A-Y-K REGION
YUKON STATE/FED REPORT #8

YUKON RIVER ANADROMOUS FISH INVESTIGATIONS
Completion Report for Period July 1, 1973 to June 30, 1974

Lance L. Trasky
Fishery Research Biologist

Alaska Department of Fish and Game
Division of Commercial Fisheries

December 1974

Project No. AFC-47
Anadromous Fish Conservation Act

Yukon River Anadromous Fish Investigations

Lance L. Trasky
Alaska Department of Fish and Game
Subport Building
Juneau, Alaska 99801

December 1974
Completion Report for Period July 1, 1973 to June 30, 1974

Prepared for:

National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Washington, D. C. 20235

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

LIST OF TABLES

LIST OF TABLES (Continued)

LIST OF FIGURES

LIST OF FIGURES (Continued)

LIST OF APPENDICES

LIST OF APPENDICES (Continued)

ABSTRACT

In May and June, 1973, inclined plane smolt traps were used to capture 694 king salmon and 149 chum salmon smolt in the Salcha River. Ninety-nine and four-tenths percent of the king salmon smolt were determined to be the offspring of the 1971 brood year, or were in their second year (one winter annulus). Six-tenths of one percent were in their first year and had not yet formed scales (no annuli). All of the chum smolt were in their first year and had not yet formed scales. Peak smolt catches were made on May 26 and June 4. Peak smolt catches showed a .62 correlation with peak flows after May 22. Hourly catches were greatest between 0000 and 0500. Adult king salmon scales and rearing fry provided additional data on freshwater age and growth.

An expanded net upstream total of 71,475 chum salmon, 517 king salmon, and 286 pink salmon was enumerated as they passed the Anvik River tower in 1973. The daily chum salmon migration peaked on July 3 and 11, king salmon on July 18, and pink salmon on July 8. Hourly migration was greatest between 2400 and 0200 for chum salmon, 1300 to 2000 for king salmon, and 2200 to 0500 for pink salmon. The post-spawning chum salmon carcass sample was composed of 77 percent age class 4_1 salmon. Female chums comprised 66 percent of the sample. An aerial survey on July 27 enumerated 26,156 chum and 222 king salmon.

Heavy rainfall and high water forced termination of the counting tower portion of the Salcha River project before a significant number of salmon could be counted. An aerial survey of the Salcha on August 6 enumerated 249 king salmon and 290 chum salmon. The post-spawning king salmon carcass sample was composed of 62 percent males. Ages 3_2 to 7_2 were represented with ages 5_2, 6_2 and 7_2 comprising 34 percent, 29 percent and 26 percent of the sample respectively. The chum salmon carcass sample was composed of 55 percent females and age class 4_1 fish composed 77 percent of the sample. Approximately 32 percent of the king salmon and 20 percent of the chum salmon in the Salcha River spawned in the area which could be affected by a break in the trans-Alaska pipeline. Four of the five major non-spawning tributaries of the Salcha River contained rearing king salmon fry in August.

A total of 228 king salmon was enumerated through the Whitehorse fishway in Yukon Territory, Canada. The sample taken for age and sex information was composed of age classes 5_2 through 7_2. Age classes 5_2 and 6_2 comprised 51 percent and 47 percent of the run respectively. Male king salmon comprised 52 percent of the total escapement. Annual fishway escapement counts indicate that the Whitehorse (upper Yukon) king salmon run is apparently declining. There is evidence to indicate that this could be due to the combined detrimental effects of the dam and the downriver fishery on the king salmon run.

During October, 1973, 303 fall chum salmon were tagged in the lower Delta River. During October and November 3,999 carcasses were examined for tags and 121 marked carcasses were recovered. A simple Peterson population estimate of 10,014 was made based on the tag-recovery data. The average stream life for fall chums in this population was 20.4 days. The age, sex, and size sample was composed of 77 percent 4_1 chums, 57 percent males. The average fecundity was 2,637 eggs per female. Aerial surveys of the Delta River on October 22 and 27 produced estimates of 6,500 and 7,971 fall chums. Aerial surveys were made of all known and suspected fall chum spawning areas in the Yukon drainage. Four new fall chum spawning areas were located: Bear Paw River, Nenana River slough, Delta Clearwater slough, and the Sheenjek River.

A test fishing site has been maintained at Flat Island since 1963. The 1973 king salmon catch per unit effort of .50 king salmon per gill net hour for 8-1/2" mesh gill nets was below the 8-year average but slightly above 1972 levels. The 5-1/2" mesh gill net catch per unit effort of 2.82 chums per gill net hour was above the 8-year average and well above 1972 levels. Flat Island catches are affected by factors other than salmon abundance, including tides, winds, fishing methods, and the percentage of the run entering the other two mouths of the Yukon.

Commercial king salmon catches in 1973 were at their lowest level since 1958. Commercial chum catches were the highest on record and total utilization of all species of salmon on the Yukon was at the highest level since 1940.

Aerial surveys were conducted on index streams in the Yukon drainage in 1973.

INTRODUCTION

The Yukon River, the largest river in Alaska, originates in British Columbia within 30 miles of the Gulf of Alaska and flows over 2,300 miles to its mouth on the Bering Sea draining an area of approximately 330,000 square miles (Figure 1). All five species of eastern Pacific salmon are indigenous to the river with chum salmon (Oncorhynchus keta) being the most abundant. King salmon (O. tshawytscha) rank second in abundance followed in order by coho (O. kisutch), pink (O. gorbuscha), and sockeye (O. nerka) salmon. The latter two species are found in limited numbers and there is no significant fishery for them. The Yukon River is the greatest single king and chum salmon producing system in Alaska.

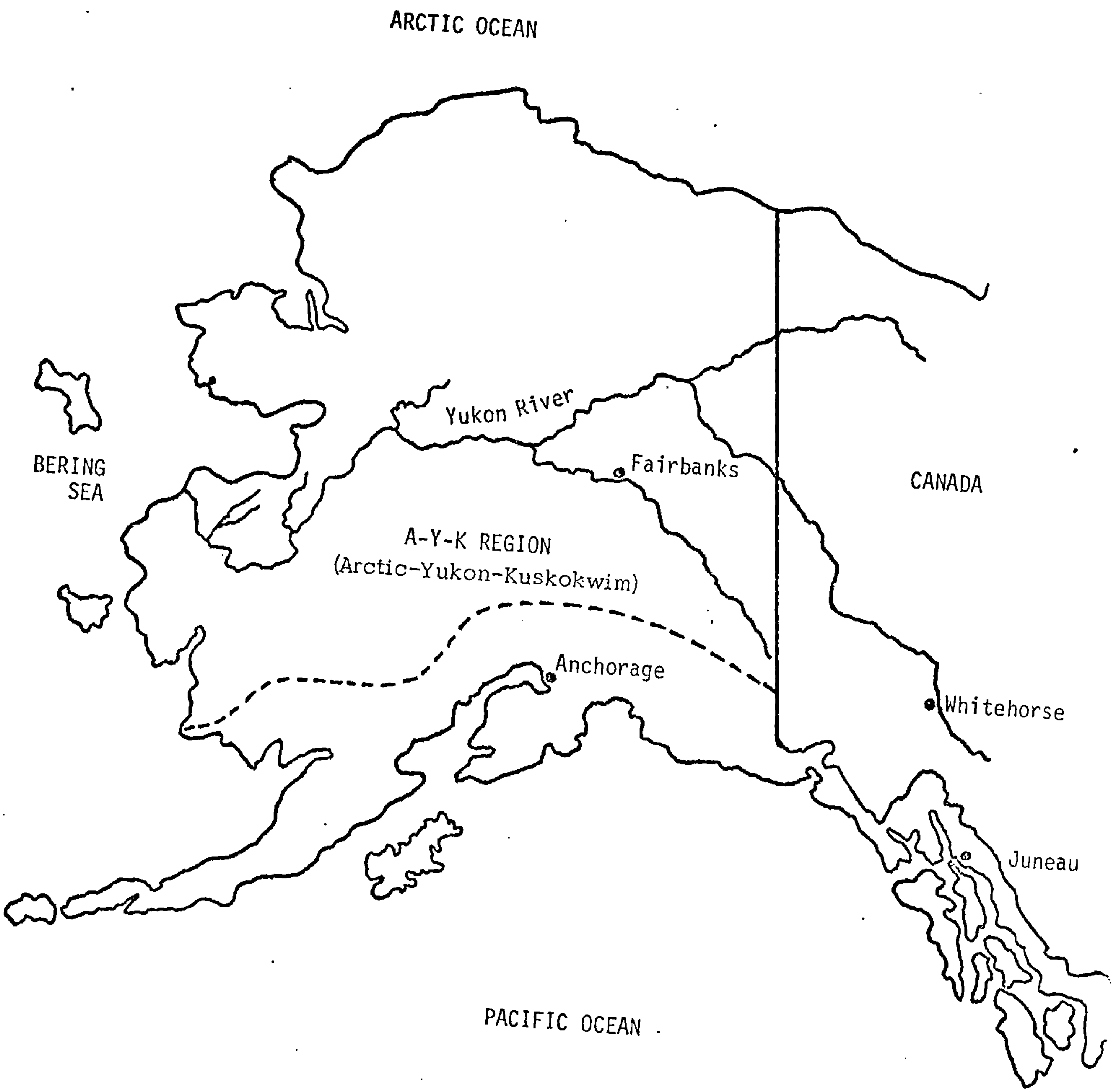
Figures 2 through 4 are detailed maps of the lower, middle and upper portions of the river. As indicated on these maps, the Alaskan portion of the drainage is divided into four statistical areas for commercial fishery management and regulatory purposes. The major commercial fisheries are found in the lower 150 miles, although limited commercial fishing is widely dispersed over 900 river miles in the upper Yukon and lower Tanana rivers. Tributary streams of the Yukon and Tanana rivers are closed to commercial fishing.

During 1973, the commercial salmon harvest was 630,029 salmon of all species, compared to an average of only 348,146 during 1968-1972. Commercial fishing effort in terms of registered fishing vessels has increased 45 percent from 510 in 1968 to 739 in 1973. The majority of the commercial fishermen are Eskimo and Indian residents of the drainage who use small (16-20 foot) outboard-powered skiffs to operate gill nets and fishwheels.

Although still important, the subsistence salmon fishery has declined in importance during recent years. The recorded subsistence harvest for 1973 was 208,394 fish. Average annual harvests for the periods 1968-1972 and 1961-1972 were 216,602 and 323,462 respectively.

The current Yukon River Anadromous Fish Investigations were initiated in 1972 to determine: (1) the size and effect of commercial and subsistence harvests on the various stocks of king and chum salmon; (2) develop estimates or indices of the magnitudes and quality of king and chum salmon runs and escapements; and (3) relate collected data to long-term trends in the salmon stocks and evaluate management procedures needed to maintain them at their level of maximum yield. The project was funded in part by the Anadromous Fish Act (P.L. 89-304) from July 1, 1973 to June 30, 1974. This report will review all the pertinent data collected during 1973. In some cases, comparative data collected prior to the project period are included for reference. Due

FIGURE 1. Yukon River map.



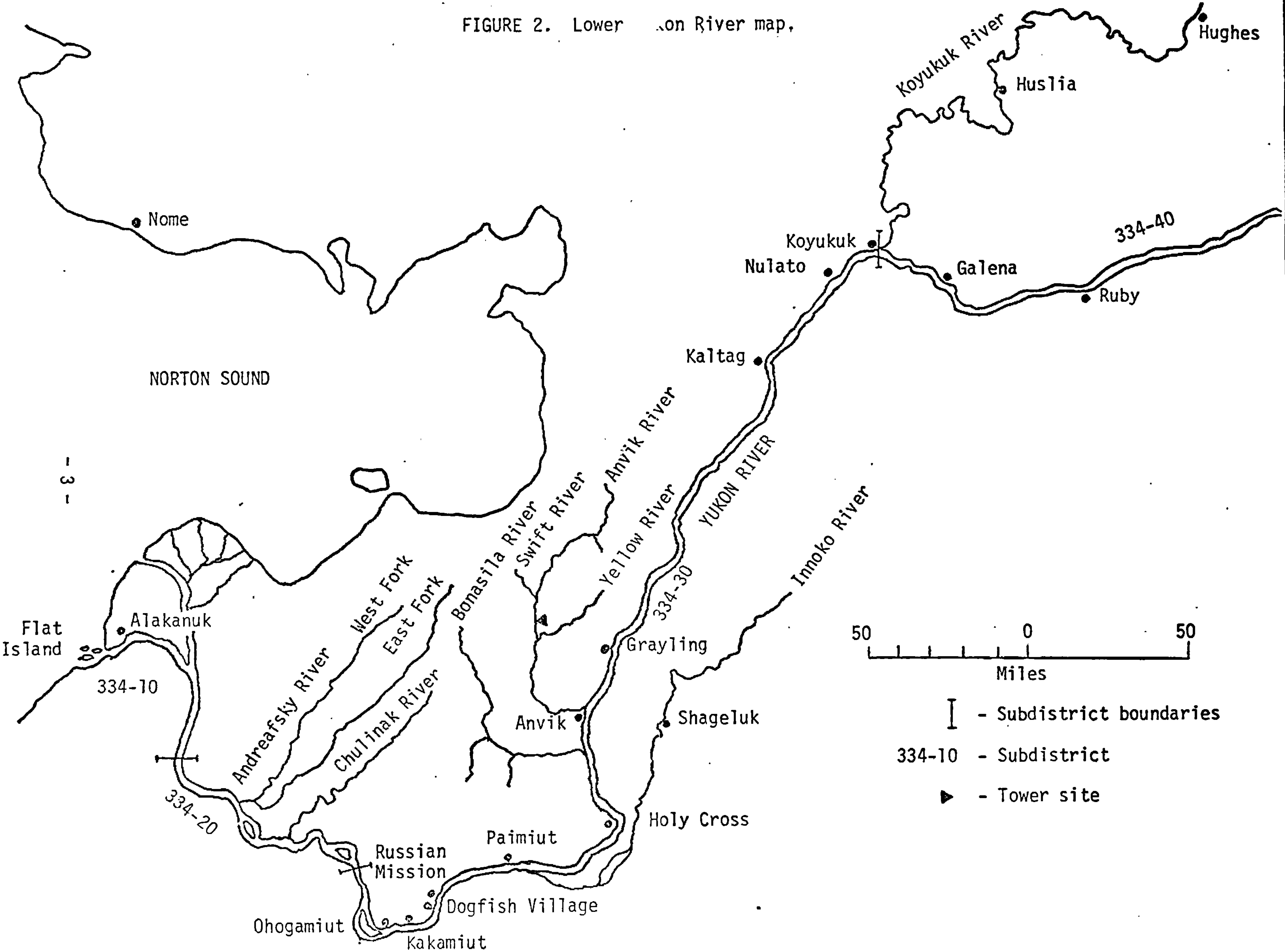


FIGURE 2. Lower .on River map.

