AYK Region
Yukon Salmon Escapement
Report No. 31

Population Estimate of Chinook Salmon Escapement in the Chena River in 1986 Based Upon Mark and Recapture Techniques

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ABSTRACT

Gillnets of two different mesh sizes were used to capture adult chinook salmon to estimate total escapement using mark and recapture techniques. A total of 515 chinook salmon was tagged, fin-clipped, and released. Sixty marked fish were subsequently recovered from a total of 1,561 carcasses examined on the spawning grounds. A mean of approximately 21 days elapsed between the dates of tagging and death for either sex.

No significant difference between rate of recovery among different length categories or between sexes was found. However, a significant difference was detected in recovery rate by time of recovery.

An adjusted Petersen estimate of 9,065 chinook salmon with an approximate 95% confidence interval of ± 2,116 resulted for fish greater than 470 mm in length, using only recovery data for the period in which no significant difference in recovery rate could be detected. An aerial census made under fair survey conditions accounted for 22.4% of the population estimate.

The population was composed of 8 age groups from 6 brood years, but the most abundant age groups of chinook salmon were 51.2% age 1.3 and 28.5% age 1.4. Males were predominantly 5-year-olds (1.3's) from the 1981 brood year, and females were predominantly 6-year-olds (1.4's) from the 1980 brood year. The male-to-female ratio for chinook salmon was approximately 3:1.

KEY WORDS: chinook salmon, Oncorhynchus tschawytscha, population estimate, mark and recapture, escapement, aerial census, Yukon River, Tanana River, Chena River.

INTRODUCTION

The Pacific Salmon Treaty, enacted in March 1985, included the provision that Yukon River issues be taken up in separate negotiations between the U.S. and Canada. Specific issues to be addressed concern ownership and allocation of transboundary salmon stocks in this drainage. The two countries have met on several occasions since April 1985 and deliberations have dealt specifically with chinook and fall chum salmon stocks, the two transboundary species.

A significant percentage of Yukon River chinook and fall chum salmon are produced in Canadian waters. Estimates from recent studies have indicated that Alaska's average annual harvest of approximately 171,000 chinook salmon for the period 1982-1985 was composed of 43% Canadian stocks (Appendix Table 1).

An evaluation of the allocation problem requires that total run size (catch plus escapement) of each species be determined annually. Estimation of total escapement to major spawning areas has been the most difficult information to acquire thus far.

The Yukon River drainage is too extensive in size for a practical, complete escapement enumeration program during any given year. Currently, mainstem salmon enumeration projects have been unable to precisely differentiate chinook salmon from the far more abundant summer chum salmon. Further, excluding a single tributary in the lower Yukon River (Andreafsky River) and a small spawning stream in the Tanana River drainage (Clear Creek), there are no streams in the Alaskan portion of the drainage where a comprehensive enumeration program for chinook salmon escapement is conducted. Consequently, low-level, aerial surveys have been the primary method used to obtain escapement information. It has been shown however, that peak spawning abundance measured by aerial survey methods is significantly lower than actual seasonal stream population of spawners due to the die-off of early spawners and arrival of late spawners (Bevan 1961, Neilson and Geen 1981, Cousens et al. 1982, Barton 1986a). As a consequence, the existing escapement data base on chinook salmon reflects trends in escapements based upon relative abundance of spawners, but does not portray total escapement abundance.

The Chena River, one of the most important chinook salmon producing streams in the Yukon River drainage and second most important in the Tanana River drainage, was selected for study in 1986. It typifies many of the larger chinook salmon producing streams in the Alaskan portion of the drainage in terms of the relative magnitude of observed chinook salmon spawners (e.g., Andreafsky, Anvik, Nulato, and Salcha rivers).

By obtaining a total estimate of chinook salmon escapement in the Chena River, the proportion represented by a peak aerial census can be estimated. This will in turn permit expansion of past aerial survey escapement records to total abundance estimates for the Chena River as well as for other major chinook salmon spawning streams in the area which are similar in physical and hydrological nature (e.g., the

Salcha River). Funding for this study was provided in part by a federal grant in support of U.S./Canadian negotiations and in part by the State of Alaska.

OBJECTIVES

Overall objectives of the 1986 Chena River chinook salmon study were to determine timing and magnitude of chinook salmon escapement and to estimate age, sex, and size of the escapement population. The following specific objectives were identified:

1. Estimate spawning population size using tag and recapture methods.

2. Estimate the proportion of the total escapement represented by an aerial survey during peak spawning period.

3. Determine migration timing in the Chena River.

4. Estimate the age, sex, and size composition of the escapement.

5. Estimate spawner stream-life.

STUDY AREA

The Chena River is located in the Yukon Plains section of the Central Alaskan Upland and Plains Province . More specifically, it lies in the Tanana Basin, heading south and east of the White Mountains in the North Plateau Province, through which it flows in a westerly direction for approximately 150 miles draining an area of approximately 1,980 square miles (Frey et al. 1970, Anderson 1970) (Figure 1).

The river is a typical non-glacial, snow melt, subarctic stream of interior Alaska. Low flows occur in winter during freeze-up after which, a gradual increase occurs in spring prior to breakup. Although, high flows may occur anytime during the open-water season due to precipitation, peak flows generally occur at breakup as the winter snow melts. Frey et al. (1970) point out this period of high flow from snow melt generally lasts for about 2 weeks. Although average annual precipitation is low, runoff in streams in the region is generally significant due to a reduced infiltration rate as a result of wet permafrost and low evaporation and transpiration rates (LaPerriere 1980).

Fairbanks is located on the flood plain of the Chena and Tanana rivers. The town sustained excessive flood damage in August 1967. The peak discharge of 74,400 cfs on the Chena River in Fairbanks on 15 August of that year was more than three times the previous maximum discharge of record (Childers et al. 1972). As a result of the 1967 flood, the Chena River Lakes Project was authorized by the Flood Control Act of 1968, part of which included construction of Moose Creek Dam (MCD) by the Army Corps of Engineers at rivermile 45 of the Chena River.

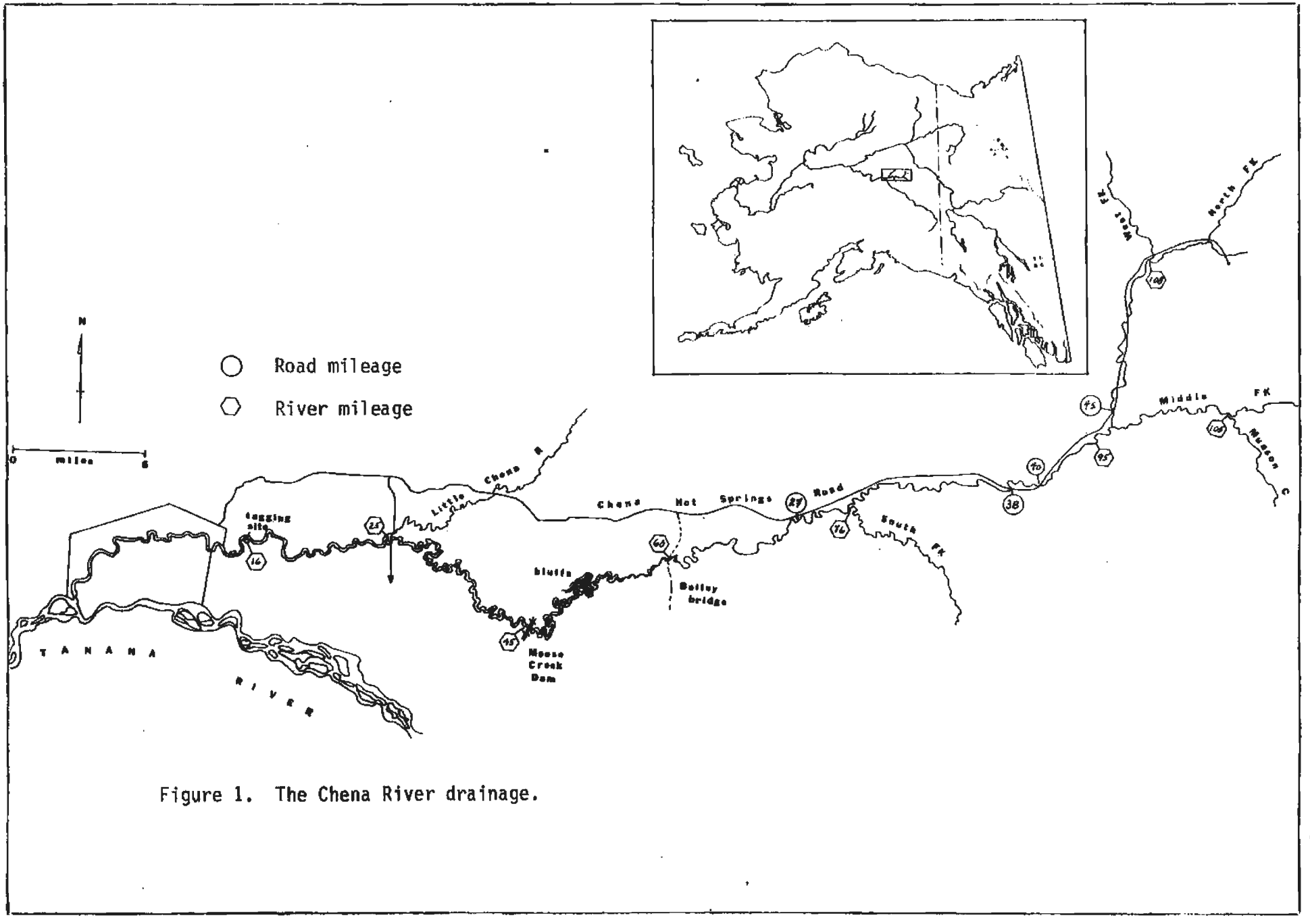

Figure 1. The Chena River drainage.

Both chinook and summer chum salmon spawn in the Chena River and the majority of both species spawns upstream of MCD. Whereas Chena River chum salmon migrate to sea in the spring following the year in which they spawn, chinook salmon over-winter for one year (infrequently two) in fresh water prior to their seaward migration. Williamson (1984) found peak outmigrations in the Chena River of each species to occur in May in the year of smolting. Thus, the seaward migrations of each species is generally associated with spring breakup high flows.

MATERIALS AND METHODS

Chinook Salmon Capture and Tagging

Two mesh size set gillnets (5-3/4 and 8-1/4 inch stretch measure) were fished daily at rivermile 16 of the Chena River to collect chinook salmon for tagging (Figure 2). Gillnets are are known to be very selective (Ricker 1975) and it was hoped that these two mesh sizes would cover the size range of the population. Each net fished measured 50 feet long by 15 feet deep and was constructed of multifilament nylon with half-inch braided filament core floatlines and oval grommeted floats. Leadlines were approximately 110 pounds per 100 fathoms.

Two gillnets of each mesh size were fished daily in eddys at four sites at the tagging location. Daily records were maintained documenting the duration of each gillnet set by mesh size and resulting catch by species.

