Fishery Data Series No. 99-13

Salmon Studies in Interior Alaska, 1998

by
Lisa Stuby

August 1999

Alaska Department of Fish and Game **Division of Sport Fish**

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
metric ton	mt
milliliter	ml
millimeter	mm

Weights and measures (English)

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

Spell out acre and ton.

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
hour (spell out for 24-hour clock)	h
minute	min
second	s

Spell out year, month, and week.

Physics and chemistry

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

General

All commonly accepted abbreviations.	e.g., Mr., Mrs., a.m., p.m., etc.
All commonly accepted professional titles.	e.g., Dr., Ph.D., R.N., etc.
and	&
at	@
Compass directions:	
east	E
north	N
south	S
west	W
Copyright	©
Corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
et alii (and other people)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.,
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
number (before a number)	# (e.g., #10)
pounds (after a number)	# (e.g., 10#)
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S. state and District of Columbia abbreviations	use two-letter abbreviations (e.g., AK, DC)

Mathematics, statistics, fisheries

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	C.I.
correlation coefficient	R (multiple)
correlation coefficient	r (simple)
covariance	cov
degree (angular or temperature)	°
degrees of freedom	df
divided by	÷ or / (in equations)
equals	=
expected value	E
fork length	FL
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.
mideye-to-fork	MEF
minute (angular)	'
multiplied by	x
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
standard length	SL
total length	TL
variance	Var

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SALMON STUDIES IN INTERIOR ALASKA, 1998

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ABSTRACT

Escapements of chinook salmon *Oncorhynchus tshawytscha* in the Salcha, Chena and Chatanika rivers near Fairbanks, Alaska were estimated using tower-count methodology. The counts were conducted from 26 June to 9 August for both the Salcha and Chena rivers, and 7 July to 31 July for the Chatanika River. Tower-count estimates for chinook salmon were 5,027 (SE=331) for the Salcha River, 4,745 (SE=503) for the Chena River and 864 (SE=74) for the Chatanika River. Aerial survey counts of chinook salmon during the periods of maximum escapement were 1,992 for the Salcha River and 386 for the Chena River. These estimates were 0.40 of the Salcha River tower estimate, and 0.08 of the Chena River mark-recapture and tower estimate. Females comprised 0.30 (SE=0.04) of a sample of chinook salmon carcasses collected in the Salcha River during late August. For the Chena and Chatanika rivers, females comprised 0.40 (SE=0.03) and 0.33 (SE=0.06) respectively. The majority of males examined from the Salcha River were age 1.3 (0.76), with the rest comprising ages 1.1 (0.03), 1.2 (0.07), 1.4 (0.13), and 1.5 (0.01). For the Chena River, the majority of males were age 1.3 (0.86) with the rest comprising ages 1.2 (0.07), 1.4 (0.04), and 1.5 (0.02). The majority of females were age 1.3 (0.65) for the Salcha river with the rest comprising 1.4 (0.30) and 1.5 (0.05). For the Chena River, females were 1.3 (0.53), 1.4 (0.38), and 1.5 (0.09). The majority of females were aged 1.4 (0.44) for the Chatanika River with the rest comprising 1.2 (0.06), 1.3 (0.39), and 1.5 (0.11). For the three rivers, age and sex ratios have varied over the years since the inception of carcass surveys.

A portion of the Salcha, Chena and Chatanika rivers chum salmon *Oncorhynchus keta* escapement was also estimated during the tower-counts. Estimated escapement of chum salmon was 17,289 (SE=696) for the Salcha River and 5,901 (SE=342) for the Chena River. Estimated escapement of chum salmon was 663 (SE=100) for the Chatanika River.

Escapement of coho salmon *Oncorhynchus kisutch* was measured in the Delta Clearwater River near Delta Junction, Alaska, by means of aerial and boat-counts. The boat-count of the mainstem river was 11,100 on 20 October, and the helicopter count on 21 October of tributaries was 2,775. Total escapement was estimated to be 13,875. A total of 221 coho salmon were sampled for age, sex and length. Females comprised 0.51 of total fish sampled. Eighty-three percent of the total coho salmon sample were age 2.1. Since 1990, 2.1 has been the predominant age group for the Delta Clearwater River coho population sampled.

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

CHINOOK AND CHUM SALMON STUDIES IN THE SALCHA, CHENA, AND CHATANIKA RIVERS

INTRODUCTION

The Salcha and Chena rivers (Figures 1 and 2) have some of the largest chinook salmon *Oncorhynchus tshawytscha* escapements in the Yukon River drainage (Schultz et al. 1994). Popular sport fisheries occur in the lower 3 km of the Salcha River and in the lower 72 km of the Chena River. Annual harvest estimates since 1978 have ranged from 47 to 1,448 fish in the Salcha River, and from 0 to 1,280 chinook salmon in the Chena River (Mills 1979-1994 and Howe et al. 1995-1998; Table 1). The Chatanika River (Figure 3) supports a small run of chinook, however recent estimates of sport harvests (0-499; Table 1) have indicated that relative exploitation may be large. Before reaching their spawning grounds in the mid to upper reaches of these rivers, the chinook salmon travel about 1,500 km from the Bering Sea and pass through six different commercial fishing districts in the Yukon and Tanana rivers (Figure 4). Subsistence and personal use fishing also occur in each district.

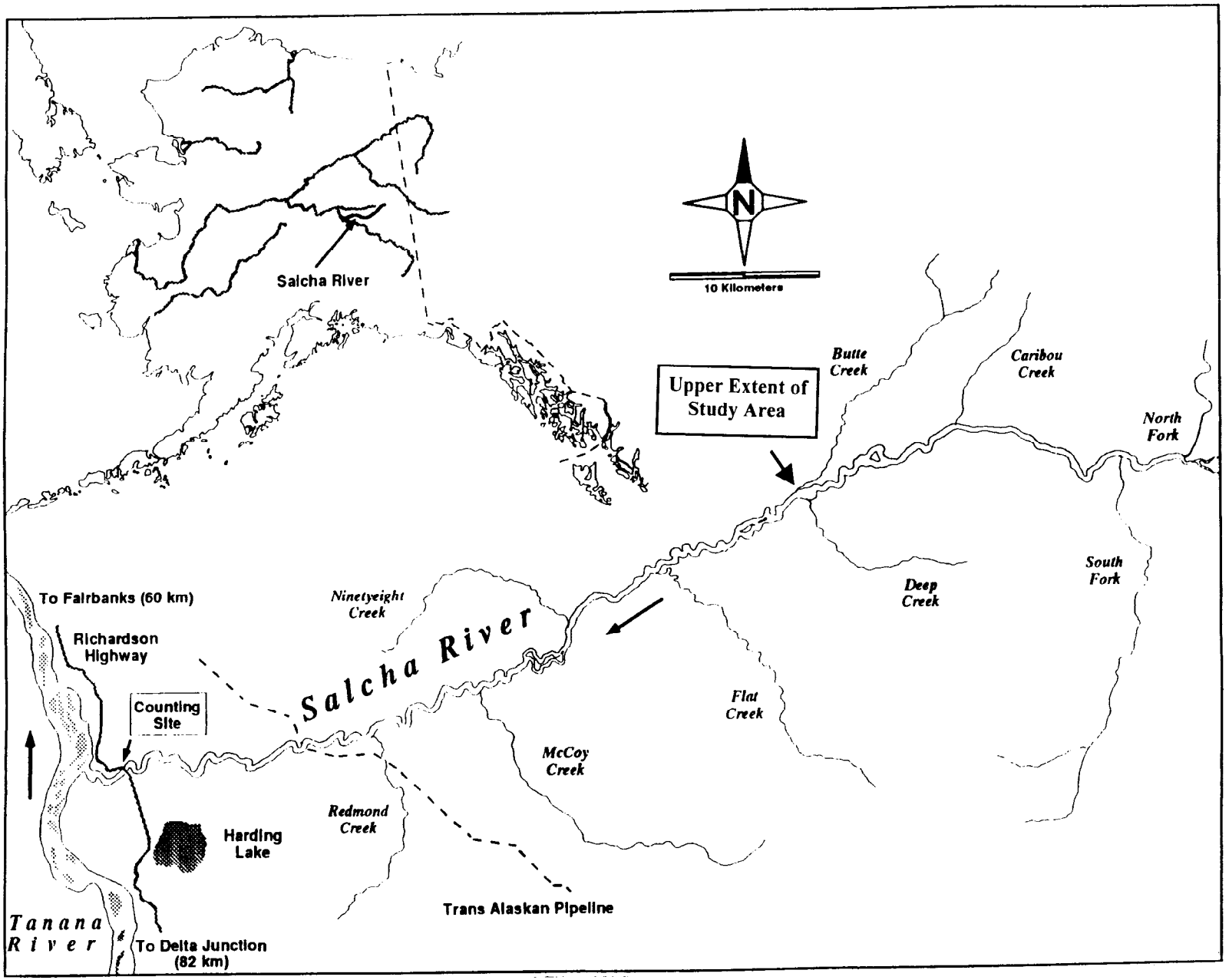


Figure 1.-Salcha River study area.

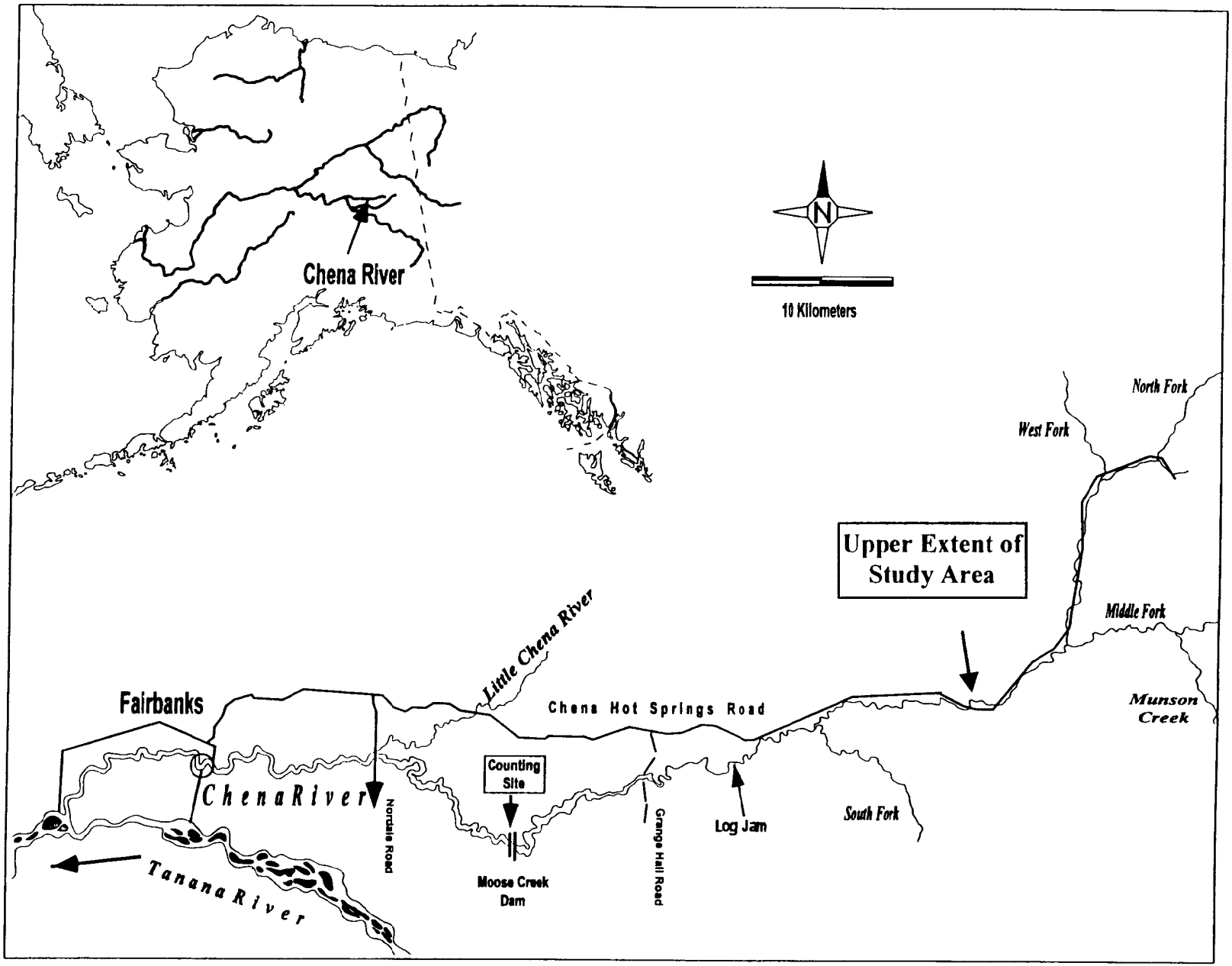


Figure 2.-Chena River study area.

Table 1.-Harvests of anadromous chinook salmon by sport, commercial, subsistence, and personal use fisheries, Tanana River drainage, 1978 - 1998.

	On Site Sport Harvest Estimates[a]		Statewide Survey Estimates of Sport Harvest[b]						Estimated Harvest by User Group		
Year	Chena River	Salcha River	Chena River	Salcha River	Chatanika River	Nenana River	Other Streams	All Waters	Commercial Harvests[c]	Subsistence and Personal Use Harvests[c]	Total Known Harvest
1978	None	None	23	105	35	None	0	163	635	1,231	2,029
1979	None	None	10	476	29	None	0	515	772	1,333	2,620
1980	None	None	0	904	37	None	0	941	1,947	1,826	4,714
1981	None	None	39	719	5	None	0	763	987	2,085	3,835
1982	None	None	31	817	136	None	0	984	981	2,443	4,408
1983	None	None	31	808	147	None	10	1,048	911	2,706	4,665
1984	None	None	0	260	78	None	0	338	867	3,599	4,804
1985	None	None	37	871	373	None	75	1,356	1,142	7,375	9,873
1986	None	526	212	525	0	None	44	781	950	3,701	5,432
1987	None	111	195	244	21	7	7	474	3,338	4,096	7,908
1988	567	19	73	236	345	36	54	744	786	5,507[e]	7,037
1989	685	123	375	231	231	39	87	963	2,181	2,999[e]	6,143
1990	24	200	64	291	37	0	0	439	2,989	3,069[e]	6,497
1991	None	362	110	373	82	11	54	630	1,163	2,515[e]	4,308
1992	None	4	39	47	16	0	0	118	785	2,438[e]	3,341
1993	None	54	733	601	192	0	19	1,573	1,445	2,098	5,116
1994	None	776	993	714	105	0	59	1,871	2,606	2,370	6,847
1995	None	811	622	1,448	58	0	320	2,488	2,747	2,178	7,413
1996	None	None	1,280	1,136	499	49	138	3,102	447	1,392	4,941
1997	None	None	936	695	225	11	0	1,878	2,728	3,025[d]	7,631
1998	None	None	NA[f]	NA[f]	NA[f]	NA[f]	NA[f]	NA[f]	963[d]	NA[f]	NA[f]

a Creel census estimates from Clark and Ridder (1987), Baker (1988, 1989), Merritt et al. (1990), and Hallberg and Bingham (1991-1996).

b Sport fishery harvest estimates from Mills (1979-1994) and Howe et al. 1995-1998.

c Commercial, subsistence, and personal use estimates (Schultz et al. 1994, and, Keith Schultz, Personal Communication. Alaska Department of Fish and Game, Sport Fish Division, 1300 College Road, Fairbanks, AK 99701).

d Preliminary data and subject to change.

e The personal use designation was implemented in 1988 to account for non-rural fishermen participating in this fishery. Harvests by personal use fishermen were 623, 453, 451, 0, and 0 for 1988-1992, respectively.

f NA means data not available at this time.

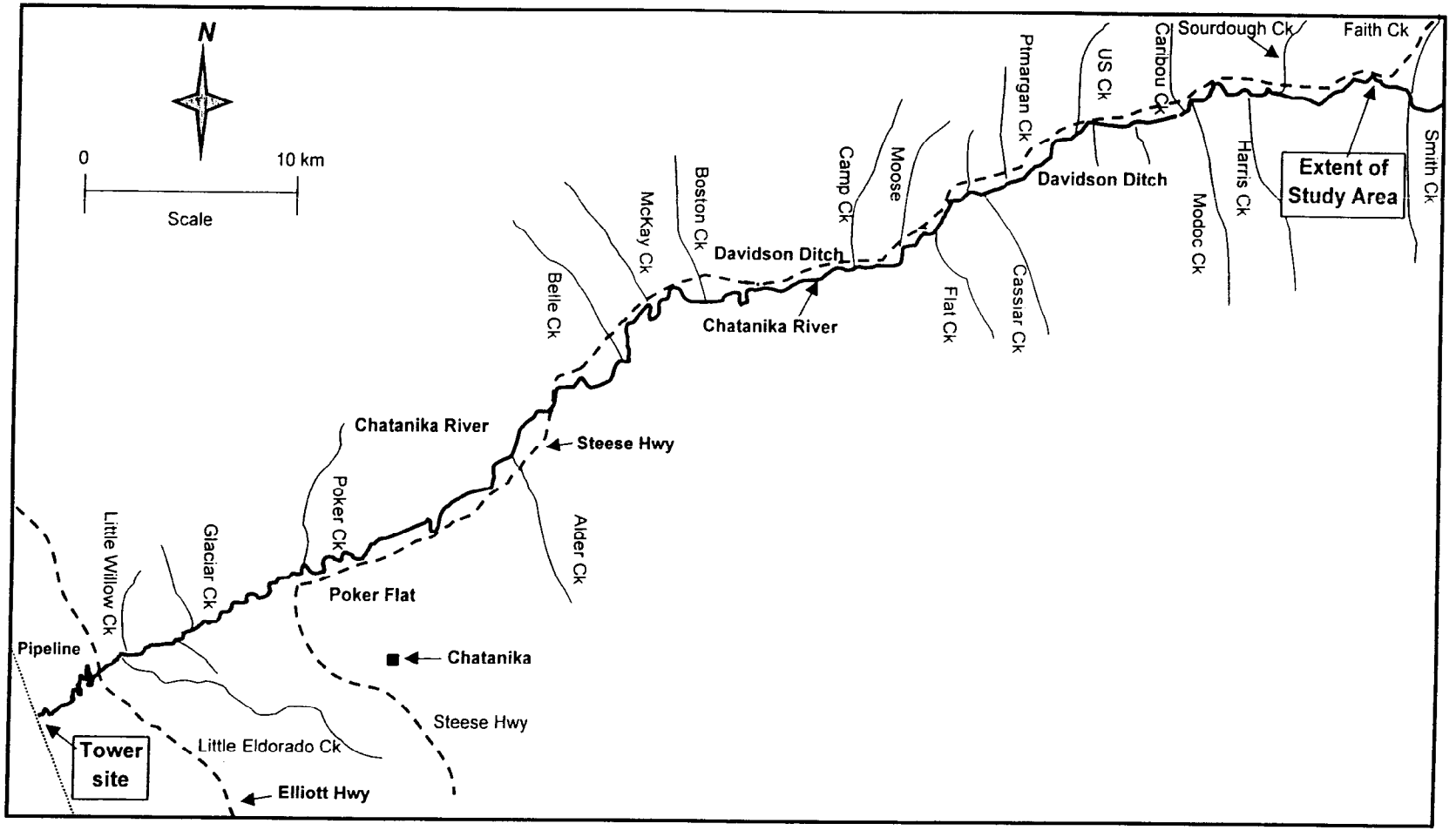


Figure 3.-Chatanika River study area.

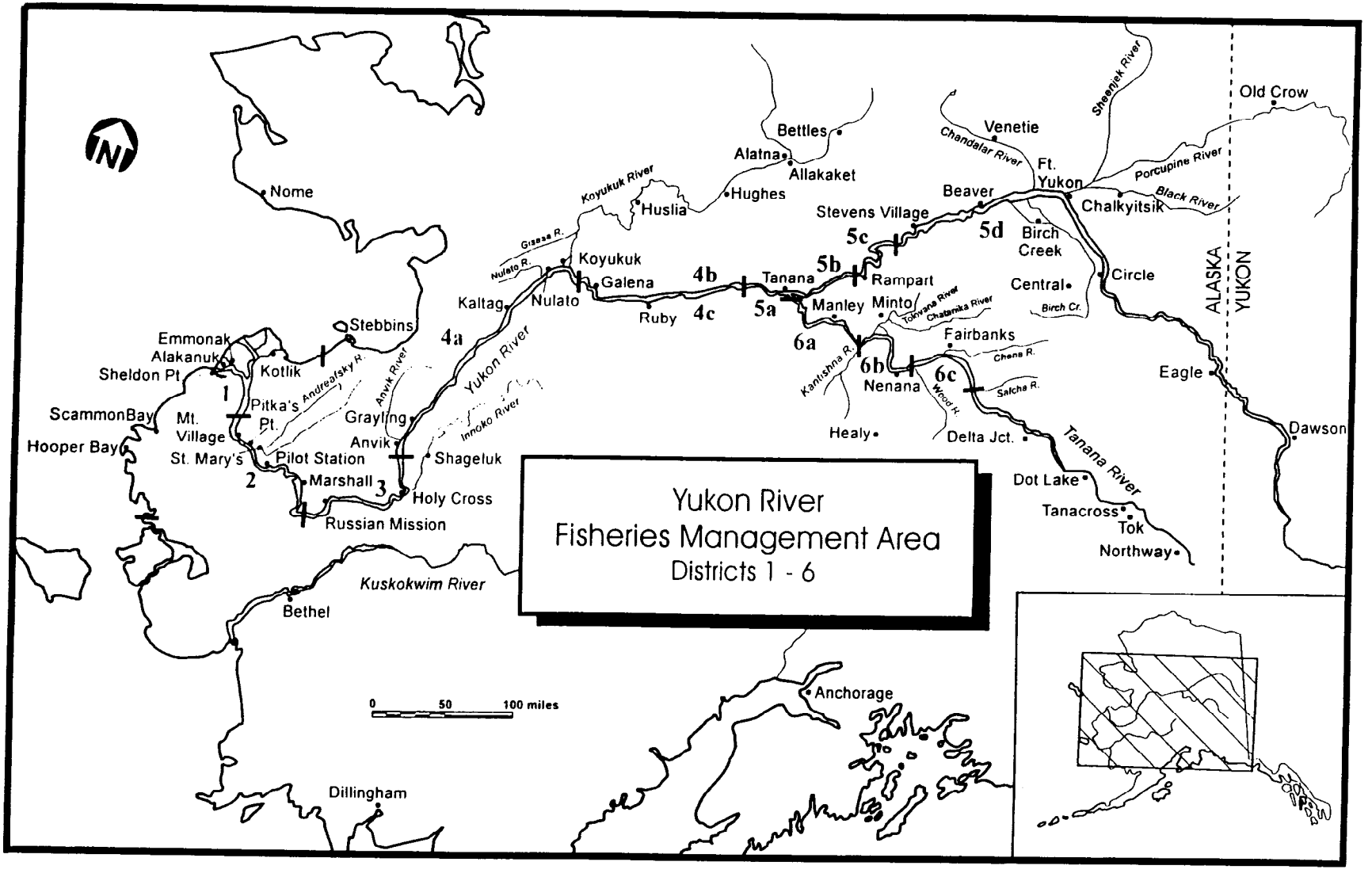


Figure 4.-Fishing districts in the Yukon River draiange.

Prior to 1993, the escapements of chinook salmon into the Salcha and Chena rivers were estimated using mark-recapture experiments and monitored with aerial surveys. This information has been used to evaluate management of the commercial, subsistence, personal use, and sport fisheries on these stocks. However, these methods provide fishery managers with limited information that can be used during the fishing season. Mark-recapture experiments occur after most of the escapement has passed through the various fisheries. Aerial surveys do not provide consistent indices of escapement. Thus, tower-counting methodology was initiated to provide the additional information on inseason escapement.

Escapements of chinook salmon in the Chatanika River prior to 1997 had been assessed on a semi-annual basis with aerial surveys from fixed wing aircraft. This methodology was inadequate, as survey estimates from some years were less than harvest estimates for the same years. A mark-recapture experiment was conducted in 1997. This was the first season (1998) tower-counting methods were applied to the Chatanika River.

The Alaska Department of Fish and Game (ADF&G) has established escapement goals for chinook salmon returning to the Salcha and Chena rivers. An aerial survey objective of 2,500 chinook salmon was set for the Salcha River and 1,700 for the Chena River. Using counts from aerial surveys and abundance estimates of escapement, the minimum escapement guidelines for aerial surveys were expanded into actual abundance (Evenson 1996). The minimum escapement guidelines using these expansions are 7,100 for the Salcha River and 6,300 for the Chena River. Escapement guidelines have not been developed based on tower-count estimates for the Chena or Salcha rivers, nor have escapement objectives of any kind been established for the Chatanika River.

In 1987 the Alaska Board of Fisheries imposed a sport harvest guideline of 300 to 700 chinook salmon for the Salcha River and 300 to 600 chinook salmon for the Chena River. The harvest by anglers in the Salcha River was monitored with creel surveys from 1986-1995. The last creel survey for the Chena River was conducted in 1990 (Evenson 1995). Creel surveys have not been conducted recently due to the relative success of tower-counts/carcass surveys and the costliness of creel surveys.

Chum salmon returning to the Salcha and Chena rivers are harvested in local sport fisheries. The migration timing of chum salmon is later than that of chinook salmon, but does overlap the chinook salmon migration. Because sport fisheries exploit these stocks, the abundance of the chum salmon escapements were monitored while conducting counts of chinook salmon in order to ensure that sport harvests do not adversely impact escapement. Currently there are no established harvest guidelines for chum salmon in the three rivers. There is an escapement goal of 3,500 chum salmon from aerial surveys for the Salcha River, but none exist for the Chena River.

The research objectives of the chinook salmon projects in 1998 were to:

1. estimate the escapement of chinook salmon in the Salcha, Chena and Chatanika rivers using tower-count methodology, and;
2. estimate age, sex, and length compositions of the escapement of chinook salmon in the Salcha, Chena and Chatanika rivers.

In addition, a project task was to count chum salmon in the Salcha, Chena, and Chatanika rivers while subsequently estimating escapement of chinook salmon using tower-counting techniques.

METHODS

Tower-counts

Daily escapements of chinook and chum salmon returning to the Salcha and Chena rivers were estimated by counting fish at fixed intervals as they passed beneath elevated counting sites. The counts were conducted from 26 June to 9 August for both the Salcha and Chena rivers, and 7 July to 31 July for the Chatanika River. The Moose Creek Dam was used for the Chena River and scaffolding towers located approximately 0.25 miles south of the Richardson Highway Bridge were used for the Salcha River (Figures 1 and 2). The counting site for the Chatanika River was located immediately downstream from the Alyeska pipeline. Little or no spawning occurs downstream from these sites. Sport fishing is restricted to areas downstream of the counting site in the Chena River. The majority of fishing occurs downstream of the counting site in the Salcha River, although regulations allow fishing up to 4.1 km upstream from the site. For these two rivers, tower-counts represent total escapement. In the Chatanika River, most sport fishing occurs upstream from the counting site since much of this location is part of the restricted Alyeska Pipeline access corridor. Thus, tower-counts represent the total in-river return for the Chatanika River.

Light-colored fabric panels were placed on the bottom of the rivers just downstream from the counting structures in order to improve visibility of moving fish. Lights were suspended over the panels to provide illumination during low light periods. Because salmon will often try to avoid areas with artificial substrate or illumination, the panels and overhanging lights formed a continuous band across the rivers. Once the light strings were turned on, they were left on until ambient light was sufficient to observe salmon. This was done to ensure that salmon would pass over the panels at the same rate during counting periods as during noncounting periods.

Sampling Design

A stratified systematic sampling design was used to estimate daily passage of chinook and chum salmon. Personnel were assigned 8-h shifts and counted salmon 20-min of each hour. Counts were limited to 20-min to alleviate eyestrain and fatigue. The width of the Salcha and Chena rivers made it possible for fish to escape the counters' watch. Thus, each river was divided in half by placing a red fabric strip across the panels near the center of the channel, allowing for 10-min counts of each side. Seibel (1967) evaluated the use of hourly 10-min counts as the basis for estimating hourly migration and thus total seasonal migration and found relative errors to be less than 10%. Start times for the first count were chosen randomly within the first 10-min of the hour. Counts began on the left side of the river facing upstream. The second count immediately followed the first. A week consisted of 21 possible, 8-h shifts (three shifts per day). Shift I started at 24:00 h and ended at 07:59 h; shift II started at 08:00 h and ended at 15:59 h; shift III started at 16:00 h and ended at 23:59 h. Three technicians were assigned to count on each of the Salcha and Chena rivers, while a fourth technician divided time between the two sites.

Three technicians were assigned to count on the Chatanika River. The Chatanika River channel was sufficiently narrow to permit a single 20-min count of the entire width. For the Salcha and Chena rivers, counts were conducted during 17-18 out of 21 possible shifts each week and 15 out of 21 possible shifts for the Chatanika River. During peak escapement, some shifts were

extended by 2 h for the Chatanika River site. The shift extensions were pre-planned. High, murky water prevented conducting some of the scheduled counts for the three rivers (Appendix A).

The total number of fish passing over the panels during any one 10 or 20-min count was recorded as the number of fish moving upstream minus the number of fish moving downstream. Drifting carcasses or obviously spawned-out fish were not counted. In some cases more fish were counted moving downstream than upstream. The resulting negative number was expanded and used as part of the daily estimate of passage.

Abundance Estimator

Estimates of abundance were stratified by day and by river half for the Salcha and Chena rivers. The daily estimates of abundance were considered a two-stage direct expansion where the first stage consisted of 8-h shifts within a day and the second stage consisted of 10-min counting periods within a shift. The second stage was considered systematic sampling because the 10-min counting periods were not randomly chosen.

The expanded shift passage on day i and shift j 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 sampling was systematic, because a period was sampled every hour in a shift. The variance associated with periods was calculated as:

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

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

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

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:

$$f_{1d} = \frac{h_d}{H_d} \quad (7)$$

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

d = day;
i = 8-h shift;
j = 10-min counting period;
y = observed period count;
Y = expanded shift passage;
m = number of 10-min counting periods sampled;
M = total number of possible 10-min counting periods;
h = number of 8-h shifts sampled;
H = total number of possible 8-h shifts;
D = total number of possible days;
f_1 = fraction of 8-h shifts sampled;
f_2 = fraction of 10-min counting periods sampled;
s_2^2 = estimated variance of total across counting periods; and,
s_1^2 = estimated variance of total across shifts.