FIGURE 3. Mid-Yukon River map.

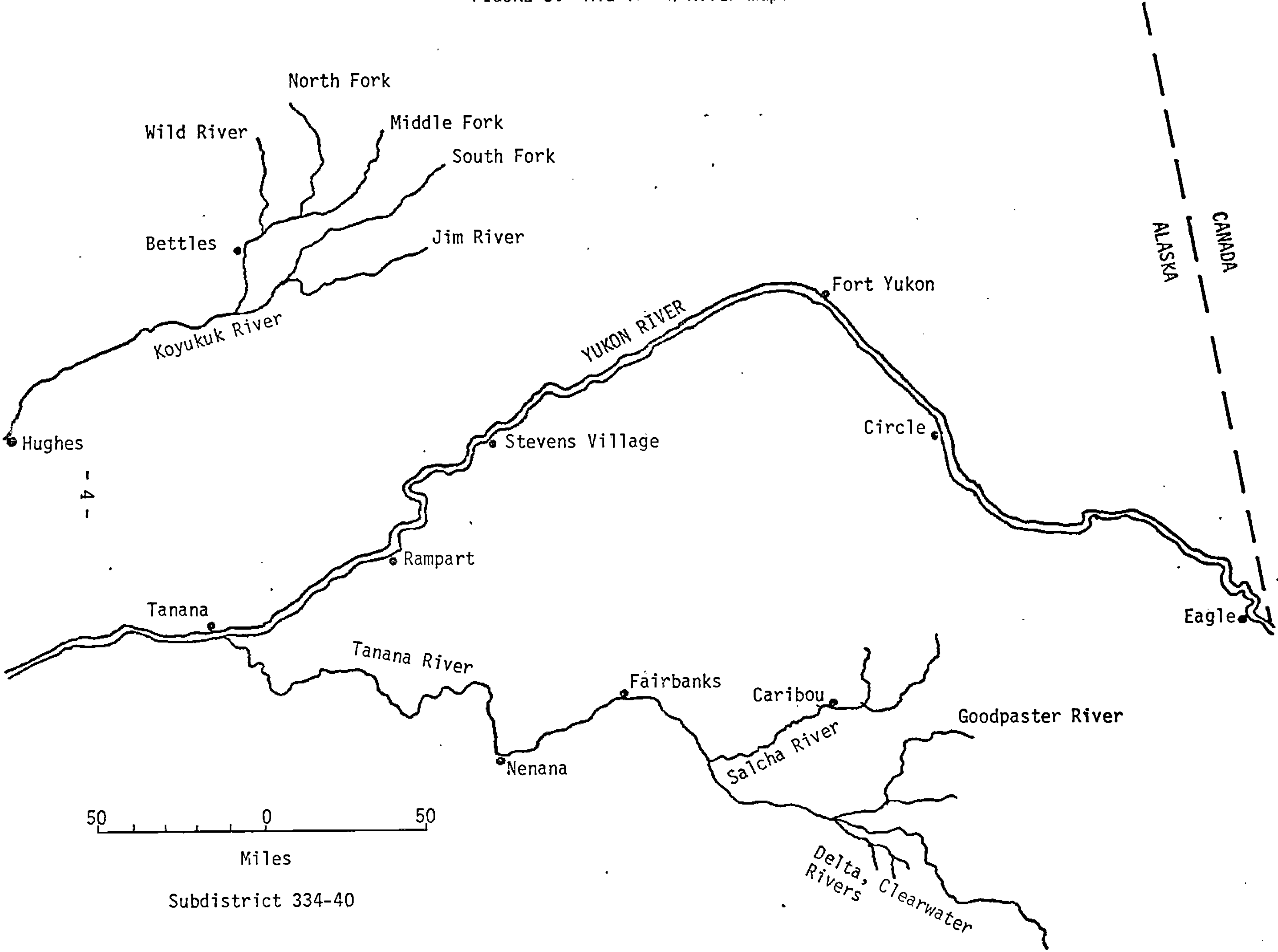
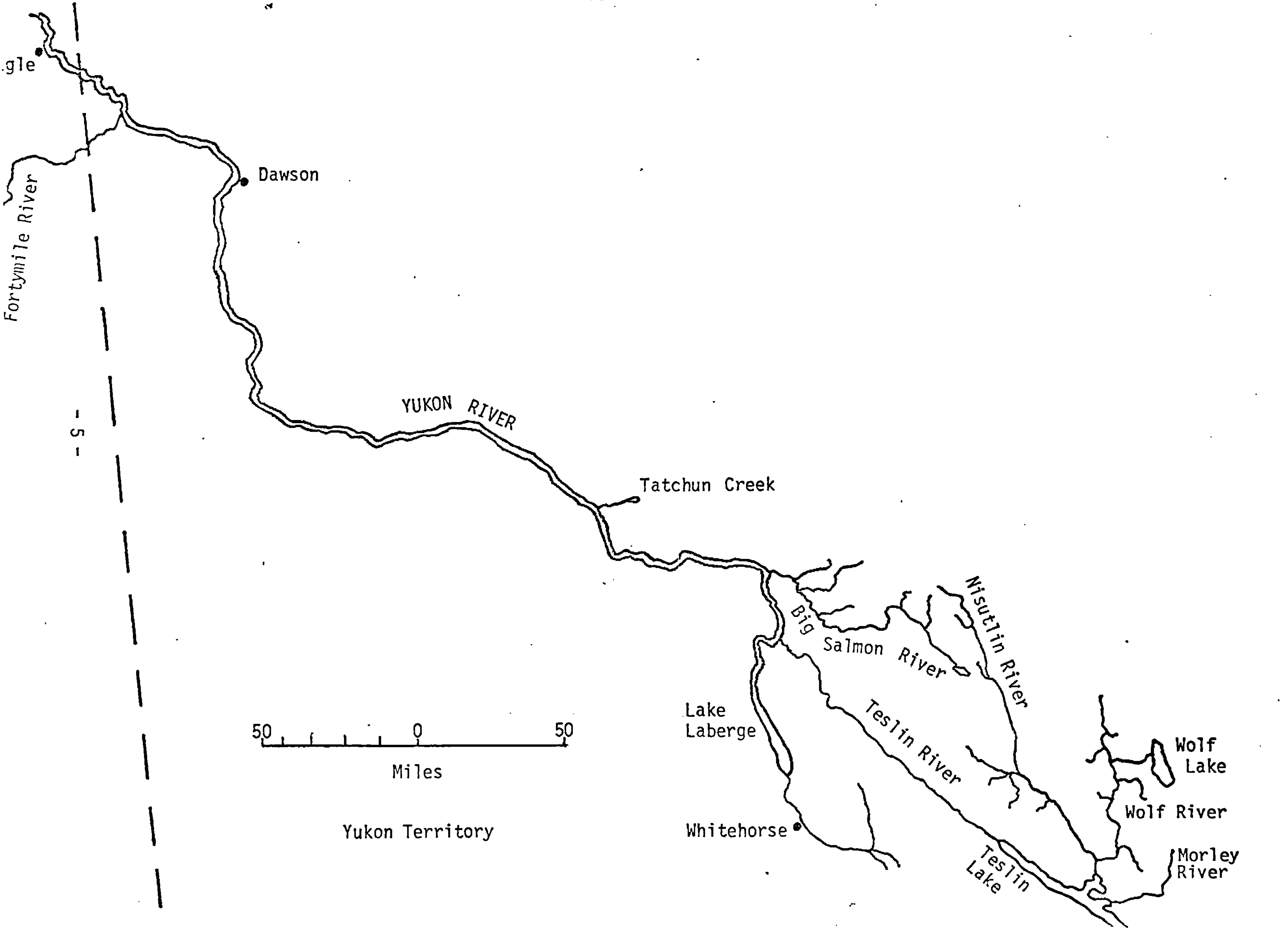


FIGURE 4. Upper Y on River map.



to personnel and funding limitations, the main emphasis of the program was on the main Yukon and a few important tributaries, recognizing that other tributaries also contribute large numbers of king and chum salmon to the fishery.

In 1973, a study was conducted on the Salcha River to obtain data on the timing, age composition and magnitude of the annual smolt outmigration. Studies were continued to develop estimates or indices of the magnitude of king and chum salmon escapements in the Anvik and Salcha rivers. The king salmon escapement through the Whitehorse fishway was enumerated and sampled for the ninth consecutive year. A comprehensive program was initiated to study fall chum salmon in the upper Yukon drainage. An intensive tag and recovery and sampling program was conducted on the fall chum population spawning in the lower Delta River to determine population size and basic life history data. Extensive aerial surveys were flown to locate fall chum salmon spawning areas throughout the upper Yukon drainage.

The Flat Island test fishing program was continued to provide information on the size, composition, and timing of the salmon run before it reaches the commercial fishery. Aerial surveys were made of index streams to provide comparative escapement estimates for king, chum and coho salmon. Catch statistics were collected and compiled after each fishing period to provide timely information on salmon abundance and fishing effort.

SALCHA RIVER SMOLT STUDY

Introduction

In May of 1973, the Yukon area research staff initiated a project to study the annual king salmon smolt outmigration in the Salcha River. The objectives of this project were: Capture king salmon smolt for age and size analysis, determine the seasonal and diurnal timing of the smolt outmigration, and collect adult king salmon scales and rearing king salmon fry for comparative freshwater age and growth analysis.

Prior to 1973, very little data was available on the early life history of king salmon in interior Alaskan streams. The lack of knowledge regarding the length of freshwater residence in particular created a problem in the aging of adult king salmon scales. The majority of adult scales showed one freshwater annulus indicating smolt outmigration occurred in the second year. However, in a small but significant percentage of adult scales, it was impossible to determine the length of freshwater residency. Accurate determination of the year classes comprising the king salmon run is important in the management of the Yukon River commercial salmon fishery. It was felt that an analysis of the age composition of the Salcha River king salmon smolt would resolve problems of aging adult scales.

The Salcha River was chosen for this study because of its accessibility and its large king salmon spawning population. It is located 40 miles southeast of Fairbanks on the Richardson highway and is 965 miles upstream from the mouth of the Yukon River (Figure 3). A map of the Salcha River is presented in Figure 5.

The smolt traps designed by Al Davis of the Alaska Department of Fish and Game were used because of their success in capturing salmon smolt under similar conditions in the Kenai River.

Due to many ambiguous definitions used to describe immature salmon, the following definitions will be used in this report:

(1) smolt: A juvenile salmon moving out of its natal stream towards the ocean.

(2) fry: A juvenile salmon between the stages of its life cycle in which the yolk sac has been absorbed and the time it begins to move toward the ocean.

(3) juvenile: Any immature salmon during the freshwater stage of its life cycle.

(4) adult: A sexually mature salmon.

Methods and Materials

Two smolt traps were moved to the Salcha River at the time of spring breakup, and as soon as the ice and debris had cleared, the traps were placed in the water. They were fished immediately below the Richardson Highway bridge from May 16 to June 8. They were fished near the south bank (location A) from May 16 to May 23 and were then moved to the middle of the river (location B).

The traps were fished in tandem and were located so that they were fishing in the main current where the water was 6-8 feet deep. The traps were tied to the bridge at four points to keep them from wandering in the current. A complete description of the traps, floats and method of fishing is presented in Figures 6-10.