A two-person crew monitored gillnets continually by tying a boat off to a bouy in mid-river. When a fish was captured in a net, as evidenced by bobbing cork(s) in the float line, the crew pulled alongside the net, removed the fish and placed it in a 25 gallon holding tank in the riverboat.

All chinook and chum salmon captured were sexed by external examination and measured from mid-eye to fork-of-tail to the nearest five millimeters. A numbered metal locking jaw tag was secured to the left jaw of each chinook salmon captured. No chum salmon were tagged. The adipose fin was removed from all salmon captured to identify recaptures and estimate tag loss in the case of chinook salmon on subsequent surveys. Upon completion of sampling (and tagging in the case of chinooks), all salmon were placed into a four foot square holding pen which was constructed in the river using metal "T" stakes and 1- by 2-inch cattle fencing. There, fish were held and subsequently released once they had recovered form the stress of handling. All releases were made approximately 100 yards upstream of the test fishing site.

Tag Recovery

Spawning ground surveys were conducted by riverboat to examine chinook salmon carcasses for tags. A 10-mile stretch of river between rivermile 65 and Hodgins Slough (rivermile 75), a major chinook salmon spawning area, was intensely examined on a daily basis subsequent to

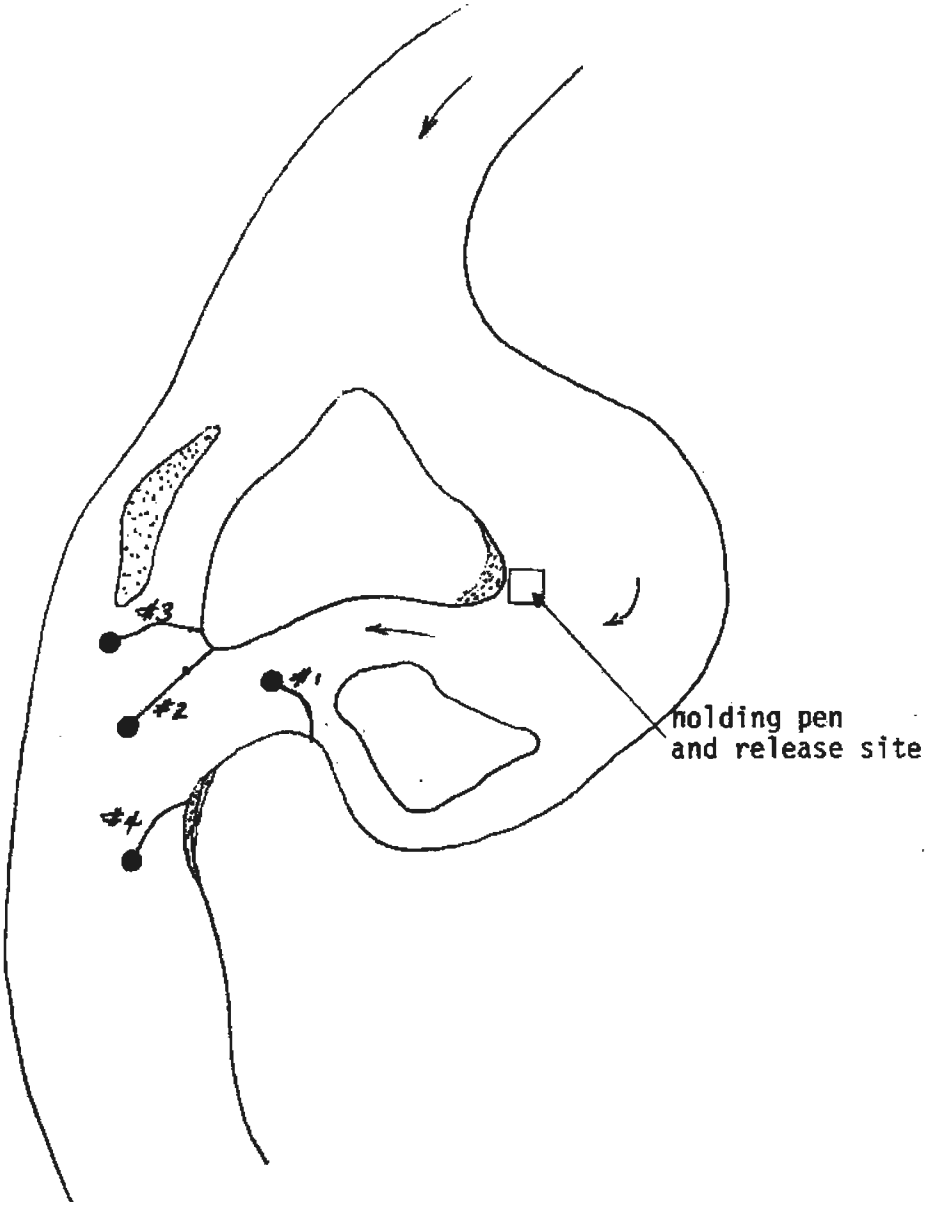

Figure 2. Gillnet fishing sites at rivermile 16 of the Chena River, 1986.

the test fishing portion of the study. The number of live and dead salmon was recorded on each survey. All chinook salmon carcasses were collected, examined for tags and clipped adipose fins, sexed by external examination, and measured from mid-eye to fork-of- tail to the nearest 5 millimeters. All tags were removed and the date, recovery location, and tag number carefully recorded on each survey. All recovered salmon carcasses were deposited on gravel bars to prevent resampling on subsequent surveys.

A final survey of the Chena River between the confluence of the Middle Fork and MCD was conducted by riverboat subsequent to major chinook salmon die-off. All chinook salmon carcasses were collected and examined for tags or clipped adipose fins. As on previous surveys all chinook salmon carcasses collected were sexed and measured.

Additional biological sampling associated with spawning ground surveys included collecting scales (3 per fish) from a subsample of chinook salmon to determine age composition and to provide samples for use in subsequent stock separation studies based upon scale pattern analysis (SPA).

Population Estimate

A population estimate of chinook salmon was made using an adjusted Petersen estimator which gives an unbiased estimate in most situations (Chapman 1951, cited in Ricker 1975). Its variance was calculated as per Seber (1982):

Population was estimated as:

$$N = ((M + 1)(C + 1)/(R + 1)) - 1$$

Its variance was estimated as:

$$V(N) = (M + 1)(C + 1)(C - R)(M - R)/((R + 1)^2 (R + 2))$$

Where:
- N = Size of population at time of tagging
- M = Number of fish marked
- C = Number examined for tags
- R = Number of recaptured marks

Approximate 95% confidence limits for the population estimate were determined as follows:

$$N \ (\pm) \ 1.96 \sqrt{V(N)}$$

To evaluate the effect of marking and recapturing with selective gear, goodness-of-fit tests (Chi-square) were conducted to detect significant differences in the recovery rate among different length categories or between sexes. Further, to investigate if fish passed the tagging site outside the tagging period, a goodness-of-fit test was conducted to detect differences in the recovery rate among recovery strata. All Chi-square tests were conducted at the $\alpha = 0.05$ level of significance.

Aerial Surveys

Attempts were made to survey the Chena River spawning areas by single engine, fixed-wing aircraft throughout the chinook salmon spawning season. The number of live and dead salmon by species was recorded as well as survey conditions and overall survey effectiveness (i.e., a subjective rating of overall survey quality as good, fair, or poor). Counts were recorded by river index area for each survey flown:

- Downstream of Moose Creek Dam
- Moose Creek Dam to confluence of South Fork
- Confluence of South Fork to confluence of Middle Fork
- Confluence of Middle Fork to confluence of West Fork
- Middle Fork from mouth upstream to confluence of Munson Cr

The primary index area for assessing whether or not the chinook salmon escapement objective (1,000 - 1,700) is met in the Chena River is that portion of the mainstem river between MCD and confluence of the Middle Fork. The escapement objective is based upon aerial survey index estimates which do not represent total escapement, but do reflect annual spawner abundance trends when using standard survey methods under acceptable survey conditions.

RESULTS

Chinook Salmon Capture and Tagging

Fishing at rivermile 16 was initiated on 8 July and terminated on 23 July. Few fish were captured after 20 July due to high river level from recent heavy rains. Figure 3 and Appendix Table 2 show mean daily discharge for July through August at the USGS gauging station located immediately downstream of Moose Creek Dam. Two peaks in discharge are shown for this period; on 22 July and 25 August.

Gillnets were initially fished at 4 sites in the river at rivermile 16 (see Figure 2). Site 1 was abandoned after 13 July because of debris problems experienced there. A total of 3 chinook salmon were captured at site 1.

Gillnets were initially fished 7 to 8 hours per day until catches started to build in mid July. At that time fishing time was increased to 13 to 24 hours daily to insure tagging was conducted during the peak of the chinook salmon run. A total of 529 chinook and 337 summer chum salmon were captured (Table 1). Other species captured during the tagging portion of these studies included 4 sheefish.

The small mesh or chum gear (5-3/4 inch gillnets) was effective in capturing both chum and chinook salmon. This gear accounted for 58% of the total chinook salmon captured and 97% of the chum salmon captured. However, of the chinook salmon captured, 78% were males while 82% of the chum salmon captured in the small mesh gear were males. The larger, chinook gear (8-1/4 inch mesh gillnets) captured approximately 42% of the chinook salmon, of which 42% were males. Only 9 male chum salmon were captured in the large mesh nets.