Passage for the entire run was estimated by:

$$\hat{N} = \sum_{d=1}^{D} \hat{N}_d \tag{9}$$

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

For the Salcha and Chena rivers, the daily-expanded shift passage and the associated variance were calculated for each side and then added. Total abundance and the associated variance were calculated similarly by summing the estimates from each side. For the Chatanika River, the same estimator and variance equations were used except that j, m, M and f_2 represented 20-min counting periods and were adjusted accordingly.

The above equations worked well when two or three 8-h shifts were worked in a day. For a few days, due to high water, technicians could only conduct one 8-h count per day for the three rivers. The equation for total estimated variance across shifts (equation 5) assumes greater than one 8-h shift, or the denominator becomes zero. For days with only one shift, the SE was estimated from the total average daily coefficient of variation (CV) for each river and species for those days with greater than one counting period. The coefficient of variation was used because it is independent of the magnitude of the estimate and is relatively constant throughout the run (Evenson 1995).

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

$$\hat{N}_i = \frac{\sum_{j=i-k}^{i+k} I(\text{day j was sampled})\hat{N}_j}{\sum_{j=i+k}^{i+k} I(\text{day j was sampled})} \tag{11}$$

where:

$$I(\cdot) = \begin{cases} 1 & \text{when the condition is true} \\ 0 & \text{otherwise} \end{cases} \tag{12}$$

is an indicator function.

The estimate of the daily variation for missed days was the maximum variance of the k days before and the k days after the missed day i.

Age-Sex-Length Compositions

Long handled spears were used to collect the carcasses. For the Salcha and Chena rivers, carcasses were collected from a jet-powered boat. For the Salcha River, carcasses were collected from the counting site to approximately 85 km upriver to Butte Creek (Figure 1). For the Chena River, samples were collected from the Moose Creek Dam to approximately 76 km upriver (Figure 2). Carcasses were collected from a canoe on the Chatanika River from the Alyeska Pipeline to approximately 85 km upriver (Figure 3). For the Salcha and Chena rivers, a target sample size of 600 carcasses was developed in order to obtain an age-sex-length proportion of females that were within $\pm$ 5 percentage points 95% of the time (Thompson 1987). The fish were measured, three scales were taken for aging, and sex was determined from external characteristics and, in questionable cases, by examining the gonads. Sampling took place on the three rivers on two occasions during 4-7 and 11-14 August. After examination, all carcasses

were sliced on their left sides in order to prevent resampling. All length measurements were made from mid-eye to fork-of-tail. Three scales were removed from the left side of the fish 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). Scale impressions were later made on acetate cards and viewed at 100X magnification using equipment similar to that described by Ryan and Christie (1976). Ages were determined from scale patterns as described by Mosher (1969).

Mean lengths were estimated for combinations of age and sex using the sample mean and sample variance of the mean (Zar 1984). For the Salcha, Chena and Chatanika rivers, proportions of chinook salmon in a carcass sample by ocean-age and the associated variances for each river were calculated separately for each sex using:

$$\hat{p}_{sg} = \frac{n_{sg}}{n_s} \tag{13}$$

$$\hat{V}(\hat{p}_{sg}) = \frac{\hat{p}_{sg}\left(1-\hat{p}_{sg}\right)}{n_s - 1} \tag{14}$$

where:

$\hat{p}_{sg}$ = estimated proportion of chinook salmon of sex *s* in age group *g*; and,

n_s = number of chinook salmon of sex *s*.

Aerial Counts

Commercial Fisheries Division personnel conducted aerial survey counts near peak escapement for the Salcha and Chena rivers. The daily tower-counts of chinook salmon and weather conditions dictated optimum flying days. The surveys were conducted on 18 July for the Chena River and 1 August for the Salcha River. Counts were made from low flying, fixed-wing aircraft. Barton (1987b) described the methods used for these aerial surveys. The proportion of salmon counted by the aerial survey to the total estimated escapement was calculated.

RESULTS

Data for these analyses are archived as described in Appendix B.

Salcha River Chinook Salmon Studies

Tower-counts were initiated for the three rivers before the chinook salmon arrived. Total escapement was estimated at 5,027 (SE=331) for the Salcha River. The largest expanded daily count of chinook salmon for the Salcha River was 396 on 22 and 23 July (SE=61 and 52, respectively; Table 2). High water due to rainfall prevented counts on 8, 19, 24-26, and 30 July. Daily passage of chinook salmon was minimal when counts were terminated on 9 August. The largest number of chinook salmon to pass during any one 10 minute count was 13 at 1300 hours on 13 July, right side. Typically, counts were larger for the right side of the Salcha River, which

Table 2.-Daily counts and estimates of the number of chinook salmon passing by the counting site in the Salcha River, 1998.

Date	Count Periods	Left Side			Right Side			Total		
		Count	Expanded Count[a]	SE[a]	Count	Expanded Count[a]	SE[a]	Count	Expanded Count[a]	SE[a]
26-Jun-98	12	0	0	0	0	0	0	0	0	0
27-Jun-98	16	0	0	0	0	0	0	0	0	0
28-Jun-98	16	0	0	0	0	0	0	0	0	0
29-Jun-98	16	0	0	0	0	0	0	0	0	0
30-Jun-98	16	0	0	0	0	0	0	0	0	0
1-Jul-98	16	1	9	9	1	9	9	2	18	13
2-Jul-98	16	0	0	0	0	0	0	0	0	0
3-Jul-98	24	0	0	0	8	48	23	8	48	23
4-Jul-98	16	1	9	7	9	81	48	10	90	49
5-Jul-98	16	1	9	9	0	0	0	1	9	9
6-Jul-98	24	0	0	0	24	144	48	24	144	48
7-Jul-98	23	1	6	6	10	59	29	11	65	29
8-Jul-98	20	2	12	14	35	222	90	37	234	91
9-Jul-98	0	0	15	14	0	115	90	0	130	91
10-Jul-98	15	2	19	12	1	9	9	3	28	15
11-Jul-98	24	5	30	14	18	108	35	23	138	38
12-Jul-98	16	2	18	9	25	225	111	27	243	112
13-Jul-98	24	9	54	27	46	276	82	55	330	86
14-Jul-98	16	2	18	14	16	144	53	18	162	55
15-Jul-98	16	0	0	0	3	27	22	3	27	22
16-Jul-98	16	14	126	58	15	135	86	29	261	104
17-Jul-98	23	14	87	22	31	212	33	45	299	40
18-Jul-98	13	7	68	30	0	0	0	7	68	30
19-Jul-98	0	0	56	30	0	67	44	0	123	53
20-Jul-98	16	5	45	25	15	135	44	20	180	50
21-Jul-98	22	13	96	36	24	168	33	37	264	49
22-Jul-98	24	27	162	43	39	234	44	66	396	61
23-Jul-98	24	25	150	31	41	246	42	66	396	52
24-Jul-98	0	0	129	60	0	189	60	0	318	85
25-Jul-98	0	0	109	60	0	157	60	0	266	85
26-Jul-98	0	0	71	60	0	114	60	0	185	85
27-Jul-98	8	6	108	60	6	108	60	12	216	85
28-Jul-98	24	3	18	13	7	42	18	10	60	22
29-Jul-98	16	1	9	9	7	63	32	8	72	33
30-Jul-98	0	0	13	10	0	40	32	0	53	33
31-Jul-98	8	1	18	10	1	18	10	2	36	14
1-Aug-98	16	3	27	18	4	36	29	7	63	34
2-Aug-98	14	0	0	0	1	9	9	1	9	9
3-Aug-98	24	2	12	12	5	30	11	7	42	16
4-Aug-98	24	2	12	8	0	0	0	2	12	8
5-Aug-98	24	1	6	6	2	12	7	3	18	9
6-Aug-98	24	1	6	6	0	0	9	1	6	11
7-Aug-98	24	-1	-6	6	2	12	8	1	6	10
8-Aug-98	24	0	0	0	2	12	6	2	12	6
9-Aug-98	16	0	0	0	0	0	0	0	0	0
Total	726	150	1,521	167	398	3,506	285	548	**5,027**	**331**

[a] Shaded cells are estimates for days with no counts and for SE, days with only one counting period or less. See Methods section for a description of how estimates for expanded count's and SE's are calculated for these days.

was deeper (Appendices C1-C2). Visual inspection of Figure 5 shows no distinct diurnal pattern for passage of chinook salmon although passage was generally higher in the early morning and mid-afternoon.

Overall run timing since 1993 when tower-counts were instigated for the Salcha River has been similar (Figure 6). Run timing of 1998 chinook salmon was most similar to 1995 and 1994. Escapement reached 50% of what would be the total on 20 July, which was five days later than that for 1993 and 1997. The average expanded cumulative escapement estimated from tower-counts for 1993-1995 and 1997 was 15,415. The estimated tower escapement for 1996 was unreliable due to high water events and a mark-recapture had to be performed in order to acquire an estimate. The 1998 escapement was the first time since the inception of tower-counts that the minimum goal has not been achieved (Figure 7).

Age-Sex-Length Compositions

One hundred forty eight carcasses were collected and examined. The sex composition for this sample including those fish not aged was 0.70 (SE=0.04) males and 0.30 (SE=0.04) females. Ages were determined for 0.83 of the sample. The average male/female ratio from 1987-1998 of fish aged was 0.54 males and 0.46 females (Table 3). The dominant age class for males and females sampled in 1998 was 1.3 with proportions of 0.76 (SE=0.05) and 0.65 (SE=0.08), respectively (Table 4). Males were also represented by ages 1.1 (0.03), 1.2 (0.07), 1.4 (0.13), and 1.5 (0.01). Females were also represented by ages 1.4 (0.30) and 1.5 (0.05). Lengths of males ranged from 390 to 950 mm (Figure 8). Lengths of females ranged from 550 to 900 mm.

Carcass sampling of chinook salmon on the Salcha River by Region III Sport Fish Division has taken place since 1987. The average length per age for chinook salmon sampled from 1987-1998 from the Salcha River has varied between years for a given age and sex. However, no consistent upward or downward trends have been apparent. The most common ages sampled for male chinook salmon were 1.2, 1.3 and 1.4 (Figure 9). Mean length at age for age 1.2 has varied from 503 mm in 1998 to 592 mm in 1990. Age 1.3 has varied from 695 mm in 1998 to 790 mm in 1989 and age 1.4 has varied from 787 mm in 1998 to 933 mm in 1990 (Figure 10). The most common ages sampled for female chinook salmon were 1.3, 1.4 and 1.5. Mean length at age for age 1.3 has varied from 736 mm in 1998 to 860 mm in 1997. Age 1.4 has varied from 782 in 1998 to 898 mm in 1990 and age 1.5 has varied from 833 mm in 1997 to 960 mm in 1989 (Figure 11).

Chena River Chinook Salmon Studies

Total escapement was estimated at 4,745 (SE=503) chinook salmon. Poor counting conditions prevented counts from being conducted on 9, 10, 15, 18, and 25-28 July. The largest expanded daily count of chinook salmon for the Chena River was 462 (SE=69) on 17 July (Table 5). Daily passage of chinook was minimal by 9 August when the count was terminated. The largest number of chinook salmon to pass during one 10-min count was 9 at 1100 hours on 23 July for the left side. Typically counts were larger for the left side of the Chena River (Appendices C3-C4). On visual inspection, passage of chinook salmon for the Chena River showed no distinct diurnal pattern (Figure 12).

The point of 50% escapement of chinook salmon past the Moose Creek Dam from 1993-1997 varied from 14 to 17 July (Figure 13). Escapement reached 50% of what would eventually be the

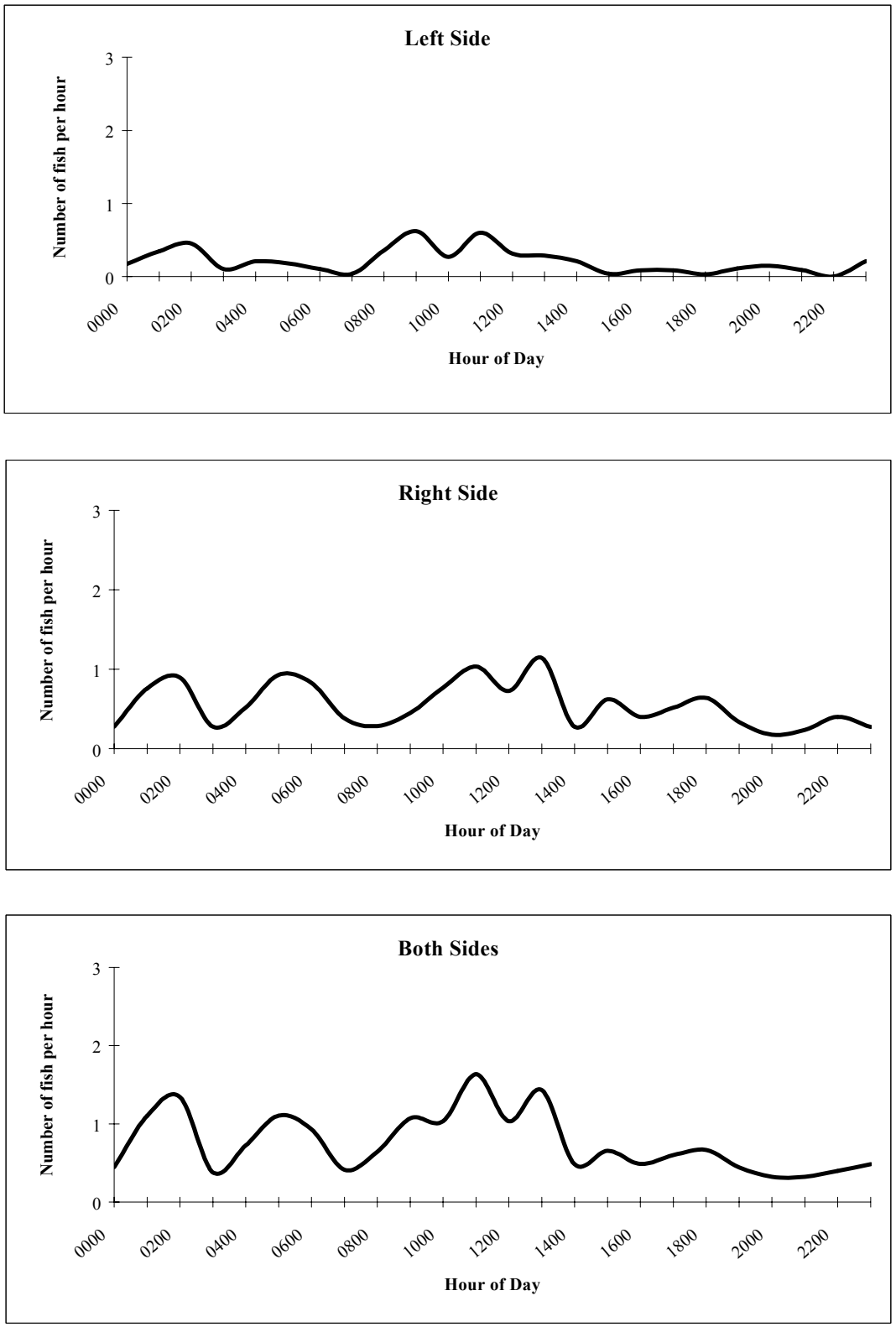


Figure 5.-Average hourly escapement of chinook salmon in the Salcha River, 1998.

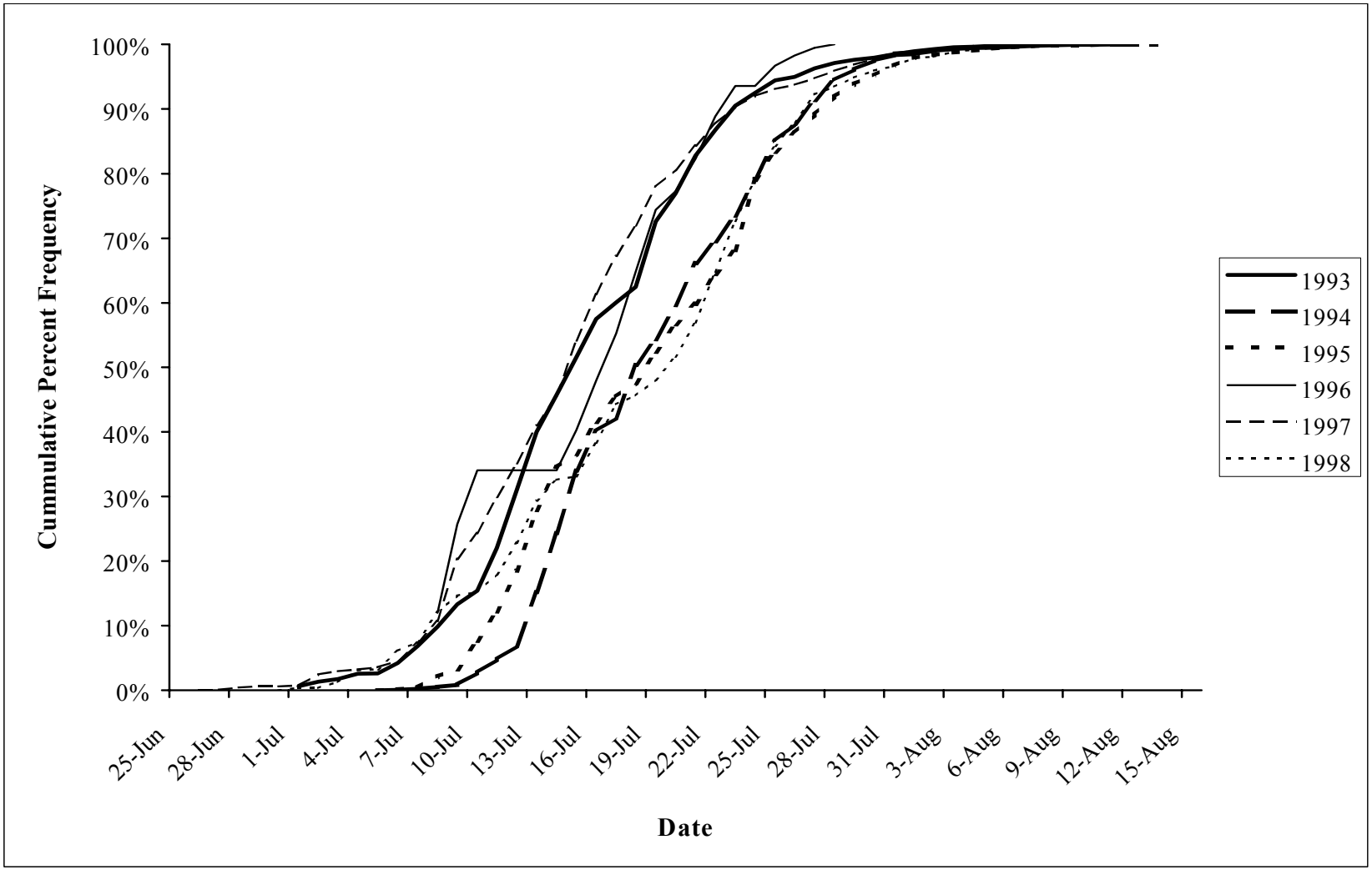


Figure 6.-Run timing of chinook salmon from 1993-1998 for the Salcha River.

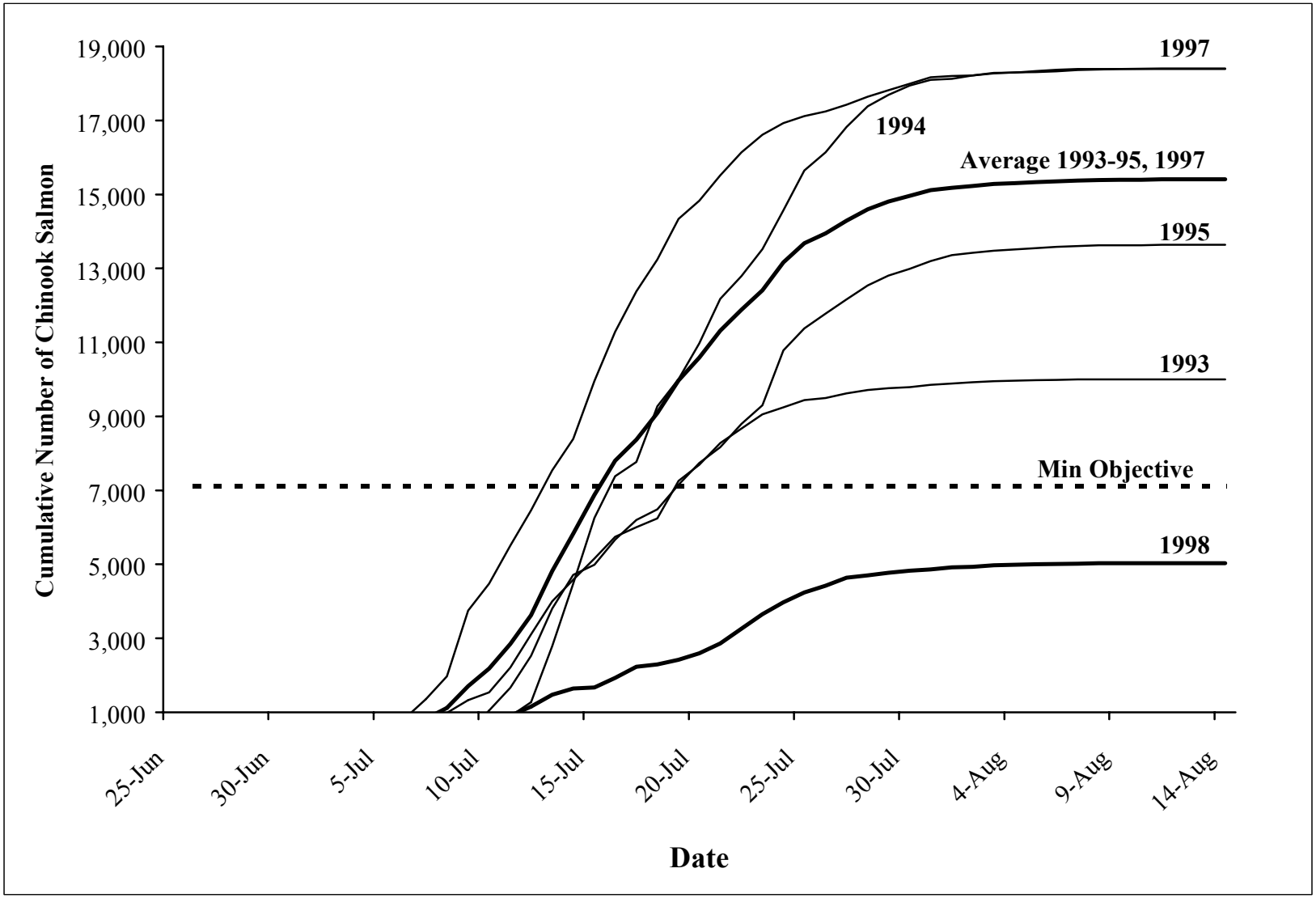


Figure 7.-Average expanded cumulative passage of chinook salmon for 1993-1995 and 1997 tower-counts compared to 1998 for the Salcha River.

Table 3.-Percent male and female chinook salmon sampled and aged during carcass surveys for the Salcha and Chena rivers from 1987-1998.

	Sample Size				
Year	Males	Females	Total	% Males	% Females
Salcha River					
1987	204	345	549	37%	63%
1988	298	195	493	60%	40%
1989	84	137	221	38%	62%
1990	261	264	525	50%	50%
1991	267	237	504	53%	47%
1992	413	214	627	66%	34%
1993	328	125	453	72%	28%
1994	287	233	520	55%	45%
1995	239	305	544	44%	56%
1996	203	210	413	49%	51%
1997	90	90	180	50%	50%
1998	86	37	123	70%	30%
Average				54%	46%
Chena River					
1989	115	196	311	37%	63%
1990	291	258	549	53%	47%
1991	231	108	339	68%	32%
1992	289	177	466	62%	38%
1993	155	30	185	84%	16%
1994	281	231	512	55%	45%
1995	267	520	787	34%	66%
1996	286	229	515	56%	44%
1997	424	278	702	60%	40%
1998	134	94	228	59%	41%
Average				57%	43%

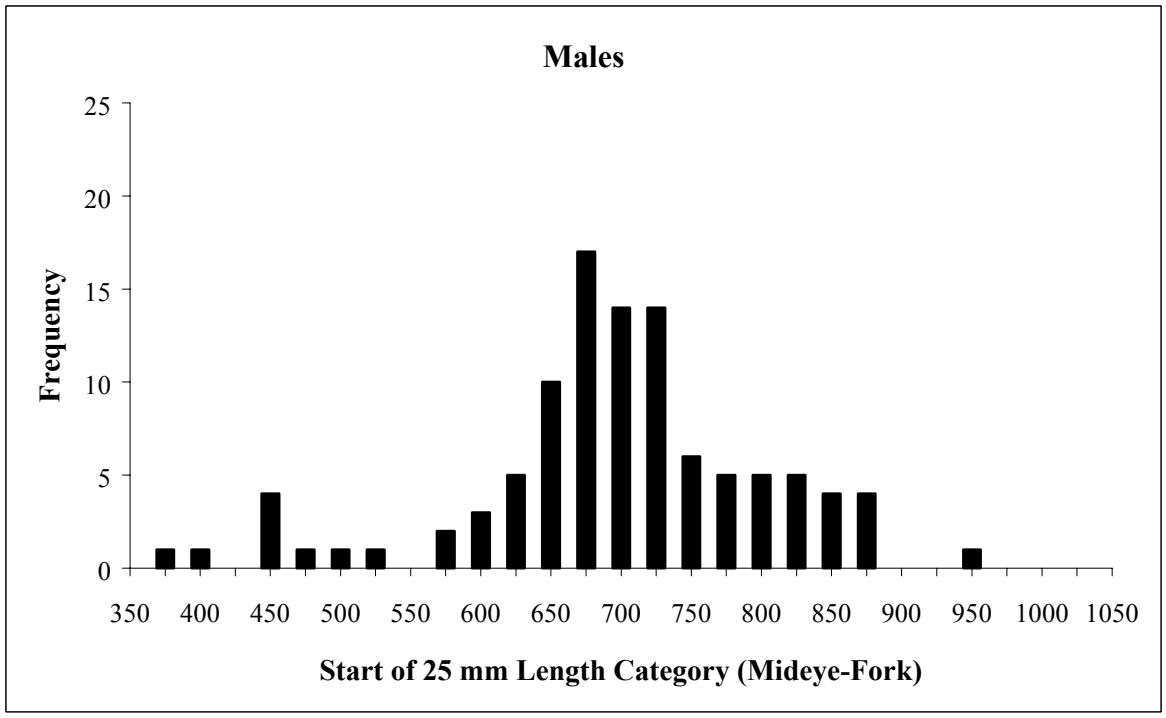
Table 4.-Estimated proportions and mean length by age class of male and female chinook salmon in the Salcha River, 1998.

		Sample			Length			
	Age[a]	Size	Proportion	SE	Mean	SE	Min	Max
Male	1.1	3	0.03	0.02	423	29	390	445
	1.2	6	0.07	0.03	503	74	435	605
	1.3	65	0.76	0.05	698	58	585	875
	1.4	11	0.13	0.04	787	82	625	875
	1.5	1	0.01	0.01	930	N/A	930	930
	Total	86	1.00					
Total[b]		104	0.70[c]	0.04[c]	685	105	375	930
Female	1.3	24	0.65	0.08	736	53	545	815
	1.4	11	0.30	0.08	782	37	743	850
	1.5	2	0.05	0.04	863	39	835	890
	Total	37	1.00					
Total[b]		44	0.30[c]	0.04[c]	759	57	545	890

[a] The notation x.x represents the number of annuli formed during river residence and ocean residence (i.e. an age of 2.4 represents two annuli formed during river residence and four annuli formed during ocean residence

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

[c] Proportion and corresponding SE are based on total number (148) of carcasses sampled.



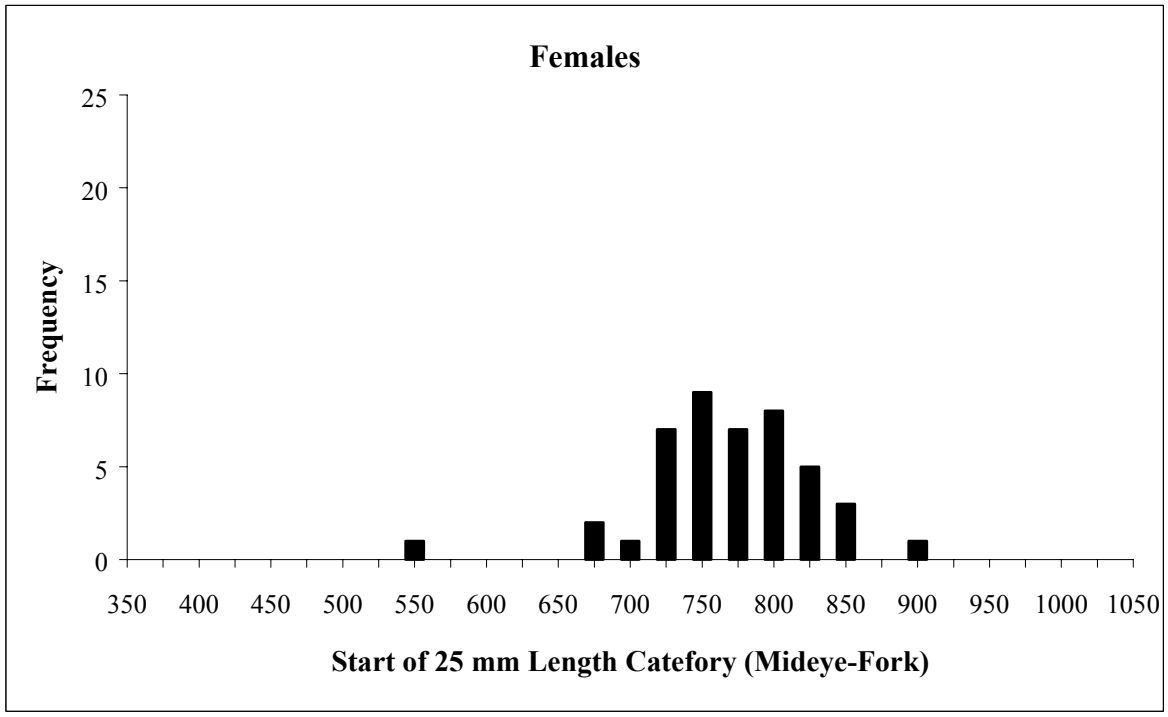
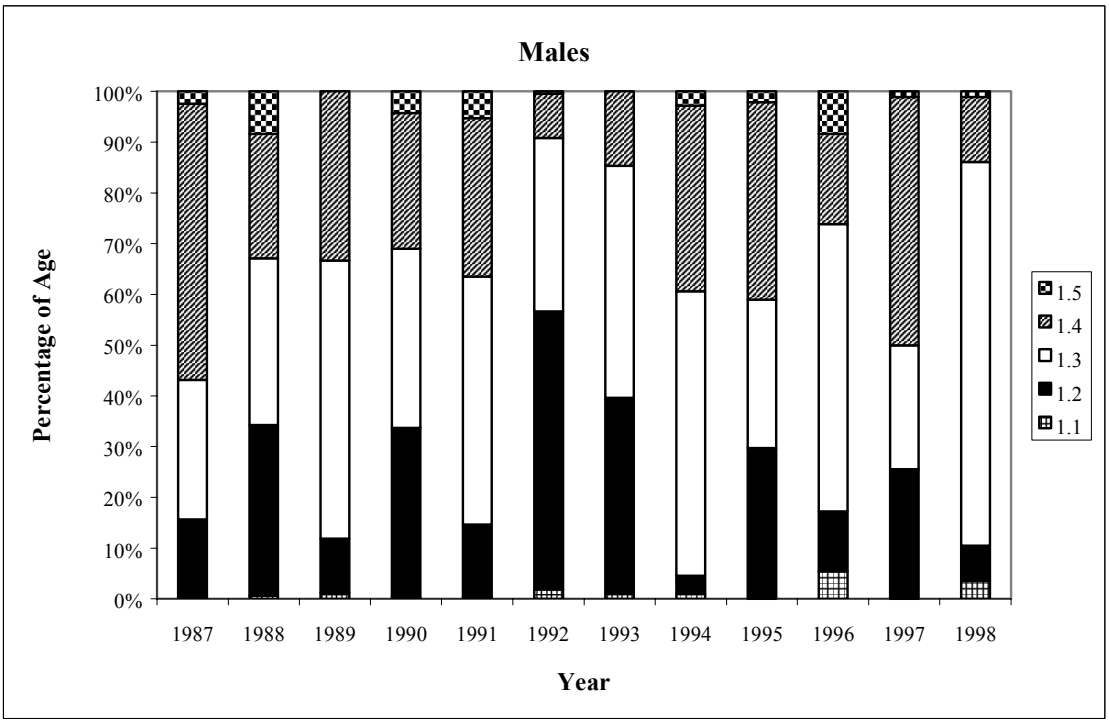


Figure 8.-Length frequency distributions of male and female chinook salmon carcasses sampled on the Salcha River, 1998.