Figure 5. Salcha River Map

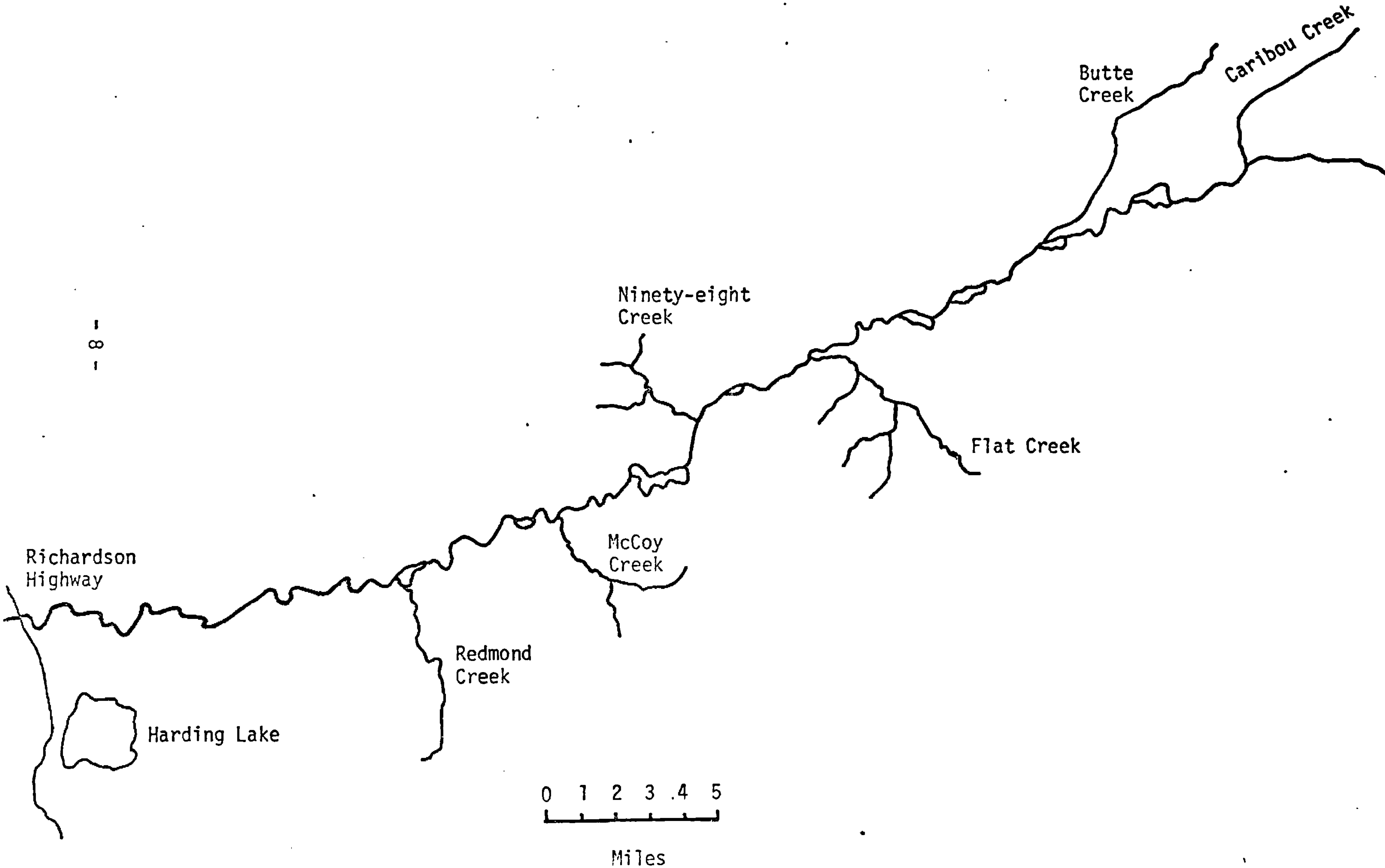
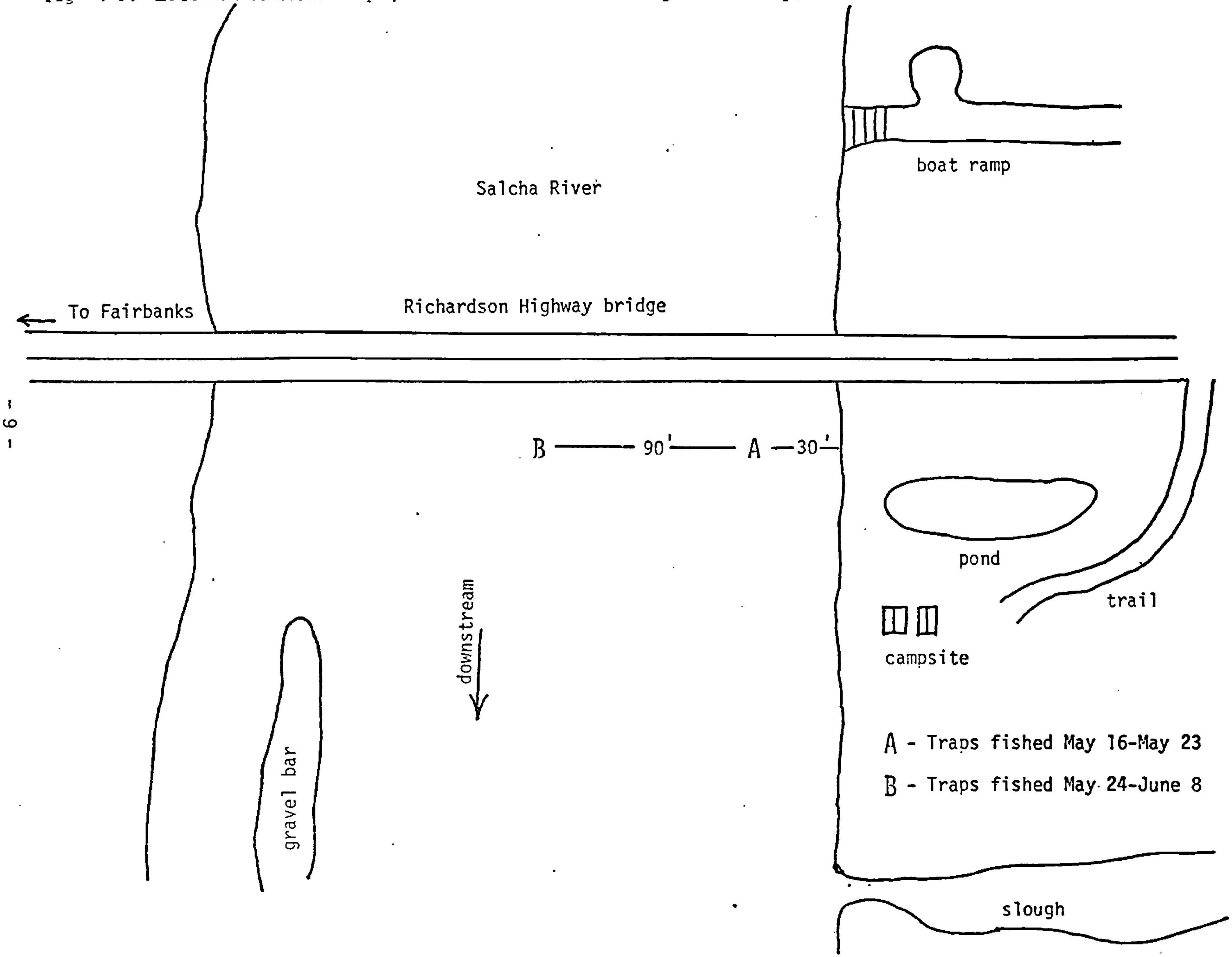
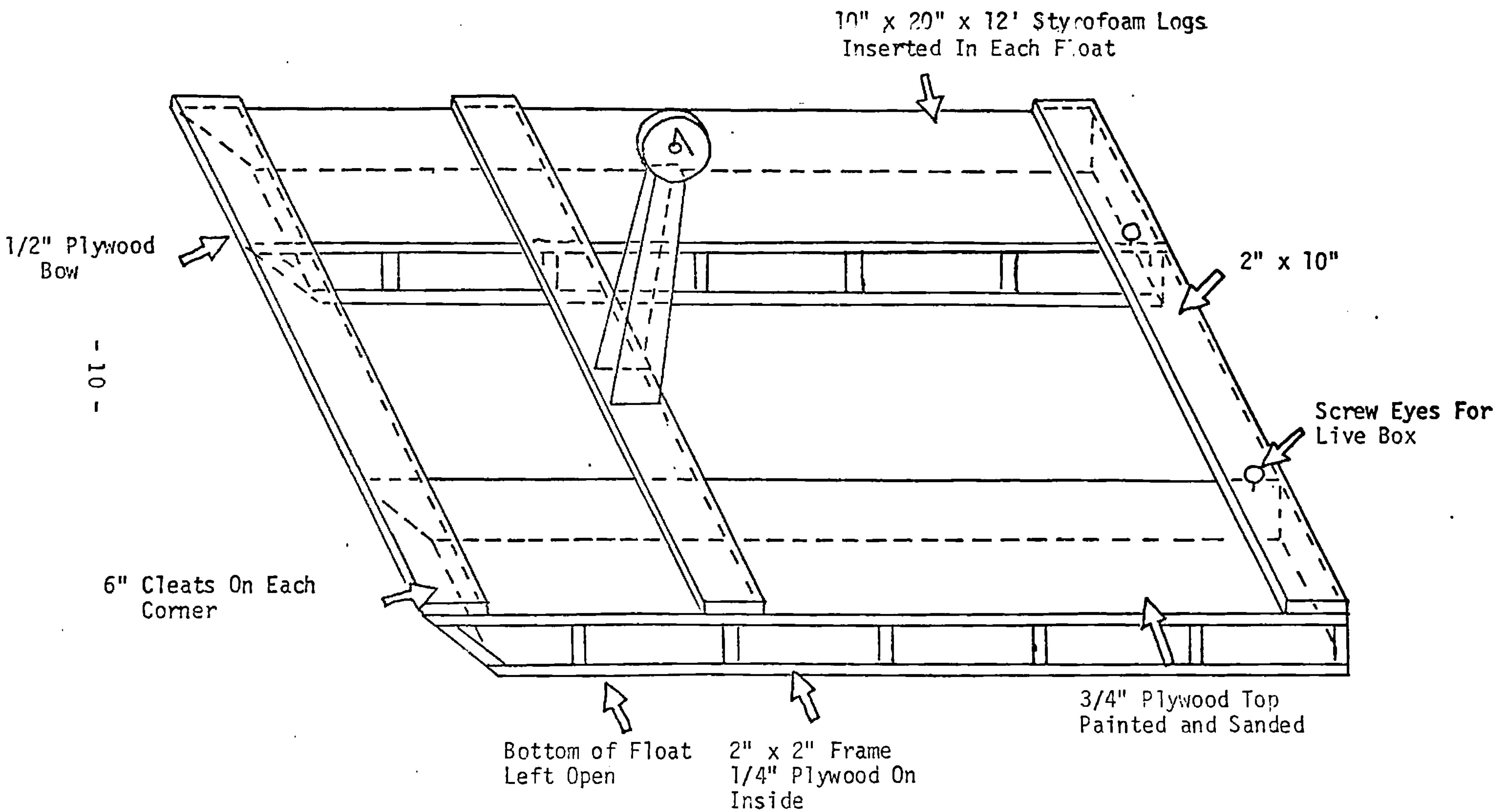


Figure 6. Location of smolt traps, Salcha River smolt outmigration study, 1973.