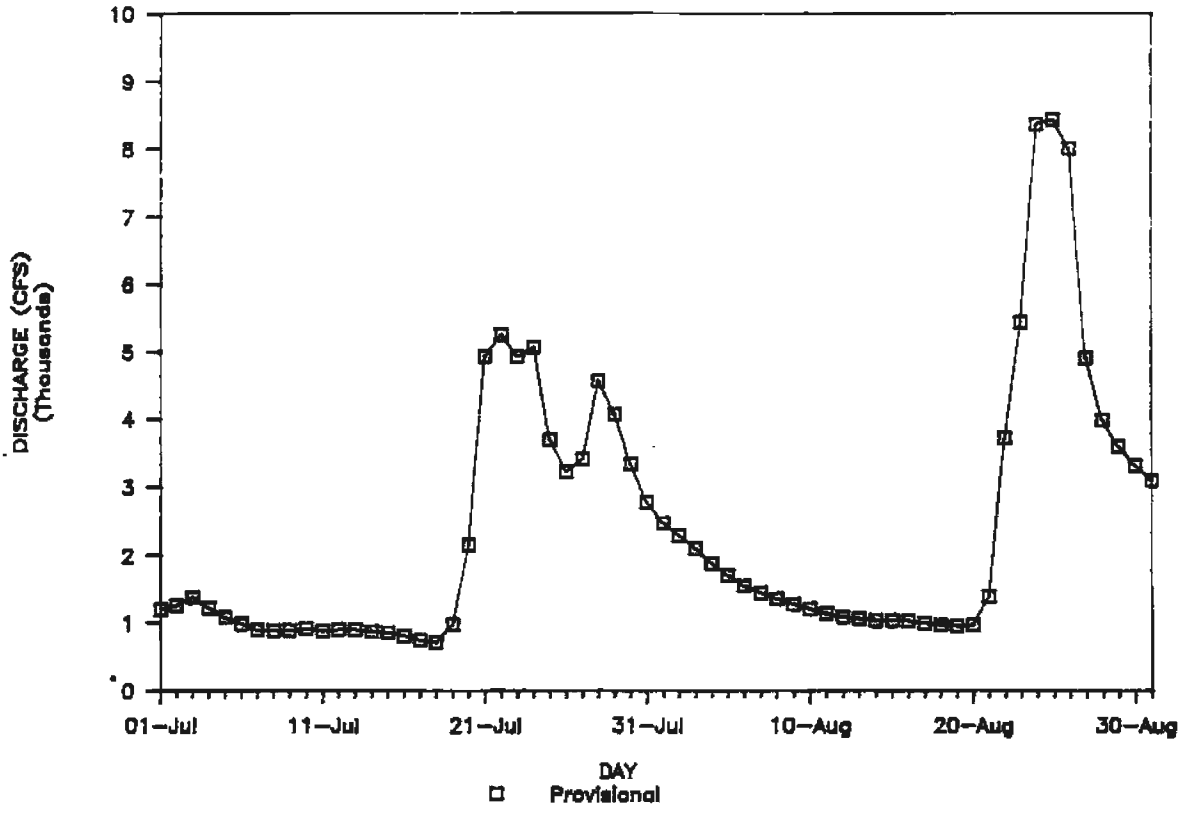

Figure 3. Mean daily discharge of the Chena River in July and August at the USGS gauging station below Moose Creek Dam, 1986.

Table 1. Daily gillnet catch records (by mesh size) in the Chena River, 1986.

Date	Site Number	Mesh Size	Fishing Time: Time Set	Fishing Time: Time Pulled	Fishing Time: Duration Minutes	Fishing Time: Duration Hours	Chinook Salmon: Male	Chinook Salmon: Female	Chinook Salmon: Total	Chum Salmon: Male	Chum Salmon: Female	Chum Salmon: Total	Remarks
08-Jul	1	5.75	1520	1640	80	1.3	0	0	0	0	0	0	debris problems
09-Jul	1	5.75	0840	1300	258	4.3	1	1	2	0	0	0	relocated net at 1300 - 1 chinook mort
10-Jul	1	5.25	0845	1810	565	9.4	1	0	1	0	0	0	debris problems
11-Jul	1	5.25	0820	1645	495	8.3	0	0	0	0	0	0	relocated net
12-Jul	1	5.25	0830	1300	270	4.5	0	0	0	0	0	0	tried drifting net no luck
13-Jul	1	5.25	0645	1600	555	9.3	0	0	0	0	0	0	
							2	1	3	0	0	0	
08-Jul	2	5.25	1422	1620	118	2.0	0	0	0	0	0	0	fishes well
09-Jul	2	5.25	0900	1830	570	9.5	0	0	0	0	0	0	
10-Jul	2	5.25	0820	1820	600	10.0	2	0	2	0	0	0	
11-Jul	2	5.25	0815	1700	525	8.8	1	3	4	0	0	0	
12-Jul	2	5.25	0815	1445	390	6.5	2	1	3	0	0	0	
13-Jul	2	5.25	0515	1610	655	10.9	5	9	14	0	0	0	
14-Jul	2	5.25	0530	1345	475	7.9	7	5	12	0	0	0	
15-Jul	2	5.25	0600	2359	765	12.8	7	11	18	0	0	0	
16-Jul	2	5.25	0001	2359	1440	24.0	24	44	68	2	0	2	2 chinook recap
17-Jul	2	5.25	0001	2359	1135	18.9	26	24	50	2	0	2	1 chinook recap, switched net (repair)
18-Jul	2	5.25	0001	1300	780	13.0	10	24	34	3	0	3	
19-Jul	2	5.25	0615	1335	440	7.3	6	4	10	1	0	1	
20-Jul	2	5.25	0830	1530	420	7.0	2	1	3	1	0	1	1 chinook recap
21-Jul	2	5.25	—	—	0	0.0							
22-Jul	2	5.25	—	—	0	0.0							
23-Jul	2	5.25	0810	1315	305	5.1	1	0	1	0	0	0	water up 5 feet
							93	125	219	9	0	9	
08-Jul	3	5.75	1538	1650	72	1.2	1	0	1	0	0	0	1 chinook mort; 1 sheefish
09-Jul	3	5.75	0830	1835	605	10.1	4	3	7	1	0	1	
10-Jul	3	5.75	0815	1830	615	10.3	8	3	11	1	0	1	1 chinook mort
11-Jul	3	5.75	0810	1635	525	8.8	5	2	7	5	1	6	
12-Jul	3	5.75	0820	1430	390	6.5	10	0	10	1	0	1	
13-Jul	3	5.75	0510	1615	665	11.1	17	6	23	3	2	5	1 chinook mort
14-Jul	3	5.75	0545	1340	475	7.9	11	1	12	2	2	4	
15-Jul	3	5.75	0605	1350	790	13.2	16	1	17	25	5	30	1 chum recap
16-Jul	3	5.75	0001	2359	1420	23.7	24	7	31	31	5	36	1 chinook + 1 chum mort; 1 chinook + 4 chum recap; 2 sheefish
17-Jul	3	5.75	0001	1335	1145	19.1	12	5	17	59	9	68	1 chum mort; 1 chinook + 1 chum recap; 1 sheefish
18-Jul	3	5.75	0001	1310	790	13.2	16	10	26	32	8	40	1 chinook + 2 chum mort; 1 chinook + 1 chum recap
19-Jul	3	5.75	0610	1340	450	7.5	6	2	8	11	3	14	1 chinook mort
20-Jul	3	5.75	0820	0940	80	1.3	0	0	0	1	0	1	high water
							130	40	170	172	35	207	
09-Jul	4	5.75	1320	1840	320	5.3	1	1	2	0	0	0	
10-Jul	4	5.75	0810	1805	595	9.9	2	2	4	2	0	2	1 chum mort
11-Jul	4	5.75	0825	1650	505	8.4	10	2	12	1	0	1	moved net upstream 20 feet
12-Jul	4	5.75	0825	1510	405	6.8	5	1	6	4	0	4	1 chum recap
13-Jul	4	5.75	0505	1620	675	11.3	19	3	22	2	0	2	1 chinook mort
14-Jul	4	5.75	0535	1335	480	8.0	9	3	12	3	2	5	
15-Jul	4	5.75	0610	1350	775	12.9	20	1	21	12	6	18	3 chinook + 1 chum mort; 1 chinook + 2 chum recap
16-Jul	4	5.75	0001	2359	1420	23.7	18	5	23	17	4	21	2 chinook + 3 chum mort; 2 chum recap **
17-Jul	4	5.75	0001	1305	1075	17.9	12	7	19	35	6	41	3 chum mort; 1 chinook + 4 chum recap
18-Jul	4	5.75	—	—	0	0.0							
19-Jul	4	5.75	0730	1330	360	6.0	5	2	7	13	4	17	3 chum recap
20-Jul	4	5.75	0840	1540	420	7.0	9	0	9	8	2	10	1 chinook mort; 1 chinook recap
							110	27	137	97	24	121	
				Grand Total			333	194	529	278	59	337	

** Leadline was wrapped around corkline for 20 minutes.

A total of 10 chinook and 19 chum salmon were recaptured in test nets during the tagging portion of these studies. Recaptures were invariably those few salmon which had been released without having first spent time in the holding pen to recuperate. Mortalities which occurred during the test fishing portion of these studies were 14 chinook (2.6%) and 12 chum salmon (3.6%).

A total of 515 chinook salmon [324 males (63%); 191 females (37%)] were successfully measured for length, sexed, tagged, fin-clipped and released over the period 8-23 July. The first release was made on 9 July. The number of chum salmon which were sexed, measured, fin-clipped and released totaled 330 (269 males; 61 females).

There was little overlap in the length frequency distributions of chinook salmon catches from the two mesh-sized gillnets (Figures 4 and 5). Chum salmon catch by sex and mesh size is shown in Table 1 while length frequency distributions are shown in Figure 6.

Tag Recovery

Daily surveys of a major spawning area between rivermile 65 and 75 were conducted during the period 31 July through 12 August to estimate chinook salmon stream life in the Chena River (Table 2). In addition, two stretches of river in the vicinity of rivermiles 100 and 45 were examined on 6 and 9 August, respectively.

A total of 35 fish still retaining jaw tags was recovered (Table 3). Average time spent between dates of tagging and recovery was approximately 21 (20.94) days. The difference in time of recovery between sexes was negligible: 20.75 days for females and 21.11 days for males.

A final survey was attempted by riverboat of the Chena River on 18 and 19 August from approximately 3 rivermiles up the Middle Fork, downstream to MCD (rivermile 45). However, the survey ended at approximately rivermile 72 of the mainstem Chena River near 27-Mile Campground due to outboard motor problems, heavy rains, and a rapidly rising river level.

A season total of 1,561 chinook salmon carcasses was examined for tags. Lengths were taken on 1,338 of these fish and sex recorded for 1,352, while 208 were neither sexed nor measured. A subsample of 832 were scale sampled for subsequent aging. The male to female ratio was 1.00:0.34 (25.4% females and 74.6% males) based upon 721 chinook salmon analyzed for ages. By comparison, a sex ratio of 1.00:0.37 (27% females and 73% males) was obtained from the total sample of 1,352 chinook salmon sexed during the spawning ground surveys.