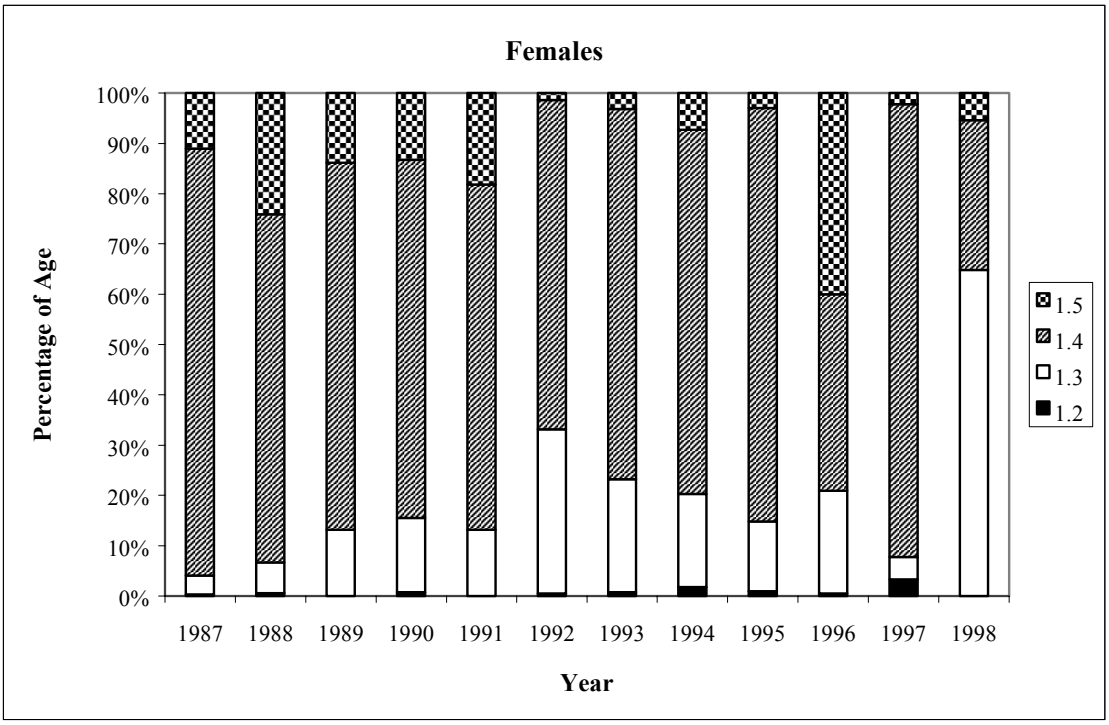


Figure 9.-Age composition of male and female chinook salmon from the Salcha River from carcasses sampled from 1987-1998.

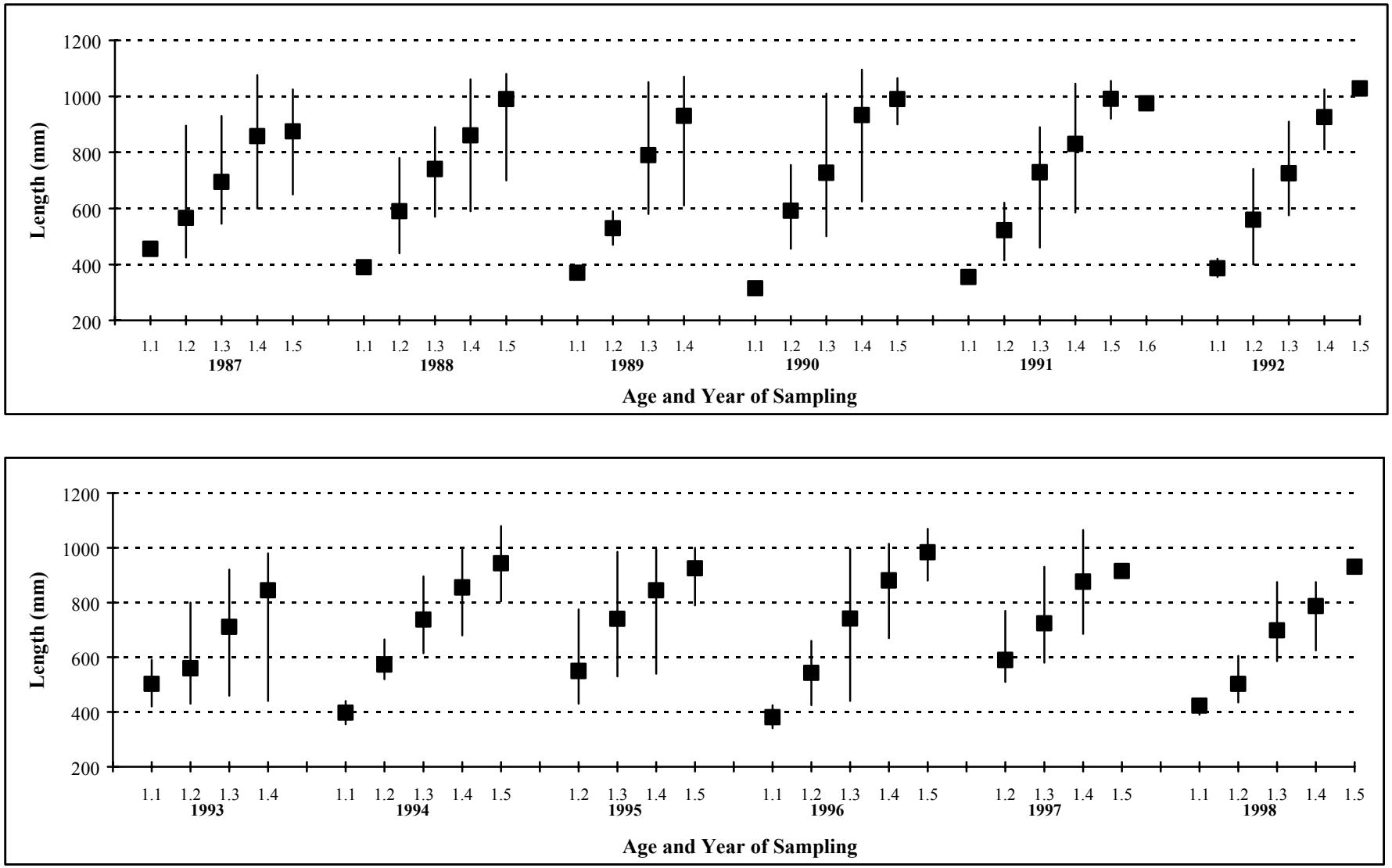


Figure 10.-Average length at age for male chinook salmon sampled from the Salcha River from 1987-1998. Error bars represent ranges.

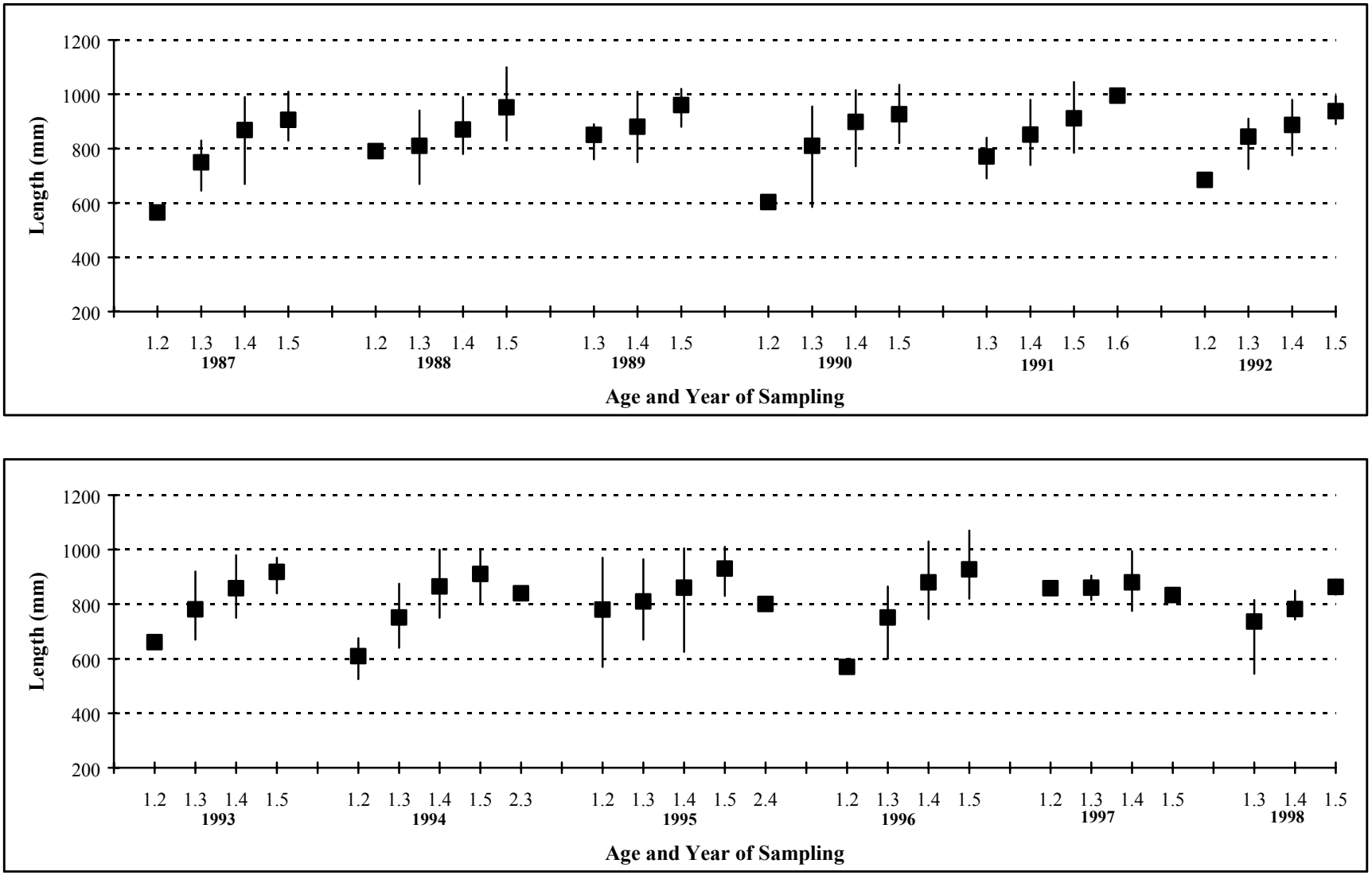
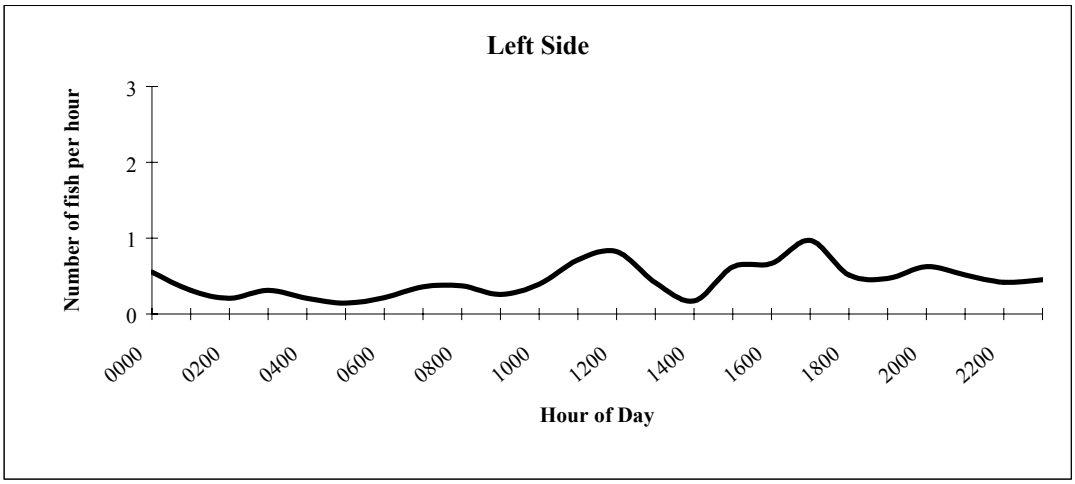


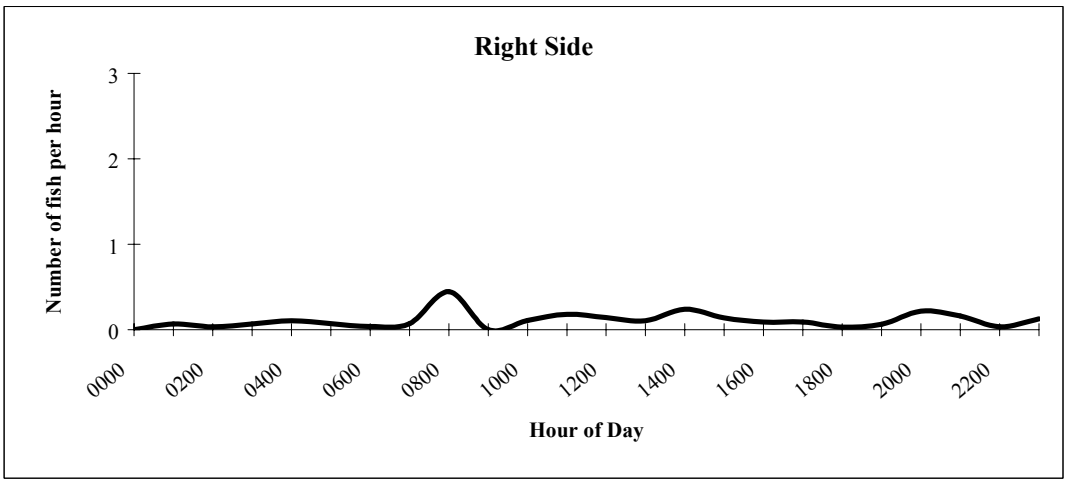
Figure 11.-Average length at age for female chinook salmon sampled from the Salcha River from 1987-1998. Error bars represent ranges.

Table 5.-Daily counts and estimates of the number of chinook salmon passing by the counting site in the Chena River, 1998.

Date	Count Periods	Left Side			Right Side			Total		
		Count	Expanded Count[a]	SE[a]	Count	Expanded Count[a]	SE[a]	Count	Expanded Count[a]	SE[a]
26-Jun-98	16	0	0	0	0	0	0	0	0	0
27-Jun-98	16	0	0	0	0	0	0	0	0	0
28-Jun-98	16	1	9	9	0	0	0	1	9	9
29-Jun-98	16	0	0	0	2	18	18	2	18	18
30-Jun-98	24	3	18	13	2	12	12	5	30	18
1-Jul-98	24	6	36	35	0	0	0	6	36	35
2-Jul-98	16	6	54	37	0	0	0	6	54	37
3-Jul-98	16	9	81	24	2	18	15	11	99	28
4-Jul-98	16	5	45	28	1	9	9	6	54	29
5-Jul-98	16	7	63	24	0	0	0	7	63	24
6-Jul-98	24	10	60	27	0	0	0	10	60	27
7-Jul-98	24	8	48	36	1	6	6	9	54	36
8-Jul-98	16	4	36	18	0	0	0	4	36	18
9-Jul-98	0	0	28	14	0	2	90	0	30	91
10-Jul-98	0	0	14	14	0	4	90	0	18	91
11-Jul-98	8	0	0	0	0	0	0	0	0	0
12-Jul-98	24	1	6	6	2	12	14	3	18	15
13-Jul-98	24	14	84	19	5	30	19	19	114	27
14-Jul-98	11	2	18	14	3	27	22	5	45	26
15-Jul-98	0	0	39	15	0	17	22	0	56	27
16-Jul-98	24	10	60	15	1	6	13	11	66	20
17-Jul-98	14	38	381	66	8	81	21	46	462	69
18-Jul-98	0	0	272	101	0	50	21	0	321	103
19-Jul-98	8	9	162	101	1	18	0	10	180	101
20-Jul-98	24	21	126	23	3	18	10	24	144	25
21-Jul-98	24	30	180	33	2	12	7	32	192	33
22-Jul-98	16	28	252	48	4	36	17	32	288	51
23-Jul-98	16	38	342	82	8	72	25	46	414	85
24-Jul-98	6	12	288	179	1	24	0	13	312	179
25-Jul-98	0	0	237	179	0	48	64	0	285	190
26-Jul-98	0	0	207	179	0	48	64	0	255	190
27-Jul-98	0	0	159	179	0	40	64	0	199	190
28-Jul-98	0	0	102	179	0	34	64	0	136	190
29-Jul-98	11	7	123	52	4	96	64	11	219	83
30-Jul-98	21	5	30	21	2	16	9	7	46	23
31-Jul-98	24	2	12	14	-1	-6	8	1	6	17
1-Aug-98	24	10	60	22	7	42	21	17	102	30
2-Aug-98	24	4	24	9	0	0	7	4	24	12
3-Aug-98	24	4	24	11	8	48	29	12	72	31
4-Aug-98	24	10	60	20	1	6	6	11	66	21
5-Aug-98	24	10	60	25	1	6	6	11	66	26
6-Aug-98	24	3	18	8	4	24	17	7	42	19
7-Aug-98	24	2	12	6	4	24	14	6	36	15
8-Aug-98	24	2	12	17	1	6	8	3	18	19
9-Aug-98	24	0	0	0	0	0	10	0	0	10
Total	711	321	3,842	457	77	903	209	398	**4,745**	**503**

[a] Shaded cells are estimates for days with no counts and for SE, days with only one counting period or less. See Methods section for a description of how estimates for expanded count's and SE's are calculated for these days.





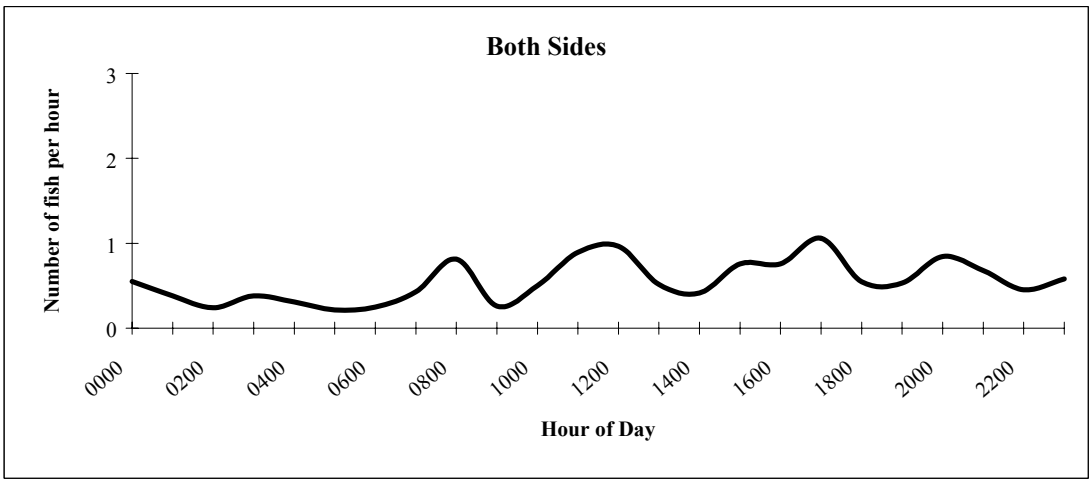


Figure 12.-Average hourly escapement of chinook salmon in the Chena River, 1998.

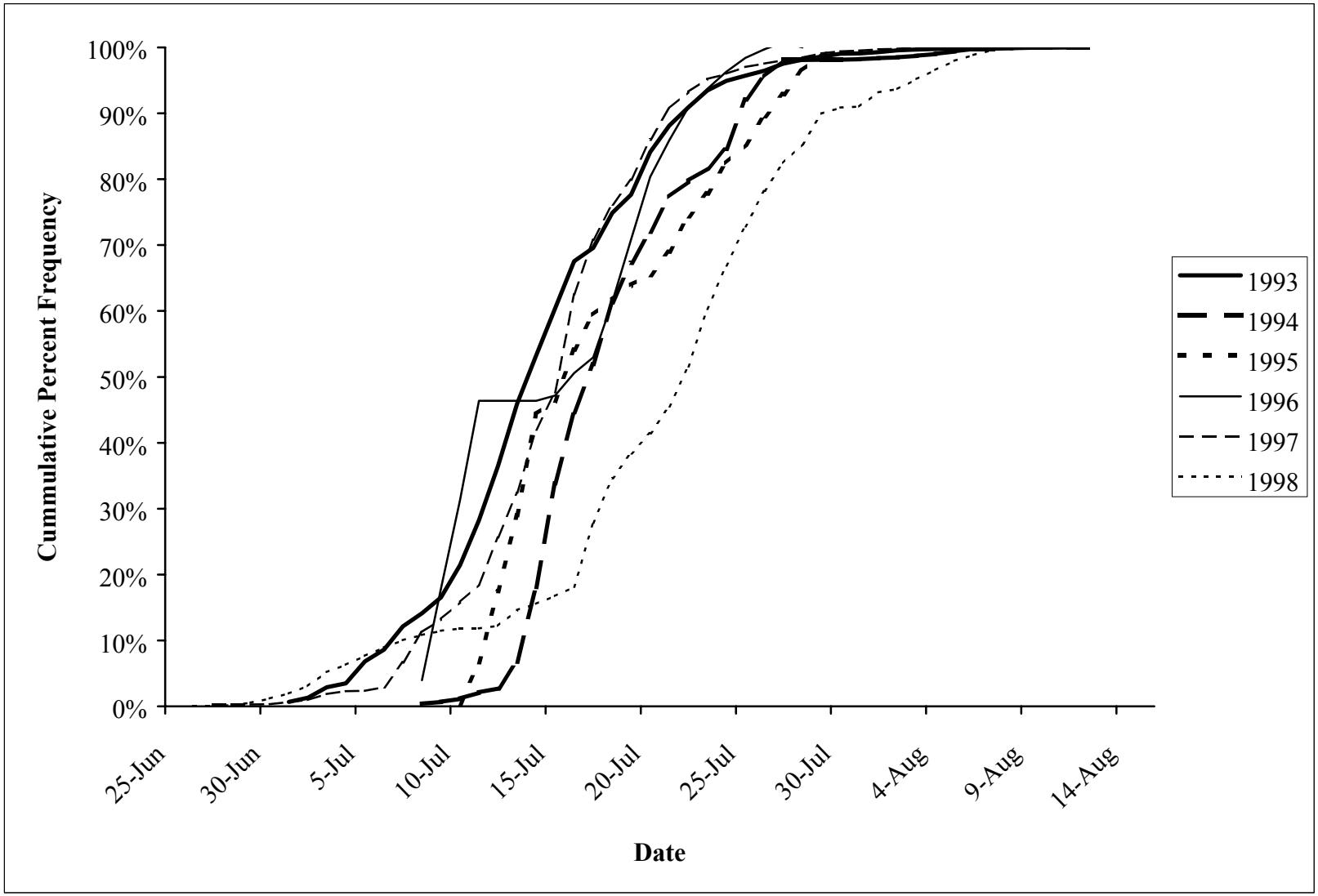


Figure 13.-Run timing of chinook salmon from 1993-1998 for the Chena River.

total on 22 July for 1998, which was considerably later than previous years, tower-counts. The average expanded cumulative escapement estimated from tower-counts for 1993, 1994, and 1997 was 12,967 (Figure 14). The tower escapements were unreliable for 1995 and 1996 due to high water events and mark-recapture experiments had to be performed in order to acquire estimates. Every year since the inception of the tower-counts, the escapement has exceeded the minimum of 6,300 chinook salmon except for 1998 (Figure 14).

Age-Sex-Length Compositions

Two hundred sixty-seven chinook salmon carcasses were collected and examined from the Chena River. The sex composition for this sample, including those fish not aged was 0.60 (SE=0.03) males and 0.40 (SE=0.03) females. Ages were determined for 85% of the sample. The average male/female ratio of aged fish from 1989-1998 was 0.57 males and 0.43 females (Table 3). The dominant age class for males and females collected in 1998 was 1.3. with proportions of 0.86 (SE=0.03) and 0.53 (SE=0.05, Table 6). Males were also represented by ages 1.2 (0.07), 1.4 (0.04), and 1.5 (0.02). Females were also represented by ages 1.4 (0.38) and 1.5 (0.09). Lengths of males ranged from 475 to 1,035 mm (Figure 15). Lengths of females ranged from 625 to 1000 mm.

Carcass sampling of chinook salmon on the Chena River by Region III Sport Fish Division has taken place since 1989. Similar to the Salcha River, the average length at age for chinook salmon sampled in the Chena River has varied over the years from 1989-1998. The most common ages sampled for male chinook were 1.2, 1.3, and 1.4 (Figure 16). Mean length at age for age 1.2 has varied from 524 mm in 1988 to 600 mm in 1995. Age 1.3 has varied from 698 mm in 1993 to 772 mm in 1989 and age 1.4 has varied from 788 mm in 1993 to 892 mm in 1996 (Figure 17). The most common ages sampled since 1989 for female chinook salmon were 1.3, 1.4 and 1.5. Mean length at age for age 1.3 has varied from 738 mm in 1991 to 857 mm in 1997. Age 1.4 has varied from 825 mm in 1998 to 888 mm in 1997 and age 1.5 has varied from 901 mm in 1997 to 995 mm in 1992 (Figure 18).

Salcha and Chena River Chum Studies

Chum salmon were first counted on 7 July for the Salcha River and 3 July for the Chena River. The chum salmon migration was still underway when tower project operations ended. Escapement through 9 August for the Salcha River was 17,289 (SE=696) and 5,901 (SE=342) for the Chena River (Tables 7 and 8). The largest expanded daily count of chum salmon for the Salcha River was 1,950 (SE=242) on 3 August and 606 (SE=77) for the Chena River on 4 August. The largest number of chum salmon passing during any one 10-min count was 54 for the right side of the Salcha River on 3 August, and 13 for the right side of the Chena River on 1 August. Overall, counts tended to be much higher for the right side of the Salcha River and similar for both sides of the Chena River (Appendices C5-C8). Similar to chinook salmon, on visual inspection, no distinct diurnal pattern could be seen for either river, although the highest passage tended to be during the very early and late hours (Figures 19 and 20).