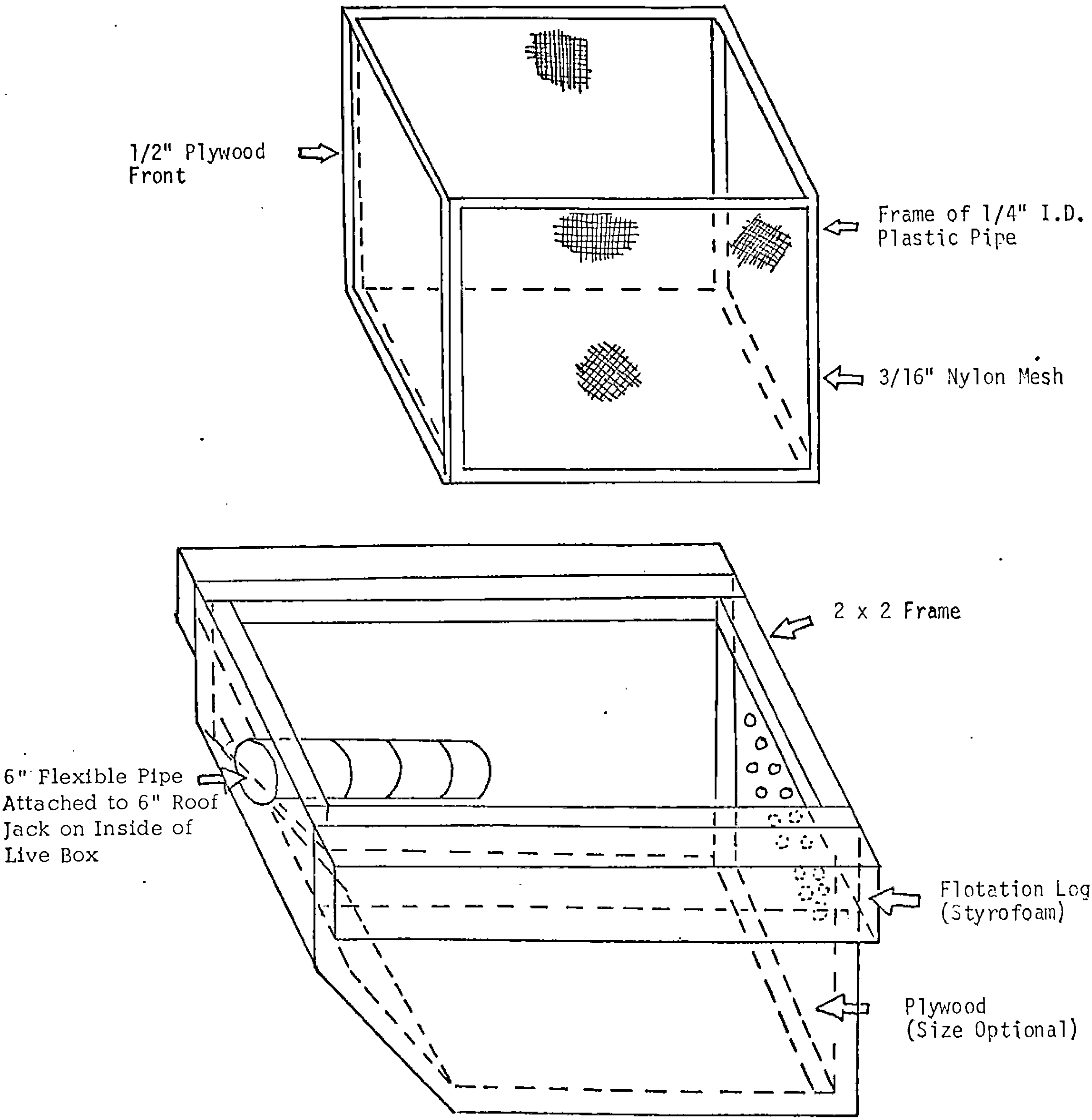


Figur 7. Support floats for smolt traps.



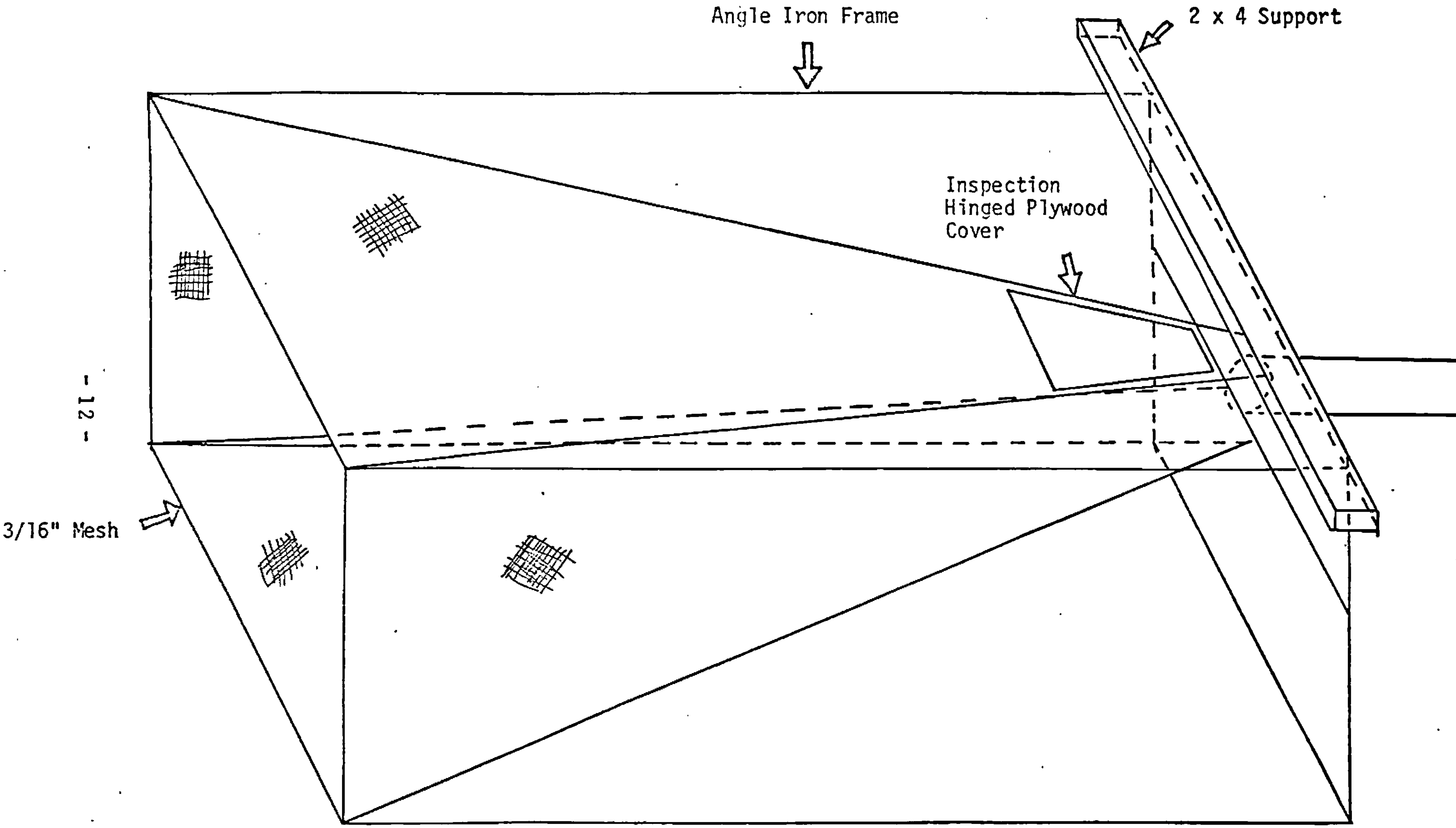
Scale: 1 in. = 2 ft.

Figure 8 . Live box used in smolt traps.



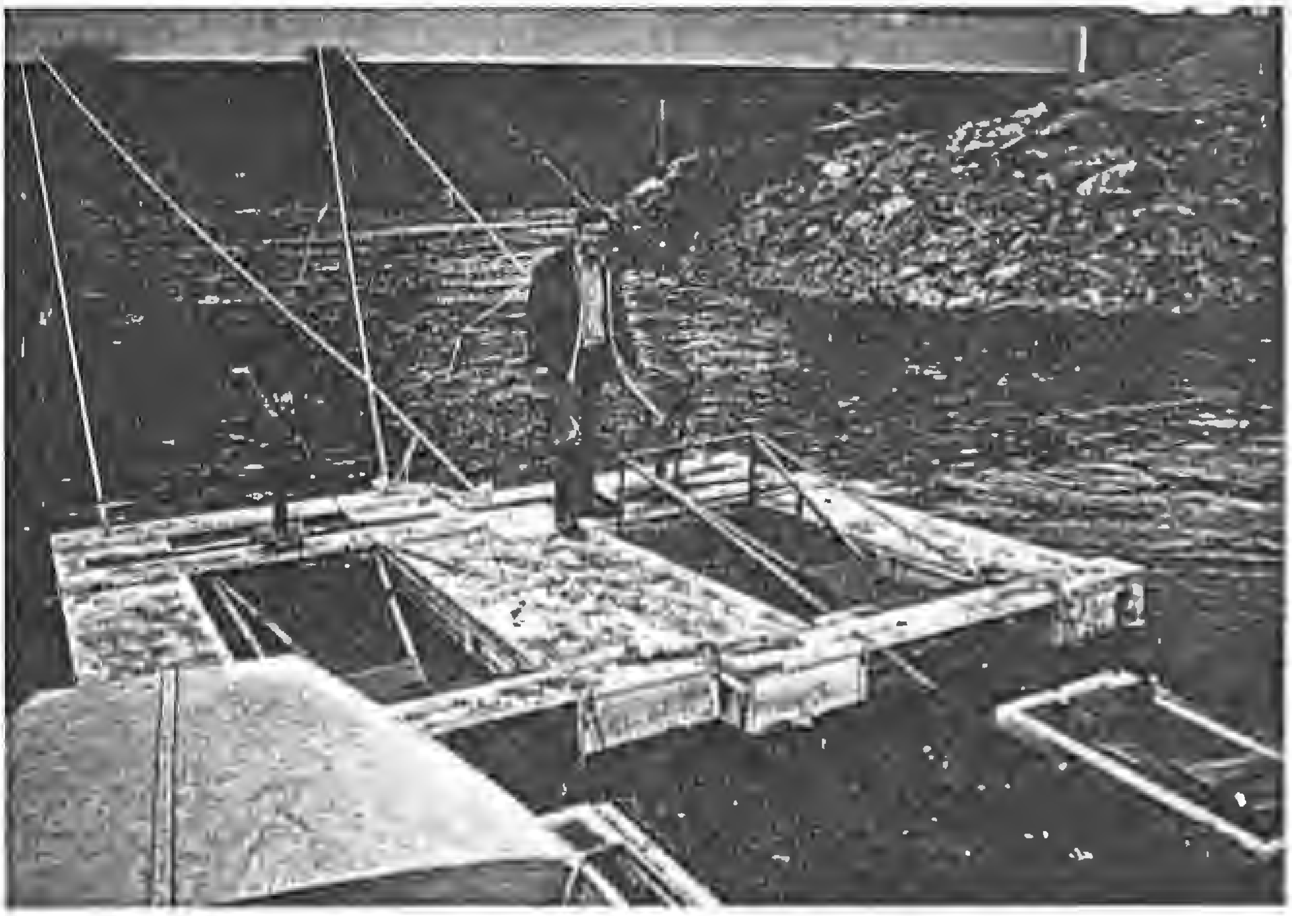
Scale: 1 in. = 1 ft.

Figure 9. Smolt trap as modified by Al .vis, ADF&G.



Scale: 1 in. = 1 ft.

Figure 10 . Method of fishing smolt traps (location A), Salcha River, 1973.



The traps were checked every 1-6 hours depending on how much debris was in the water. When checked, the total number of smolt in the live box was divided by the number of hours the traps were fished to obtain the average catch per hour. This was recorded in the catch enumeration log (Appendix Table 1). The traps were then cleaned, checked for damage and lowered back into the water until the top of the trap was approximately 1 inch above the surface of the water. Each trap then strained a 25" x 36" section of the river.

The traps were fished 24 hours a day except during periods of extremely high water or when equipment breakdowns occurred. When the traps were not fished 24 hours a day, missing hourly counts were estimated by computing the percentage (P) of the total catch taken during the same hours over the course of the project when catches were made. This percentage (P) was then subtracted from one (1 - P) and divided into the actual daily catch (A) to produce an expanded daily catch (E) or:

$$\frac{A}{1 - P} = E$$

Hourly catches were then calculated by taking the same percentage (P) of the daily expanded catch and substituting it for the missing hourly catches (Appendix Table 1).

Two-thirds of all the smolt captured in the traps were preserved in a 30 percent formaldehyde solution. In August, rearing king salmon fry from Ninety-eight Creek and Flat Creek were captured with a dip net to provide comparative data on age and growth.

The length from mideye to fork of tail and weight was recorded for all juvenile salmon captured. A scale smear was taken from each fish, mounted between glass slides and read with a dissecting microscope.

A sample of 76 scales from the 1973 Salcha River adult king salmon spawning population was read to determine the length of freshwater residency and the number of circuli to the first freshwater annulus.

Water temperature and level were recorded daily; stream flow and velocity measurements were recorded periodically.

Results

Over the period May 16 to June 8 a total of 694 king salmon smolt was captured (Table 1). Adding estimated catches for a total of 90 hours, which

Table 1. Actual and expanded daily smolt catches, Salcha River, 1973.

Date	Hours Fished	Number Captured Kings	Number Captured Chums	Expanded Daily Catches Kings
5/16	8	1	-	10
17	17	6	-	11
18	15	4	1	7
19	15	2	-	4
20	17	4	-	7
21	21	7	6	9
22	24	33	7	33
23	23	48	26	50
24	17	30	3	34
25	24	39	11	39
26	23	205	15	205
27	18	37	7	54
28	24	14	4	15
29	24	11	1	11
30	24	7	-	7
31	24	2	1	2
6/ 1	24	-	-	-
2	24	4	-	4
3	24	2	4	2
4	15	61	36	86
5	16	35	11	58
6	24	58	8	58
7	24	52	3	52
8	17	31	4	39
TOTALS	486	694	149	797

were not fished, yielded an expanded total catch of 797 king salmon smolt (Appendix Table 1). Peak catches were made on May 26 and June 4 (Figure 11). Hourly catches were highest between 0000 and 0500 hours (Figure 12).