Scale age determination indicated that chinook salmon were represented by 8 age groups from 6 brood years (Table 4). Nearly 48% of the sample was 5-year-old males (1.3's) from the 1981 brood year. By comparison, females were primarily represented (≅14%) by 6-year-olds (1.4's) from the 1980 brood year. The most abundant age groups for

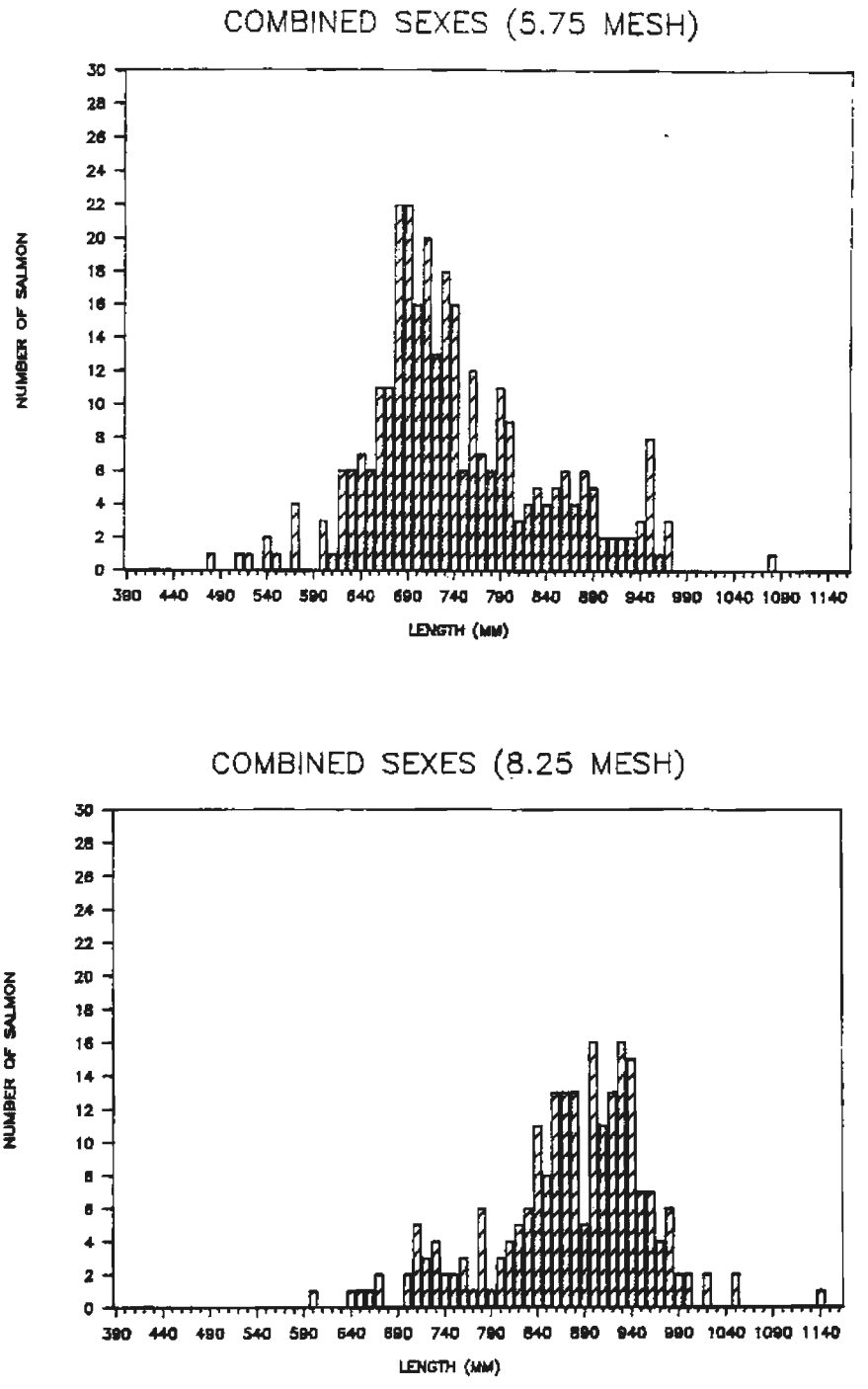

Figure 4. Length frequency distributions of chinook salmon captured in two mesh size gillnets at rivermile 16 of the Chena River, 8-23 July 1986.

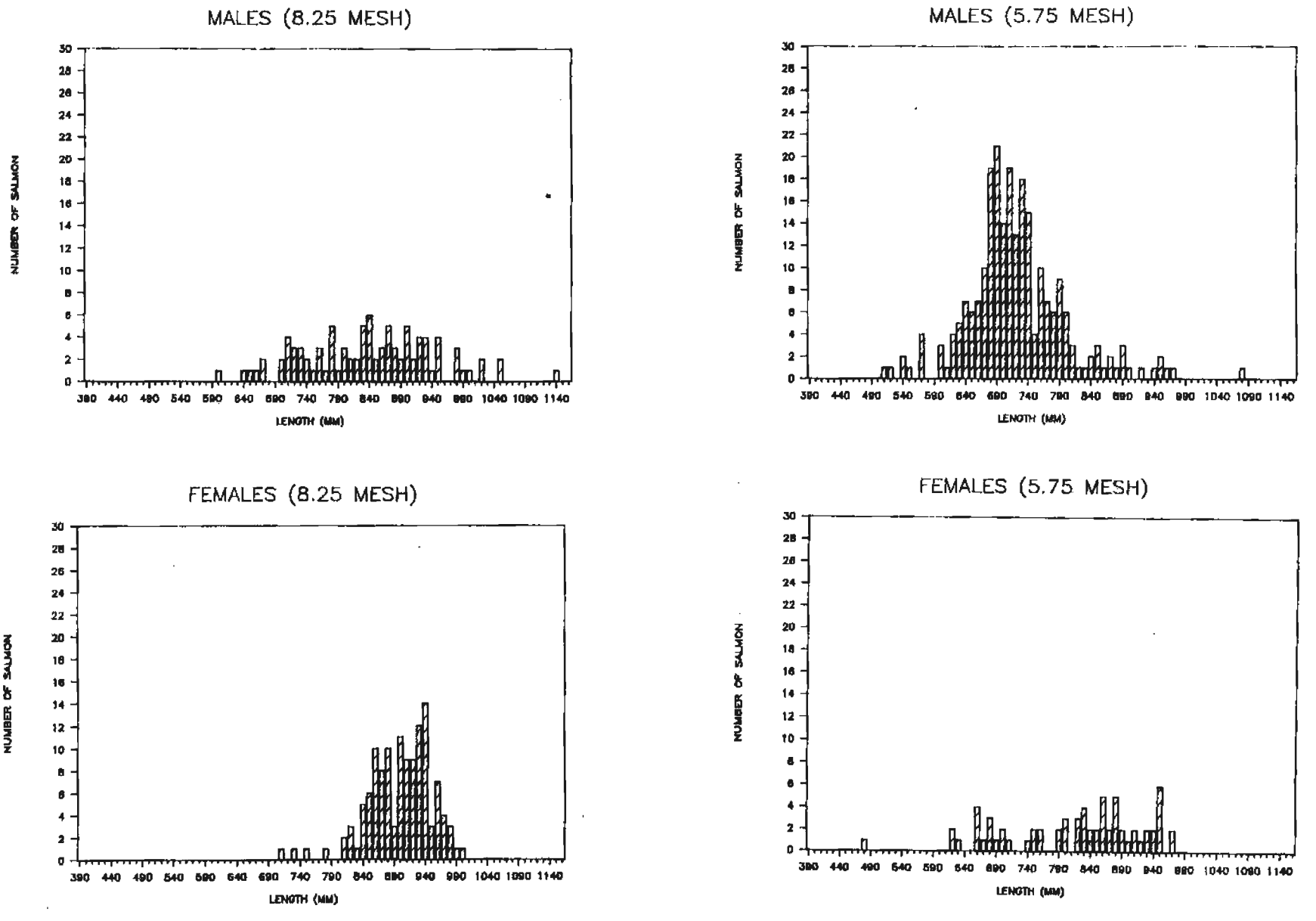

Figure 5. Length frequency distributions of chinook salmon (by sex and mesh size) captured in gillnets at rivermile 16 of the Chena River, 8-23 July 1986.

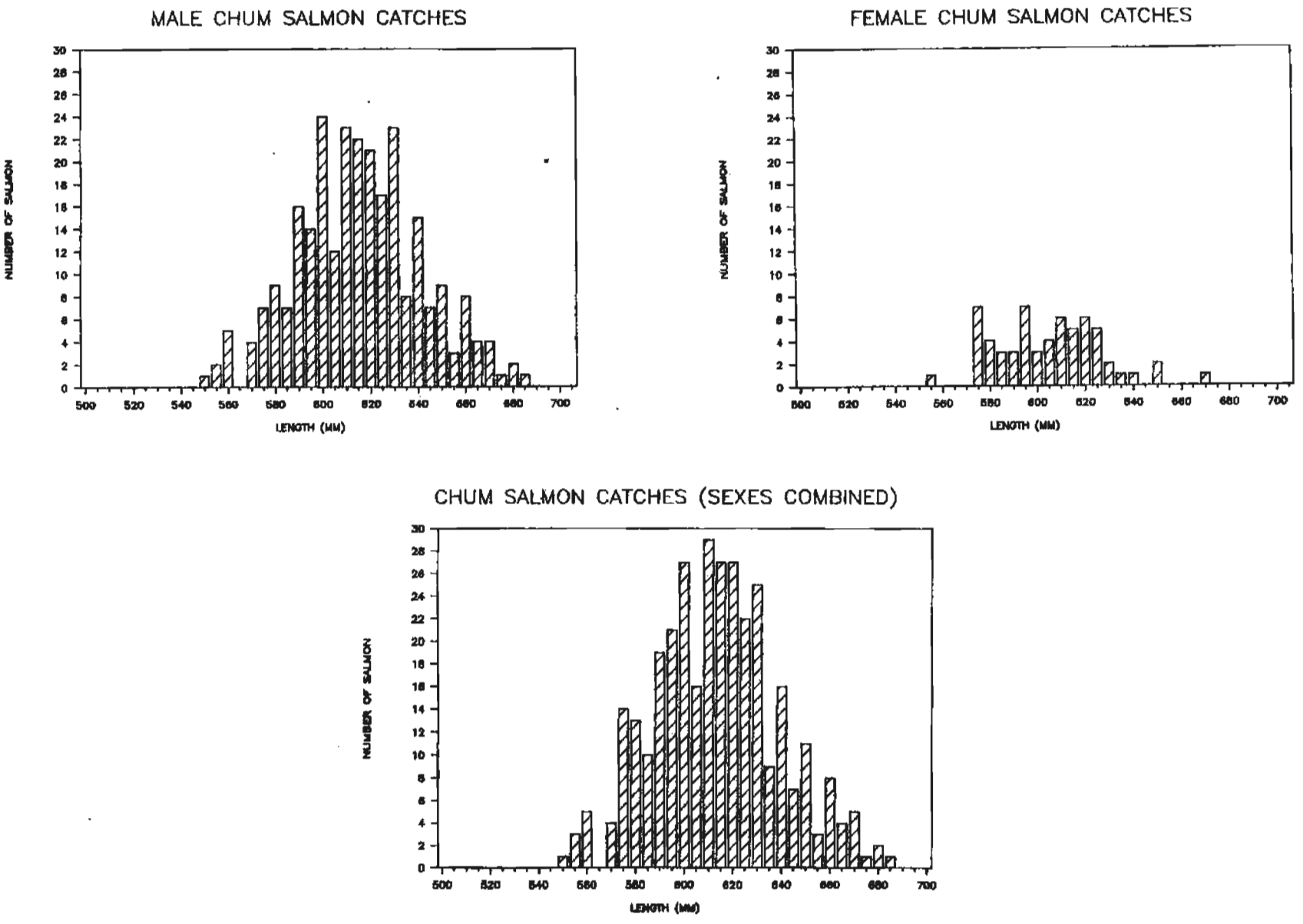

Figure 6. Length frequency distributions of chum salmon captured in gillnets at rivermile 16 of the Chena River, 8-23 July 1986.

Table 2. Daily riverboat survey results for chinook and chum salmon in the Chena River between rivermile 65 and 75 in 1986.