Aerial Surveys for Salcha and Chena Rivers

The 4 August peak aerial survey counted 1,992 chinook salmon for the Salcha River. Visibility was poor. This count represented about 0.40 of the abundance estimated by the 1998 tower-counts. The peak Chena River aerial survey was conducted on 31 July and counted 386 chinook salmon. Visibility for the Chena River was poor and the count was incomplete. The Chena

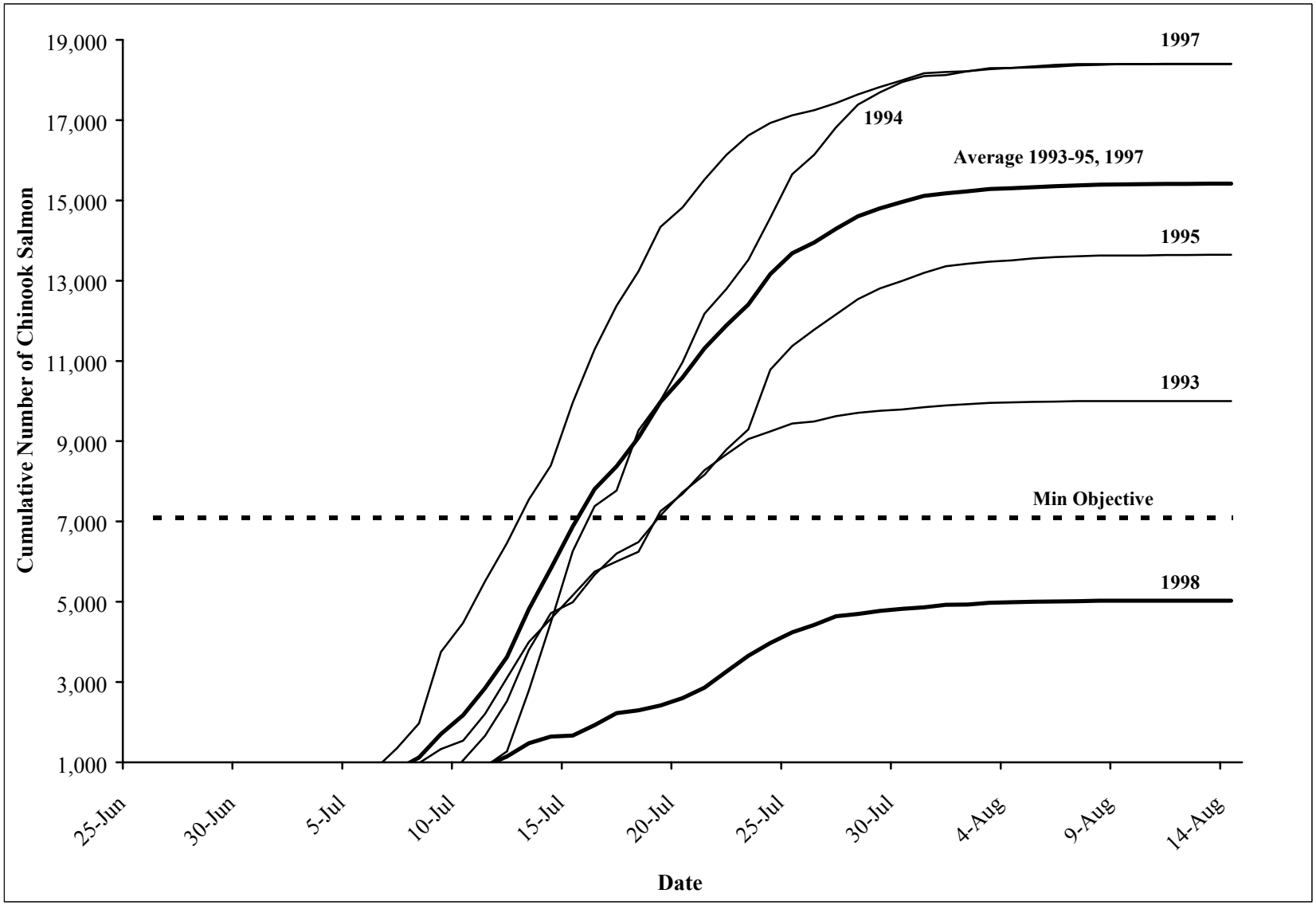


Figure 14.-Average expanded cumulative passage of chinook salmon for 1993, 1994 and 1997 tower-counts compared to 1998 for the Chena River.

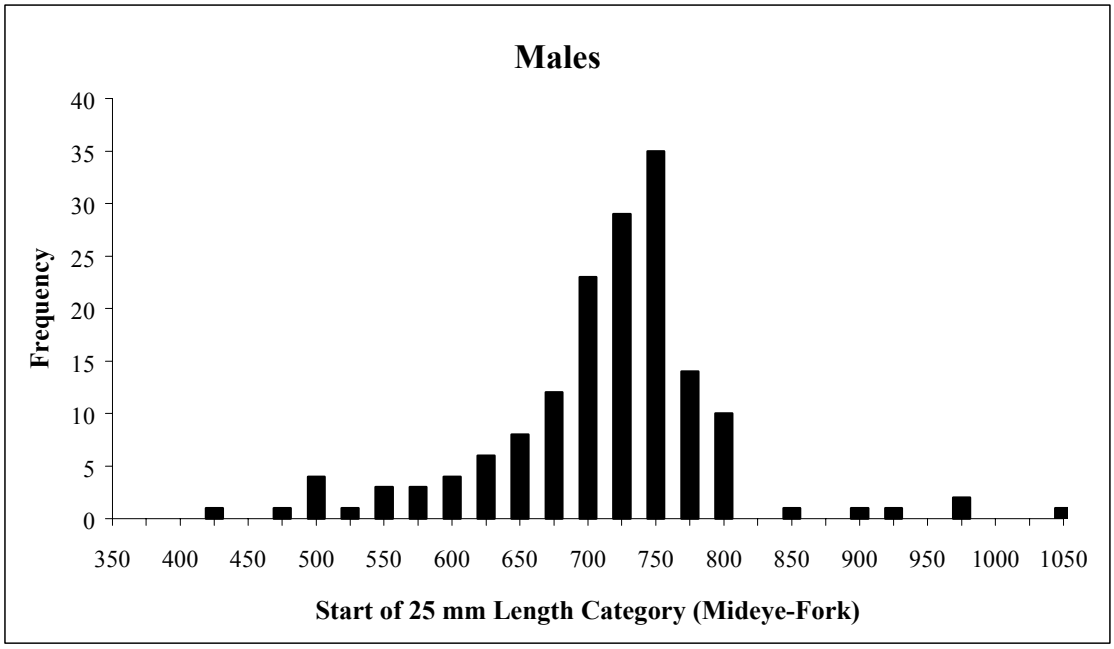
Table 6.-Estimated proportions and mean length by age class of male and female chinook salmon in the Chena River, 1998.

		Sample			Length			
	Age[a]	Size	Proportion	SE	Mean	SE	Min	Max
Male	1.2	10	0.07	0.02	524	38	475	590
	1.3	115	0.86	0.03	717	50	580	885
	1.4	6	0.04	0.02	794	120	655	955
	1.5	3	0.02	0.01	918	139	765	1035
	Total	134	1.00					
Total[b]		160	0.60[c]	0.03[c]	704	85	420	1,035
Female								
	1.3	50	0.53	0.05	766	42	675	870
	1.4	36	0.38	0.05	825	44	705	890
	1.5	8	0.09	0.03	918	38	880	980
	Total	94	1.00					
Total[b]		107	0.40[c]	0.03[c]	798	64	620	980

[a] The notation x.x represents the number of annuli formed during river residence and ocean residence (i.e. an age of 2.4 represents two annuli formed during river residence and four annuli formed during ocean residence

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

[c] Proportion and corresponding SE are based on total number (267) of carcasses sampled.



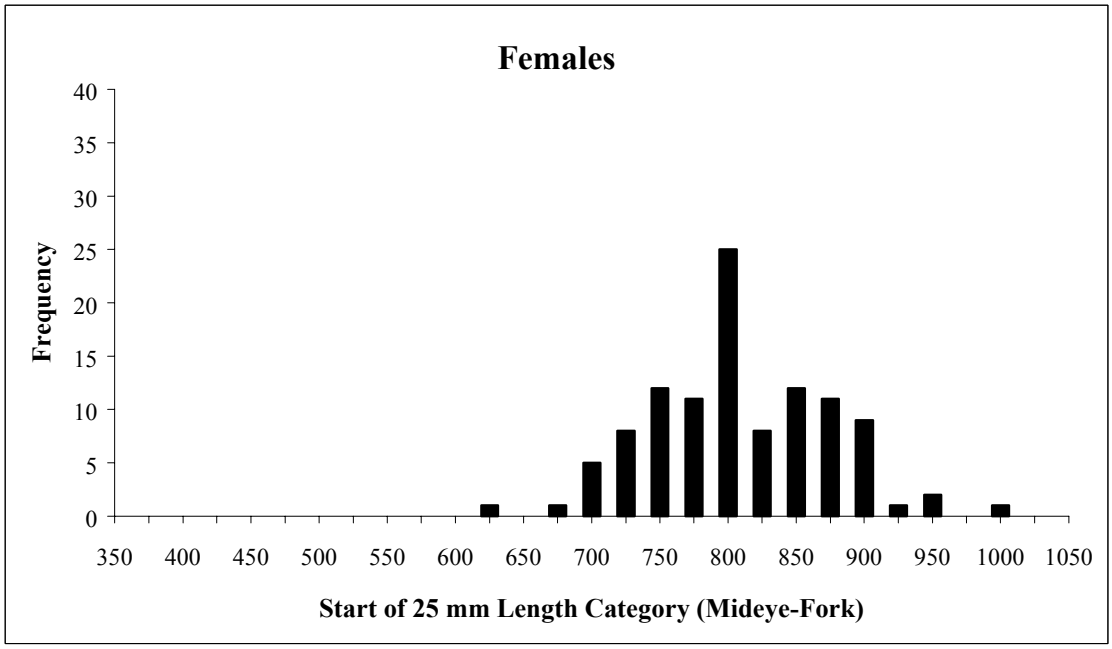
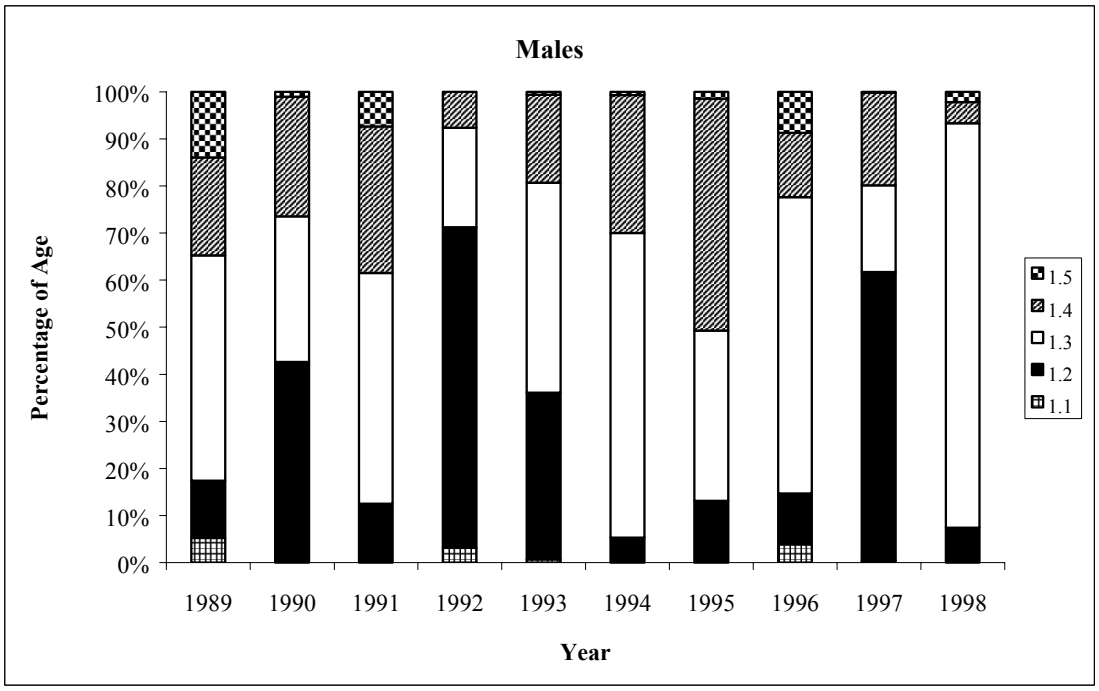


Figure 15.-Length frequency distributions of male and female chinook salmon carcasses sampled on the Chena River, 1998.



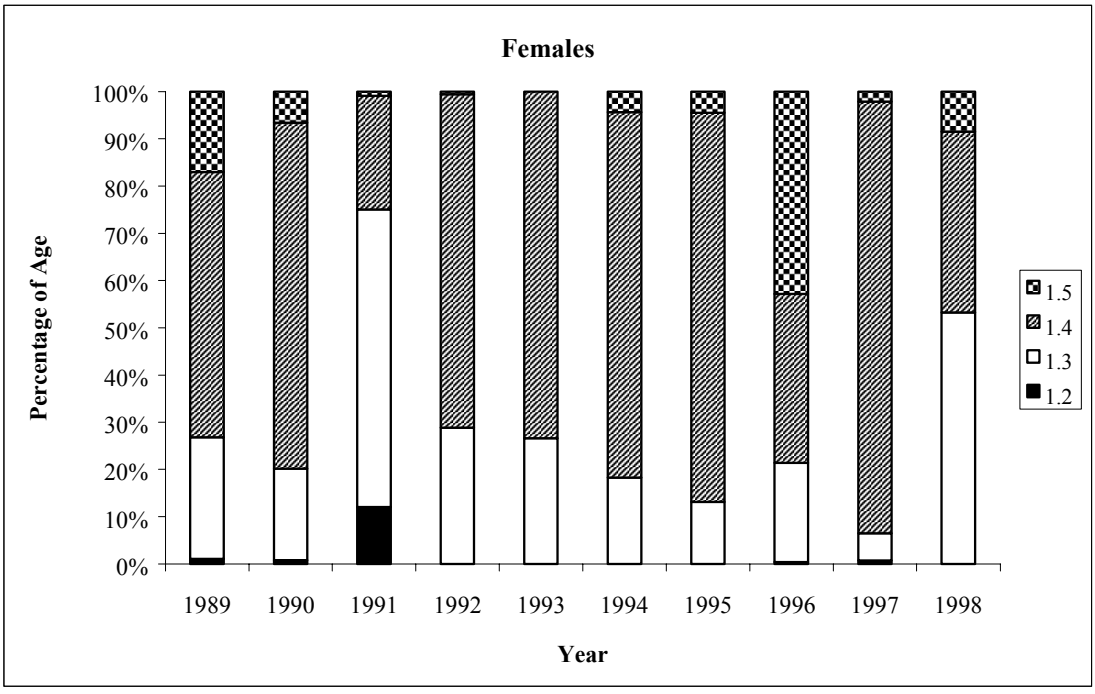


Figure 16.-Age composition of male and female chinook salmon from the Chena River from carcasses sampled during 1989-1998.

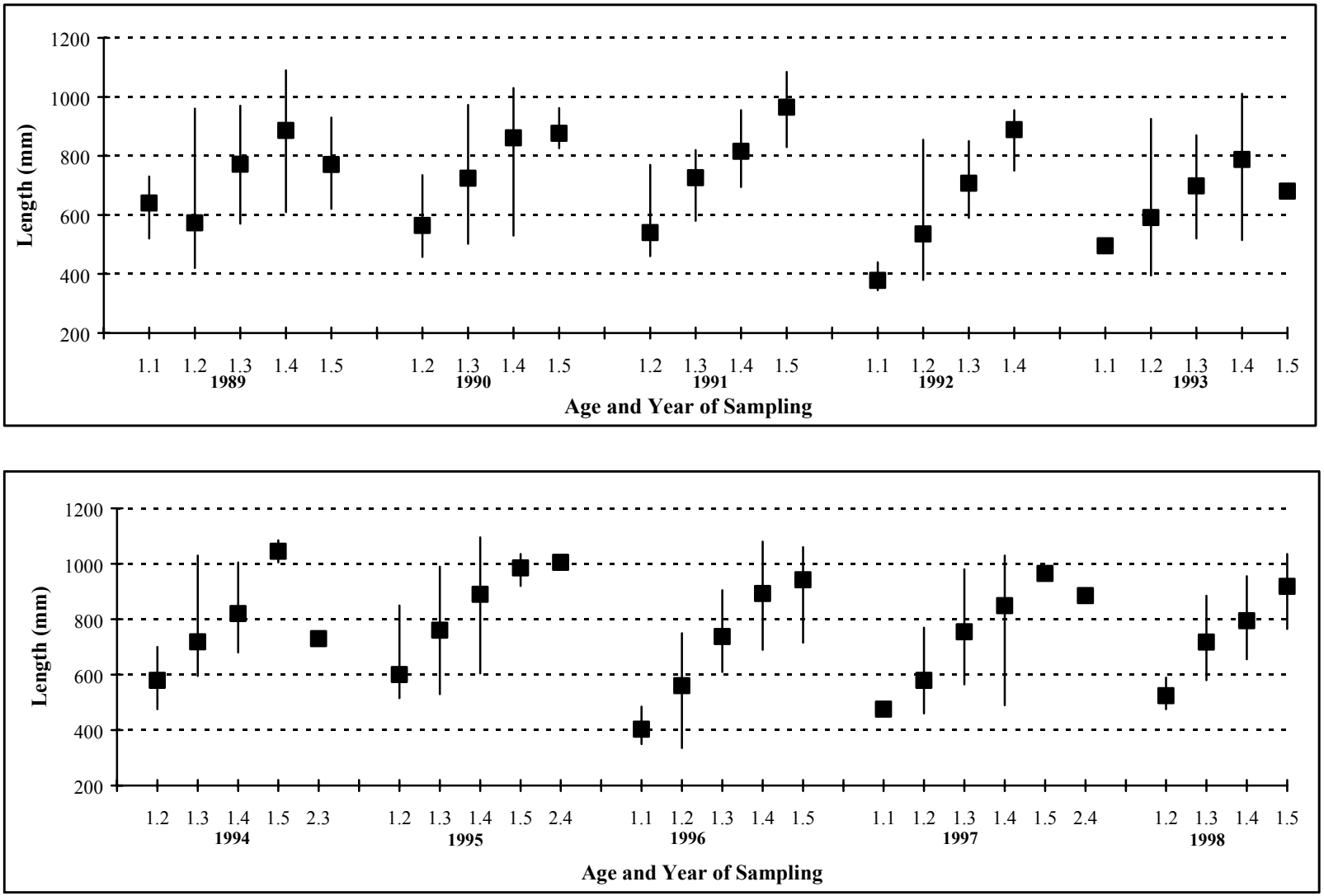


Figure 17.-Average length at age for male chinook salmon sampled from the Chena River from 1989-1998. Error bars represent ranges.

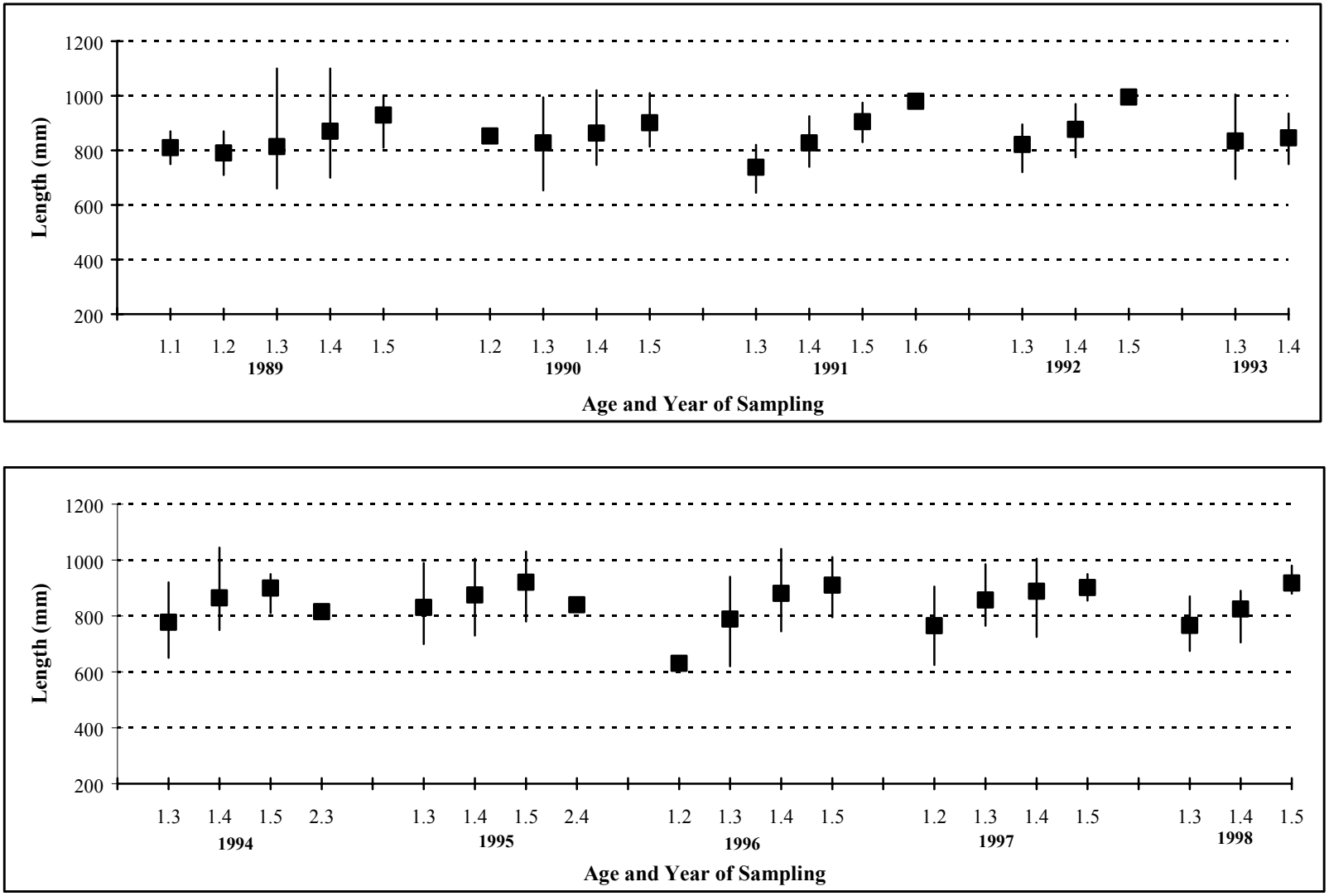


Figure 18.-Average length at age for female chinook salmon sampled from the Chena River from 1989-1998. Error bars represent ranges.

Table 7.-Daily counts and estimates of the number of chum salmon passing by the counting site in the Salcha River, 1998.

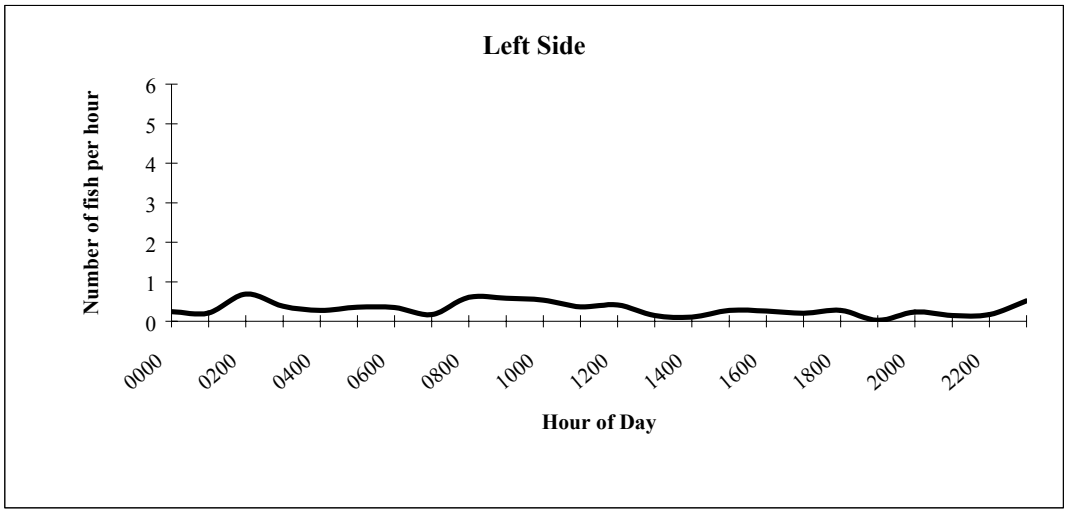
Date	Count Periods	Left Side			Right Side			Total		
		Count	Expanded Count[a]	SE[a]	Count	Expanded Count[a]	SE[a]	Count	Expande Count[a]	SE[a]
26-Jun-98	12	0	0	0	0	0	0	0	0	0
27-Jun-98	16	0	0	0	0	0	0	0	0	0
28-Jun-98	16	0	0	0	0	0	0	0	0	0
29-Jun-98	16	0	0	0	0	0	0	0	0	0
30-Jun-98	16	0	0	0	0	0	0	0	0	0
1-Jul-98	16	0	0	0	0	0	0	0	0	0
2-Jul-98	16	0	0	0	0	0	0	0	0	0
3-Jul-98	24	0	0	0	0	0	0	0	0	0
4-Jul-98	16	0	0	0	0	0	0	0	0	0
5-Jul-98	16	0	0	0	0	0	0	0	0	0
6-Jul-98	24	0	0	0	0	0	0	0	0	0
7-Jul-98	23	0	0	0	1	7	5	1	7	5
8-Jul-98	20	0	0	0	0	0	0	0	0	0
9-Jul-98	0	0	4	9	0	0	0	0	4	9
10-Jul-98	15	1	9	9	0	0	0	1	9	9
11-Jul-98	24	1	6	6	1	6	6	2	12	8
12-Jul-98	16	2	18	15	0	0	0	2	18	15
13-Jul-98	24	2	12	6	4	24	15	6	36	17
14-Jul-98	16	3	27	22	5	45	39	8	72	45
15-Jul-98	16	1	9	9	0	0	0	1	9	9
16-Jul-98	16	3	27	19	5	45	29	8	72	35
17-Jul-98	23	15	99	33	16	120	19	31	219	39
18-Jul-98	13	8	72	51	2	18	14	10	90	53
19-Jul-98	0	0	63	51	0	54	32	0	117	60
20-Jul-98	16	6	54	37	10	90	32	16	144	49
21-Jul-98	22	18	118	36	16	102	26	34	220	44
22-Jul-98	24	53	318	60	35	210	38	88	528	71
23-Jul-98	24	24	144	40	34	204	44	58	348	59
24-Jul-98	0	0	163	40	0	165	69	0	328	79
25-Jul-98	0	0	145	40	0	268	69	0	413	79
26-Jul-98	0	0	77	40	0	585	69	0	662	79
27-Jul-98	8	4	72	35	8	144	69	12	216	78
28-Jul-98	24	8	48	21	86	516	112	94	564	114
29-Jul-98	16	5	45	28	164	1476	281	169	1521	283
30-Jul-98	0	0	148	120	0	936	189	0	1084	224
31-Jul-98	8	14	252	121	22	396	191	36	648	226
1-Aug-98	16	15	135	58	45	405	132	60	540	144
2-Aug-98	14	15	144	45	118	1185	159	133	1329	165
3-Aug-98	24	12	72	19	313	1878	242	325	1950	242
4-Aug-98	24	6	36	9	172	1032	101	178	1068	102
5-Aug-98	24	3	18	8	183	1098	141	186	1116	141
6-Aug-98	24	3	18	12	239	1434	135	242	1452	136
7-Aug-98	24	4	24	9	169	1014	134	173	1038	134
8-Aug-98	24	1	6	9	99	594	107	100	600	107
9-Aug-98	16	1	9	7	94	846	236	95	855	236
Total	726	228	2,392	241	1,841	14,897	653	2,069	**17,289**	**696**

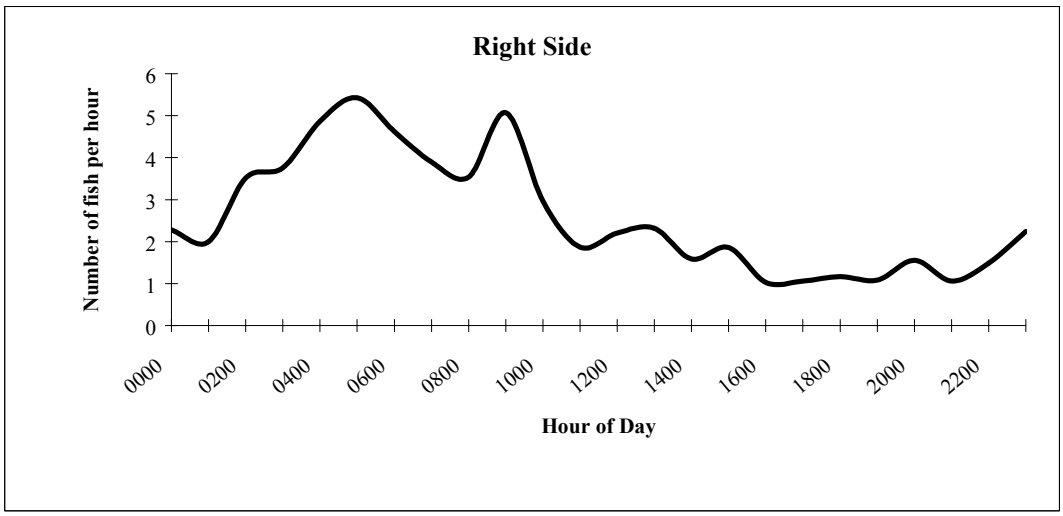
[a] Shaded cells are estimates for days with no counts and for SE, days with only one counting period or less. See Methods section for a description of how estimates for expanded count's and SE's are calculated for these days.

Table 8.-Daily counts and estimates of the number of chum salmon passing by the counting site in the Chena River, 1998.

Date	Count Periods	Left Side			Right Side			Total		
		Count	Expanded Count[a]	SE[a]	Count	Expanded Count[a]	SE[a]	Count	Expanded Count[a]	SE[a]
26-Jun-98	16	0	0	0	0	0	0	0	0	0
27-Jun-98	16	0	0	0	0	0	0	0	0	0
28-Jun-98	16	0	0	0	0	0	0	0	0	0
29-Jun-98	16	0	0	0	0	0	0	0	0	0
30-Jun-98	24	0	0	0	0	0	0	0	0	0
1-Jul-98	24	0	0	0	0	0	0	0	0	0
2-Jul-98	16	0	0	0	0	0	0	0	0	0
3-Jul-98	16	0	0	0	1	9	7	1	9	7
4-Jul-98	16	5	45	32	2	18	14	7	63	35
5-Jul-98	16	0	0	0	0	0	0	0	0	0
6-Jul-98	24	0	0	0	0	0	0	0	0	0
7-Jul-98	24	0	0	0	0	0	0	0	0	0
8-Jul-98	16	0	0	0	0	0	0	0	0	0
9-Jul-98	0	0	6	7	0	0	7	0	6	10
10-Jul-98	0	0	10	7	0	4	7	0	14	10
11-Jul-98	8	1	18	7	0	0	0	1	18	7
12-Jul-98	24	2	12	7	2	12	7	4	24	10
13-Jul-98	24	2	12	7	2	12	7	4	24	10
14-Jul-98	11	1	9	7	1	9	9	2	18	11
15-Jul-98	0	0	29	16	0	5	9	0	33	18
16-Jul-98	24	8	48	16	0	0	0	8	48	16
17-Jul-98	14	5	54	33	0	0	0	5	54	33
18-Jul-98	0	0	27	33	0	0	13	0	27	36
19-Jul-98	8	0	0	0	0	0	0	0	0	0
20-Jul-98	24	21	126	30	3	18	13	24	144	33
21-Jul-98	24	22	132	31	2	12	6	24	144	32
22-Jul-98	16	10	90	29	0	0	0	10	90	29
23-Jul-98	16	9	81	31	1	9	9	10	90	33
24-Jul-98	6	2	48	20	0	0	0	2	48	20
25-Jul-98	0	0	91	63	0	13	94	0	104	113
26-Jul-98	0	0	95	63	0	42	94	0	137	113
27-Jul-98	0	0	98	63	0	65	94	0	163	113
28-Jul-98	0	0	111	63	0	110	94	0	221	113
29-Jul-98	11	5	105	63	5	45	28	10	150	69
30-Jul-98	21	24	151	23	25	161	33	49	312	40
31-Jul-98	24	18	108	24	19	114	54	37	222	59
1-Aug-98	24	24	144	31	39	234	94	63	378	99
2-Aug-98	24	37	222	43	27	162	48	64	384	64
3-Aug-98	24	29	174	49	33	198	23	62	372	54
4-Aug-98	24	43	258	56	58	348	54	101	606	77
5-Aug-98	24	41	246	53	44	264	48	85	510	71
6-Aug-98	24	20	120	38	39	234	46	59	354	60
7-Aug-98	24	9	54	21	28	168	51	37	222	55
8-Aug-98	24	30	180	42	44	264	46	74	444	62
9-Aug-98	24	33	198	42	45	270	79	78	468	89
Total	711	401	3,102	213	420	2,800	267	821	**5,901**	**342**

[a] Shaded cells are estimates for days with no counts and for SE, days with only one counting period or less. See Methods section for a description of how estimates for expanded count's and SE's are calculated for these days.