Four hundred ninety-one of the king salmon smolt captured by the traps were examined to determine age and size composition. It was determined that 488 of the smolt examined had scales exhibiting one annulus. These fish were in their second year of freshwater residence (2 year olds) and were the offspring of the 1971 brood year. Three of the king salmon smolt examined had not formed scales. These fish were in their first year of freshwater residence (1 year olds) and were the offspring of the 1972 brood year. The 2 year old smolt averaged 73 mm in length and weighed 4.3 grams. They had an average of 7.5 circuli before the first annulus. The 1 year old smolt averaged 38 mm in length and weighed .7 grams (Table 2).

The 26 king salmon fry captured in Ninety-eight Creek and Flat Creek in August were determined to be 1+ years old. The Ninety-eight Creek and Flat Creek fry averaged 59 mm and 58 mm in length and 2.1 and 2.0 grams, respectively. Fry from both creeks had an average of 5 circuli with no visible annulus (Table 2).

The 76 scales from the 1973 adult king salmon spawning population all had one freshwater annulus and had spent two years in freshwater. The sample was composed of age class 4_2 through 7_2 and were the offspring of the 1966-1969 brood years (Table 2).

One hundred forty-nine chum salmon smolt were captured incidentally in the traps and 106 of these were sampled for age and size information. They averaged 39.5 mm in length and weighed .6 grams. None of the chum smolt had scales.

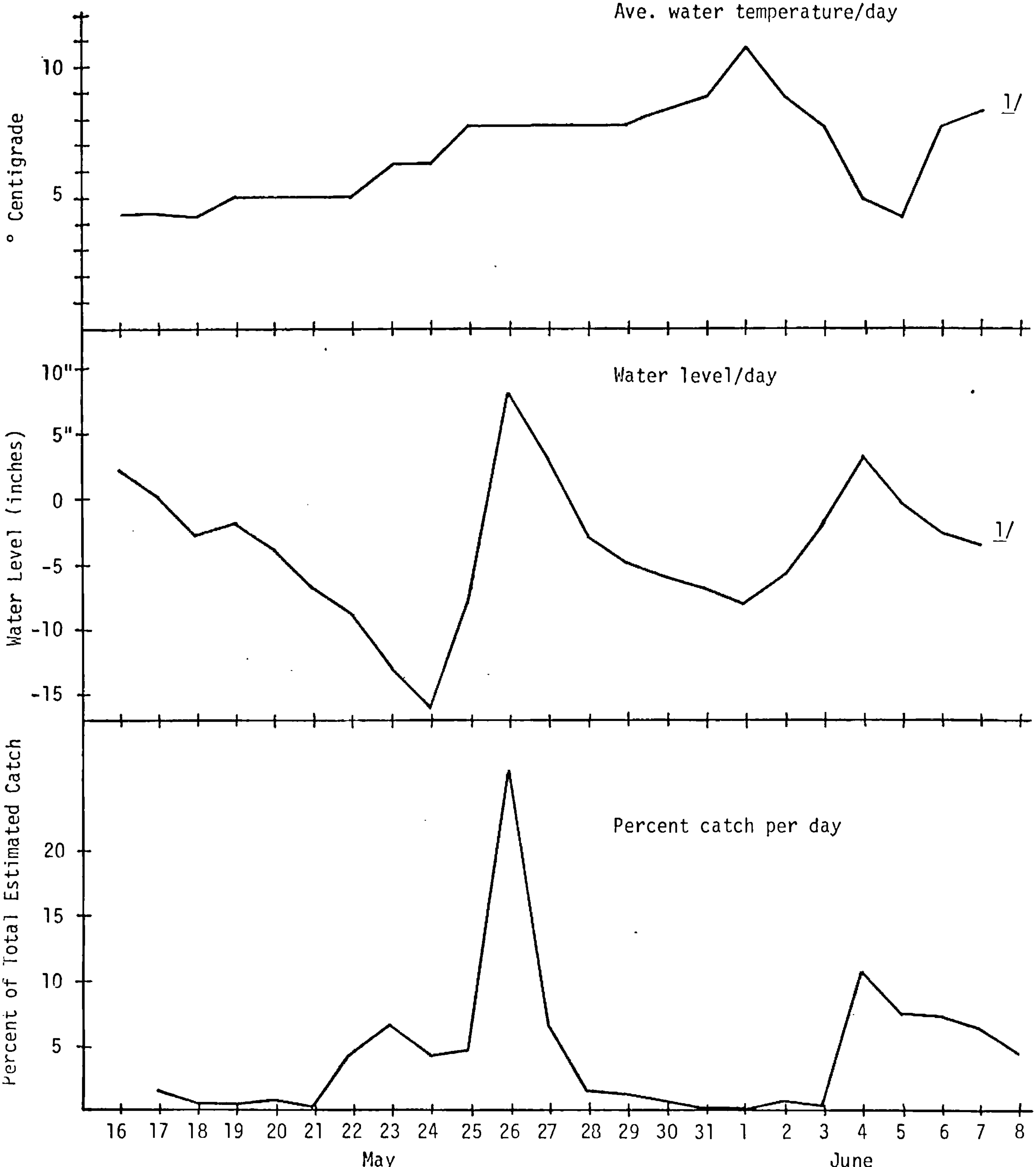
Water level, water temperature and other stream measurements are presented in Appendix Table 2.

Discussion

Before the smolt project was initiated, it was felt that the peak of the king salmon smolt outmigration might coincide with the spring breakup. Based on 1973 catch data, this was apparently not the case. Very few smolt were captured until May 22, which was ten days after the May 12 breakup.

There was a good correlation (.62) between peaks in water level and peak catches after May 22 (Appendix Table 3). The increased catches after

Figure 11. Comparison of king salmon smolt catches with water temperature and water level, Salcha River, 1973.



1/ No data on June 8.

Figure 12. Percentage of total estimated king salmon smolt catch by hour (expanded), Salcha River, 1973.

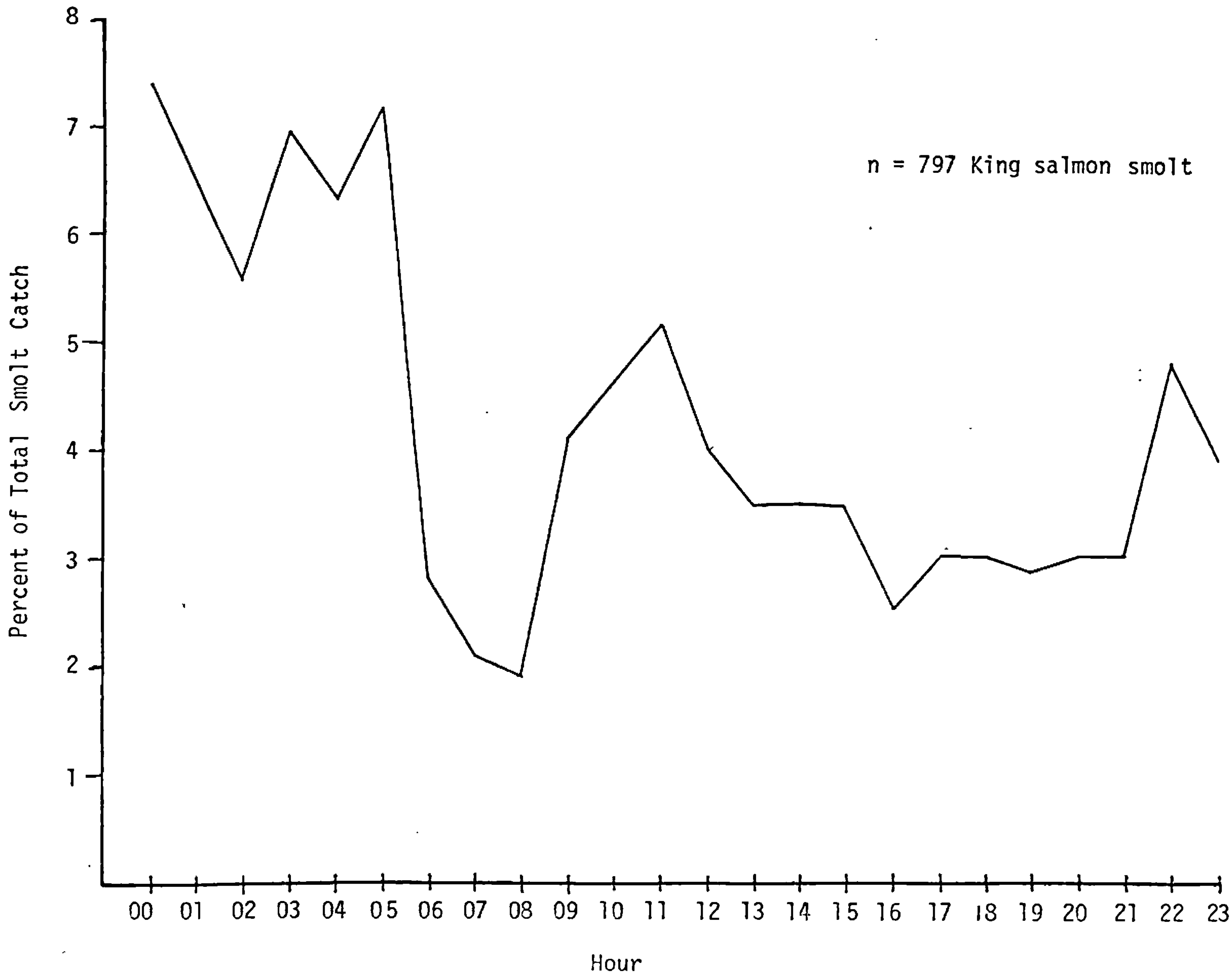


Table 2. Age and size of Salcha River drainage salmon during freshwater stage of life cycle.

Sample	Age 1/	Sample Size	Average Length	Average Weight	Average no. of circuli before first annulus
(1) Salcha River king salmon smolt catch sample	2	488	73.0 mm	4.3 grams	7.5
(2) Salcha River king salmon smolt catch sample	1	3	38.0 mm	0.7 grams	No scales
(3) Ninety-eight Creek king salmon fry sample	1	9	59.0 mm	2.1 grams	5.0
(4) Flat Creek king salmon fry sample	1	17	58.0 mm	2.0 grams	5.0
(5) 1973 adult king salmon escapement sample	-	76	-	-	7.2
(6) Salcha River chum salmon smolt catch sample	1	106	39.5 mm	0.6 grams	No scales

1/ Gilbert Rich method of aging. A 2 year old smolt taken in the spring of 1973 was the offspring of the 1971 brood year, and would exhibit one freshwater annulus.

May 22 were not entirely due to peak flows and increased trap efficiency. This is illustrated by the fact that from May 16-21 the water level averaged 9" higher than it did from May 22-25 (Figure 11). The catches for this period, however, only averaged .32 smolt per hour compared to 1.62 smolt per hour for May 22-25. The increase in catches after May 22 was probably due to a combination of factors including warming water, increased photo-period and peak flows (Foerster, 1968).

Peak king salmon smolt catches were made from 0000 to 0500 hours which are the hours of semidarkness at this latitude during May and June. Due to the small number of smolt captured each day, however, there is no way of determining with any degree of confidence if the increase in catches was due to nocturnal migration or reduced visual trap avoidance.

When the project was terminated on June 8, the catch rate had not diminished significantly (Figure 11). In 1965, the Fish and Wildlife Service captured king salmon smolt in their traps near the village of Beaver on the main Yukon as late as August (Gissberg and Benning, 1965). It is possible that the smolt migration on the Salcha extends through June or even later.

There is some evidence to indicate that all but a very small percentage of the king salmon in the Salcha River spend two years in freshwater. Ninety-nine and four-tenths percent of the smolt captured were two years old (one freshwater annulus). All of the 1973 adult king salmon scales examined had spent two years in freshwater (one freshwater annulus). Only three 0 annulus smolt and no smolt from any other age class were captured. The 0 annulus smolt captured were very small. It is possible that they were swept downstream by high water before they had a chance to establish themselves in a rearing area and were not actually migrating out of the river.

A comparison of the various juvenile king salmon samples yields some information on their growth rate in the Salcha River. The three individual smolt from the 1972 year class taken in May had no scales and averaged 38 mm in length. Fry, taken in August from Ninety-eight Creek and Flat Creek, had scales with five circuli and were 59 mm long. Smolt from the 1971 brood year, which were captured in the traps as they migrated downstream in May, were 73 mm long and had 7.5 circuli and one annulus.

Between the time the juveniles from the 1972 brood year were sampled in May and the middle of August, they added 21 mm in length and five circuli to the scale. Smolt captured in May and June were 10 months older, 14 mm longer and had 2.5 more circuli than fry captured in rearing areas in August.

There appears to be a relationship between the age and size of juvenile Salcha River king salmon and the number of circuli on the scale. Smolt scales taken in 1973 only had an average of 0.3 circuli more (to the first freshwater annulus) than the 1973 adult escapement sample, which was comprised of four year classes. Fry taken in Ninety-eight Creek and Flat Creek were only 1 mm apart in average length and had the same number of scale circuli. Although very limited, this data may indicate that the growth rate of fry in the Salcha is fairly constant from year to year.