	Chinook Salmon					Chum Salmon				
Date	Live	Dead	Cum Dead	Number Scale-Sampled	Number Marked Carcasses a	Live	Dead	Cum Dead	Area Surveyed	Remarks
31-Jul	16	21	21	21	0	0	1	1	Theiss Cabin-Hodgins Sl	Poor - murky water
01-Aug	76	33	54	33	1	32	1	2	Theiss Cabin-Hodgins Sl	Poor - murky water
02-Aug	162	22	76	22	1	35	1	3	Theiss Cabin-Hodgins Sl	Fair, Poor - sunny
03-Aug	312	72	148	72	7	53	2	5	Theiss Cabin-Hodgins Sl	Fair, Poor - sunny
04-Aug	412	109	257	109	8	142	8	13	Theiss Cabin-Hodgins Sl	Fair, Poor - sunny
05-Aug	533	100	357	100	7	203	7	20	Theiss Cabin-Hodgins Sl	Fair - 30% CC
06-Aug	501	105	462	278 b	2	311	14	34	Theiss Cabin-Hodgins Sl	Fair, Good - 20% CC
07-Aug	295	171	633	18	11	364	41	75	Theiss Cabin-Hodgins Sl	Fair, Good - 20% CC
08-Aug	216	109	742	0	3	621	54	129	Theiss Cabin-Hodgins Sl	Fair - 80% CC
09-Aug	152	105	847	179 c	1	436	68	197	Theiss Cabin-Hodgins Sl	Fair - 90% CC
10-Aug	122	103	950	0	0	763	62	259	Theiss Cabin-Hodgins Sl	Fair - 90% CC
11-Aug	77	91	1,041	0	1	702	117	376	Theiss Cabin-Hodgins Sl	Fair - 60% CC
12-Aug	27	35	1,076	0	0	492	82	458	Theiss Cabin-Hodgins Sl	Poor - shwrs 100% CC
18-Aug	0	0	1,076	0	0	0	0	458	Upstr East Fk to 3 Mi	Poor - rain, 100% CC
18-Aug	0	26	1,102	0	0	0	147	605	East Fk - 2nd Bridge	Poor - rain, 100% CC
18-Aug	0	2	1,104	0	1	0	52	657	2nd Bridge - 1st Bridge	Poor - rain, 100% CC
19-Aug	0	49	1,153	0	1	0	484	1,141	1st Bridge - Hodgins Sl	Poor - shwrs 100% CC
19-Aug	0	1	1,154	0	0	0	34	1,175	Hodgins Sl - 27 Mi Campgd	Poor - 100% CC
TOTAL			1,154	832	44 d			1,175		

a All marked fish (tagged and/or clipped) recovered by field crew.

b 50 of these scale samples taken by Commercial Fish and 228 by Sport Fish.

c All 179 of these scale samples taken by Sport Fish.
Total number of chinook salmon sampled for scales = 832 (425 by Comm Fish and 407 by Sport Fish)

d 25 of these 44 recoveries had tags; an additional 10 tagged and 6 fin-clipped fish were recovered by the Sport Fish Division for a total of 60 marked fish (35 tagged and 25 fin-clipped).

Table 3. Recovery record of marked chinook salmon in the Chena River, 1986.

Recovery of TAGGED fish only

Number		Tag Number	Sex	Length	Tag Date	Recovery Date	Time (days)	Approx Distance (if known)	Miles Per Day
1		4634	F	810	18-Jul	03-Aug	16	54	3.4
2		4681	M	725	19-Jul	04-Aug	16	54	3.4
3		4560	F	940	17-Jul	03-Aug	17	54	3.2
4		4637	F	930	18-Jul	04-Aug	17	54	3.2
5		4356	M	680	15-Jul	03-Aug	19	54	2.8
6		4386	M	695	15-Jul	03-Aug	19	54	2.8
7		4391	M	780	15-Jul	03-Aug	19	54	2.8
8		4500	M	770	16-Jul	04-Aug	19	54	2.8
9		4521	F	880	16-Jul	04-Aug	19	54	2.8
10	*	4642	F	950	18-Jul	06-Aug	19	74	3.9
11		4151	M	690	12-Jul	01-Aug	20	54	2.7
12		4314	F	890	14-Jul	03-Aug	20	54	2.7
13		4378	M	775	15-Jul	04-Aug	20	54	2.7
14		4393	M	695	15-Jul	04-Aug	20	54	2.7
15		4426	M	720	16-Jul	05-Aug	20	54	2.7
16	*	4551	M	660	17-Jul	06-Aug	20	74	3.7
17		4303	M	780	13-Jul	03-Aug	21	54	2.6
18	*	4459	M	700	16-Jul	06-Aug	21	74	3.5
19		4654	F	925	18-Jul	08-Aug	21	54	2.6
20	*	4683	F	620	19-Jul	09-Aug	21	29	1.4
21		4111	F	675	11-Jul	02-Aug	22	54	2.5
22		4134	M	815	13-Jul	04-Aug	22	54	2.5
23		4515	F	930	16-Jul	07-Aug	22	54	2.5
24		4516	F	835	16-Jul	07-Aug	22	54	2.5
25		4528	F	960	17-Jul	08-Aug	22	54	2.5
26		4667	F	965	18-Jul	09-Aug	22	54	2.5
27	*	4565	M	730	17-Jul	09-Aug	23	29	1.3
28	*	4596	M	710	17-Jul	09-Aug	23	29	1.3
29	*	4607	F	475	17-Jul	09-Aug	23	29	1.3
30	*	4171	M	770	13-Jul	06-Aug	24	74	3.1
31	*	4198	M	615	13-Jul	06-Aug	24	74	3.1
32		4310	M	650	14-Jul	07-Aug	24	54	2.3
33		4389	F	880	15-Jul	08-Aug	24	54	2.3
34		4167	F	940	13-Jul	07-Aug	25	54	2.2
35	*	4166	M	710	13-Jul	09-Aug	27	29	1.1
	10					AVG =	20.94	AVG =	2.60
					MIN =	11-Jul	01-Aug	MIN =	1.1
					MAX =	19-Jul	09-Aug	MAX =	3.9

* Recovered by the Sport Fish Division.

Recovery of UNTAGGED fish only

Number		Tag Number	Sex	Length	Tag Date a	Recovery Date
1			M	665	14-Jul	04-Aug
2			F	850	15-Jul	05-Aug
3			M	725	15-Jul	05-Aug
4			M	695	15-Jul	05-Aug
5			M	815	15-Jul	05-Aug
6			M	895	15-Jul	05-Aug
7			M	695	15-Jul	05-Aug
8			F	940	16-Jul	06-Aug
9			F	—	16-Jul	06-Aug
10	*		M	840	16-Jul	06-Aug
11	*		M	610	16-Jul	06-Aug
12			M	—	17-Jul	07-Aug
13			M	—	17-Jul	07-Aug
14			M	—	17-Jul	07-Aug
15			M	—	17-Jul	07-Aug
16			M	—	17-Jul	07-Aug
17			M	—	17-Jul	07-Aug
18			M	—	17-Jul	07-Aug
19	*		M	710	19-Jul	09-Aug
20	*		M	820	19-Jul	09-Aug
21	*		M	990	19-Jul	09-Aug
22	*		M	790	19-Jul	09-Aug
23			M	965	20-Jul b	11-Aug
24			F	840	17-Jul b	18-Aug
25			F	805	16-Jul b	19-Aug

* Recovered by the Sport Fish Division.

a Tag date is estimated by subtracting 21 days from recovery date.

b Tag date estimated from size and sex of fish recovered compared to size and sex of fish captured in test nets.

Table 4. Age and sex composition (percent) of chinook salmon in the Chena River, 1986.

Sample Size		Brood Year and Age Group a									
		1983	1982	1981		1980		1979		1978	
		1.1	1.2	1.3	2.2	1.4	2.3	1.5	2.4	2.5	Total
183	Females	0.0	0.2	3.6	0.0	13.9	0.0	7.7	0.1	0.1	25.4
538	Males	0.1	9.3	47.6	0.0	14.7	1.4	1.5	0.0	0.0	74.6
721	Combined	0.1	9.3	51.2	0.0	28.5	1.5	9.2	0.1	0.1	100.0
	S.E. b	1	8	14		12	3	8	1	1	

a Age is designated as European: number of freshwater annuli followed by number of saltwater annuli.
b Standard Error

sexes combined were 51.2% age 1.3; 28.5% age 1.4; 9.3% age 1.2; and 9.2% age 1.5. Less than 2% of the samples aged possessed 2 freshwater annuli.

Sexual dimorphism in size of Chena River chinook salmon is illustrated in Table 5. Females were substantially larger than males for a given age. Figure 7 presents length frequency distributions from carcass surveys.

A total of 60 marked chinook salmon (39 males and 21 females) was recovered; 35 with tags and 25 which had lost tags but were identified by a clipped adipose fin. This represents an overall tag loss of 41.6%. Tag loss for males was greater than for females: 51.2% versus 23.8%. An additional 7 tags were returned by sport fishermen but these fish were not included for the population estimate as creel census data were not collected from the Chena River sport fishery in 1986 to estimate the total sport harvest.

Aerial Surveys

Three aerial surveys were flown of the Chena River in 1986 to enumerate salmon escapement. Surveys were flown on 17 July, 1 August, and 4 August. The first survey on 17 July was rated fair and a total of 1,111 chinook and 14 chum salmon were observed. Only live fish were seen on this survey. The distribution of chinook salmon was as follows:

. MCD to South Fork - 257 (23%)
. Confluence South Fork to confluence Middle Fork - 785 (71%)
. In Middle Fork upstream to Munson Creek - 69 (6%)

The 1 August survey was rated poor due to very dark stained water from the heavy rains which occurred in late July. Only 346 live chinook salmon were counted with an additional 108 carcasses observed along gravel bars or in extremely shallow water. A total of 544 live chum salmon were also observed on this survey between MCD and confluence of the Middle Fork.

The best survey of the season was obtained on 4 August which was given an overall rating of "fair". This less than "good" rating was given as it was estimated that approximately 40% of the middle of the river downstream of the South Fork was obscured by dark stained water. A total of 2,031 chinook salmon (1,495 live and 536 dead) was counted as follows:

. MCD to South Fork - 816 (40%) Includes 29 fish in lower South Fork
. Confluence South Fork to confluence Middle Fork - 1,119 (55%)
. In Middle Fork upstream to Munson Creek - 96 (5%)

It was learned after the 4 August survey that the field crew had removed 257 chinook salmon carcasses from view prior to the date of the survey.

Table 5. Mean length at age (by sex) of chinook salmon in the Chena River, 1986. a

	Brood Year and Age Group a									
	1983	1982	1981		1980		1979		1978	
	1.1	1.2	1.3	2.2	1.4	2.3	1.5	2.4	2.5	Total
FEMALE										
Length	0	0	724	0	842	0	890	860	830	
S.E.	-	-	12.1	-	5.2	-	5.4	0	0	
Sample Size	0	0	24	0	101	0	56	1	1	183 (25.4%)
MALE										
Length	445	555	704	0	778	693	853	0	0	
S.E.	0	9.0	2.8	-	6.5	16.4	23.1	-	-	
Sample Size	1	68	342	0	106	10	11	0	0	538 (74.6%)
										721 (100%)

a Mid-eye to fork-of-tail length in millimeters; S.E. is standard error.