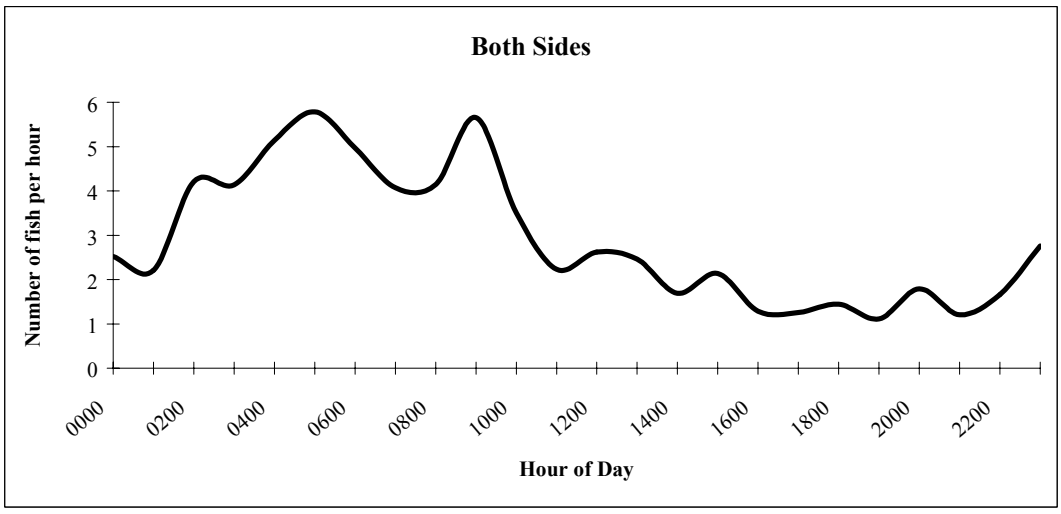
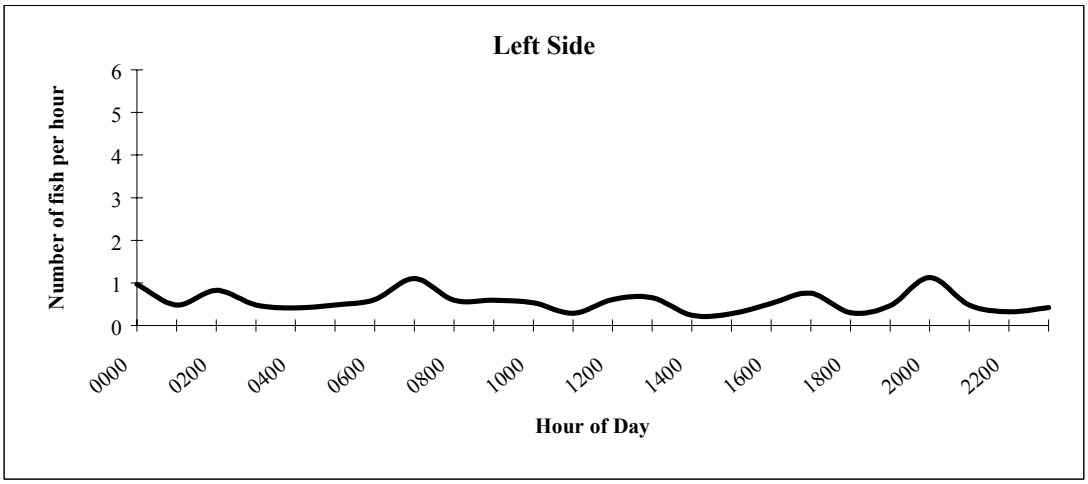
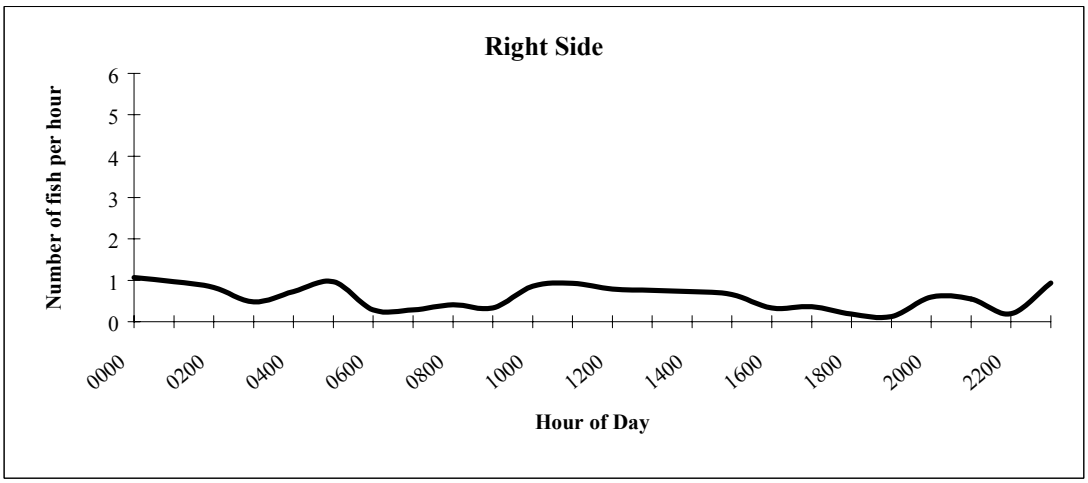


Figure 19.-Average hourly escapement of chum salmon in the Salcha River, 1998.





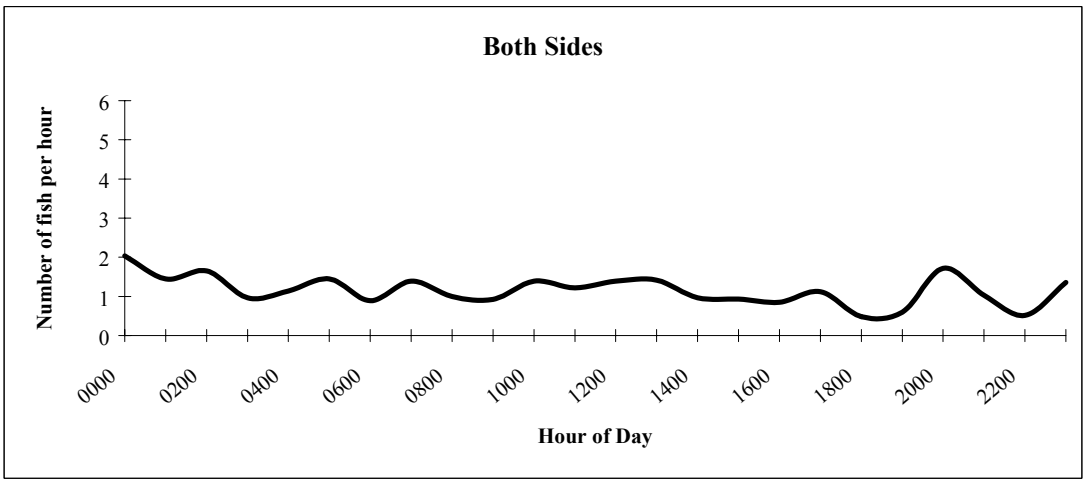


Figure 20.-Average hourly escapement of chum salmon in the Chena River, 1998.

River count represented 0.08 of the tower-counts. Aerial survey escapement goals are 2,500 for the Salcha River and 1,700 for the Chena River. Since 1986, the proportion of the population observed during aerial surveys has ranged from 0.19 to 0.71 of tower/mark-recapture estimates and averaged 0.43 for the Salcha River. For the Chena River, aerial surveys have ranged from 0.08 to 0.59 of tower/mark-recapture estimates and averaged 0.29 (Table 9).

Chatanika River Chinook/Chum Salmon Studies

From 1980-1996, chinook salmon abundance for the Chatanika River was assessed with aerial or boat-counts (Table 10). For 1997, a mark-recapture experiment was performed. This year a tower-count was used to estimate escapement (Table 11). Total escapement of chinook salmon was estimated to be 864 (SE=74). Counts were missed on 9 and 24 July due to high water conditions. The largest daily expanded count of chinook for the Chatanika River was 97 (SE=40) for 26 July. The largest number of chinook salmon to pass during one 20-min count was 8 at 1700 hours on 26 July (Appendix C9). Daily passage of chinook salmon was minimal when counts were terminated on 31 July. On visual inspection, Chatanika River chinook salmon showed no distinct diurnal pattern of passage (Figure 21).

The main objective of the tower-count was to estimate chinook salmon escapement; counting chum salmon was ancillary. Similar to the Salcha and Chena rivers, the tower-count was concluded while the chum salmon were still travelling to their spawning grounds. The estimate of chum salmon from 7 July through 31 July was 663 (SE=100). The largest daily-expanded count of chum salmon was 201 (SE=80) on 31 July (Table 11). The largest number of chum salmon to pass during one 20-minute count was 35 at 2200 hours on 31 July (Appendix C10). Chatanika River chum salmon appear to show a late hour pulse in their diurnal migration pattern (Figure 21). This can be attributed to a single large count of fish on 31 July.

Age-Sex-Length Compositions

A total of 60 chinook salmon carcasses were collected, measured, sex determined and a scale taken for later aging from the study area. Ages were determined for 83% and gender was determined for all fish (Table 12). Of the fish examined, 0.67 were male and 0.33 were female. The majority of males examined were age 1.3 (0.88), while age 1.4 (0.13) was the only other age class in the sample. Females were typically older with the majority age 1.4 (0.44) and 1.3 (0.39). Age 1.5 (0.11) and 1.2 (0.06) were also present in the sample. Male lengths varied from 625 mm to 950 mm (Figure 22). Female lengths varied from 670 mm to 960 mm.

Chatanika River chinook carcasses have been collected since 1995 for determining age, sex, and length compositions. Similar to the Salcha and Chena river populations, Chatanika River chinook have shown length variations between the years (Figure 23). The most common ages sampled for male chinook salmon were 1.2, 1.3, and 1.4 (Figure 24). Mean length at age for age 1.2 has varied from 575 mm in 1995 to 596 mm in 1997. Age 1.3 has varied from 712 mm in 1997 to 775 mm in 1995 and age 1.4 has varied from 740 mm in 1998 to 885 mm in 1995. The most common ages seen for female chinook salmon were 1.3 and 1.2. Mean length at age 1.3 has varied from 685 mm in 1996 to 855 mm in 1995. Age 1.4 has varied from 785 mm in 1998 to 862 mm in 1997.

Table 9.-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 and Chena rivers.

River	Estimated		Aerial Survey		Proportion Observed During
Year	Abundance[a]	SE	Count	Condition[b]	Aerial Survey
Salcha:					
1987	4,771[c]	504	1,898	Fair	0.40
1988	4,562[c]	556	2,761	Good	0.61
1989	3,294[c]	630	2,333	Good	0.71
1990	10,728[c]	1,404	3,744	Good	0.35
1991	5,608[c]	664	2,212	Poor	0.39[d]
1992	7,862[c]	975	1,484	Fair-Poor[e]	0.19
1993	10,007[f]	360	3,636	Fair	0.36
1994	18,399[f]	549	11,823	Good	0.64
1995	13,643[f]	471	3,978	Fair-Good	0.29
1996	7,570[c]	1,238	4,866	Fair-Good	0.64
1997	18,514[f]	1,043	3,458	Poor	0.19
1998	5,027[f]	331	1,992	Poor	0.40
					Avg=0.43
Chena:					
1986	9,065[c]	1,080	2,031	Fair	0.22
1987	6,404[c]	557	1,312	Fair	0.20
1988	3,346[c,g]	556	1,966	Fair-Poor[e]	0.59
1989	2,666[c]	249	1,180	Fair-Good[e]	0.44
1990	5,603[c]	1,164	1,436	Fair-Poor[e]	0.26
1991	3,025[c]	282	1,276	Poor	0.42
1992	5,230[c]	478	825	Fair-Poor[e]	0.16
1993	12,241[f]	387	2,943	Fair	0.24
1994	11,877[f]	479	1,570	Fair-Poor	0.13
1995	9,680[c]	958	3,567	Fair	0.37
1996	7,153[c]	913	2,233	Poor-Good	0.31
1997	10,811[c]	1,160	3,495	Fair-Good	0.32
1997	13,390[f]	699	3,495	Fair-Good	0.26
1998	4,745[f]	503	386	Incomplete	0.08
					Avg=0.29

[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, 1990b, 1992, 1993, and 1994), and Stuby and Evenson (1998).

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

[c] Estimate was obtained from mark-recapture techniques.

[d] Aerial survey conducted before peak spawning.

[e] During these surveys, conditions were judged to vary by area on a scale of "poor, fair, and good".

[f] Estimate was obtained from tower-counts.

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

Table 10.-Aerial survey counts, boat-counts, abundance estimates, and sport harvest and catch estimates of chinook salmon in the Chatanika River, 1980-1998.

Year	Method	Lower[a]	Middle[b]	Upper[c]	Total	Survey Condition	Sport Harvest[d]	Sport Catch[d]
1980	Aerial	NA[e]	NA	NA	37	Fair	37	NE[f]
1981			No Survey				5	NE
1982	Aerial	NA	NA	NA	159	Fair-Good	136	NE
1983			No Survey				147	NE
1984	Aerial	NA	NA	NA	9	Poor	78	NE
1985			No Survey				373	NE
1986	Aerial	NA	NA	NA	79	Fair	0	NE
1987			No Survey				21	NE
1988			No Survey				345	NE
1989	Aerial	NA	NA	NA	75	Fair	231	NE
1990	Aerial	10	46	5	61	Fair-Poor	37	164
1991	Aerial	2	84	18	104	Fair	82	181
1992	Aerial	NC[g]	78	NC[g]	78[h]	Fair	16	31
1993	Aerial	6	46	23	75	Fair	192	625
1993	Boat	NC	253	NC[g]	253[h]	Good	192	625
1994	Aerial	49	NC	NC[g]	372	Fair	105	278
1995	Boat	NC	326	118	444[h]	Fair-Good	58	134
1996	Boat	NC	147	51	198[h]	Fair-Good	499	1,164
1997	M-R	NE	NE	NE	3,809		225	425
1998	Tower	NE	NE	NE	864		NE	NE

[a] Lower section runs from the Trans Alaska Pipeline upstream to the Elliott Highway Bridge.

[b] Middle section runs form the Elliott Highway Bridge upstream to the Steese Highway Bridge.

[c] Upper section runs from the Steese Highway Bridge upstream to the confluence of Faith and McManus Creeks (Figure 3).

[d] Data from Mills (1981-1994) and Howe et al. (1995-1998).

[e] NA = section subtotals are not available.

[f] NE = no estimate is available.

[g] NC = no count was conducted during this survey.

[h] Incomplete survey.

Table 11.-Daily counts and estimates of the number of chinook and chum salmon passing by the counting site in the Chatanika River, 1998.

		Chinook			Chum		
Date	Count Periods	Count	Expanded Count[a]	SE[a]	Count	Expanded Count[a]	SE[a]
7-Jul-98	12	0	0	0	0	0	0
8-Jul-98	5	0	0	0	2	29	15
9-Jul-98	0	0	0	0	0	15	15
10-Jul-98	12	0	0	0	0	0	0
11-Jul-98	16	0	0	0	0	0	0
12-Jul-98	24	0	0	0	3	9	6
13-Jul-98	19	2	6	3	2	7	4
14-Jul-98	20	7	24	10	5	21	9
15-Jul-98	18	6	18	7	0	0	0
16-Jul-98	20	10	30	9	0	0	0
17-Jul-98	24	16	48	16	15	45	12
18-Jul-98	24	21	63	14	10	30	13
19-Jul-98	20	21	78	11	3	9	6
20-Jul-98	20	11	39	12	3	9	5
21-Jul-98	18	14	69	36	2	15	12
22-Jul-98	24	17	51	14	8	24	10
23-Jul-98	16	13	59	13	2	9	7
24-Jul-98	0	0	55	17	0	27	22
25-Jul-98	16	11	50	17	10	45	22
26-Jul-98	15	21	97	40	9	42	21
27-Jul-98	24	12	36	17	6	18	10
28-Jul-98	24	18	54	13	10	30	17
29-Jul-98	24	12	36	6	16	48	20
30-Jul-98	24	14	42	12	10	30	9
31-Jul-98	24	3	9	5	67	201	80
Total	443	229	**864**	**74**	76	**663**	**100**

[a] Shaded cells are estimates for days with no counts and for SE, days with only one counting period or less. See Methods section for a description of how estimates for expanded count's and SE's are calculated for these days.

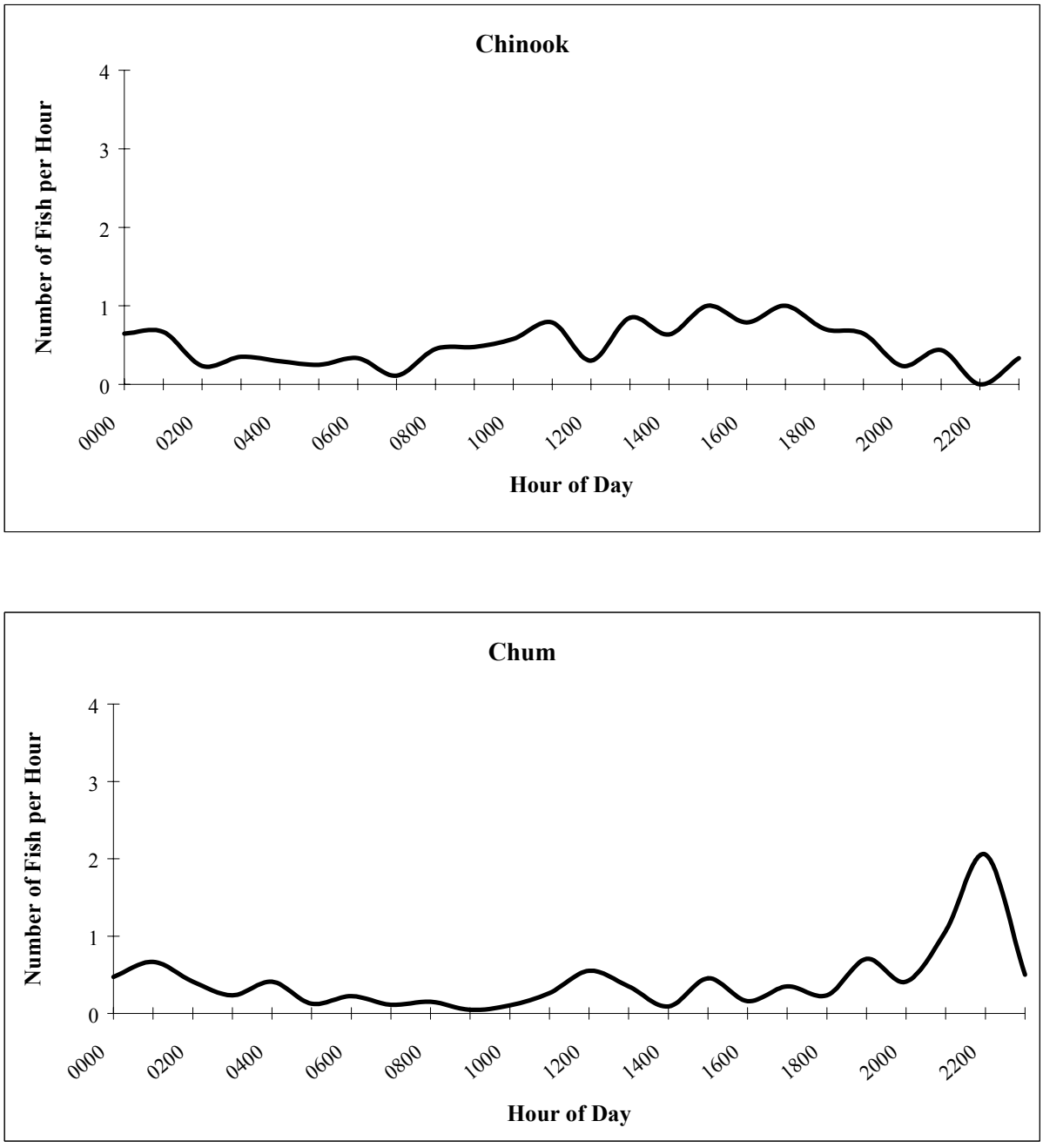


Figure 21.-Average hourly escapement of chinook and chum salmon in the Chatanika River, 1998.

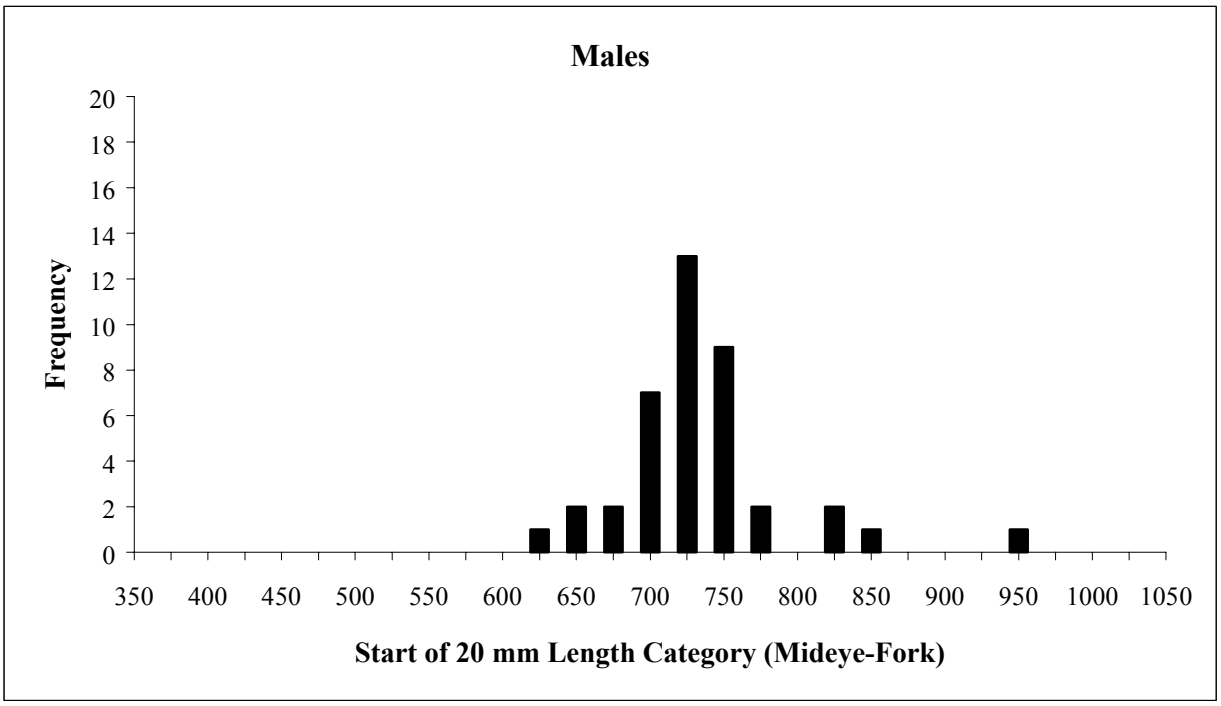
Table 12.-Estimated proportions and mean length by age class of male and female chinook salmon in the Chatanika River, 1998.

		Sample			Length			
	Age[a]	Size	Proportion	SE	Mean	SE	Min	Max
Male	1.3	28	0.88	0.06	720	42	650	830
	1.4	4	0.13	0.06	740	56	690	820
	Total	32	1.00					
Total[b]		40	0.67[c]	0.061[c]	725	55	610	930
Female	1.2	1	0.06	0.06	670	N/A	670	670
	1.3	7	0.39	0.12	755	28	720	785
	1.4	8	0.44	0.12	785	31	740	825
	1.5	2	0.11	0.08	895	92	830	960
	Total	18	1.00					
Total[b]		20	0.33[c]	0.061[c]	783	62	670	960

[a] The notation x.x represents the number of annuli formed during river residence and ocean residence (i.e. an age of 2.4 represents two annuli formed during river residence and four annuli formed during ocean residence

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

[c] Proportion and corresponding SE are based on total number (60) of carcasses sampled.



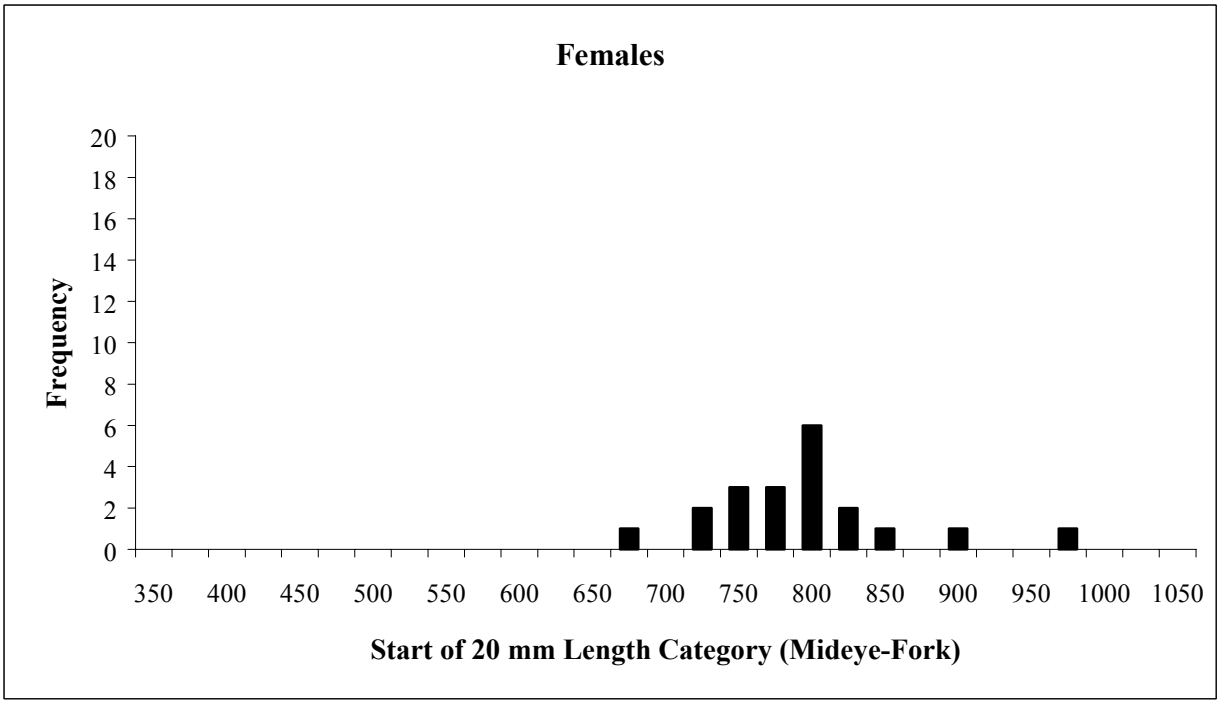


Figure 22.-Length frequency distributions of male and female chinook salmon carcasses sampled on the Chatanika River, 1998.

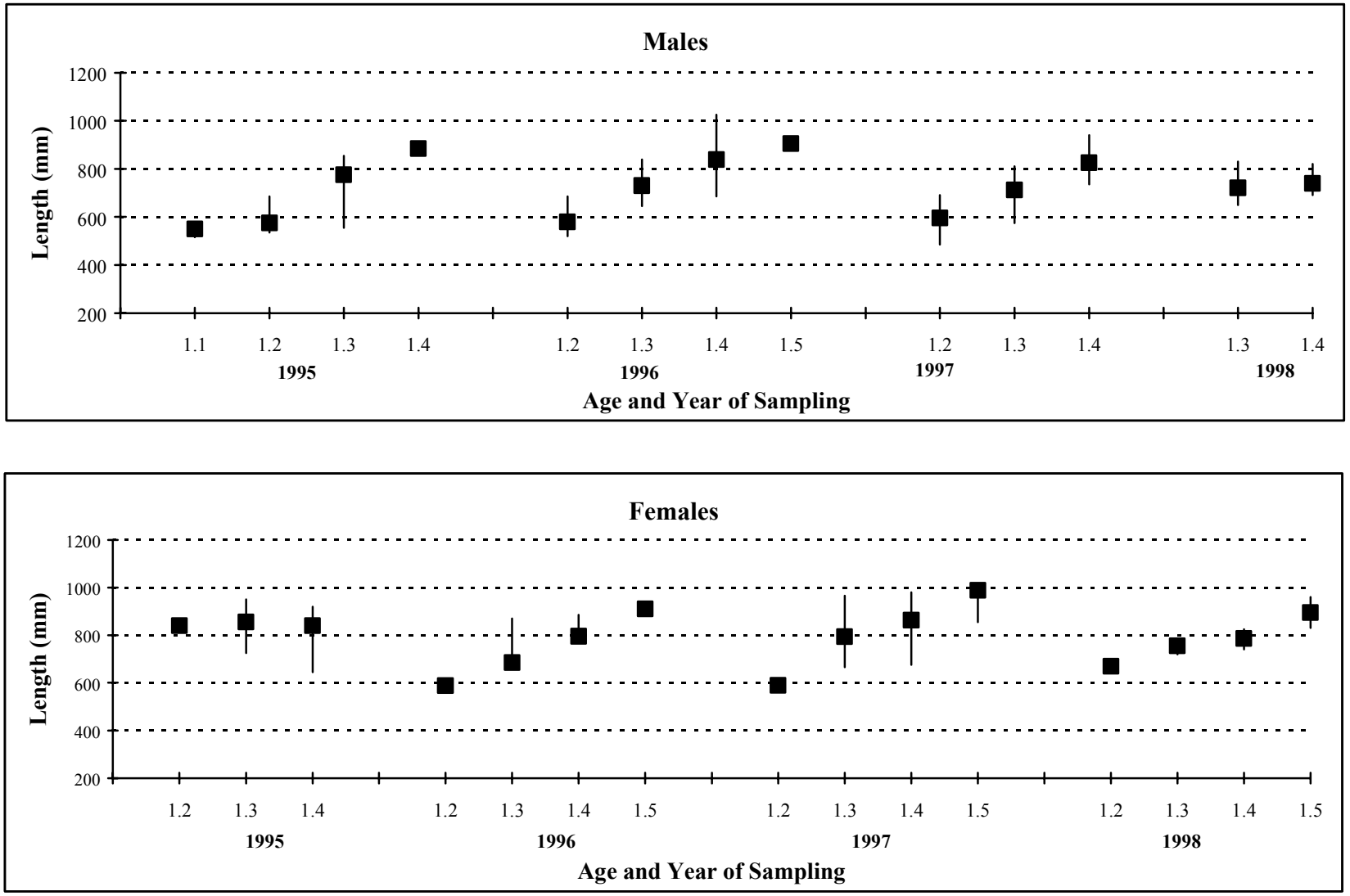


Figure 23.-Average length at age for male and female chinook salmon sampled from the Chatanika River during 1995-1998. Error bars represent ranges.