Although based on only one year's sampling, the lack of scale formation for any of the 106 chum smolt sampled is important. It indicated that, at least in 1973, scale formation occurred after the smolt left the Salcha and at some length over 39.5 mm. Too few king salmon smolt in their first year were captured in the traps to reach any conclusions. However, none of the three smolts, which averaged 41 mm in length, had formed scales.

The performance of the smolt traps under the varying water conditions encountered over the course of the project was excellent. Neither trap was damanged even after being struck repeatedly by logs and debris. The 3/16" mesh hardware cloth was fine enough to capture very small smolt but did not load up except when there was a lot of debris in the water. All of the smolt captured were alive and in good condition when removed from the live box. The traps had one drawback. They could only fish on the surface and could not be used to sample the vertical distribution of smolt in the water column.

<u>Summary</u>

1. A total of 694 king salmon and 149 chum salmon smolt was captured from May 16 to June 8.

2. The peak catches of king salmon smolt were made on May 26 and June 4.

3. The peak hourly catches were between 0000 and 0500 hours.

4. After May 22 catches showed a good correlation (.62) with water level.

5. Ninety-nine and four-tenths percent of the king salmon smolt captured were in their 2nd year.

6. All of the scales from the 1973 adult escapement sample had one freshwater check (in 2nd year of life).

7. None of the 106 chum smolt or three 1+ year old king salmon smolt captured had formed scales.

8. The performance of the smolt traps was excellent except that they could not sample the vertical distribution of smolt.

ANVIK RIVER SALMON ESCAPEMENT STUDIES, 1973

Introduction

For the second consecutive year a salmon enumeration project was conducted to develop estimates or indices of the magnitude of king and summer chum salmon escapements in the Anvik River system (Figure 13). The purpose of these studies was to (1) determine the daily and seasonal timing and magnitude of the salmon runs, (2) evaluate aerial survey methods by comparing aerial counts to tower counts, (3) observe behavior of salmon migrating upstream past a counting tower, (4) measure climatological and hydrographic data, (5) determine age, sex and size composition of the king and chum salmon escapement, and (6) select an optimum location for a counting tower.

Method and Materials

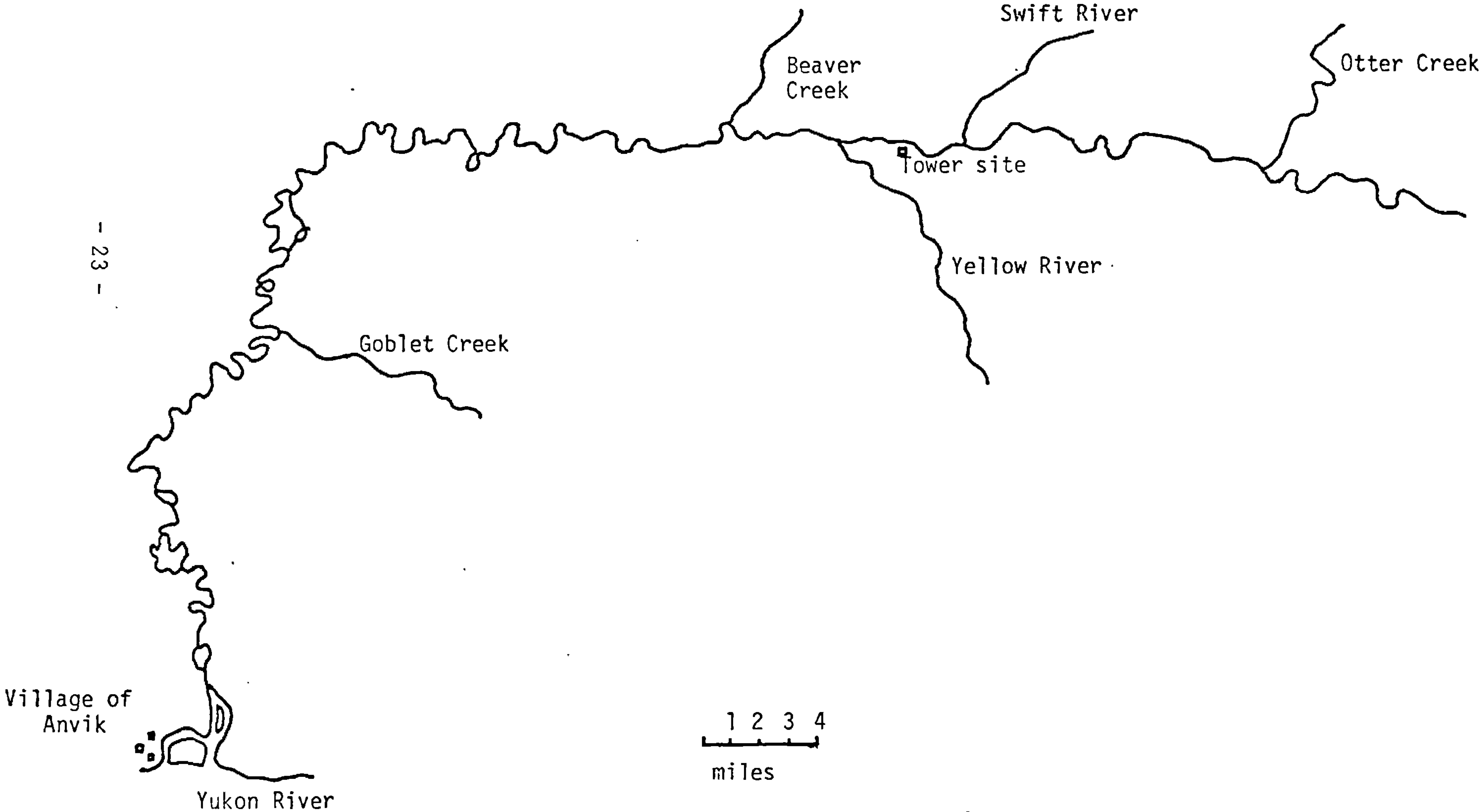
A 22 foot prefabricated aluminum tower was erected on the east bank of the Anvik River about 5-1/2 miles upstream from its confluence with the Yellow River (Figure 14). An 80 foot weir was constructed out from the west bank, directly opposite the tower, to direct the salmon into the area which could be readily observed from the tower (Figure 15).

A power line incorporating four 300-watt light bulbs housed in 18-inch diameter reflectors was strung across the river to provide illumination during darkness. A 1500-watt generator provided electric current for the lights.

A background panel was provided by laying an 80 foot x 3 foot mat of 1/4 inch mesh hardware cloth across the stream bottom between the tower and the weir. It was anchored to a cable running across the bottom and weighted down with sandbags.

A three-man crew began 24-hour counting operations on June 28, which were terminated on July 31. Each crew member was scheduled to enumerate salmon for two 4-hour periods each day. Counts were recorded for both hourly totals and the first 10 minutes of each hour. Salmon moving downstream were subtracted from the hourly count to obtain a net upstream total. Missing hourly counts were estimated by computing the percentage (P)

Figure 13. Anvik River Map



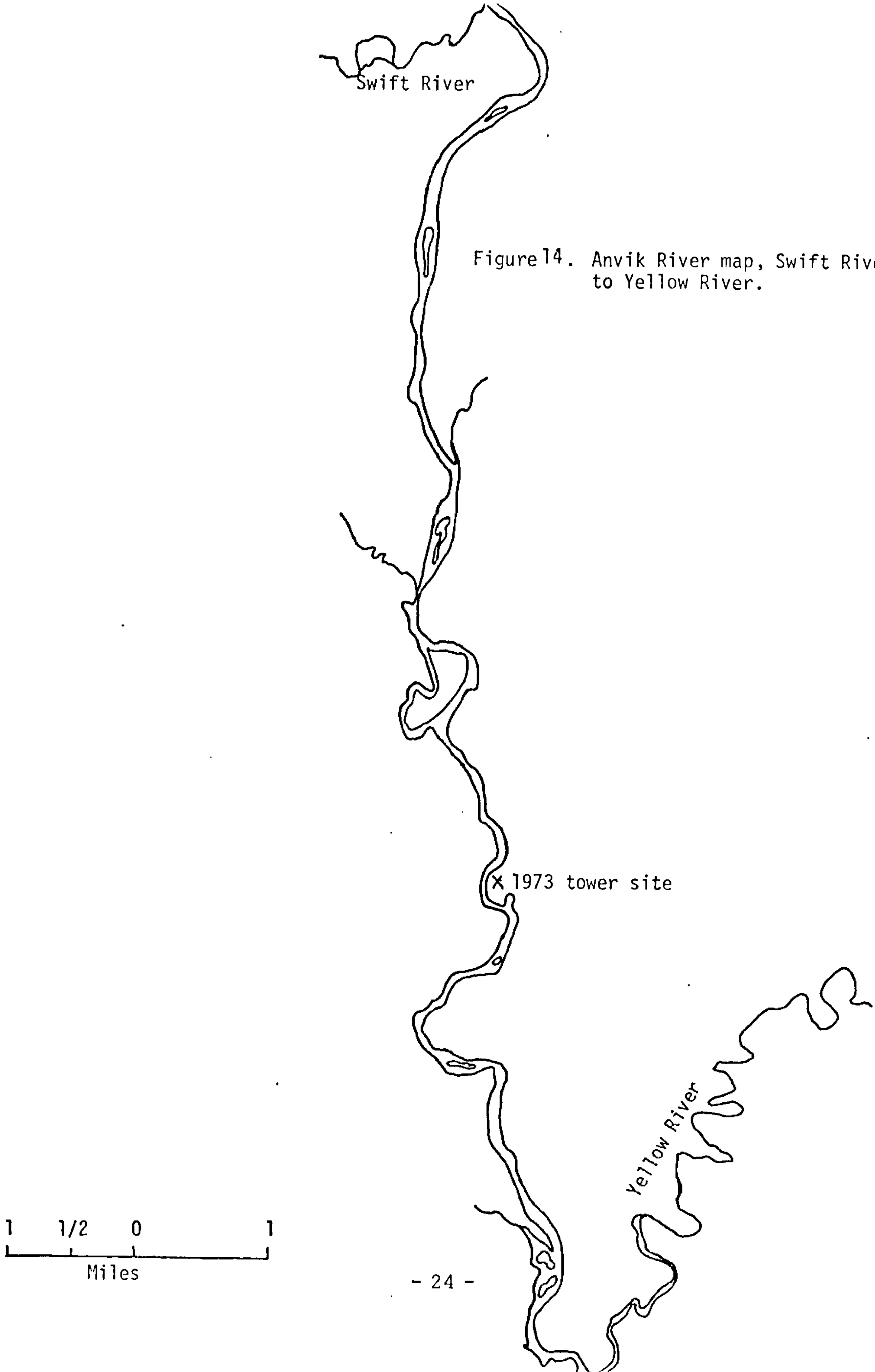


Figure 14. Anvik River map, Swift River to Yellow River.

Figure 15. Anvik River tower site, weir and light system, 1973

of the total count made during the same hours on days when 24-hour counts were made. This percentage (P) was subtracted from 100 percent (I-P) and divided into the daily count (A) to produce an expanded daily count (E) or

$$\frac{A}{I - P} = E$$

Hourly counts were then calculated by taking the same percentage (P) of the daily expanded count and substituting it for the missing hourly counts (Appendix Tables 4-9).

The size of king salmon passing the tower was estimated by comparing them with models attached to the background panel. The sizes were < 50 cm (trout size), 50-60 cm (chum size), 60-80 cm (average king) and > 80 cm (large king). The size information would be used to determine the approximate age and size composition of the Anvik king salmon escapement.

Carcass sampling and enumeration surveys were conducted above and below the tower site from July 18 to August 3. A scale smear was taken from each fish examined and the length from mideye to fork of tail recorded. Spawning success was gauged by examining the gonads of carcasses.

A single aerial survey was made of the Anvik on July 27 by a Department biologist in a Cessna 180. Climatological information was recorded daily. Stream flows and limnological data were taken periodically.

Results

Over the period June 28 to July 31, a net expanded upstream total of 71,475 chum salmon, 517 king salmon and 286 pink salmon was enumerated as they migrated past the Anvik River tower (Table 3). Estimates of the actual net hourly upstream counts made from 10-minute counts for the same hours (expanded by 6) were within 4 percent of the actual net upstream hourly totals for chum salmon, 1 percent for king salmon and 20 percent for pink salmon (Table 4). Upstream and downstream hourly enumeration logs and expanded counts are presented in Appendix Tables 4-9.

The summer chum salmon run peaked on July 3 and 11. The king salmon migration peaked on July 18 and the pink salmon migration on July 8 (Figure 16). The daily chum salmon migration was greatest from 2400 to 0200 hours, the king salmon migration from 1300 to 2000 hours, and the pink salmon migration from 2200 to 0500 hours (Figure 17).

Table 3. Daily net upstream salmon counts (expanded), Anvik River tower, 1973.