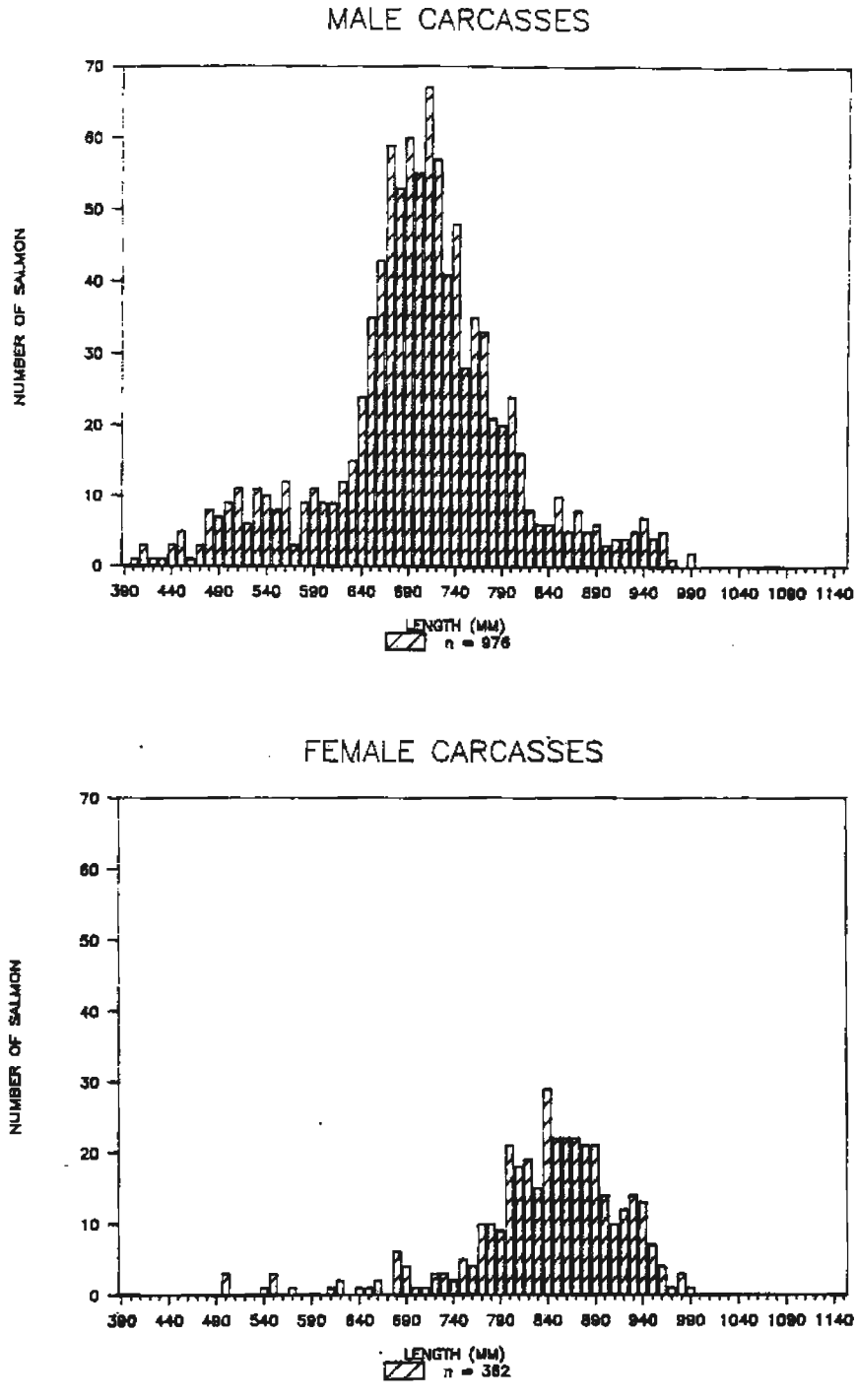

Figure 7. Length frequency distributions of male and female chinook salmon carcasses sampled in the Chena River, 31 July-19 August 1986.

Weather and/or Chena River water conditions were never conducive for conducting more aerial surveys in 1986 during the chinook salmon spawning season.

DISCUSSION

A total of 515 chinook salmon were tagged and released over the period 8-23 July of which 60 were recovered from the spawning ground from 31 July through 18 August. Although there was little overlap in the length frequency distributions of chinook salmon catches from the two mesh sizes fished, gillnets are known to be very size selective. However, carcass surveys conducted through time are thought not to be size selective though availability of carcasses could differ between sexes due to different spawning behavior and redd defense resulting in different wash out patterns.

To evaluate the effect of marking and recapturing with selective gear, Chi-square tests were conducted to detect differences in the recovery rate among different length categories or between the sexes. A significant difference was not detected between the rate of recovery among length categories (Table 6 and Figure 8) or between sexes (Table 7). There was no need to stratify by sex or size in deriving a population estimate.

There was some concern that when tagging was suspended due to high water conditions, some portion of the run had yet to enter the river as set net CPUE was still high (Figure 9). The CPUE was fairly high at site 3 when fishing began on 8 July and both site 3 and 4 maintained fairly constant catch rates throughout the tagging period. By comparison, CPUE in the large mesh gear at site 2 was more normally distributed through time, although low CPUE after 19 July may have been due to high water conditions.

Recovery rates by time period were examined to investigate if fish passed outside the tagging period (Table 8). Recovery effort must be of a duration to completely cover the migration. The recovery rate increased from zero on 31 July to 0.1 on 3 August but made a dramatic fall and remained at a very low level after 9 August (near zero). A significant difference was detected in the rate of recovery for the carcass sampling period 31 July through 19 August (Table 9), indicating the need for stratifying through time. However, no significant difference in recovery rate for the period 31 July - 9 August was detected (Table 10); nor for the period 10-18 August (Table 11). Unfortunately, too few tags were recovered to stratify by time in order to estimate the population size using an approach by Darroch (1961, cited in Seber 1982).

Of the 60 marked chinook salmon recovered, 41.6% (25) were identified by a freshly clipped adipose fin as the jaw tag had fallen off making time of release unknown. The averaged time to recovery was approximately 21 days as estimated from the 35 marked fish which were recovered with tags in place. Recoveries with a clipped fin were lagged back 21 days from date of recovery to estimate the period of release with the exception of the three clipped fish recovered on 11,

Table 6. Goodness-of-fit test for equal probability of capture among length categories for the 1986 Chena River chinook salmon mark-recapture project. a

	Length (mm) 475-650	651-800	)800	Total
Total Marked Recovered	5	23	24	52
Total Unmarked Recovered	37	205	221	463
Total Released	42	228	245	515
Recovery Rate	0.12	0.10	0.10	
Total Chi-square (b) =	0.14 +	0.00 +	0.02 +	
	0.02 +	0.00 +	0.00 =	0.18 c

a Length measured from mid-eye to fork-of-tail. A total of 8 marked recoveries did not have length measurements.

b Arranged in order of correspondence to the above contingency table.

c Non-significant (a = .05 with 2 degrees of freedom.X^2) 5.991)

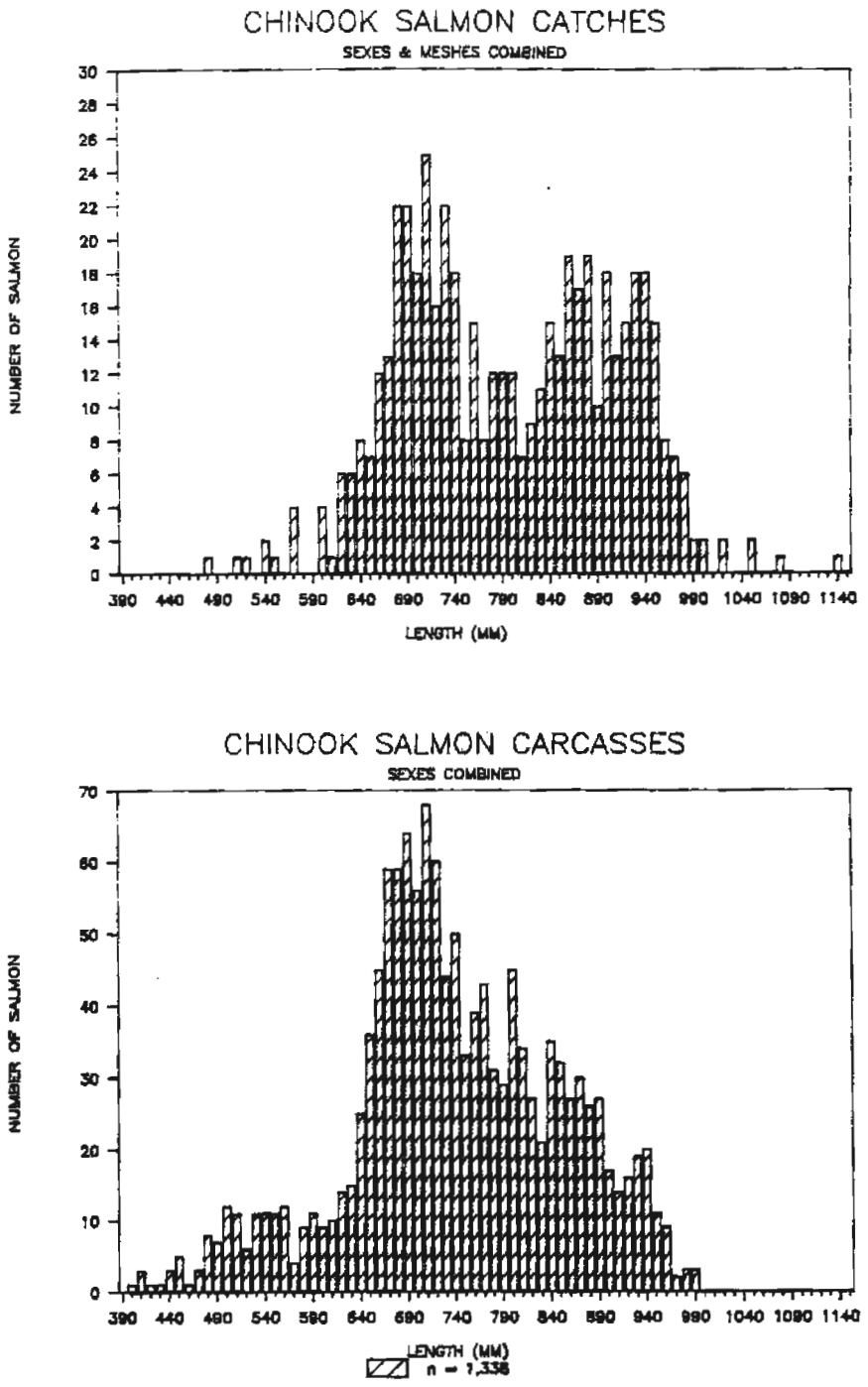

Figure 8. Comparison of length frequency distributions of chinook salmon captured at rivermile 16 (8-23 July) and chinook salmon carcasses recovered (31 July-19 August) in the Chena River, 1986.