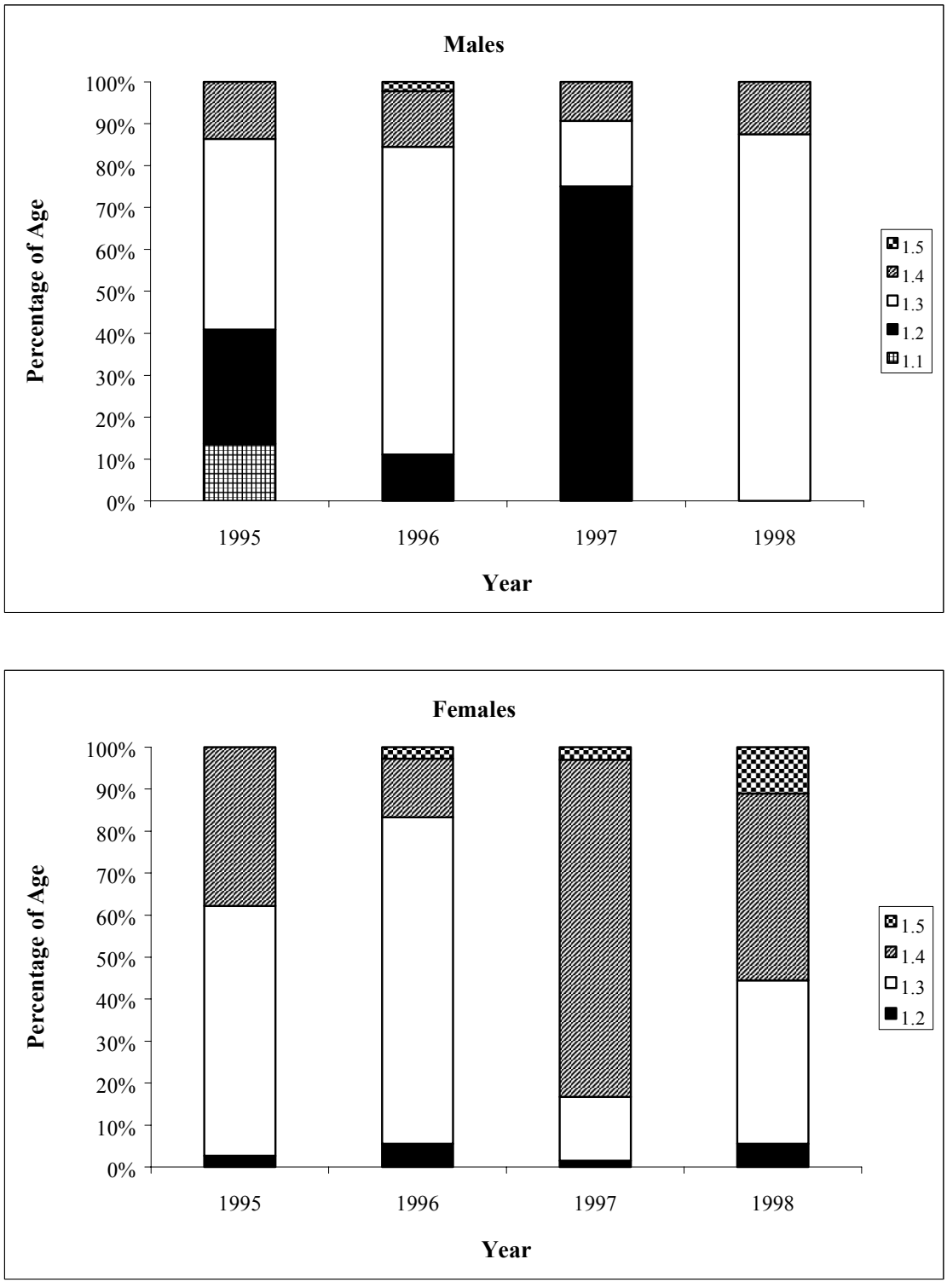


Figure 24.-Age composition of male and female chinook salmon from the Chatanika River from carcasses sampled from 1995-1998.

DISCUSSION

Tower-count methodology has been used for six consecutive years as a means of estimating daily and seasonal abundance of chinook salmon for the Salcha and Chena rivers. Tower-counts offer a few advantages over mark-recapture techniques and aerial surveys. For one, tower-counts are an on-going process throughout the salmon run. Thus, they provide in-season information that can be used by fishery managers to help regulate harvest on the fisheries. Based on historical run-timing data shown in Figures 6 and 13, managers can predict when a salmon run is due to reach a particular percentage mark. Based on timing and escapement, a manager can take measures to increase or decrease harvest. For example, the sport fishing bag limit was increased by emergency order regulation from one to two chinook salmon per day in 1993 and 1994 as a result of large, early escapements. In 1998, due to poor escapement into the Salcha and Chena rivers by what should have been the 50% mark of at least the minimum objective, the chinook salmon fisheries on the three rivers were restricted to catch-and release only on 14 July for the duration of the 1998 season.

Aerial surveys offer managers the ability to manage in-season and are usually less expensive than tower-counts. Aerial counts conducted during peak escapements can be used as an index of total escapement. However aerial surveys are dependent on weather and water visibility, and in these systems do not appear to provide a consistent index of abundance. Also, aerial survey estimates tend to be much lower than both tower and mark-recapture estimates with good visibility.

The precision of the estimates obtained from the tower-counts has been substantially better than the precision of mark-recapture estimates obtained from prior years. However, this precision may be misleading. The variance estimator assumes that during a count all salmon that pass over the panels are correctly identified and counted. Counting errors have been apparent during past tower-count estimates. During the 1996 season, duplicate counts with two counters showed small discrepancies between counters (Evenson and Stuby 1997). Although these discrepancies appear to be slight in magnitude, the cumulative effect on the overall estimates of abundance and variance may be significant over time. Some of the errors may result from poor visibility as a result of adverse weather and/or water conditions, fish passing through a poorly illuminated portion of the panels, more than one group passing at a time, counter fatigue during the late evening/early morning shifts, and different experience levels of the counters in differentiating chum from chinook salmon. The bias resulting from fish not seen passing over the panels is negative and therefore makes the estimates conservative. The extent of the counting errors resulting from misidentification is unknown and could potentially over or under-bias the estimate. Another drawback to the tower-count method is that it can only be assumed that a representative carcass sample is being taken to estimate age-sex-length compositions.

Mark-recapture techniques allow for the detection and possible correction of some of the tower-count biases. However, mark-recapture experiments can also show bias. The past 13 mark-recapture experiments in the Salcha and Chena rivers have shown that size and sex composition estimates were biased during four experiments. For example, during 1992, size composition was biased, however this bias was not substantial enough to alter the estimated abundance and was thus not considered biologically significant (Evenson 1993). The extent of the bias associated with sex compositions in terms of its affect on estimates of population proportions is not known.

The greatest limitation of tower-counting methodology is that it requires low water conditions (good visibility) for most of the run. High water events persisting for more than two days add a great deal of uncertainty to the estimate, especially during peak portions of the runs. Six days of counting were missed in 1998 for the Salcha River due to high, murky water. In addition, for two days only one counting shift was conducted due to poor visibility. Of the six total attempted tower-count estimates performed for the Salcha River, five were successful. For the Chena River, eight days were missed and only one shift was counted for three days. Of the six total attempted tower-count estimates performed for the Salcha River, four were successful. For those years when a total estimate of escapement cannot be generated from tower-counts, the daily estimates can still be used for in-season management purposes, especially during the early portion of the run. If estimating total escapement remains an objective, then mark-recapture experiments should continue to be planned as a back-up means of estimating total escapement.

Mark-recapture techniques should, however, be considered a secondary means of estimating escapement. The marking event occurs late into the run at the end of the chinook fishery. Without the tower-counts, managers would have to rely on aerial survey estimates to provide in-season escapement information. Also, in order for the experiment to be successful, a large sample relative to population size needs to be examined. During a 1997 mark-recapture study in the Chatanika River, insufficient sample size and sex selective sampling led to an abundance estimate with a large standard error (Stuby and Evenson, 1998). Due to the relatively large exploitation of chinook salmon in the Chatanika River, a precise estimate is especially important for managing this stock.

Mark-recapture experiments likely do not provide a total estimate of escapement for the Chena and Salcha rivers because spawning occurs in areas upstream from the upper boundaries of the study areas, whereas tower-count estimates are considered total estimates. In 1997 a tower-count and mark-recapture experiment were successfully conducted on the Chena River (Stuby and Evenson, 1998). Although the Chena River tower-count estimate for total escapement of chinook salmon was 24% higher than the mark-recapture estimate, the difference was not significant given the precision for each estimate.

Due to inclement weather and relatively small escapements, target sample sizes were not achieved on the three rivers in 1998. The large proportion of males in this sample compared to previous years may have been a result of timing of the carcass sampling. The run-timing figures show, especially for the Chena River, the run arriving a few days later than in the past (Figures 6 and 13). Also, most of the carcass sampling was conducted in the first week with high water not allowing for much sampling during the second week.

COHO SALMON STUDY IN THE DELTA CLEARWATER RIVER

INTRODUCTION

The Delta Clearwater River has the largest known coho salmon escapements in the Yukon River drainage (Parker 1991). The river is a spring-fed tributary to the Tanana River located near Delta Junction about 160 km southeast of Fairbanks (Figure 25). The main river spans 32 km, with a 10-km north fork. There are a number of small, shallow spring areas adjacent to the mainstream river. Spawning occurs throughout the mainstream river and in the spring areas. The river supports a popular fall sport fishery. Annual harvests exceeded 1,000 coho salmon from 1986-1991. In recent years catch has been high, but harvest relatively low (Mills 1979-1994; Howe et al. 1995 -1998; Table 13). Before reaching spawning grounds, the coho salmon travel about 1,700 km from the ocean and pass through six different commercial fishing districts in the Yukon and Tanana rivers (Figure 4). Subsistence and personal use fishing also occur in each district.

Escapements of coho salmon into the Delta Clearwater River have been historically monitored by counting fish from a drifting riverboat (Parker 1991). In recent years aerial surveys have been conducted to estimate escapement into non-boatable portions of the river (Evenson 1994). This information has been used to evaluate management of the commercial, subsistence, and personal use fisheries, and is also used to regulate the harvest of coho salmon in the Delta Clearwater River sport fishery by opening and closing the season and changing the bag limit. The daily bag and possession limit is three coho salmon. The Alaska Department of Fish and Game has established a biological escapement goal of 9,000 coho salmon for the Delta Clearwater River. When counts indicate that the goal may not be achieved, the bag limit is reduced or the fishery is closed. If the count exceeds the minimum escapement, the bag limit may be increased. The objectives of the coho salmon escapement project for the Delta Clearwater River in 1998 were:

1. count coho salmon from a drifting riverboat at approximately weekly intervals throughout the run, and estimate total escapement through a combination of boat-counts and aerial surveys; and,
2. estimate age, sex, and length compositions of the escapement.

METHODS

Counts

Adult coho salmon were counted from a drifting riverboat equipped with an observation platform elevated 2 m above the water. The Delta Clearwater River was divided into 1.6-km (1-mi.) sections and fish were counted by section (Figure 25). The sections were numbered from the mouth (mile 0) upstream. Many coho salmon spawn in shallow spring areas adjacent to the mainstream river. Prior to 1994, these areas were not included in the surveys. To determine the proportion of fish that spawn in these areas relative to the main river, an aerial survey was conducted using a Robertson (R22) helicopter flying at approximately 100 m above ground level.

Age-Sex-Length Compositions

Coho salmon carcasses were collected from river kilometer 24 (mile 15) to 14 (mile 9) on 18 November. Collection took place from a drifting riverboat using long handled spears. Length

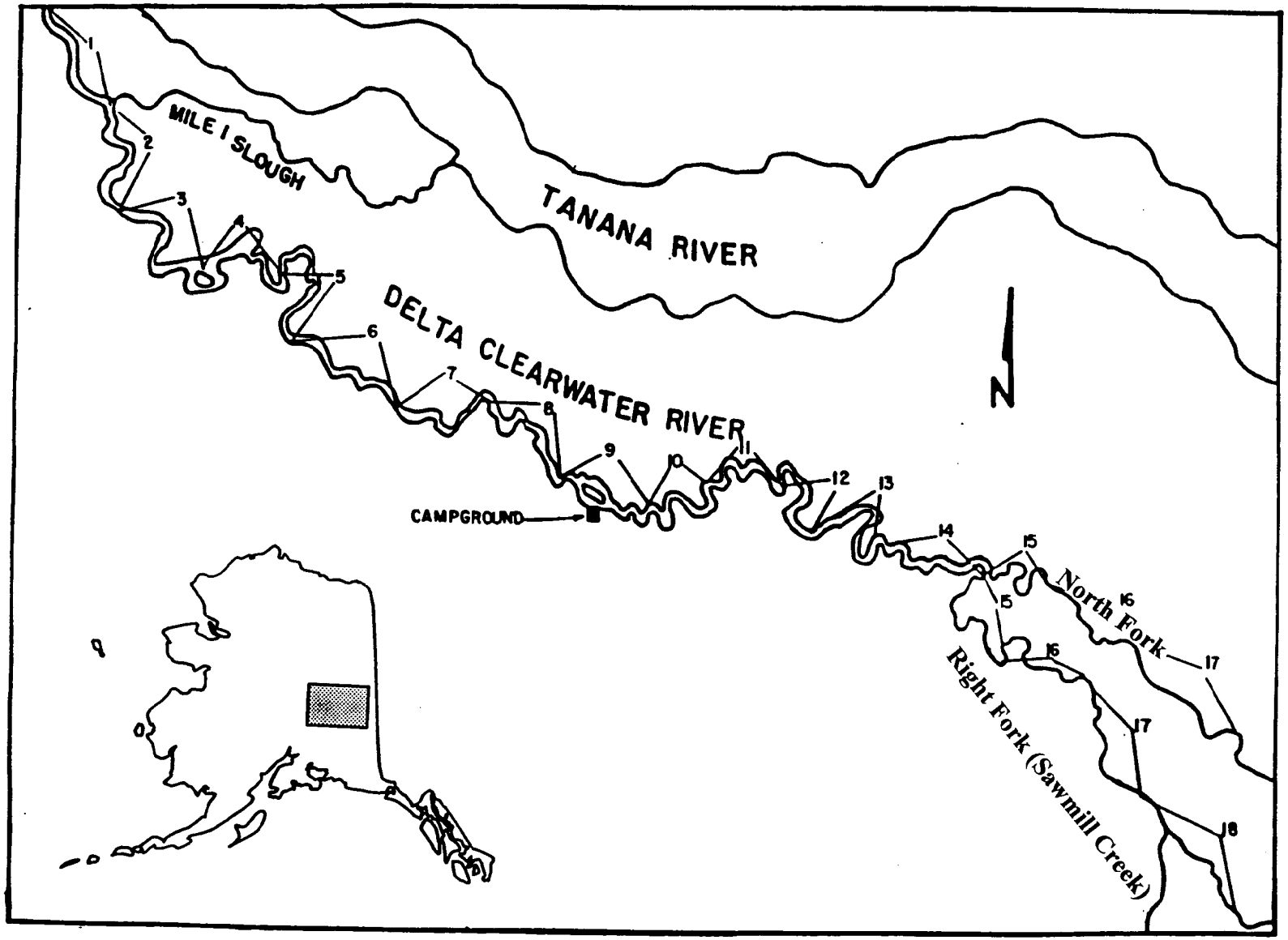


Figure 25.-Delta Clearwater River study area.

Table 13.-Peak escapements, harvests, and catch of coho salmon in the Delta Clearwater River from boat surveys conducted from 1972-1998.

	Peak Escapement Counts							
Year	Survey Date	Lower River[a]	Upper River[b]	Spring Areas	Total[c]	Previous 5 yr Avg.	Sport Harvest[d]	Sport Catch[d]
1972	9 Nov	NA[e]	NA	NA	632		NA	NA
1973	20 Oct	NA	NA	NA	3,322		NA	NA
1974	NA	NA	NA	NA	3,954[f]		NA	NA
1975	24 Oct	NA	NA	NA	5,100		NA	NA
1976	22 Oct	NA	NA	NA	1,920		NA	NA
1977	25 Oct	2,331	2,462	NA	4,793	2,986	31	NA
1978	26 Oct	2,470	2,328	NA	4,798	3,818	126	NA
1979	23 Oct	3,407	5,563	NA	8,970	4,113	0	NA
1980	28 Oct	2,206	1,740	NA	3,946	5,116	25	NA
1981	21 Oct	4,110	4,453	NA	8,563[g]	4,885	45	NA
1982	3 Nov	4,015	4,350	NA	8,365[g]	6,214	21	NA
1983	25 Oct	3,849	4,170	NA	8,019[g]	6,928	63	NA
1984	6 Nov	5,434	5,627	NA	11,061	7,573	571	NA
1985	13 Nov	NA	NA	NA	6,842[f]	7,991	722	NA
1986	21 Oct	5,490	5,367	NA	10,857	8,570	1,005	NA
1987	27 Oct	11,700	10,600	NA	22,300	9,029	1,068	NA
1988	28 Oct	5,300	16,300	NA	21,600	11,816	1,291	NA
1989	25 Oct	5,400	7,200	NA	12,600	14,532	1,049	NA
1990	26 Oct	4,525	3,800	NA	8,325	14,840	1,375	3,271
1991	23 Oct	11,525	12,375	NA	23,900	15,136	1,721	4,382
1992	26 Oct	1,118	2,845	NA	3,963	17,745	615	1,555
1993	21 Oct	3,425	7,450	NA	10,875	14,078	48	1,695
1994	24 Oct	19,450	43,225	17,565[h]	80,240[i]	11,933	509	3,009
1995	23 Oct	7,850	12,250	6,283[h]	26,383[i]	25,461	391	5,195
1996	29 Oct	4,000	10,075	3,300[h]	17,375[i]	29,072	983	2,543
1997	24 Oct	4,975	6,550	2,375[h]	13,900[i]	27,767	866	4,174
1998	20 Oct	7,700	3,400	2,775[h]	13,875[i]	29,755	NA[e]	NA[e]

[a] Mile 0 to Mile 8.

[b] Mile 8 to Mile 17.5.

[c] Boat survey by Alaska Department of Fish and Game, Division of Sport Fish unless otherwise noted.

[d] Data were obtained from Mills (1979-1994) and Howe et al. (1995-1998).

[e] Data are not available.

[f] Survey by Alaska Department of Fish and Game, Commercial Fisheries Division.

[g] Mark-recapture population estimate.

[h] Helicopter Survey by Alaska Department of Fish and Game, Division of Sport Fish.

[i] Combination of boat survey and helicopter survey.

was measured from mid-eye to fork-of-tail to the nearest 5 mm. Sex was determined from observation of body morphology, by extruding gametes from live fish, or by cutting into the body cavity of carcasses to examine the gonads. Three scales were removed from the left side 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 for age determination (Scarnecchia 1979). Scale impressions were later made on acetate cards and viewed at 100X magnification using equipment similar to that described by Ryan and Christie (1976). Ages were determined from scale patterns as described by Mosher (1969). The proportions of the population represented by combinations of age and sex were estimated using Equations 12 and 13. Mean lengths were estimated for combinations of age and sex using the sample mean and variance (Zar 1984).

RESULTS

Counts

An aerial survey of the Delta Clearwater River was conducted on 21 October from river mile 0 to 17.5, including tributaries. A total of 2,775 were counted in the tributaries (Table 14). A boat survey of the mainstem river was conducted on 20 October. A total of 11,100 fish were counted during this survey. Coho salmon were distributed throughout the entire stretch in densities varying from 75 to 1,400 fish per mile during the boat survey (Table 14). Counts for individual spring areas ranged from 0 to 675 (Table 15). Weather conditions for the aerial survey were overcast, but visibility was good. Yet, visibility for the boat survey was thought to be better because overhanging vegetation blocked the near-bank areas from the air. Thus, the boat-count was used as the estimate for the mainstem river and the aerial survey of the tributaries was added to this count to determine total escapement. The total escapement was estimated to be 13,875 coho salmon. The tributaries comprised 0.20 of this count.

Age-Sex-Length Compositions

Two hundred twenty-one coho salmon carcasses were collected, measured and scales were taken for later aging. Males comprised 0.49 and females 0.51 of the collected coho salmon carcasses. Ages were determined for 0.90 of the sample. Most of the males and females were age 2.1 (0.94 and 0.90 respectively). To a much lesser degree, 0.04 of males and 0.05 of females were age 1.1 and 0.03 of males and 0.04 of females were age 3.1 (Table 16). Males varied over a larger length range (410-650 mm) than females (500-640 mm) for all coho salmon sampled (Figure 26).

Delta Clearwater coho salmon carcasses have been collected by Region III Division of Sport Fish since 1990. This population has shown length variations between the years (Figure 27). For males, age 1.1 coho salmon have varied from an average of 523 mm to 574 mm and females have varied from 549 mm to 583 mm. The most common age sampled for coho salmon over the years was 2.1 (Figure 28). Male fish varied from 523 mm to 574 mm and females ranged from 550 mm to 578 mm for age 2.1 (Figure 27).

DISCUSSION

Escapement survey counts for 1998 were lower than the previous five-year average, but still well in excess of the minimum escapement goal of 9,000 salmon. The reasons for this moderate escapement are not known. The 1994 parent year, from which most of this escapement originated, was the strongest on record (Table 13). For those years such as 1992 when the

Table 14.-Counts of adult coho salmon in the Delta Clearwater River, 1998.

	Mainstem River (Boat Survey)	Mainstem River (Aerial Survey)
River Mile	Count (20 Oct)	Count (21 Oct)
17.5-16	450	N/A
16-15	825	N/A
15-14	975	N/A
14-13	1,250	N/A
13-12	850	N/A
12-11	700	N/A
11-10	1,400	N/A
10-9	825	N/A
9-8	425	N/A
8-7	400	N/A
7-6	75	N/A
6-5	900	N/A
5-4	250	N/A
4-3	650	N/A
3-2	75	N/A
2-1	925	N/A
1-0	125	N/A
Summary		
17.5-8	7,700	N/A
8-0	3,400	N/A
14-0	8,850	N/A
17.5-0	**11,100**	N/A
Tributaries	N/A	**2,775**
Clearwater Lake Inlet	N/A	350
Clearwater Lake Outlet	2,775	N/A
	Total Count (i.e. boat-count of mainstream and aerial survey of tributaties)	**13,875**

Table 15.-Aerial survey counts of adult coho salmon in spring areas of the Delta Clearwater River, 1998.

Nonboatable Portion (Aerial Survey)		
Name of Spring	Count (22 Oct)	Description of Location
Sawmill Creek	375	Headwaters to Richard Lake
Andersen	0	South Spring into Sawmill
Granite	50	Headwaters to Sawmill
South Clearwater	575	Headwaters to Reed Lake
Middle Clearwater	225	Headwaters to Reed Lake
Peckham	0	Spring on north side of Clearwater Creek.
Clearwater-Section 1	250	Including Reed Lake, to Peckham
Clearwater-Section 2	675	Peckham to confluence of Sawmill Creek.
Fronty	0	First spring below Granite-South Side
Jan	0	Between Fronty and Jesse
Jesse	25	South side of Sawmill Creek
Jennie	0	North side-near mouth of CH20-DCR
Chad	0	South side of Delta Clearwater River
Buns	0	South side of Delta Clearwater River
Patty	0	North side of Delta Clearwater River
Dave	0	North side of Delta Clearwater River
Travis	0	North side of Delta Clearwater River
Dubois	0	South side of Delta Clearwater River
Christie	125	North side of Delta Clearwater River
Caleb	75	North side of DCR across from camp
Isaac's Slough	125	Between Caleb and Parker-north side
Parker	0	North side of Delta Clearwater River
Kenna	50	North side of Delta Clearwater River
Dos Gris	0	South side of DCR (Gartz)
Remmington	100	South side of DCR (lodge)
Barb	0	North side of Delta Clearwater River
Backy	0	South side of DCR (Forck)
Ridder	25	North side of Delta Clearwater River
Pearse	50	South side of DCR connects at mile 3
Hodges	25	North side of Delta Clearwater River
Stuga	0	South side of DCR (Al Svenston)
Salmon Alley	25	Loop of north side of DCR
Mallard	0	North side of DCR, above mile one

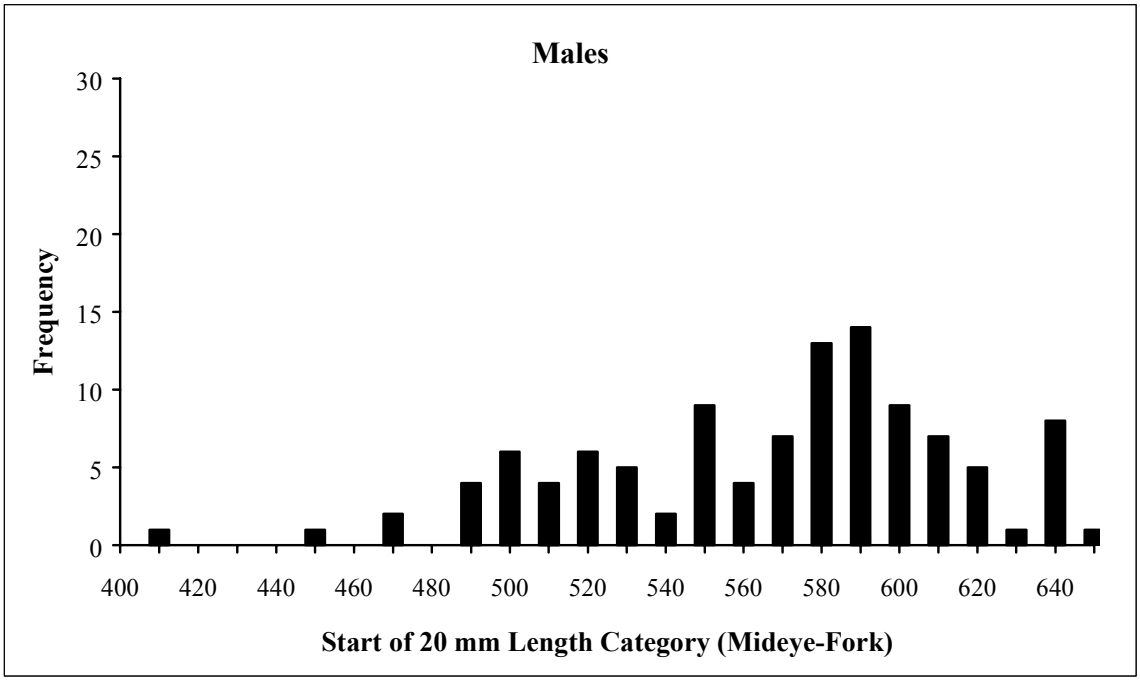
Table 16.-Statistics by age and sex for coho salmon carcasses collected from the Delta Clearwater River, 1998.

		Sample			Length			
	Age[a]	Size	Proportion	SE	Mean	SE	Min	Max
Male	1.1	4	0.04	0.02	543	50	490	595
	2.1	94	0.93	0.03	565	48	405	645
	3.1	3	0.03	0.02	580	18	565	600
	Total	101	1.00					
Total[b]		109	0.49	0.03	564	47	405	645
Female								
	1.1	5	0.05	0.02	580	18	555	605
	2.1	90	0.91	0.03	573	30	500	640
	3.1	4	0.04	0.02	593	34	565	640
	Total	99	1.00					
Total [b]		112	0.51	0.03	575	69	500	640

[a] The notation X.X represents the number of annuli formed during river residence and ocean residence (i.e. an age of 2.1 represents two annuli formed during river residence and one annuli formed during ocean residence

[b] Totals include those coho salmon that could not be aged.

[c] Proportion and corresponding SE are based on total number (221) of carcasses sampled.



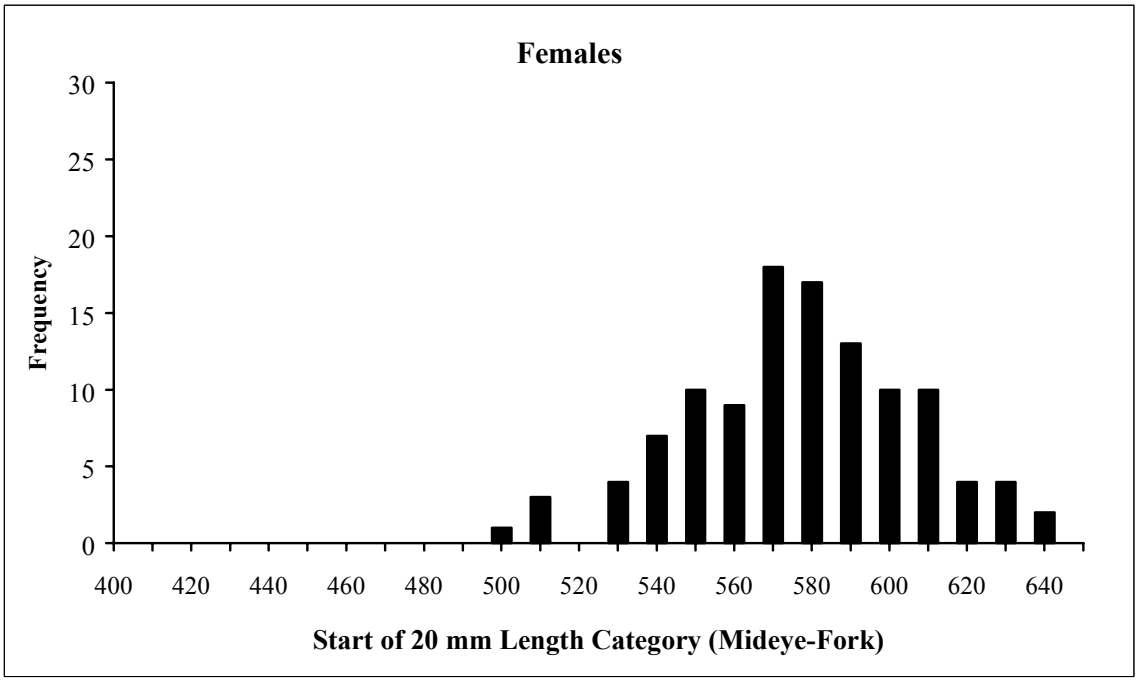


Figure 26.-Length frequency distributions of male and female coho salmon collected in the Delta Clearwater River, 1998.