Date		Kings		Pinks		Chums	
		Number	%	Number	%	Number	%
June	28	-	-	-	-	73	.1
	29	1	.2	-	-	639	.9
	30	-	-	-	-	1,227	1.7
July	1	-	-	-	-	2,415	3.4
	2	2	.4	-	-	3,966	5.5
	3	3	.6	2	.7	6,105	8.5
	4	4	.8	4	1.4	5,150	7.2
	5	2	.4	2	.7	4,097	5.7
	6	6	1.2	6	2.1	3,423	4.8
	7	- 1	- .2	1	.3	1,559	2.2
	8	6	1.2	14	4.9	3,025	4.2
	9	16	3.1	20	7.0	5,700	7.9
	10	17	3.3	26	9.1	4,295	6.0
	11	25	4.8	49	17.1	8,152	11.4
	12	25	4.8	30	10.5	4,680	6.5
	13	23	4.4	35	12.2	3,739	5.3
	14	23	4.4	14	4.9	2,775	3.9
	15	18	3.5	17	5.9	2,278	3.3
	16	10	1.9	17	5.9	1,144	1.6
	17	42	8.1	18	6.3	1,868	2.6
	18	49	9.5	6	2.1	1,400	2.0
	19	31	6.1	8	2.8	829	1.2
	20	33	6.4	- 1	- .3	536	.8
	21	27	5.2	10	3.5	577	.8
	22	31	6.0	0	-	482	.7
	23	34	6.6	6	2.1	317	.4
	24	8	1.5	- 3	- 1.0	167	.2
	25	8	1.5	-	-	116	.2
	26	9	1.7	-	-	89	.1
	27	6	1.2	-	-	62	.1
	28	26	5.0	-	-	132	.2
	29	14	2.7	-	-	233	.3
	30	15	2.9	-	-	107	.1
	31	4	.8	5	1.7	118	.2
		517	100.0	286	100.0	71,475	100.0

Tab 4. Comparison of expanded 10-minute counts wit ctual counts for the same hours, Anvik River, 1 3. 1/

		Chums			Kings			Pinks		
		Net 10 min.	Expanded	Net upstream	Net 10 min.	Expanded	Net upstream	Net 10 min.	Expanded	Net upstream
June	28	12	72	73	0	0	0	0	0	0
	29	68	408	639	0	0	1	0	0	0
	30	193	1,158	1,227	0	0	0	0	0	0
July	1	353	2,118	2,415	0	0	0	0	0	0
	2	689	4,134	3,966	0	0	2	0	0	0
	3	903	5,418	6,105	0	0	3	0	0	2
	4	843	5,058	5,150	1	6	4	0	0	4
	5	708	4,248	4,097	0	0	2	1	6	2
	6	573	3,438	3,423	3	18	6	0	0	6
	7	250	1,500	1,559	0	0	-1	0	0	1
	8	477	2,862	3,025	0	0	6	2	12	14
	9	1,009	6,054	5,700	2	12	16	4	24	20
	10	864	5,184	4,295	0	0	17	3	18	26
	11	1,516	9,096	8,152	6	36	25	11	66	49
	12	786	4,716	4,680	4	24	25	10	60	30
	13	771	4,626	3,739	3	18	23	12	72	35
	14	518	3,108	2,775	4	24	23	2	12	14
	15	453	2,718	2,278	4	24	18	4	24	17
	16	185	1,110	1,144	4	24	10	3	18	17
	17	311	1,866	1,868	6	36	42	2	12	18
	18	265	1,590	1,400	9	54	49	2	12	6
	19	110	660	829	3	18	31	2	12	8
	20	98	588	536	5	30	33	3	18	-1
	21	113	678	577	7	42	27	2	12	10
	22	66	396	482	5	30	31	-1	-6	0
	23	37	222	317	4	24	34	0	0	6
	24	18	108	123	0	0	7	0	0	-2
	25	2	12	14	1	6	0	0	0	0
	26	0	0	0	0	0	0	0	0	0
	27	6	36	28	0	0	4	0	0	0
	28	20	120	66	5	30	18	0	0	0
	29	35	210	90	3	18	11	0	0	0
	30	4	24	32	3	18	9	-2	-12	0
	31	6	36	49	-1	-6	3	-1	-6	3
TOTAL		12,262	73,572	70,853	81	486	479	59	354	285

1/ All data represents actual net upstream counts.

Figure 16. Daily net upstream salmon migration (expanded), Anvik River Tower, 1973.

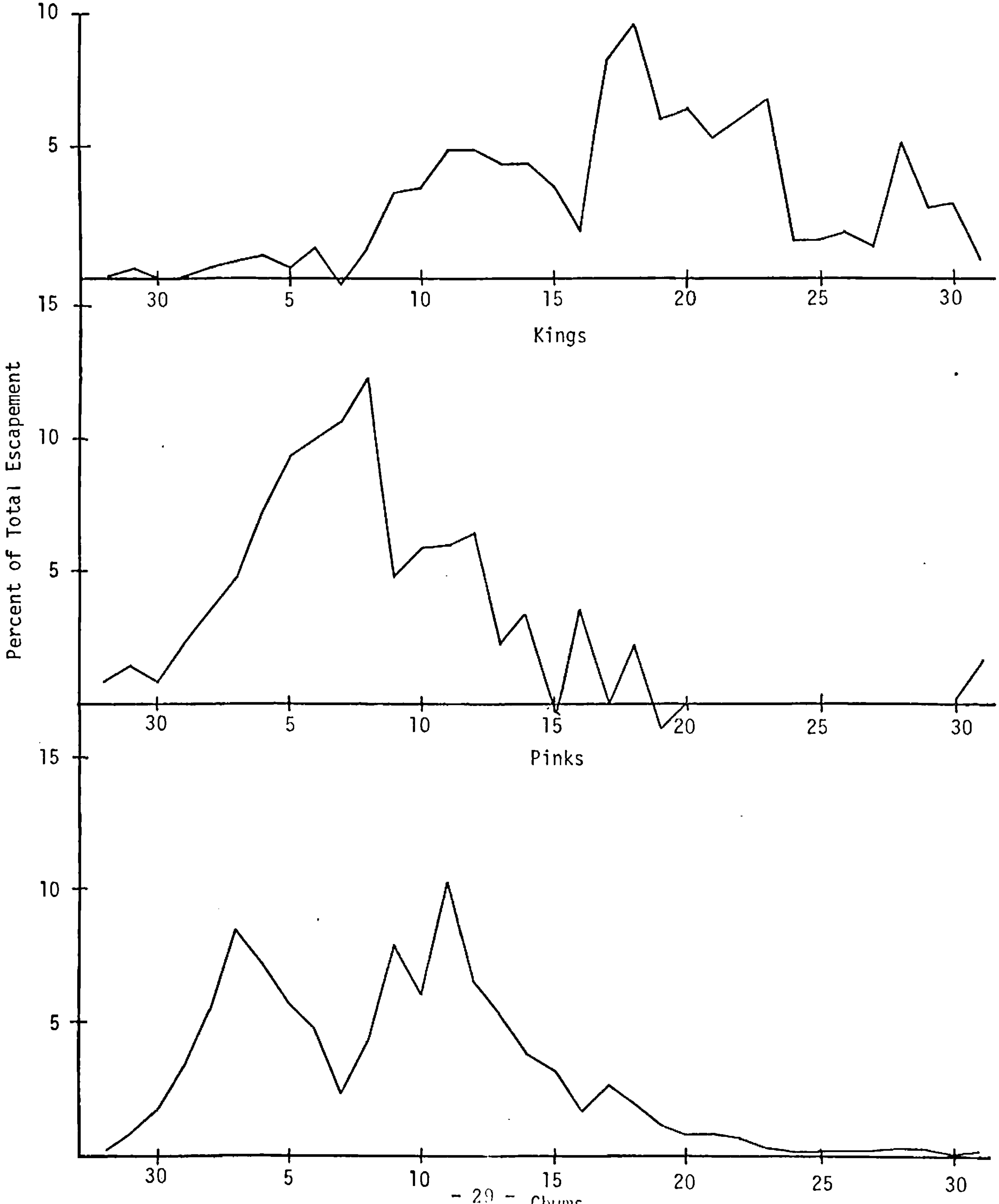
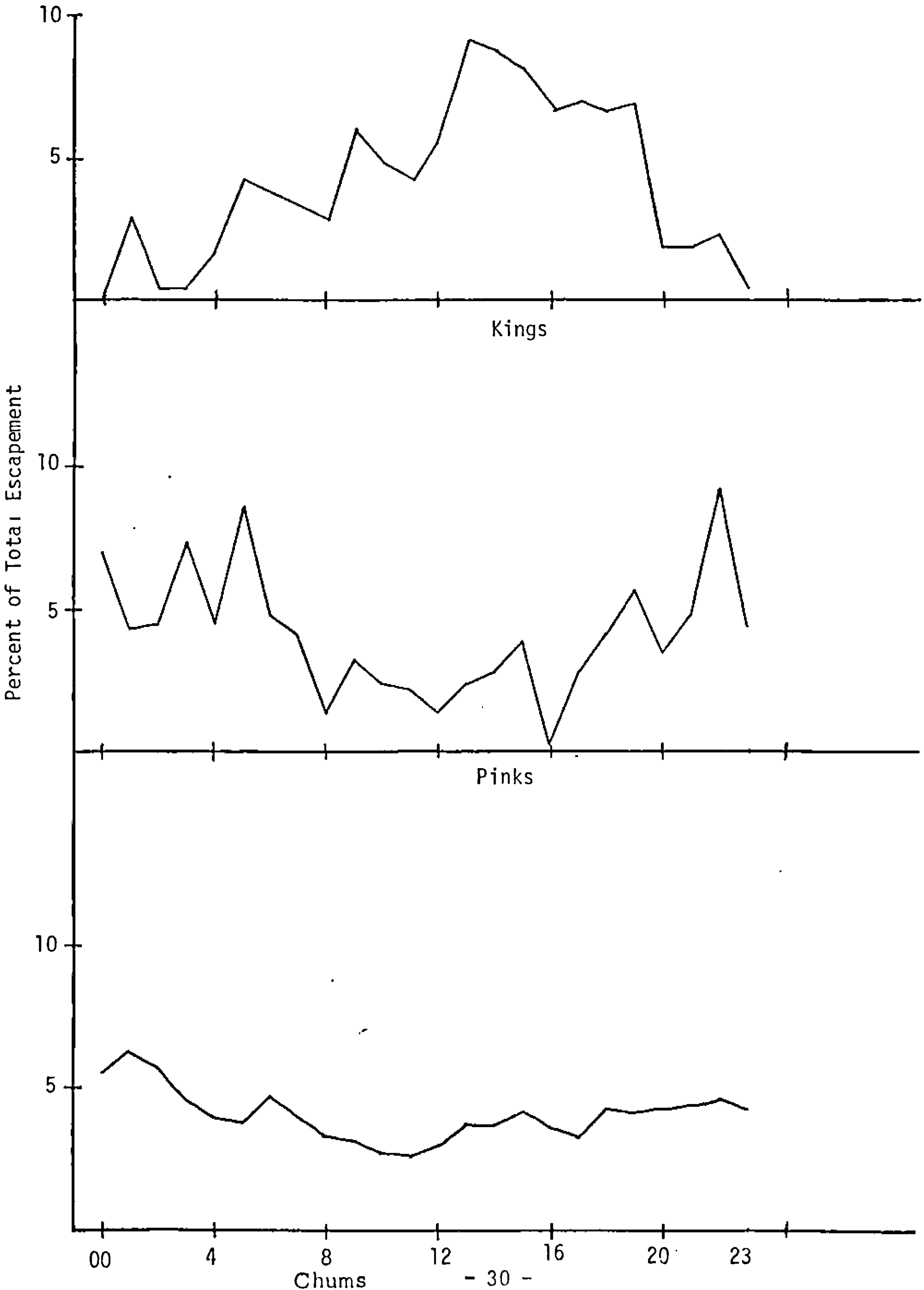


Figure 17. Hourly net upstream salmon counts (expanded), Anvik River counting tower, 1973.



Based on size estimates made from the tower, the net upstream migration of king salmon consisted of 4.1 percent fish less than 50 cm in length, 9.7 percent between 50-60 cm, 23.6 percent between 60-80 cm and 62.6 percent over 80 cm (Table 5).

Based on 783 carcass survey samples, the 1973 Anvik chum escapement was made up of 66 percent females. Age classes 3_1 to 6_1 were represented with 4_1 fish comprising 77 percent of the carcasses sampled (Table 6). Only 10 king salmon and no pink salmon carcasses were sampled (Table 7). Eight of the small samples of ten kings were 6_2 aged fish.

All of the female chums and 98 percent of the male chum carcasses examined were partially or completely spent. An average of 4.9 eggs was retained per female. All the king salmon carcasses examined were completely spent (Table 8). Sixteen percent of the total number of chum salmon carcasses, 5 percent of the king salmon carcasses and 9 percent of the pink salmon were found above the tower site (Table 9). A total of 6,395 chum carcasses, 28 pinks and 5 king carcasses was observed drifting downstream past the tower between July 10 and 31 (Table 10).

One aerial survey was flown on July 27 and a total of 26,156 chum salmon and 222 king salmon was enumerated. Fifty-seven percent of the king salmon and 42 percent of the chum salmon were enumerated above the tower (Appendix Table 10). The overall survey rating was fair.