Table 7. Goodness-of-fit test for equal probability of capture between sex categories for the 1986 Chena River chinook salmon mark-recapture project.

	Males	Females	Total
Total Marked Recovered	39	21	60
Total Unmarked Recovered	285	170	455
Total Released	324	191	515
Recovery Rate	0.12	0.11	

Total Chi-square (a) =	0.04 +	0.07 +		
	0.01 +	0.01	=	0.13 b

a Arranged in order of correspondence to the above contingency table.
b Non-significant (a = .05 with 1 degree of freedom X^2) 3.841)

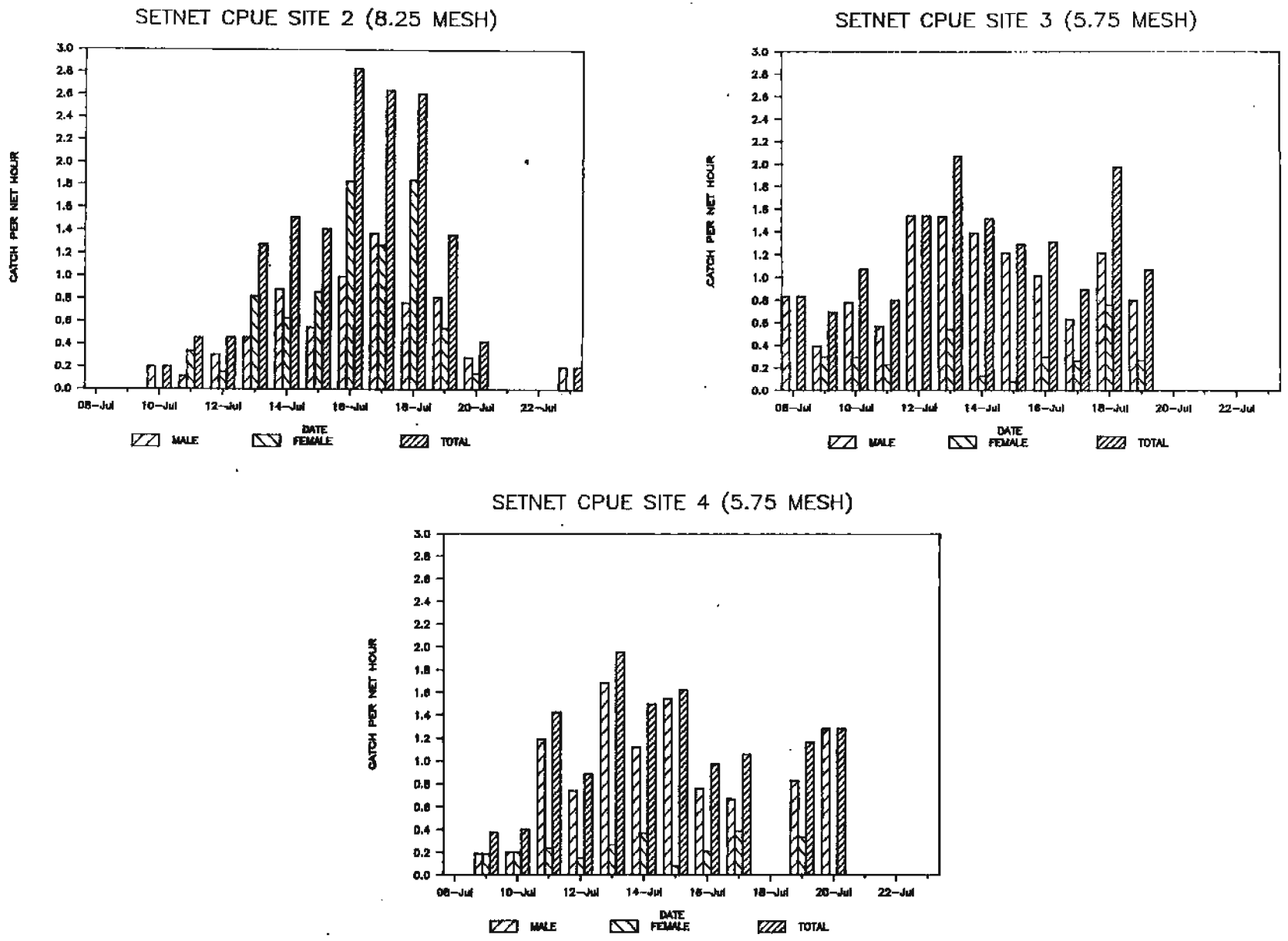

Figure 9. Catch per unit effort (CPUE) of chinook salmon captured in two mesh size gillnets at three sites (rivermile 16) of the Chena River, July 1986.

Table 8. Number of chinook salmon tagged and examined for tags in the Chena River in 1986 by release and recovery date.

Release Strata (July)	Total Released	Marked Fish Recovered		Daily Recoveries of Tagged Chinook Salmon 31 July - 18 August															Recovery Rate
		Clipped a	With Tags	31	1	2	3	4	5	6	7	8	9	10	11	12	18	19	Total	
9	10	0	0																0	0.00
10	17	0	0																0	0.00
11	23	0	1			1													1	0.04
12	19	0	1		1														1	0.05
13	57	0	6				1	1		2	1		1						6	0.11
14	36	1	2				1	1			1								3	0.08
15	53	6	6				3	2	6			1							12	0.23
16	119	5	6					2	1	5	2							1	11	0.09
17	86	8	6				1			1	7	1	3				1		14	0.16
18	59	0	5				1	1		1		1	1						5	0.08
19	24	4	2					1					5						6	0.25
20	11	1	0												1				1	0.09
21	0	0	0																0	—
22	0	0	0																0	—
23	1	0	0																0	0.00
Total Released	515																			0.12
Total Marked		25	35	0	1	1	7	8	7	9	11	3	10	0	1	0	1	1	60	
Total Unmarked				21	32	21	65	101	93	324	160	106	274	103	90	35	27	49	1,501	
Total Sampled for Tags				21	33	22	72	109	100	333	171	109	284	103	91	35	28	50	1,561	
Recovery Rate				0.00	0.03	0.05	0.10	0.07	0.07	0.03	0.06	0.03	0.04	0.00	0.01	0.00	0.04	0.02	0.04	

a Clipped recoveries represent tagged fish that were identified by a freshly clipped adipose fin.
The release date was estimated to be 21 days before the date of recovery except that the three clipped fish recovered on 11, 18, and 19 August without tags were estimated to be tagged on 16, 17, and 20 July based upon sex and length comparisons between test fishing samples and recovery samples.

Table 9. Goodness-of-fit test for equal probability of capture among recovery strata (31 Jul-19 Aug) for the 1986 Chena River chinook salmon mark-recapture project.

	Date of Recovery Strata (31 July - 19 August)															
	31	1	2	3	4	5	6	7	8	9	10	11	12	18	19	Total
Total Marked Recovered	0	1	1	7	8	7	9	11	3	10	0	1	0	1	1	60
Total Unmarked Recovered	21	32	21	65	101	93	324	160	106	274	103	90	35	27	49	1,501
Total Examined for Marks	21	33	22	72	109	100	333	171	109	284	103	91	35	28	50	1,561
Recovery Rate	0.00	0.03	0.05	0.10	0.07	0.07	0.03	0.06	0.03	0.04	0.00	0.01	0.00	0.04	0.02	

Total Chi-square (a) =	0.81 +	0.06 +	0.03 +	6.47 +	3.47 +	2.59 +	1.13 +	2.98 +	0.34 +	0.08 +	3.96 +	1.78 +	1.35 +	0.01 +	0.44 +	
	0.03 +	0.00 +	0.00 +	0.26 +	0.14 +	0.10 +	0.05 +	0.12 +	0.01 +	0.00 +	0.16 +	0.07 +	0.05 +	0.00 +	0.02 =	26.50 b

a Arranged in order of correspondence to the above contingency table.
b Significant (a = .05 with 14 degrees of freedom X^2) 23.685)

Table 10. Goodness-of-fit test for equal probability of capture among recovery strata (31 Jul-9 Aug) for the 1986 Chena River chinook salmon mark-recapture project.

	Date of Recovery Strata (31 July - 9 August)										
	31	1	2	3	4	5	6	7	8	9	Total
Total Marked Recovered	0	1	1	7	8	7	9	11	3	10	57
Total Unmarked Recovered	21	32	21	65	101	93	324	160	106	274	1,197
Total Examined for Marks	21	33	22	72	109	100	333	171	109	284	1,254
Recovery Rate	0.00	0.03	0.05	0.10	0.07	0.07	0.03	0.06	0.03	0.04	

Total Chi-square (a) = 0.95 + 0.17 + 0.00 + 4.24 + 1.87 + 1.33 + 2.49 + 1.34 + 0.77 + 0.66 +
0.05 + 0.01 + 0.00 + 0.20 + 0.09 + 0.06 + 0.12 + 0.06 + 0.04 + 0.03 = 14.48 b

a Arranged in order of correspondence to the above contingency table.
b Non-significant (a = .05 with 9 degrees of freedom X^2) 16.919)

Table 11. Goodness-of-fit test for equal probability of capture among recovery strata (10-19 Aug) for the 1986 Chena River chinook salmon mark-recapture project.

	Date of Recovery Strata (10 - 19 August)					
	10	11	12	18	19	Total
Total Marked Recovered	0	1	0	1	1	3
Total Unmarked Recovered	103	90	35	27	49	304
Total Examined for Marks	103	91	35	28	50	307
Recovery Rate	0.00	0.01	0.00	0.04	0.02	

Total Chi-square (a) = 1.01 + 0.01 + 0.34 + 1.53 + 0.54 + 0.01 + 0.00 + 0.00 + 0.02 + 0.01 = 3.86 b

a Arranged in order of correspondence to the above contingency table.
b Non-significant (a = .05 with 4 degrees of freedom X^2) 9.488)

18, and 19 August. Date of release for these three fish was estimated by comparing size and sex to test fishing records. This was because these 3 fish were recovered long after death and if lagged back 21 days the indicated release dates would have been after the test fishing portion of these studies (i.e., sometime after 23 July).

No significant difference in probability of recapture was detected among release strata (Table 12). Because of the low number of tag recaptures from the last recovery period (3 for 10-19 August) and the need to estimate date of release for 41.6% of the recoveries a population estimate stratified by time was not successfully made.

The population of Chena River chinook salmon was estimated using only recovery data from 31 July - 9 August, the period for which no significant differences in recovery rate could be detected. In addition only carcasses larger than 470 mm in length (98% of the total sampled during this period) were included in the estimate. Table 13 presents the population estimate of 9,065 with an approximate 95% confidence interval of ± 2,116 fish. Also shown for comparison are population estimates generated for each sex. The sum of these two estimates (8,834) differ little from the combined sex estimate of 9,065.