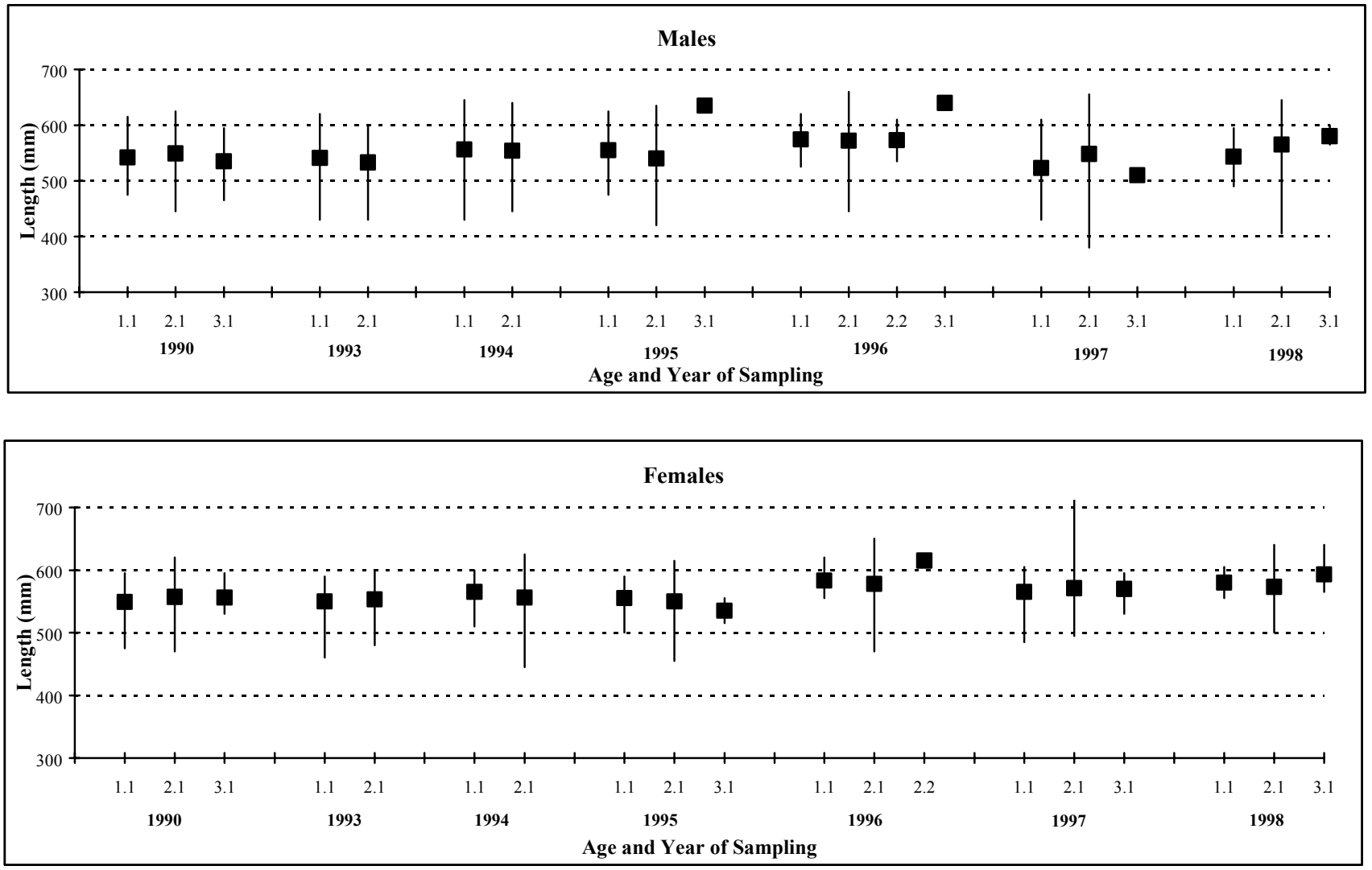
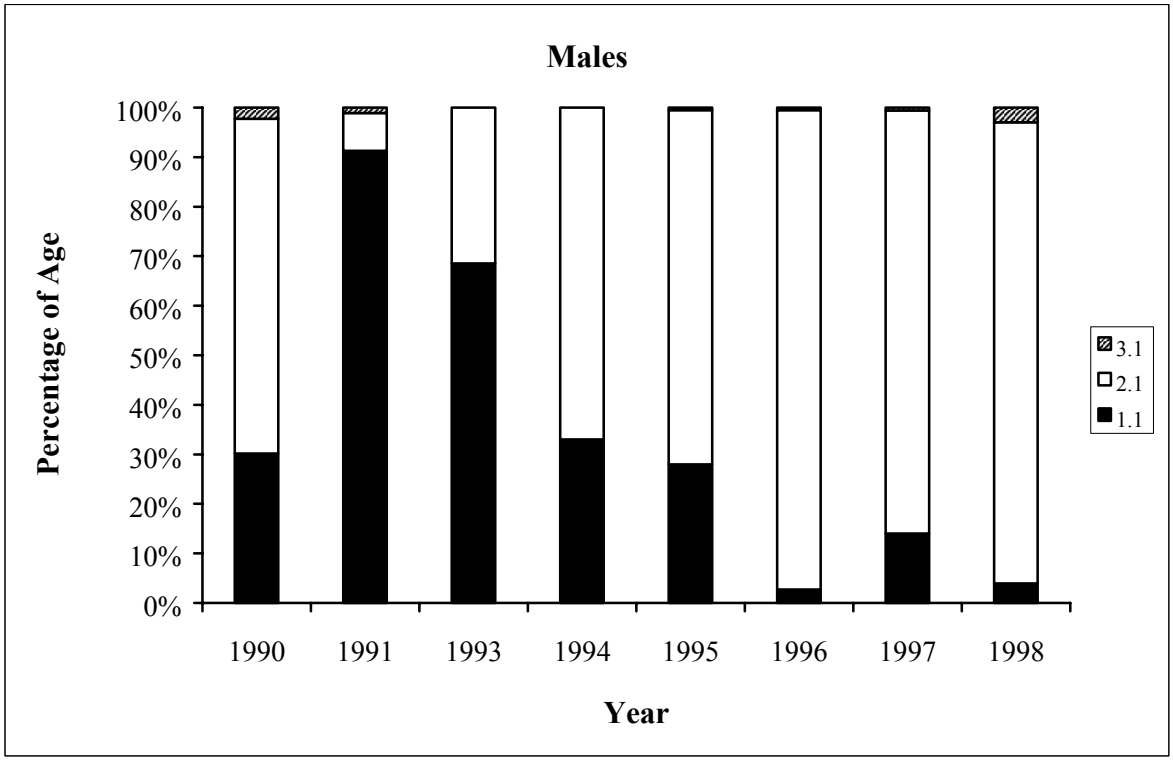


Figure 27.-Average length at age for male and female coho salmon sampled from the Delta Clearwater River from 1990-1998. Error bars represent ranges. Lengths for 1991 and 1992 are not available.



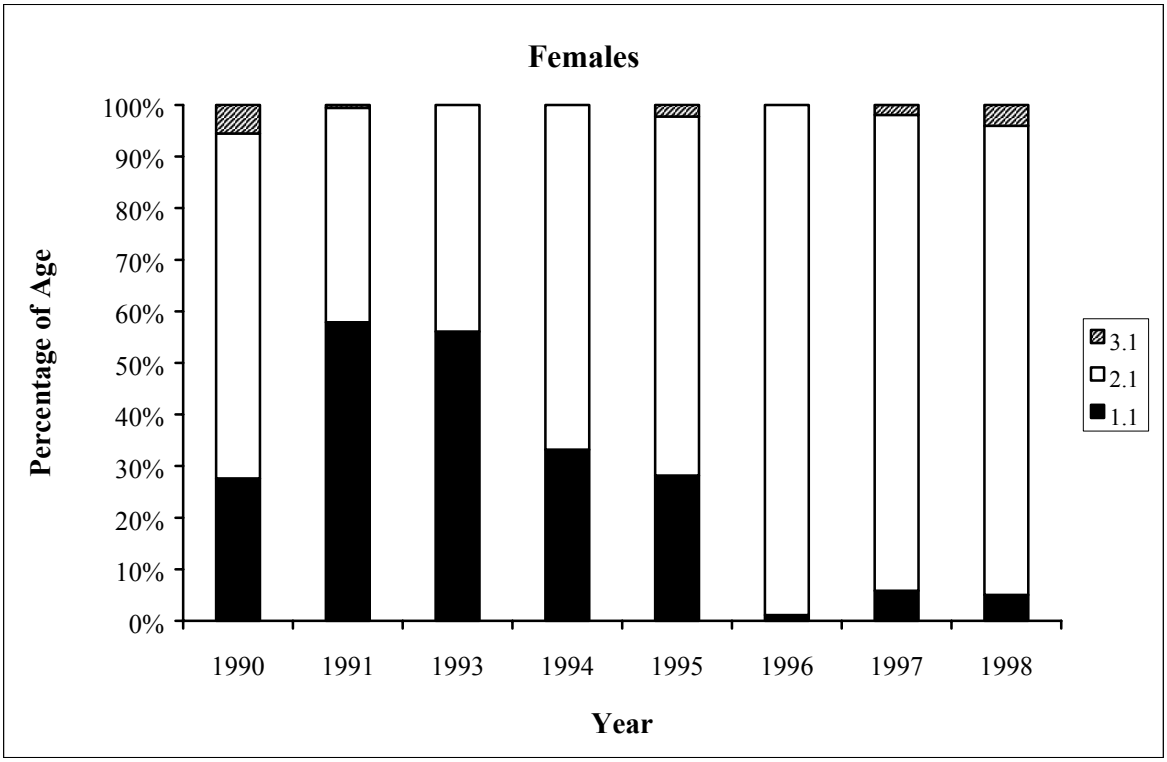


Figure 28.-Age composition of male and female coho salmon from the Delta Clearwater River from carcasses sampled from 1990-1998. Values for 1992 are not available.

escapement goal was not met, the sport fishery can be closed. For large abundance years which has recently been the case, modifying sport fishing bag limits would likely be of little consequence since most of the coho salmon are caught and then released. Thus, few fish are actually harvested and increasing the bag and possession limit would probably have little effect.

This year (1998) was the fifth year that aerial surveys were conducted to count the number of coho salmon in the non-boatable waters adjacent to the mainstream river. The proportion of fish spawning in tributaries was similar for all years (0.22, 0.24, 0.19, 0.17, and 0.20 respectively). Thus, even though boat-counts have been primarily used in the past to enumerate coho salmon escapement in the main river channel, aerial counts of the tributaries make a significant contribution to the overall estimate.

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LITERATURE CITED

Baker, T. T. 1988. Creel censuses in interior Alaska in 1987. Alaska Department of Fish and Game, Fishery Data Series No. 64, Juneau.

Baker, T. T. 1989. Creel censuses in interior Alaska in 1988. Alaska Department of Fish and Game, Fishery Data Series No 95, Juneau.

Barton, L. H. 1987a. Population estimate of chinook salmon escapement in the Chena River in 1986 based upon mark and recapture techniques. Alaska Department of Fish and Game, Division of Commercial Fisheries, Fairbanks. Arctic, Yukon, and Kuskokwim Region, Yukon River Salmon Escapement Report No. 31.

Barton, L. H. 1987b. Yukon area salmon escapement aerial survey manual. Alaska Department of Fish and Game, Division of Commercial Fisheries, Fairbanks. Arctic, Yukon, and Kuskokwim Region, Yukon River Salmon Escapement Report No. 33.

Barton, L. H. 1988. Population estimate of chinook salmon escapement in the Chena River in 1987 based upon mark and recapture techniques. Alaska Department of Fish and Game, Regional Informational Report No. 3F88-05, Fairbanks.

Barton, L. H. and R. Conrad. 1989. Population estimate of chinook salmon escapement in the Chena River in 1988 based upon mark and recapture techniques. Alaska Department of Fish and Game, Regional Informational Report No. 3F89-13, Fairbanks.

Burkholder, A. 1991. Abundance, egg production, and age-sex-size composition of the chinook salmon escapement in the Salcha River, 1990. Alaska Department of Fish and Game, Fishery Data No. 91-5, Anchorage.

LITERATURE CITED (Continued)

Clark, R. A., and W. P. Ridder. 1987. Tanana Drainage creel census and harvest surveys, 1986. Alaska Department of Fish and Game, Fishery Data Series No. 12, Juneau.

Evenson, M. J. 1991. Abundance, egg production, and age-sex-size composition of the chinook salmon escapement in the Chena River, 1990. Alaska Department of Fish and Game, Fishery Data Series No. 91-6, Anchorage.

Evenson, M. J. 1992. Abundance, egg production, and age-sex-size composition of the chinook salmon escapement in the Chena River, 1991. Alaska Department of Fish and Game, Fishery Data Series No. 92-4, Anchorage.

Evenson, M. J. 1993. Abundance, egg production, and age-sex-length composition of the chinook salmon escapement in the Chena River, 1992. Alaska Department of Fish and Game, Fishery Data Series No. 93-6, Anchorage.

Evenson, M. J. 1995. Salmon studies in Interior Alaska, 1994. Alaska Department of Fish and Game, Fishery Data Series No. 95-5, Anchorage.

Evenson, M. J. 1996. Salmon studies in Interior Alaska, 1995. Alaska Department of Fish and Game, Fishery Data Series No. 96-17, Anchorage.

Evenson, M. J. and L. Stuby. 1997. Salmon studies in Interior Alaska, 1996. Alaska Department of Fish and Game, Fishery Data Series No. 97-31, Anchorage.

Hallberg, J. E. and A. E. Bingham. 1991. Creel surveys conducted in interior Alaska during 1990. Alaska Department of Fish and Game, Fishery Data Series No. 91-56, Anchorage.

Hallberg, J. E. and A. E. Bingham. 1992. Creel surveys conducted in interior Alaska during 1991. Alaska Department of Fish and Game, Fishery Data Series No. 92-7, Anchorage.

Hallberg, J. E. and A. E. Bingham. 1993. Creel surveys conducted in interior Alaska during 1992. Alaska Department of Fish and Game, Fishery Data Series No. 93-7, Anchorage.

Hallberg, J. E. and A. E. Bingham. 1994. Creel surveys conducted in interior Alaska during 1993. Alaska Department of Fish and Game, Fishery Data Series No. 94-27, Anchorage.

Hallberg, J. E. and A. E. Bingham. 1995. Creel surveys conducted in interior Alaska during 1994. Alaska Department of Fish and Game, Fishery Data Series No. 95-21, Anchorage.

Hallberg, J. E. and A. E. Bingham. 1996. The Delta Clearwater and Salcha River creel surveys conducted in 1995. Alaska Department of Fish and Game, Fishery Data Series No. 96-20, Anchorage.

Howe, A. L., G. Fidler, and M. J. Mills. 1995. Harvest, catch, and participation in Alaska sport fisheries during 1994. Alaska Department of Fish and Game, Fishery Data Series No. 95-24, Anchorage.

Howe, A. L., G. Fidler, A. E. Bingham, and M. J. Mills. 1996. Harvest, catch, and participation in Alaska sport fisheries during 1995. Alaska Department of Fish and Game, Fishery Data Series No. 96-32, Anchorage.

Howe, A. L., G. Fidler, C. Olnes, A. E. Bingham, and M. J. Mills. 1997. Harvest, catch, and participation in Alaska sport fisheries during 1996. Alaska Department of Fish and Game, Fishery Data Series No. 97-29, Anchorage.

Howe, A. L., G. Fidler, C. Olnes, A. E. Bingham, and M. J. Mills. 1998. Harvest, catch, and participation in Alaska sport fisheries during 1997. Alaska Department of Fish and Game, Fishery Data Series No. 98-25, Anchorage.

Merritt, M. F., A. Bingham, and N. Morton. 1990. Creel surveys conducted in Interior Alaska during 1989. Alaska Department of Fish and Game. Fishery Data Series No. 90-54, Anchorage.

Mills, M. J. 1979. Alaska statewide sport fish harvest studies (1977). Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1978-1979 Project F-9-11, 20 (SW-I-A).

LITERATURE CITED (Continued)

Mills, M. J. 1980. Alaska statewide sport fish harvest studies (1978). Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1979-1980, Project F-9-12, 21 (SW-I-A).

Mills, M. J. 1981a. Alaska statewide sport fish harvest studies (1979). Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1980-1981, Project F-9-13, 22 (SW-I-A).

Mills, M. J. 1981b. Alaska statewide sport fish harvest studies (1980). Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1980-1981, Project F-9-13, 22 (SW-I-A).

Mills, M. J. 1982. Alaska statewide sport fish harvest studies (1981). Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1981-1982, Project F-9-14, 23 (SW-I-A).

Mills, M. J. 1983. Alaska statewide sport fish harvest studies (1982). Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1982-1983, Project F-9-15, 24 (SW-I-A).

Mills, M. J. 1984. Alaska statewide sport fish harvest studies (1983). Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1983-1984, Project F-9-16, 25 (SW-I-A).

Mills, M. J. 1985. Alaska statewide sport fish harvest studies (1984). Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1984-1985, Project F-9-17, 26 (SW-I-A).

Mills, M. J. 1986. Alaska statewide sport fish harvest studies (1985). Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1985-86, Project F-10-1, 27(RT).

Mills, M. J. 1987. Alaska statewide sport fisheries harvest report (1986). Alaska Department of Fish and Game. Fishery Data Series No. 2, Juneau.

Mills, M. J. 1988. Alaska statewide sport fisheries harvest report (1987). Alaska Department of Fish and Game. Fishery Data Series No. 52, Juneau.

Mills, M. J. 1989. Alaska statewide sport fisheries harvest report (1988). Alaska Department of Fish and Game. Fisheries Data Series No. 122, Juneau.

Mills, M. J. 1990. Harvest and participation in Alaska Sport Fisheries during 1989. Alaska Department of Fish and Game, Fishery Data Series No. 90-44, Anchorage.

Mills, M. J. 1991. Harvest, catch, and participation in Alaska sport fisheries during 1990. Alaska Department of Fish and Game, Fishery Data Series No. 91-58, Anchorage.

Mills, M. J. 1992. Harvest, catch, and participation in Alaska sport fisheries during 1991. Alaska Department of Fish and Game, Fishery Data Series No. 92-40, Anchorage.

Mills, M. J. 1993. Harvest, Catch, and Participation in Alaska Sport Fisheries During 1992. Alaska Department of Fish and Game, Fishery Data Series No. 93-42, Anchorage.

Mills, M. J. 1994. Harvest, Catch, and Participation in Alaska Sport Fisheries During 1993. Alaska Department of Fish and Game, Fishery Data Series No. 94-28, Anchorage.

Mosher, K. H. 1969. Identification of Pacific salmon and steelhead trout by scale characteristics. United States Department of the Interior, U.S. Fish and Wildlife Service, Bureau of Commercial Fisheries, Washington, D.C., Circular 317.

Parker, J. F. 1991. Status of coho salmon in the Delta Clearwater River of interior Alaska. Alaska Department of Fish and Game, Fishery Manuscript No. 91-4, Anchorage.

Ryan, P, and M. Christie. 1976. Scale reading equipment. Fisheries and Marine Service, Canada, Technical Report PAC/T-75-8, Vancouver.

Scarnecchia, D.L. 1979. Variation of scale characteristics of coho salmon with sampling location on the body. Progressive Fish Culturist 41(3):132-135.

LITERATURE CITED (Continued)

Schultz, K., D. Bergstrom, R. Holder, and B. Borba. 1994. Salmon fisheries in the Yukon area, Alaska, 1994. A report to the Alaska Board of Fisheries. Alaska Department of Fish and Game, Regional Information Report No. 3A94-31, Anchorage.

Seibel, M. C. 1967. The use of expanded ten-minute counts as estimates of hourly salmon migration past counting towers on Alaskan rivers. Information Leaflet No. 101, Juneau.

Skaugstad, C. L. 1988. Abundance and age-sex-size composition of the 1987 Salcha River chinook salmon escapement. Alaska Department of Fish and Game, Fishery Data Series No. 37, Juneau.

Skaugstad, C. L. 1989. Abundance and age-sex-size composition of the 1988 Salcha River chinook salmon escapement. Alaska Department of Fish and Game, Fishery Data Series No. 75, Juneau.

Skaugstad, C. L. 1990a. Abundance, egg production, and age-sex-size composition of the chinook salmon escapement in the Salcha River, 1989. Alaska Department of Fish and Game, Fishery Data No. 90-23, Anchorage.

Skaugstad, C. L. 1990b. Abundance, egg production, and age-sex-size composition of the 1989 Chena River chinook salmon escapement. Alaska Department of Fish and Game, Fishery Data No. 90-13, Anchorage.

Skaugstad, C. L. 1992. Abundance, egg production, and age-sex-length composition of the chinook salmon escapement in the Salcha River, 1991. Alaska Department of Fish and Game, Fishery Data Series No. 92-2, Anchorage.

Skaugstad, C. L. 1993. Abundance, egg production, and age-sex-length composition of the chinook salmon escapement in the Salcha River, 1992. Alaska Department of Fish and Game, Fishery Data Series No. 93-23, Anchorage.

Skaugstad, C. L. 1994. Salmon Studies in Interior Alaska, 1993. Alaska Department of Fish and Game, Fishery Data Series No. 94-14, Anchorage.

Stuby, L., and M. J. Evenson. 1998. Salmon studies in Interior Alaska, 1997. Alaska Department of Fish and Game, Fishery Data Series No. 97-11, Anchorage.

Thompson, S. K. 1987. Sample size for estimating multinomial Proportions. The American Statistician. Vol. 41, No. 1.

Welander, A. D. 1940. A study of the development of the scale of the chinook salmon (*Oncorhynchus tshawytscha*). Master's thesis, University of Washington, Seattle.

Zar, J. H. 1984 Biostatistical analysis, second edition. Prentice-Hall, Inc., Englewood Cliffs, New Jersey.

APPENDIX A

Appendix A1.-Schedule for counting salmon in the Salcha River, 1998. Shaded boxes indicate periods of time when counting was not possible due to high water and poor visibility or schedule conflicts.

June 22 – June 28	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
0000-0800						COUNT	COUNT
0800-1600					COUNT		COUNT
1600-0000					COUNT	COUNT	

June 29 – July 5	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
0000-0800	COUNT	COUNT	COUNT	COUNT	COUNT	COUNT	
0800-1600					COUNT		COUNT
1600-0000	COUNT	COUNT	COUNT	COUNT	COUNT	COUNT	COUNT

July 6 – July 12	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
0000-0800	COUNT	COUNT	COUNT	COUNT		COUNT	COUNT
0800-1600	COUNT	COUNT	COUNT	COUNT	COUNT	COUNT	COUNT
1600-0000	COUNT	COUNT	COUNT	COUNT	COUNT	COUNT	

July 13 – July 19	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
0000-0800	COUNT	COUNT	COUNT		COUNT	COUNT	COUNT
0800-1600	COUNT			COUNT	COUNT	COUNT	COUNT
1600-0000	COUNT	COUNT	COUNT	COUNT	COUNT	COUNT	COUNT

July 20 – July 26	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
0000-0800	COUNT	COUNT	COUNT	COUNT		COUNT	COUNT
0800-1600	COUNT	COUNT	COUNT	COUNT	COUNT		
1600-0000	COUNT	COUNT	COUNT	COUNT	COUNT	COUNT	COUNT

July 27 – Aug 2	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
0000-0800	COUNT	COUNT	COUNT	COUNT	COUNT	COUNT	
0800-1600	COUNT	COUNT	COUNT	COUNT	COUNT	COUNT	COUNT
1600-0000	COUNT	COUNT		COUNT	COUNT	COUNT	COUNT

Aug 3 – Aug 9	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
0000-0800	COUNT	COUNT	COUNT	COUNT	COUNT	COUNT	COUNT
0800-1600	COUNT	COUNT	COUNT	COUNT	COUNT	COUNT	COUNT
1600-0000	COUNT	COUNT	COUNT	COUNT	COUNT	COUNT	COUNT

Appendix A2.-Schedule for counting salmon in the Chena River, 1998. Shaded boxes indicate periods of time when counting was not possible due to high water and poor visibility or schedule conflicts.

June 22 – June 28	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
0000-0800					COUNT	COUNT	COUNT
0800-1600							COUNT
1600-0000					COUNT	COUNT	

June 29 – July 5	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
0000-0800	COUNT	COUNT	COUNT		COUNT		
0800-1600		COUNT	COUNT	COUNT		COUNT	COUNT
1600-0000	COUNT	COUNT	COUNT	COUNT	COUNT	COUNT	COUNT

July 6 – July 12	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
0000-0800	COUNT	COUNT	COUNT	COUNT	COUNT	COUNT	COUNT
0800-1600	COUNT	COUNT	COUNT	COUNT	COUNT	COUNT	COUNT
1600-0000	COUNT	COUNT			COUNT	COUNT	COUNT

July 13 – July 19	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
0000-0800	COUNT	COUNT	COUNT	COUNT			COUNT
0800-1600	COUNT		COUNT	COUNT	COUNT	COUNT	COUNT
1600-0000	COUNT	COUNT	COUNT	COUNT	COUNT	COUNT	COUNT

July 20 – July 26	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
0000-0800	COUNT	COUNT			COUNT		COUNT
0800-1600	COUNT	COUNT	COUNT	COUNT	COUNT	COUNT	COUNT
1600-0000	COUNT	COUNT	COUNT	COUNT	COUNT	COUNT	COUNT

July 27 – Aug 2	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
0000-0800	COUNT		COUNT	COUNT	COUNT	COUNT	COUNT
0800-1600	COUNT	COUNT	COUNT	COUNT	COUNT	COUNT	COUNT
1600-0000	COUNT	COUNT		COUNT	COUNT	COUNT	COUNT

Aug 3 – Aug 9	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
0000-0800	COUNT	COUNT	COUNT	COUNT	COUNT		COUNT
0800-1600	COUNT	COUNT	COUNT	COUNT	COUNT	COUNT	COUNT
1600-0000	COUNT	COUNT	COUNT	COUNT	COUNT	COUNT	COUNT

Appendix A3.-Schedule for counting salmon in the Chatanika River, 1998. Shaded boxes indicate periods of time when counting was not possible due to high water and poor visibility or schedule conflicts.

July 6 – July 12	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
0000-0800	COUNT	COUNT	COUNT	COUNT		COUNT[a]	COUNT
0800-1600	COUNT	COUNT	COUNT		COUNT	COUNT	COUNT
1600-0000		COUNT		COUNT	COUNT		COUNT

July 13 – July 19	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
0000-0800	COUNT[c]	COUNT[c]			COUNT	COUNT	COUNT[a]
0800-1600			COUNT[a]	COUNT[a]	COUNT	COUNT	COUNT[e]
1600-0000	COUNT[d]	COUNT[d]	COUNT[b]	COUNT	COUNT	COUNT	

July 20 – July 26	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
0000-0800	COUNT[f]	COUNT[f]	COUNT			COUNT	COUNT
0800-1600	COUNT[e]	COUNT[e]	COUNT	COUNT	COUNT		
1600-0000			COUNT	COUNT	COUNT	COUNT	COUNT

July 27 – Aug 2	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
0000-0800	COUNT	COUNT	COUNT	COUNT	COUNT		
0800-1600	COUNT	COUNT	COUNT	COUNT	COUNT		
1600-0000	COUNT	COUNT	COUNT	COUNT	COUNT		

a. Shift scheduled from 0600-1600 hours.
b. Shift scheduled from 1600-0200 hours.
c. Shift scheduled from 0000-1000 hours.
d. Shift scheduled from 1400-0000 hours.
e. Shift scheduled from 0800-1800 hours.
f. Shift scheduled from 2200-0800 hours.

APPENDIX B

Appendix B.-Data files used to estimate parameters of chinook, chum, and coho salmon populations in the Salcha, Chena, Chatanika, and Delta Clearwater rivers, 1998.

Data File	Description
SRCREK98.AWL[a]	Data file of length, sex, and age data for chinook salmon carcasses collected from the Salcha River, 1998.
CHRCRK98.AWL[a]	Data file of length, sex, and age data for chinook salmon carcasses collected from the Chena River, 1998.
CTRCRK98.AWL[a]	Data file of length, sex, and age data for chinook salmon carcasses collected from the Chatanika River, 1998.
DCW3CS98.ASL[a]	Data file of length, sex, and age data for coho salmon carcasses collected from the Delta Clearwater River, 1998.
KINGTOW.XLS[b]	Excel spreadsheet of hourly counts of chinook salmon, daily expansions of escapement, and variance estimates for the Salcha and Chena rivers, 1998.
CHUMTOW.XLS[b]	Excel spreadsheet of hourly counts of chum salmon, daily expansions of escapement, and variance estimates for the Salcha and Chena rivers, 1998.
CHATTOW.XLS[b]	Excel spreadsheet of hourly counts of chinook and chum salmon, daily expansions of escapement, and variance estimates for the Chatanika River, 1998.
SALCHA98.XLS[b]	Excel spreadsheets with analysis of tower-count and age, sex, and length data. File includes spreadsheets of hourly escapement, run timing, daily counts and estimates, expanded cumulative passage, estimated proportions of age, sex and length, length frequency distributions, average length per age class by sex from 1987-1998, and percent age composition from 1987-1998.
CHENA98.XLS[b]	Excel spreadsheets with analysis of tower-count and age, sex, and length data. File includes spreadsheets of hourly escapement, run timing, daily counts and estimates, expanded cumulative passage, estimated proportions of age, sex and length, length frequency distributions, average length per age class by sex from 1987-1998, and percent age composition from 1987-1998.
CHAT98.XLS[b]	Excel spreadsheets with analysis of tower-count and age, sex, and length data. File includes spreadsheets of hourly escapement, daily counts and estimates, expanded cumulative passage, estimated proportions of age, sex and length, length frequency distributions, average length per age class by sex from 1987-1998, and percent age composition from 1987-1998.
DCR98.XLS[b]	Excel spreadsheets with analysis of age, sex, and length data. File includes spreadsheets of estimated proportions of age, sex and length, length frequency distributions, average length per age class by sex from 1990-1998, and percent age composition from 1990-1998.

