCR; however the escapement was still well above the SEG range of 5,200 – 17,000 fish.

Table 19.–Counts of adult coho salmon in the Delta Clearwater River, 2004.

River Mile	Mainstem River (Boat Survey)
	Count (27 Oct)
17.5-16	1,525
16-15	2,525
15-14	3,150
14-13	2,275
13-12	2,250
12-11	2,275
11-10	3,375
10-9	2,425
9-8	975
8-7	1,925
7-6	250
6-5	1,950
5-4	2,900
4-3	3,950
3-2	1,925
2-1	3,175
1-0	700
Summary	
17.5-0 (Mainstem)	37,950
Tributaries[a]	9,701
Total Count (boat-count of mainstream plus tributary expansion)	47,651

[a] Expansion for the tributaries/spring areas is based on the average proportion of total escapement (0.204) observed in these areas during five annual aerial surveys.

Table 20.–Counts of adult coho salmon in the Delta Clearwater River, 2005.

River Mile	Mainstem River (Boat Survey) Count (25 Oct)
18-17	825
17-16	725
16-15	1,500
15-14	2,950
14-13	1,800
13-12	1,950
12-11	1,775
11-10	2,900
10-9	1,450
9-8	1,475
8-7	1,325
7-6	475
6-5	2,175
5-4	2,325
4-3	3,525
3-2	900
2-1	2,625
1-0	475
Summary	
18-0 (Mainstem)	34,293
Tributaries[a]	8,766
Total Count (boat-count of mainstream plus tributary expansion)	43,059

[a] Expansion for the tributaries/spring areas is based on the average proportion of total escapement (0.204) observed in these areas during 5 annual aerial surveys.

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APPENDIX A

Appendix A1.–Example of Chena River counting tower staff schedule.

		0000-0730	0800-1530	1600-2330	Tasks
Monday	13-Jun		Doug, Josh, Tristan		set-up
Tuesday	14-Jun		Doug, Josh, Tristan		set-up
Wednesday	15-Jun		Doug, Josh, Tristan		set-up
Thursday	16-Jun		Doug, Josh, Tristan		set-up
Friday	17-Jun		Doug, Josh, Tristan		set-up
Saturday	18-Jun				RDO
Sunday	19-Jun				RDO
Monday	20-Jun		Doug, Josh, Virgil		set-up
Tuesday	21-Jun		Doug, Josh, Virgil		set-up
Wednesday	22-Jun		ALL		set-up
Thursday	23-Jun		ALL		set-up
Friday	24-Jun		ALL		First-aid/ CPR
Saturday	25-Jun				RDO
Sunday	26-Jun				RDO
Monday	27-Jun		ALL		set-up
Tuesday	28-Jun		ALL		set-up
Wednesday	29-Jun	Virgil	Melissa	Lauren	counting
Thursday	30-Jun	Virgil	Melissa	Lauren	counting
Friday	1-Jul	Virgil	Melissa	David	counting
Saturday	2-Jul	None	Melissa	David	counting
Sunday	3-Jul	Lauren	Melissa	David	counting
Monday	4-Jul	Lauren	Virgil	Melissa	counting
Tuesday	5-Jul	Lauren	Virgil	Melissa	counting
Wednesday	6-Jul	Lauren	David	Melissa	counting
Thursday	7-Jul	Lauren	David	None	counting
Friday	8-Jul	Lauren	David	Virgil	counting
Saturday	9-Jul	Melissa	David	Virgil	counting
Sunday	10-Jul	Melissa	David	Virgil	counting
Monday	11-Jul	Melissa	Lauren	Virgil	counting
Tuesday	12-Jul	Melissa	Lauren	Virgil	counting
Wednesday	13-Jul	Melissa	Lauren	David	counting
Thursday	14-Jul	Melissa	Lauren	David	counting
Friday	15-Jul	Virgil	Lauren	David	counting
Saturday	16-Jul	Virgil	None	David	counting
Sunday	17-Jul	Melissa	Virgil	David	counting
Monday	18-Jul	Lauren	Virgil	Melissa	counting
Tuesday	19-Jul	None	Lauren	Melissa	counting
Wednesday	20-Jul	David	Lauren	Melissa	counting
Thursday	21-Jul	David	Lauren	Virgil	counting
Friday	22-Jul	David	Lauren	Virgil	counting
Saturday	23-Jul	David	Melissa	Virgil	counting
Sunday	24-Jul	David	Melissa	Virgil	counting

-continued-

Appendix A1.–Page 2 of 2.

		0000-0800	0800-1600	1600-0000	Tasks
Monday	25-Jul	Lauren	Virgil	Melissa	counting
Tuesday	26-Jul	Lauren	Virgil	Melissa	counting
Wednesday	27-Jul	David	Virgil	Melissa	counting
Thursday	28-Jul	David	Virgil	Melissa	counting
Friday	29-Jul	David	Virgil	Lauren	counting
Saturday	30-Jul	None	David	Lauren	counting
Sunday	31-Jul	Melissa	David	Lauren	counting
Monday	1-Aug		ALL	start carcass survey or break-down	
Tuesday	2-Aug		ALL	carcass survey or break-down	
Wednesday	3-Aug		ALL	carcass survey or break-down	
Thursday	4-Aug		ALL	carcass survey or break-down	
Friday	5-Aug		ALL	carcass survey or break-down	
Saturday	6-Aug				RDO
Sunday	7-Aug				RDO
Monday	8-Aug		ALL	break-down/ clean-up	
Tuesday	9-Aug		ALL	break-down/ clean-up	
Wednesday	10-Aug		ALL	break-down/ clean-up	
Thursday	11-Aug		ALL	break-down/ clean-up	
Friday	12-Aug		ALL	break-down/ clean-up	

APPENDIX B

Appendix B1.–Archived project data and operational files germane to this report.

Tower Count Data Spreadsheets (Chinook & Chum)

CHENATOW04.xls
CHENATOW05.xls
SALCHATOW04.xls
SALCHATOW05.xls
CHATTOW04.xls
CHATTOW05.xls

ASL Data

KS ASL Master Calculations 2004-05.xls

Delta Clearwater River (Coho) counts and expansion spreadsheets

DCR-coho counts2004.xls
DCR-coho counts2005.xls

Note: Data files have been archived at, and are available from, the Alaska Department of Fish and Game, Division of Sport Fish, 1300 College Road, Fairbanks, 99701-1599.