It is difficult to make a statement concerning the accuracy of the population estimate. If there was only non-differential mortality between the tagged and untagged fish occurring upriver (i.e., a sport fishery), the estimate would represent the population passing the tag release site and need to be reduced by the level of mortality for an estimate of escapement. If only immigration occurred, here in the form of fish entering the river during high water subsequent to tagging, the estimate would represent the population at the time of recovery and include immigration. Unfortunately, both mortality and immigration occurred. In that only recovery data from 31 July-9 August were used in the estimate, the effect of immigration was thought to be minimized and, if so, the population would be representative of that passing the release site prior to 20 July. It would be a minimum in that it does not include some unknown proportion of the fish entering subsequent to 20 July.

Results from the peak aerial census (rated "fair") flown on 4 August revealed the Chena River chinook salmon escapement objective was met in 1986, by the occurrence of 1,935 fish between MCD and the Middle Fork. The total survey estimate of 2,031 chinook salmon represents 22.4% of the population estimate of 9,065 fish. Assuming that the additional 257 chinook salmon carcasses deposited from view by the field crew prior to the 4 August survey would have normally been seen by the aerial observer, the total aerial count would have been 2,288 chinook salmon. Such an aerial count would still have only accounted for approximately 25% of the population estimate.

It is probable that a higher proportion of the actual population would have been accounted for by a peak aerial census if survey observations had been made under "good" survey conditions. Consequently, it is considered that peak aerial counts made in the Chena River under

Table 12. Goodness-of-fit test for equal probability of capture among release strata (9-23 July) for the 1986 Chena River chinook salmon mark-recapture project.

	Date of Release Strata in July															
	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Total
Recaptured	0	0	1	1	6	3	12	11	14	5	6	1	0	0	0	60
Not Recaptured	10	17	22	17	52	33	41	108	72	54	18	10	0	0	1	455
Total Released	10	17	23	19	57	36	53	119	86	59	24	11	0	0	1	515
Recovery Rate	0.00	0.00	0.04	0.11	0.09	0.08	0.23	0.09	0.16	0.08	0.25	0.09	—	—	0.00	

Total Chi-square (a) = 1.17 + 1.98 + 1.05 + 0.67 + 0.06 + 0.34 + 5.50 + 0.59 + 1.58 + 0.51 + 3.67 + 0.06 + 0.12 +
0.15 + 0.26 + 0.14 + 0.00 + 0.05 + 0.04 + 0.72 + 0.08 + 0.21 + 0.07 + 0.48 + 0.01 + 0.02 = 19.54 b

a Arranged in order of correspondence to the above contingency table.
b Non-significant (a = .05 with 12 degrees of freedom X^2) 21.026)

Table 13. Population estimate for Chena River chinook salmon, 1986. Estimate is based upon recovery data from 31 July - 9 August for chinook salmon greater than 470 mm in length. a

Sex	Number Tagged	Number Sampled for Tags	Number Tags Recovered	Estimated Population Size	Estimated Population Variance	Lower Confidence Bound b	Upper Confidence Bound b
Male	324	754	38	6,291	825,886	4,510	8,072
Females	191	264	19	2,543	255,248	1,553	3,533
Total		1,018	57	8,834	1,081,134	6,737	10,931
Combined	515	1,018	57	9,065	1,166,017	6,949	11,181

a Population was estimated as: $N = ((M + 1)(C + 1)/(R + 1)) - 1$

and its variance as: $V(N) = (M + 1)(C + 1)(C - R)(M - R)/((R + 1)^2(R + 2))$

where: N = Population Size
M = Number Tagged
C = Number Sampled for Tags
R = Number Tags Recovered

b A 95% confidence bound with a = .05

"good" survey conditions account for more than 25% of the total season escapement in a given year. More studies are needed to define the actual percentage accounted for under "good" survey conditions. Results from other studies suggest that a higher proportion of the actual population should be observed on peak surveys.

For example, the Department of Fisheries and Oceans operated a salmon weir in the Big Salmon River (Yukon River drainage, Yukon Territory, Canada) to enumerate chinook salmon escapement in that major spawning stream in 1986. A season total of 1,816 chinook salmon were enumerated (Cronkite, DFO, personal communication). The peak aerial salmon count in this stream was obtained by ADF&G on 21 August when 701 chinook salmon were observed upstream of the DFO weir (Barton 1986b). The survey was rated only "fair" and this peak aerial count represented 38.6% of the total season escapement passing the weir.

In a 1979 study of the Morice River in British Columbia, Neilson and Geen (1981) reported that the peak aerial chinook salmon count represented 52% of the total estimated spawning population for the season.

SUMMARY

1. A total of 529 chinook and 337 chum salmon and 4 sheefish were captured with two mesh-size gillnets at rivermile 16 of the Chena River from 8-23 July.

2. Mortalities were 14 and 12 for chinook and chum salmon respectively, while 10 chinook and 19 chums were recaptured in test nets.

3. A total of 515 chinook salmon (324 males; 191 females) were successfully measured, sexed, tagged, fin-clipped and released. The number of chum salmon measured, sexed, fin-clipped, and released totaled 330. Chum salmon were not tagged.

4. Chinook salmon carcass surveys were conducted by riverboat at major spawning areas in the upper Chena River during the periods 31 July - 12 August and 18-19 August. A season total of 1,561 chinook salmon carcasses were examined for tags. Lengths were taken on 1,338 of these fish and sex recorded for 1,352.

5. A total of 60 marked chinook salmon were recovered; 35 with tags and 25 identified by clipped adipose fin. This represents a 41.6% tag loss while the total number of marked fish recovered (60) represented 11.65% of the number of tags applied (515).

6. Based upon the 35 tags recovered, an average of approximately 21 days elapsed between date of tagging and death for either sex.

7. The most abundant age groups of chinook salmon as determined by scales were 51.2% age 1.3; 28.5% age 1.4; 9.3% age 1.2; and 9.2% age 1.5. Males were dominated by 5-year-olds (1.3's) from the

1981 brood year while females were dominated by 6-year-olds (1.4's) from the 1980 brood year. The male to female ratio was 1.00:0.34 (75% males; 25% females).

8. No significant difference in probability of recapture was detected by chinook salmon sex or size category or by time of release.

9. The Chena River population estimate for chinook salmon was estimated using only recovery data for the period for which no significant differences in recovery rate could be detected. A population estimate of 9,065 chinook salmon larger than 470 mm in length was made from recovery data collected from 31 July - 9 August.

10. The peak aerial census was made under "fair" survey conditions on 4 August. A total of 2,031 chinook salmon were enumerated which represents 22.4% of the population estimate. Based upon the 4 August survey, the Chena River chinook salmon escapement objective was achieved in 1986.

CONCLUSIONS

It is concluded from these studies that gillnets can be an effective gear for capturing adult salmon (particularly chinook) for tag and release in the Chena River if nets are continually attended and fish are removed immediately after entanglement. The slightly higher percentage of mortalities among chum salmon resulted from a tendency of these fish to be captured in larger numbers (i.e., they tended to hit the nets in schools and in turn many remained tangled in the gillnets for a longer period of time than on those occasions when only one or two fish had to be contended with). Further, chum salmon were generally more difficult to remove from gillnets; particularly males. Chinook salmon mortalities resulted primarily when a fish hit the bottom of a net near the leadline. On such occasions it was not always obvious that a fish was entrapped and as a result died before it was detected and removed unharmed. This was not a serious problem as each gillnet was periodically checked regardless of whether or not it was apparent a fish was entrapped. Further, to avoid recaptures or fish falling back down river after being tagged it is essential they be placed into a holding pen to recover from handling stress prior to their release.

The population estimate of 9,065 chinook salmon is considered to reflect the general order of magnitude of the 1986 Chena River chinook salmon spawning population. Whereas, the peak aerial census represented only 22.4% of the population estimate, it was conducted under "fair" survey conditions and thus does not necessarily typify the proportion of the total population which would be represented under "good" survey conditions. More studies are needed to define the actual percentage accounted for under "good" survey conditions since a large proportion of the historic data base consists of aerial estimates made under good conditions.

RECOMMENDATIONS

It is recommended that studies on the Chena River be continued in 1987 to again estimate total chinook salmon escapement abundance and the proportion observed on a peak aerial census made during the period of peak spawning.

Test fishing and tagging should begin by 1 July with subsequent carcass surveys initiated not later than 21 days after the first chinook salmon is released. Due to tag loss experienced in 1986, either double tagging or a combination of tagging and clipping or marking (that changes through time, e.g., every 4-5 days) should be attempted.

Each marked carcass recovered should be examined and a record made on gill condition so as to more clearly identify "recently" dead fish. Carcasses should not be deposited from view to aerial surveyors.

Finally, the 8-1/4 inch mesh gillnets should be replaced with slightly smaller mesh gear (e.g., 8 to 8-1/8 inch) in hopes of eliminating the bimodal curve observed in catch length composition in 1986.

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PERSONAL COMMUNICATION

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Appendix Table 1. Percentage of total Alaskan commercial and subsistence catch of chinook salmon estimated to be of Canadian origin (1982-1985). a

Year	Total Alaskan Catch	Catch of Canadian Origin Fish	Percent of Catch which is Canadian Origin	Source
1982	152,205	83,419	54.81%	Wilcock and McBride 1983
1983	185,033 b	85,138	46.01%	Wilcock 1984
1984	162,293	46,542	28.68%	Wilcock 1985
1985	185,959	82,541	44.39%	Wilcock 1986
Total	685,490	297,640		
Average	171,373	74,410	43.42%	

a Proportion of Canadian origin chinook salmon in the Alaskan catch was estimated each year based upon scale pattern analyses.

b Does not include District 4 commercial and subsistence catch as enough samples were not collected from that District to include in apportionment exercise.

Appendix Table 2. Mean daily discharge in the Chena River below Moose Creek Dam, July - August 1986. a

July	Discharge (cfs)	August	Discharge (cfs)
1	1,200	1	2,480
2	1,260	2	2,290
3	1,380	3	2,100
4	1,220	4	1,880
5	1,080	5	1,700
6	985	6	1,550
7	892	7	1,450
8	887	8	1,360
9	891	9	1,280
10	922	10	1,210
11	884	11	1,140
12	911	12	1,090
13	906	13	1,060
14	874	14	1,040
15	862	15	1,040
16	816	16	1,030
17	748	17	995
18	714	18	969
19	980	19	954
20	2,150	20	971
21	4,940	21	1,390
22	5,270	22	3,730
23	4,940	23	5,450
24	5,080	24	8,370
25	3,700	25	8,440
26	3,230	26	8,010
27	3,420	27	4,910
28	4,580	28	3,990
29	4,080	29	3,600
30	3,350	30	3,320
31	2,780	31	3,100

a Provisional data provided by U.S.G.S.