[a] Data files have been archived at, and are available from, the Alaska Department of Fish and Game, Commercial Fisheries Research and Development Division, 333 Raspberry Road, Anchorage, 99518-1599.

[b] Data files are available from the author.

APPENDIX C

Appendix C1.-Numbers of chinook salmon counted during 10 min periods for the left side of the Salcha River, 1998. Counts were conducted near the top of each hour. Negative counts indicate fish movement down river. Shaded areas indicate hours not counted.

Date	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	Total
6/26											0	0	0	0	0	0			0	0	0	0	0	0	0
6/27	0	0	0	0	0	0	0	0									0	0	0	0	0	0	0	0	0
6/28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0									0
6/29	0	0	0	0	0	0	0	0									0	0	0	0	0	0	0	0	0
6/30	0	0	0	0	0	0	0	0									0	0	0	0	0	0	0	0	0
7/1	0	0	0	0	0	0	0	0									0	0	0	1	0	0	0	0	1
7/2	0	0	0	0	0	0	0	0									0	0	0	0	0	0	0	0	0
7/3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/4	0	0	0	0	0	0	0	0									1	0	0	0	0	0	0	0	1
7/5									0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
7/6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/7	0	0	0	0	1	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
7/8	0	0	0	0	0	0	-1	0	0	2	0	0	0	1	0	0	0	0	0	0					2
7/9																									0
7/10									0	1	1	0	0	0	0	-1	0	0	0	0	0	1	0		2
7/11	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	5
7/12	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0									2
7/13	0	0	5	2	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9
7/14	1	0	1	0	0	0	0	0									0	0	0	0	0	0	0	0	2
7/15	0	0	0	0	0	0	0	0									0	0	0	0	0	0	0	0	0
7/16									2	1	0	6	2	0	0	0	0	0	0	0	1	0	0	2	14
7/17	1	1	0	0	2		1	-1	2	0	1	2	1	2	0	0	0	0	0	0	0	0	0	2	14
7/18	1	3	1	0	0	1	0	0	1	0	0	0	0												7
7/19																									0
7/20									0	1	0	2	0	1	0	0	0	0	0	0	1	0	0	0	5
7/21	0	1	1	0	0	0	0	0	1	5	1	0			2	0	0	0	1	1	0	0	0	0	13
7/22	1	1	4	0	1	0	2	0	2	6	1	1	2	0	3	0	0	0	0	0	0	0	0	3	27
7/23	0	2	1	1	0	3	0	0	1	1	4	3	3	4	0	2	0	0	0	0	0	0	0	0	25
7/24																									0
7/25																									0
7/26																									0
7/27																	2	0	0	0	2	2	0	0	6
7/28	0	1	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	3
7/29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0									1
7/30																									0
7/31																	0	1	0	0	0	0	0	0	1
8/1									1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	3
8/2									0	0	0	0	0	0	0	0	0	0	0	0			0	0	0
8/3	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	-1	0	1	0	0	0	0	2
8/4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	2
8/5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
8/6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
8/7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-1	0	0	0	0	-1
8/8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/9									0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	5	10	13	3	6	5	3	1	10	18	8	18	9	8	6	1	3	3	1	4	5	3	0	7	150

Appendix C2.-Numbers of chinook salmon counted during 10 min periods for the right side of the Salcha River, 1998. Counts were conducted near the top of each hour. Negative counts indicate fish movement down river. Shaded areas indicate hours not counted.

Date	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	Total
6/26											0	0	0	0	0	0			0	0	0	0	0	0	0
6/27	0	0	0	0	0	0	0	0									0	0	0	0	0	0	0	0	0
6/28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0									0
6/29	0	0	0	0	0	0	0	0									0	0	0	0	0	0	0	0	0
6/30	0	0	0	0	0	0	0	0									0	0	0	0	0	0	0	0	0
7/1	0	0	0	0	0	0	0	0									0	0	0	1	0	0	0	0	1
7/2	0	0	0	0	0	0	0	0									0	0	0	0	0	0	0	0	0
7/3	0	0	0	0	0	0	0	0	0	0	1	4	0	0	0	0	0	0	0	0	0	2	1	0	8
7/4	0	0	0	0	0	6	0	0									1	0	0	0	0	0	2	0	9
7/5									0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/6	0	1	-1	0	7	3	5	0	2	0	1	0	0	1	1	0	0	4	1	0	-1	0	0	0	24
7/7	0	1	3	1	0	0	0	0		0	0	-1	0	0	0	0	2	0	0	0	0	0	4	0	10
7/8	0	8	0	0	0	0	2	0	0	1	0	9	0	7	0	6	0	2	0	0					35
7/9																									0
7/10									0	0	0	0	0	0	1	0	0	0	0	0	0	0	0		1
7/11	0	0	0	1	3	7	1	0	0	0	0	2	0	0	1	0	0	1	1	0	1	0	0	0	18
7/12	0	3	2	0	0	0	11	5	0	0	1	2	2	0	0	-1									25
7/13	1	0	7	0	2	0	0	0	2	0	5	0	4	13	2	4	0	1	2	3	0	0	0	0	46
7/14	0	2	2	5	0	2	0	0									0	2	0	0	3	0	0	0	16
7/15	0	0	0	0	0	0	0	0									0	2	0	0	0	0	1	0	3
7/16									0	0	0	0	0	0	0	0	3	0	1	1	2	2	0	6	15
7/17	3	4	4	0	0		0	2	3	4	2	2	1	2	0	0	0	2	0	1	0	1	0	0	31
7/18	0	0	0	0	0	0	0	0	0	0	0	0	0												0
7/19																									0
7/20									0	0	0	0	4	2	1	0	1	0	4	0	0	0	3	0	15
7/21	1	2	1	0	0	0	0	0	0	1	3	4			0	4	3	0	2	0	0	1	1	1	24
7/22	1	0	2	0	0	7	4	3	0	4	4	2	4	1	0	1	0	1	2	2	0	1	0	0	39
7/23	2	1	4	0	0	1	1	1	1	2	2	5	3	2	2	2	1	0	6	3	0	0	0	2	41
7/24																									0
7/25																									0
7/26																									0
7/27																	3	0	2	0	0	1	0	0	6
7/28	0	0	1	0	1	0	0	0	0	1	0	1	0	0	-1	0	0	0	2	1	0	0	1	0	7
7/29	0	0	1	0	0	0	0	0	0	0	1	0	2	2	0	1									7
7/30																									0
7/31																	0	1	0	0	0	0	0	0	1
8/1									0	0	2	0	0	2	0	0	0	0	0	0	0	0	0	0	4
8/2									0	0	1	0	0	0	0	0	0	0	0	0			0	0	1
8/3	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	5
8/4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	2
8/6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8/7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	2
8/8	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	2
8/9									0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	8	22	26	8	15	26	24	11	8	13	23	31	21	32	8	18	14	18	23	12	6	8	14	9	398

Appendix C3.-Numbers of chinook salmon counted during 10 min periods for the left side of the Chena River, 1998. Counts were conducted near the top of each hour. Negative counts indicate fish movement down river. Shaded areas indicate hours not counted.

Date	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	Total
6/26	0	0	0	0	0	0	0	0									0	0	0	0	0	0	0	0	0
6/27	0	0	0	0	0	0	0	0									0	0	0	0	0	0	0	0	0
6/28	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0									1
6/29	0	0	0	0	0	0	0	0									0	0	0	0	0	0	0	0	0
6/30	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2	0	3
7/1	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	6
7/2									0	0	0	1	0	0	0	0	0	0	4	0	0	1	0	0	6
7/3	0	0	0	0	0	0	1	2									0	0	0	2	1	0	2	1	9
7/4									0	0	0	0	1	0	0	0	1	0	3	0	0	0	0	0	5
7/5									0	0	0	2	1	0	0	0	0	0	2	0	2	0	0	0	7
7/6	0	0	0	1	0	1	0	2	1	0	0	0	0	0	0	0	0	4	0	1	0	0	0	0	10
7/7	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	8
7/8	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	2									4
7/9																									0
7/10																									0
7/11																	0	0	0	0	0	0	0	0	0
7/12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
7/13	0	0	0	0	1	0	0	1	3	1	1	0	1	1	0	1	0	0	0	1	0	0	0	3	14
7/14	1	0	1	0	0	0	0	0									0	0	0						2
7/15																									0
7/16	0	0	0	1	0	0	0	0	1	1	0	0	0	0	0	1	0	1	1	0	1	2	0	1	10
7/17											4	0	4	4	0	1	1	2	3	5	5	3	3	3	38
7/18																									0
7/19																	0	0	0	0	1	2	4	2	9
7/20	0	0	0	0	1	0	2	1	2	1	2	1	2	2	-1	1	0	2	1	1	0	1	1	1	21
7/21	6	2	0	0	1	0	2	1	0	1	1	1	2	1	0	0	4	1	0	1	4	1	0	1	30
7/22									0	1	1	0	3	1	2	4	8	5	-1	0	2	2	0	0	28
7/23									3	1	1	9	1	2	0	6	4	3	3	0	2	1	0	2	38
7/24	5	5	1	1	0	0																			12
7/25																									0
7/26																									0
7/27																									0
7/28																									0
7/29	0	0	0	1	1	0	0	1						0	2	2									7
7/30	2	0	1	0	1	0	0	0	0	0	0	1	0	0	0	0	-1	1	0	0	0				5
7/31	-2	0	1	0	0	0	0	0	0	0	1	0	1	0	0	0	0	1	0	0	0	0	0	0	2
8/1	1	0	0	0	0	1	0	-1	0	1	0	2	0	0	0	0	3	1	0	0	2	0	0	0	10
8/2	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	4
8/3	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	4
8/4	2	1	0	2	0	0	0	1	0	0	0	0	0	0	0	0	2	0	0	0	0	2	0	0	10
8/5	0	1	0	1	0	0	1	0	0	0	0	1	0	0	0	0	0	3	0	1	0	2	0	0	10
8/6	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	1	0	0	0	0	3
8/7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	2
8/8	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	-1	0	-1	0	0	2
8/9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	16	9	6	9	6	4	6	10	10	7	11	20	23	12	5	18	22	32	17	15	20	16	13	14	321

Appendix C4.-Numbers of chinook salmon counted during 10 min periods for the right side of the Chena River, 1998. Counts were conducted near the top of each hour. Negative counts indicate fish movement down river. Shaded areas indicate hours not counted.

Date	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	Total
6/26	0	0	0	0	0	0	0	0									0	0	0	0	0	0	0	0	0
6/27	0	0	0	0	0	0	0	0									0	0	0	0	0	0	0	0	0
6/28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0									0
6/29	0	0	0	0	0	0	0	0									0	0	2	0	0	0	0	0	2
6/30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2
7/1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/2									0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/3	0	0	0	0	0	0	0	0									0	0	0	0	0	0	0	2	2
7/4									0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
7/5									0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/7	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
7/8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0									0
7/9																									0
7/10																									0
7/11																	0	0	0	0	0	0	0	0	0
7/12	1	0	0	0	0	0	0	0	0	0	0	0	0	-2	0	0	1	1	0	1	0	0	0	0	2
7/13	0	1	0	0	0	0	0	0	1	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	5
7/14	0	0	0	1	0	2	0	0									0	0	0						3
7/15																									0
7/16	0	1	0	0	0	0	1	0	0	1	0	1	0	0	0	0	-1	-1	0	0	0	0	0	-1	1
7/17										1	1	1	0	0	0	0	0	0	0	0	3	1	1	0	8
7/18																									0
7/19																	0	0	0	0	0	0	0	1	1
7/20	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	1	0	0	3
7/21	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
7/22									0	0	0	0	0	0	1	0	1	2	0	0	0	0	0	0	4
7/23									0	0	0	1	0	0	3	0	2	1	0	0	1	0	0	0	8
7/24	0	0	1	0	0	0																			1
7/25																									0
7/26																									0
7/27																									0
7/28																									0
7/29	0	0	0	0	0	0	0	0						0	2	2									4
7/30	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0				2
7/31	-1	0	0	0	0	0	0	0	0	0	0	0	-1	0	0	1	0	0	0	0	0	0	0	0	-1
8/1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	3	0	0	2	7
8/2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	-1	0	0	0	0	0	0	0	0
8/3	0	0	0	0	0	0	0	1	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8
8/4	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
8/5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
8/6	0	0	0	0	0	0	0	1	0	-1	1	0	1	0	0	0	0	0	0	2	0	0	0	0	4
8/7	0	0	0	0	0	0	0	0	3	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	4
8/8	0	0	0	1	1	0	0	0	0	-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
8/9	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	-1	-1	0	1	0	0	0
Total	0	2	1	2	3	2	1	2	12	0	3	5	4	3	7	4	3	3	1	2	7	5	1	4	77

Appendix C5.-Numbers of chum salmon counted during 10 min periods for the left side of the Salcha River, 1998. Counts were conducted near the top of each hour. Negative counts indicate fish movement down river. Shaded areas indicate hours not counted.

Date	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	Total
6/26											0	0	0	0	0	0			0	0	0	0	0	0	0
6/27	0	0	0	0	0	0	0	0									0	0	0	0	0	0	0	0	0
6/28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0									0
6/29	0	0	0	0	0	0	0	0									0	0	0	0	0	0	0	0	0
6/30	0	0	0	0	0	0	0	0									0	0	0	0	0	0	0	0	0
7/1	0	0	0	0	0	0	0	0									0	0	0	0	0	0	0	0	0
7/2	0	0	0	0	0	0	0	0									0	0	0	0	0	0	0	0	0
7/3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/4	0	0	0	0	0	0	0	0									0	0	0	0	0	0	0	0	0
7/5									0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0					0
7/9																									0
7/10									0	0	1	0	0	0	0	0	0	0	0	0	0	0	0		1
7/11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
7/12	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0									2
7/13	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0		0	0	0	0	0	0	0	2
7/14	0	0	2	0	0	0	1	0									0	0	0	0	0	0	0	0	3
7/15	0	1	0	0	0	0	0	0									0	0	0	0	0	0	0	0	1
7/16									0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	1	3
7/17	2	1	2	5	0		0	0	0	0	1	0	3	1	0	0	0	0	0	0	0	0	0	0	15
7/18	1	0	3	1	0	3	0	0	0	0	0	0	0												8
7/19																									0
7/20									0	2	0	1	2	0	1	0	0	0	0	0	0	0	0	0	6
7/21	2	0	3	0	3	0	1	0	2	0	0	2			0	1	0	2	2	0	0	1	-1	0	18
7/22	0	1	4	0	5	0	4	1	12	8	3	1	0	0	0	1	1	0	1	0	2	0	1	8	53
7/23	0	1	3	1	0	4	0	0	0	1	3	3	0	0	0	1	1	1	0	0	1	0	4	0	24
7/24																									0
7/25																									0
7/26																									0
7/27																	2	0	0	0	0	0	0	2	4
7/28	0	0	1	1	0	0	3	0	1	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	8
7/29	0	0	0	1	0	0	0	0	0	0	3	0	0	0	0	1									5
7/30																									0
7/31																	4	3	2	0	0	3	0	2	14
8/1									1	5	2	1	0	0	0	3	0	0	2	0	0	0	0	1	15
8/2									1	1	3	2	2	2	1	0	0	0	1	0			1	1	15
8/3	1	1	2	1	0	2	0	1	0	0	0	0	2	0	1	1	0	0	0	0	0	0	0	0	12
8/4	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	1	1	6
8/5	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	3
8/6	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	3
8/7	1	1	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	4
8/8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	-1	0	1	1
8/9									0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Total	7	6	20	11	8	10	10	5	17	17	16	11	12	4	3	8	9	7	10	1	8	5	6	17	228

Appendix C6.-Numbers of chum salmon counted during 10 min periods for the right side of the Salcha River, 1998. Counts were conducted near the top of each hour. Negative counts indicate fish movement down river. Shaded areas indicate hours not counted.

Date	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	Total
6/26											0	0	0	0	0	0			0	0	0	0	0	0	0
6/27	0	0	0	0	0	0	0	0									0	0	0	0	0	0	0	0	0
6/28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0									0
6/29	0	0	0	0	0	0	0	0									0	0	0	0	0	0	0	0	0
6/30	0	0	0	0	0	0	0	0									0	0	0	0	0	0	0	0	0
7/1	0	0	0	0	0	0	0	0									0	0	0	0	0	0	0	0	0
7/2	0	0	0	0	0	0	0	0									0	0	0	0	0	0	0	0	0
7/3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/4	0	0	0	0	0	0	0	0									0	0	0	0	0	0	0	0	0
7/5									0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/7	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
7/8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0					0
7/9																									0
7/10									0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0
7/11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
7/12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0									0
7/13	0	0	0	0	0	0	0	0	3	0	0	0	1	0	0	0	1	0	0	0	-1	0	0	0	4
7/14	0	0	4	0	0	1	0	0									0	0	0	0	0	0	0	0	5
7/15	0	0	0	0	0	0	0	0									0	0	0	0	0	0	0	0	0
7/16									0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	2	5
7/17	2	3	4	2	0		1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	2	16
7/18	1	0	1	0	0	0	0	0	0	0	0	0	0												2
7/19																									0
7/20									0	0	0	0	4	1	0	1	0	2	2	0	0	0	0	0	10
7/21	1	0	2	0	0	0	0	0	0	0	0	1			0	2	0	0	2	0	3	3	1	1	16
7/22	1	1	3	0	0	2	0	0	0	3	2	3	3	2	0	2	2	4	6	0	0	0	0	1	35
7/23	2	1	3	2	0	0	1	0	0	5	1	1	4	0	0	3	4	2	1	0	3	0	1	0	34
7/24																									0
7/25																									0
7/26																									0
7/27																	0	0	0	0	4	3	0	1	8
7/28	8	3	3	1	4	5	25	11	1	2	1	3	1	0	3	0	0	0	4	1	1	3	0	6	86
7/29	4	2	7	6	15	11	0	17	19	10	5	0	15	30	16	7									164
7/30																									0
7/31																	6	3	2	0	5	5	0	1	22
8/1									0	3	2	4	-1	3	0	1	0	4	1	6	6	1	9	6	45
8/2									14	26	17	8	9	0	0	3	0	4	3	1			18	15	118
8/3	21	17	39	23	28	54	13	19	12	15	8	7	10	12	2	6	1	3	1	2	5	4	3	8	313
8/4	8	10	16	7	13	7	11	15	9	12	10	3	1	2	4	0	5	6	4	11	2	4	11	1	172
8/5	6	6	5	11	26	20	20	8	8	26	12	2	1	1	0	1	4	0	5	2	4	2	4	9	183
8/6	3	11	6	26	29	32	23	17	1	12	19	12	2	3	9	10	2	4	2	3	7	0	2	4	239
8/7	5	2	6	16	22	16	34	21	20	3	3	2	0	1	0	0	1	1	1	6	4	0	1	4	169
8/8	4	2	3	15	4	4	6	5	4	8	3	0	9	0	5	4	1	1	6	0	4	1	1	9	99
8/9									8	20	3	7	4	9	4	11	9	3	1	0	4	6	1	4	94
Total	66	58	102	109	141	152	134	113	99	146	86	53	63	65	43	51	36	37	42	33	52	34	52	74	1,841

Appendix C7.-Numbers of chum salmon counted during 10 min periods for the left side of the Chena River, 1998. Counts were conducted near the top of each hour. Negative counts indicate fish movement down river. Shaded areas indicate hours not counted.

Date	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	Total
6/26	0	0	0	0	0	0	0	0									0	0	0	0	0	0	0	0	0
6/27	0	0	0	0	0	0	0	0									0	0	0	0	0	0	0	0	0
6/28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0									0
6/29	0	0	0	0	0	0	0	0									0	0	0	0	0	0	0	0	0
6/30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/2									0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/3	0	0	0	0	0	0	0	0									0	0	0	0	0	0	0	0	0
7/4									0	0	0	0	0	0	0	0	0	0	0	1	1	3	0	0	5
7/5									0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0									0
7/9																									0
7/10																									0
7/11																	0	0	0	0	0	0	1	0	1
7/12	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	2
7/13	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
7/14	0	0	0	0	0	0	0	1									0	0	0						1
7/15																									0
7/16	1	0	0	2	1	0	0	2	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	8
7/17											0	0	0	0	3	0	0	0	0	0	1	0	1	0	5
7/18																									0
7/19																	0	0	0	0	0	0	0	0	0
7/20	1	0	2	1	1	1	0	1	0	1	1	0	1	1	0	0	0	4	0	2	2	2	0	0	21
7/21	2	1	2	2	1	1	0	0	0	0	0	2	0	0	0	1	0	0	0	0	2	2	0	6	22
7/22									-1	0	2	0	3	1	0	0	2	3	0	0	0	0	0	0	10
7/23									0	2	2	0	1	0	0	1	0	0	0	0	3	0	0	0	9
7/24	2	0	0	0	0	0																			2
7/25																									0
7/26																									0
7/27																									0
7/28																									0
7/29	0	0	0	0	0	1	0	0						3	1	0									5
7/30	0	1	1	2	1	2	2	4	1	2	0	1	3	2	0	0	0	1	0	0	1				24
7/31	3	5	1	0	0	0	0	0	0	2	0	0	0	0	0	1	2	1	0	0	0	1	1	1	18
8/1	0	0	2	0	0	0	3	3	4	3	4	0	0	3	0	2	0	0	0	0	0	0	0	0	24
8/2	0	0	0	0	0	0	6	8	0	0	0	2	1	1	0	0	1	4	2	4	6	0	0	2	37
8/3	4	2	1	2	0	3	0	0	0	0	0	2	0	0	0	1	1	3	0	0	2	1	7	0	29
8/4	3	2	4	2	2	0	2	1	0	3	2	0	4	0	0	0	10	0	0	2	4	2	0	0	43
8/5	2	1	4	0	0	6	0	0	6	1	2	1	1	0	0	0	0	3	2	2	5	4	0	1	41
8/6	2	0	1	0	2	0	0	3	4	0	0	0	0	0	0	0	0	3	1	0	4	0	0	0	20
8/7	1	0	0	0	1	0	1	0	0	0	0	0	1	1	0	0	0	0	3	0	0	0	0	1	9
8/8	6	1	0	2	0	0	3	7	1	0	0	0	0	4	0	1	0	0	0	2	1	0	0	2	30
8/9	1	1	6	1	3	0	0	0	0	0	2	0	1	3	3	1	1	2	2	2	4	0	0	0	33
Total	28	14	24	14	12	14	17	31	16	16	15	8	17	19	7	8	17	25	10	15	36	15	10	13	401

Appendix C8.-Numbers of chum salmon counted during 10 min periods for the right side of the Chena River, 1998. Counts were conducted near the top of each hour. Negative counts indicate fish movement down river. Shaded areas indicate hours not counted.

Date	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	Total
6/26	0	0	0	0	0	0	0	0									0	0	0	0	0	0	0	0	0
6/27	0	0	0	0	0	0	0	0									0	0	0	0	0	0	0	0	0
6/28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0									0
6/29	0	0	0	0	0	0	0	0									0	0	0	0	0	0	0	0	0
6/30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/2									0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/3	0	0	0	0	0	0	0	0									1	0	0	0	0	0	0	0	1
7/4									0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	2
7/5									0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0									0
7/9																									0
7/10																									0
7/11																	0	0	0	0	0	0	0	0	0
7/12	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2
7/13	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
7/14	0	0	0	1	0	0	0	0									0	0	0						1
7/15																									0
7/16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/17										0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/18																									0
7/19																	0	0	0	0	0	0	0	0	0
7/20	0	0	0	0	1	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	3
7/21	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
7/22									0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/23									0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
7/24	0	0	0	0	0	0																			0
7/25																									0
7/26																									0
7/27																									0
7/28																									0
7/29	2	1	1	0	0	0	1	0						0	0	0									5
7/30	1	4	2	4	3	1	0	0	0	0	1	0	0	0	4	2	0	0	1	0	2				25
7/31	0	8	0	0	0	0	0	1	0	0	4	1	0	0	0	3	0	1	0	0	0	0	1	0	19
8/1	1	0	1	0	5	0	0	1	2	6	0	13	0	0	0	0	5	0	0	0	5	0	0	0	39
8/2	1	0	1	1	0	6	3	3	0	0	1	0	0	0	1	0	0	0	0	0	1	0	0	9	27
8/3	5	3	2	2	0	0	0	0	0	0	0	2	2	3	3	2	1	1	0	0	3	2	2	0	33
8/4	4	3	6	4	2	0	2	0	4	0	0	0	8	4	3	6	3	4	0	0	2	3	0	0	58
8/5	6	2	3	0	4	2	2	0	0	0	4	2	0	0	3	4	0	1	2	1	0	2	0	6	44
8/6	9	2	3	0	1	0	0	2	2	2	1	6	2	1	1	0	0	1	0	1	3	1	0	1	39
8/7	0	2	1	0	2	3	0	0	1	0	6	0	2	3	0	0	0	0	0	2	0	0	0	6	28
8/8	2	1	1	0	0	4	0	0	1	1	5	2	0	4	3	1	1	4	0	0	2	4	3	5	44
8/9	0	2	3	0	2	12	0	0	0	0	2	0	7	5	3	1	0	0	2	0	1	4	0	1	45
Total	31	28	24	14	21	28	8	8	11	9	24	26	22	22	21	19	11	12	6	4	19	17	6	29	420

Appendix C9.-Numbers of chinook salmon counted during 20 min periods for the Chatanika River, 1998. Counts were conducted near the top of each hour. Negative counts indicate fish movement down river. Shaded areas indicate hours not counted.

Date	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	Total
7/7	0	0	0	0	0	0	0	0					0	0	0	0									0
7/8	0	0	0	0	0																				0
7/9																									0
7/10									0	0	0	0	0	0	0	0		0	0	0	0				0
7/11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0									0
7/12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/13		1	0	0	0	0	0	0	0	0					0	0	0	0	0	1	0	0	0	0	2
7/14	0	1	1	0	0	0	0	0	0	0					0	1	0	0	0	1	0	3	0	0	7
7/15							0	0	0	-1	0	0	0	0	0	0	0	0	1	0	2	3	1	0	6
7/16	0	0					0	0	0	1	0	0	2	0	0	3	1	0	1	1	1	0	0	0	10
7/17	4	-1	0	1	0	0	0	0	0	0	1	2	0	1	0	6	0	0	0	0	0	0	1	1	16
7/18	1	2	2	0	3	0	0	0	0	0	2	0	1	2	2	2	1	1	-1	0	0	3	0	0	21
7/19	1	0	0	0	0	1	3	0	0	0	3	1	1	2	2	2	0	1					2	2	21
7/20	0	1	0	1	0	0	0	0	0	1	0	1	0	3	2	0	2	0					0	0	11
7/21	2	1	0	1	-1	0	0	0	0	2	0	3	1	2	1	-1	3	0							14
7/22	2	3	0	0	4	0	1	0	2	0	0	0	0	0	2	0	1	2	0	0	0	0	0	0	17
7/23									0	0	0	3	0	0	1	2	4	3	0	0	0	0	0	0	13
7/24																									0
7/25									1	2	0	0	0	3	2	-1	3	-1	0	1	1	0	0	0	11
7/26										1	2	0	-1	1	0	1	0	8	6	5	1	-1	-2	0	21
7/27	0	2	0	0	0	2	0	1	0	1	2	2	-2	0	-1	0	0	5	1	1	-1	0	-1	0	12
7/28	1	2	0	0	-1	0	2	1	2	2	-1	0	2	1	1	3	0	0	3	0	0	0	0	0	18
7/29	1	0	0	0	0	1	0	0	1	0	1	1	1	1	2	2	0	1	0	-1	0	0	0	1	12
7/30	-1	0	0	3	0	0	0	0	3	1	1	2	1	0	0	2	0	0	1	1	0	-1	-1	2	14
7/31	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	3
Total	11	12	4	6	5	4	6	2	9	10	11	15	6	17	14	22	15	20	12	11	4	7	0	6	229

Appendix C10.-Numbers of chum salmon counted during 20 min periods for the Chatanika River, 1998. Counts were conducted near the top of each hour. Negative counts indicate fish movement down river. Shaded areas indicate hours not counted.

Date	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	Total
7/7	0	0	0	0	0	0	0	0					0	0	0	0									0
7/8	1	0	0	1	0																				2
7/9																									0
7/10									0	0	0	0	0	0	0	0		0	0	0	0				0
7/11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0									0
7/12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2	0	3
7/13		1	0	1	0	0	0	0	0	0					0	0	0	0	0	0	0	0	0	0	2
7/14	0	1	1	1	0	0	0	0	2	0					0	0	0	0	0	0	0	0	0	0	5
7/15							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/16	0	0					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/17	6	2	0	0	0	1	3	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	15
7/18	0	2	3	0	4	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10
7/19	-1	1	0	1	0	0	1	0	0	0	0	0	0	1	0	0	0	0					0	0	3
7/20	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0					0	0	3
7/21	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0							2
7/22	0	1	0	0	2	1	0	0	0	0	0	3	0	0	0	0	0	1	0	0	0	-1	0	1	8
7/23									0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	2
7/24																									0
7/25									0	0	0	0	1	0	0	1	0	0	4	0	1	3	0	0	10
7/26										0	0	0	3	0	0	0	0	5	0	1	0	0	0	0	9
7/27	0	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	-1	4	6
7/28	0	1	0	0	0	0	0	0	0	1	0	0	0	0	2	0	0	0	0	0	6	0	0	0	10
7/29	1	0	1	0	0	0	0	1	0	0	0	0	0	4	0	9	0	0	0	0	0	0	0	0	16
7/30	1	0	0	0	1	0	0	0	0	0	0	0	3	1	0	0	2	0	0	0	0	1	0	1	10
7/31	0	1	1	0	0	0	0	1	0	0	0	0	2	0	0	0	0	0	0	10	0	14	35	3	67
Total	8	12	7	4	7	2	4	2	3	1	2	5	11	7	2	10	3	7	4	12	7	17	37	9	183