Climatological and limnological data are presented in Appendix Table 11.

Discussion

The 1973 expanded net upstream total of 71,475 summer chum and 517 king salmon are 34 and 53 percent respectively less than the 1972 expanded upstream total of 108,342 chums and 1,104 kings (Lebida, 1972). No pink salmon were counted in 1972. The 1972 counts are not as accurate as the 1973 counts because counts were not made each hour and 55 percent of the hourly counts were estimates. In 1972 no adjustment was made for downstream movement. Using the 1973 upstream and downstream movement pattern to adjust the 1972 counts gave an expanded net upstream total of 99,675 chum salmon and 705 king salmon in 1972. This includes a 23 percent deduction for downstream movement for king salmon and a 9 percent deduction for chum salmon. Even at the lowest 1972 escapement estimate, it is evident that there was a significant reduction in numbers of spawning salmon in 1973. This reduction could be due to natural fluctuations in the run or, in the case of summer chums, an increased harvest in 1973.

Table 5. Estimated size of king salmon migrating past Anvik River tower, 1973.[1/]

Direction of movement	Estimated Size[2/] <50 cm Number	%	50-60 cm Number	%	60-80 cm Number	%	>80 cm Number	%	Total
Upstream	20	3.3	64	10.6	140	23.2	380	62.9	604
Downstream	1	.8	18	13.8	28	21.6	83	63.8	130
Net upstream	19	4.1 [1/]	46	9.7	112	23.6	297	62.6	474

1/ Does not include king salmon seen, but not clearly discernible in the water.

2/ Total length.

Table 6. Age, sex and size composition of chum salmon carcass samples, Anvik River, 1973.

	Dates		Age Class 3_1	4_1	5_1	6_1	Total
Carcass survey 1	7/18/73 to 7/24/73	Males					
		Number	1	49	16	-	66
		Percent	1	28	9	-	38
		Mean length (mm)	540	570	600	-	580
		Females					
		Number	8	87	11	1	107
		Percent	5	50	6	1	62
		Mean length (mm)	520	540	560	560	540
	1/	Combined					
		Number	9	136	27	1	173
		Percent	6	78	15	1	100
		Mean length (mm)	522	550	580	560	550
Carcass survey 2	7/27/73 to 7/30/73	Males					
		Number	5	76	8	1	90
		Percent	3	50	5	1	59
		Mean length (mm)	570	580	610	620	580
		Females					
		Number	3	49	12	-	64
		Percent	2	31	8	-	41
		Mean length (mm)	500	540	560	-	540
	1/	Combined					
		Number	8	125	20	1	154
		Percent	5	81	13	1	100
		Mean length (mm)	540	560	580	620	570
Carcass survey 3	7/31/73 to 8/03/73	Males					
		Number	5	79	25	-	109
		Percent	1	17	6	-	24
		Mean length (mm)	510	570	580	-	570
		Females					
		Number	26	265	56	-	347
		Percent	6	58	12	-	76
		Mean length (mm)	530	530	550	-	530
	1/	Combined					
		Number	31	344	81	-	456
		Percent	7	75	18	-	100
		Mean length (mm)	530	540	560	-	540
TOTALS		Males					
		Number	11	204	49	1	265
		Percent	1	26	6	0.5	34
		Mean length (mm)	540	570	590	620	580
		Females					
		Number	37	401	79	1	518
		Percent	5	51	10	0.5	66
		Mean length (mm)	530	530	550	560	540
	1/	Combined					
		Number	48	605	128	2	783
		Percent	6	77	16	1	100
		Mean length (mm)	530	550	570	590	550

1/ Weighted sample.

Table 7. Age, sex and size composition of king salmon carcass samples, Anvik River, 1973

	Age Class				
	4_2	5_2	6_2	7_2	Total
Males					
Number	1	-	5	-	6
Percent	10	-	50	-	60
Mean length (mm)	660	-	890	-	850
Females					
Number	-	-	3	1	4
Percent	-	-	30	10	40
Mean length (mm)	-	-	830	850	840
Combined sexes					
Number	1	-	8	1	10
Percent	10	-	80	10	100
Mean length (mm)	660	-	870	850	850

Table 8. Post spawning condition of Anvik River salmon carcasses, 1973.

CHUM SALMON

Males

Date of Survey	Survey No.	Spawned Out	Partially Spent	Did Not Spawn	Total
(7/18-7/24)	1	11(3.5%)	97(30.5%)	1(.3%)	109(34.3%)
(7/27-7/30)	2	8(2.5%)	68(21.4%)	2(.6%)	78(24.5%)
(7/31-8/3)	3	6(1.9%)	121(38.1%)	4(1.2%)	131(41.2%)
Combined Surveys		25(7.9%)	286(90.0%)	7(2.1%)	318(100.0%)

Females

Spawned Out	Did Not Spawn	Partially Spent	Average No. of Eggs Retained Per Female	Total
53(9.2%)	-	35(6.1%)	4.7	88(15.3%)
109(19.0%)	-	15(2.6%)	2.0	124(21.6%)
298(51.8%)	-	65(11.3%)	6.1	363(63.1%)
460(80.0%)	-	115(20.0%)	4.9	575(100.0%)

KING SALMON

Males

Date of Survey	Survey No.	Spawned Out	Partially Spent	Did Not Spawn	Total
Combined Surveys		-	6(100.0%)	-	6(100.0%)

Females

Spawned Out	Did Not Spawn	Partially Spent	Average No. of Eggs Retained Per Female	Total
4(100.0%)	-	-	-	4(100.0%

Table 9. Distribution of salmon carcasses, Anvik River, 1973.

Area of River	Survey 1 Chums	Survey 1 Pinks	Survey 1 Kings	Survey 2 Chums	Survey 2 Pinks	Survey 2 Kings	Survey 3 Chums	Survey 3 Pinks	Survey 3 Kings	Totals Chums	Totals Pinks	Totals Kings
Swift River to Otter Creek	1/	1/	1/	1,350	1	-	150 3/		-	1,500	1	-
Tower to Swift River	600	-	-	1,400	-	1	1,700	-	1	3,700	-	1
Yellow River to Tower	9,550	-	-	2,500	-	5	4/	-	-	12,500	-	5
Beaver Creek to Yellow River	4,650 2/	1	-	1,950 2/	-	11	4/	-	-	6,600	1	11
Goblet Creek to Beaver Creek	-	-	-	-		-	6,000	10	2	6,000	10	2
Anvik Village to Goblet Creek	-	-	-	-		-	2,000	-	1	2,000	-	1
Total	14,800	1	-	7,200	1	17	8,850	10	4	32,300 5/	12 5/	20 5/

1/ Did not survey on first survey.
2/ Did not survey below on first and second survey.
3/ Only surveyed two miles above Swift River.
4/ Area not surveyed because surveyed shortly before.
5/ A total of 6,395 chums, 28 pink and 5 king salmon carcasses were observed drifting downstream past the tower from July 10-July 31. These carcasses originated above the tower, but were enumerated with the carcasses below the tower.

Note: Survey 1 (7/18 - 7/24) Survey 2 (7/27 - 7/30) Survey 3 (7/31 - 8/3)

Table 10. Number of dead chum, pink, and king salmon passing tower site, Anvik River, 1973.

Date	Chums		Pinks		Kings	
	No.	%	No.	%	No.	%
July 10	2	(.04)	-		-	-
11	4	(.06)	-	-	-	-
12	11	(.2)	-	-	-	-
13	22	(.3)	-	-	-	-
14	36	(.6)	-	-	-	-
15	66	(1.0)	-	-	-	-
16	95	(1.5)	-	-	-	-
17	138	(2.2)	-	-	-	-
18	141	(2.2)	-	-	-	-
19	331	(5.2)	-	-	-	-
20	463	(7.2)	2	(7.0)	-	-
21	623	(9.8)	-	-	-	-
22	631	(9.8)	5	(17.9)	-	-
23	699	(10.9)	-	-	-	-
24	378	(5.9)	1	(3.6)	-	-
25	499	(7.8)	-	-	-	-
26	883	(13.8)	13	(46.6)	-	-
27	930	(14.6)	5	(17.9)	-	-
28	295	(4.6)	2	(7.0)	2	(40)
29	148	(2.3)	-	-	1	(20)
30	-	-	-	-	1	(20)
31	-	-	-	-	1	(20)
	6,395	(100.0)	28	(100.0)	5	(100.0)

The hourly migration patterns for king and chum salmon were similar in 1972 and 1973. The daily chum migration was greatest from 2400 to 0200 in 1973, while it reached its peak between 2100 and 0100 in 1972. The daily king salmon migration was greatest from 1300 to 1900 in 1973 and from 1300 to 1800 in 1972. The 1973 chum salmon seasonal migration which peaked on July 3 and 11 showed a different pattern from 1972 when the run peaked on July 12. The seasonal king salmon migration showed a similar pattern in 1972 and 1973.

There was a significant difference in the age and sex composition of the 1972 and 1973 chum salmon escapement on the Anvik. The 1972 carcass sample was composed of 49 percent 5_1 and 46 percent 4_1 salmon. The 1973 carcass sample was composed of 77 percent 4_1 salmon. The 1972 sample was composed of 48.0 percent females, compared to 66 percent females in the 1973 sample. This change in the 1973 age and sex composition was not apparently due to increased fishing effort with gear that is known to be selective for the larger male chums. Both the 1973 commercial catch sample and the Flat Island test fishing catches showed a preponderance of female chums in the catch (57 percent; see Appendix Tables 22 and 23). The potential chum salmon productivity in 1973 was high, with females making up 66 percent of the sample. Most of the chum carcasses examined were spent with an average of only 4.9 eggs retained per female.

Both the 1972 and 1973 king salmon carcass sample sizes were too small to provide any conclusive data on the age and sex composition of the Anvik River spawning population. Because of the lack of current comparative data from a known age and total length sample, age analysis was not made of the estimated size (total length) of king salmon passing the Anvik tower in 1973. To provide the necessary data it is recommended that in future years a total length frequency breakdown by age and sex be made for both the commercial king salmon catch sample at Emmonak and for all spawning ground carcass samples.

The potential productivity of the 1973 Anvik River king salmon spawning population cannot be determined without an accurate estimate of the percentage of females in the run. However, potential productivity is probably below 1972 levels.

The first chum salmon carcasses were observed drifting past the counting tower on July 10, 13 days after the first chums had been observed migrating upstream. Seasonal peaks in the numbers of chum carcasses drifting past the tower occurred on July 23 and 27 (Table 10). This was 20 and 16 days respectively after the seasonal peaks in upstream migration occurred. These observations may indicate that the stream life for chum salmon spawning above the tower site ranges between 13 and 20 days. Not enough king and pink salmon carcasses were observed to make any estimates of stream life for these species. By August 1, all of the pink salmon and most of the chum salmon were dead. Most of the king salmon, however, lived through the first week in August.

Because of less than ideal survey conditions, the 1973 aerial survey only enumerated a small percentage of the salmon that were actually in the river. It is interesting to note that the percentage of chum (42 percent) and king salmon (57 percent) observed above the tower was very close to the percentage estimated by the carcass survey (Appendix Table 10).

The current Anvik River tower site has proved to be satisfactory for enumerating salmon. Extensive surveys were made above and below the present site and no sites were found which offered any greater advantages.

Based on 1972 and 1973 data, it would be feasible to reduce counting time to 18 hours per day. Unfortunately, the lowest king salmon counts coincide with the highest chum salmon counts. To count the greatest percentage of the king salmon migration each day, the optimum period is from 0400 to 2200 hours. These hours comprise 94 percent of the daily migration. The optimum period for counting chum salmon is from 1300 to 0700. These hours comprise 81 percent of the total daily migration. The optimum counting period, to maximize the percentage of both the chum and king salmon daily migration counted, is between 1100 and 0500. These hours comprise 79 percent of the chum migration and 75 percent of the king salmon migration.

Summary

1. During June 28 to July 31 an expanded net upstream total of 71,475 chum salmon, 517 king salmon and 286 pink salmon was enumerated past the Anvik River tower.

2. In 1973 chum salmon escapements were down 34 percent and king salmon escapements were down 53 percent from 1972 counts.

3. Expanded ten-minute counts were within 4 percent of the actual net upstream totals for chum salmon, 1 percent for king salmon and 20 percent for pink salmon.

4. Daily chum salmon migration peaked on July 3 and 11, king salmon migration on July 18 and pink salmon migration on July 8.

5. Hourly migration was heaviest for chum salmon between 2400 and 0200, king salmon between 1300 to 2000 and pink salmon between 2200 and 0500.

6. The 1973 chum salmon carcass sample was made up of 66 percent females and 34 percent males. Age class 4_1 made up 77 percent of the carcass sample. The king and pink salmon samples were too small to make any conclusions.

SALCHA RIVER SALMON ESCAPEMENT STUDIES

Introduction

The Salcha River is the most important king and summer chum salmon spawning stream in the Tanana River drainage. In 1972 a preliminary study was initiated to determine the abundance and distribution of the king salmon spawning population in the river. The age, sex and size composition of the spawning population was determined and a potential tower and weir site was located.

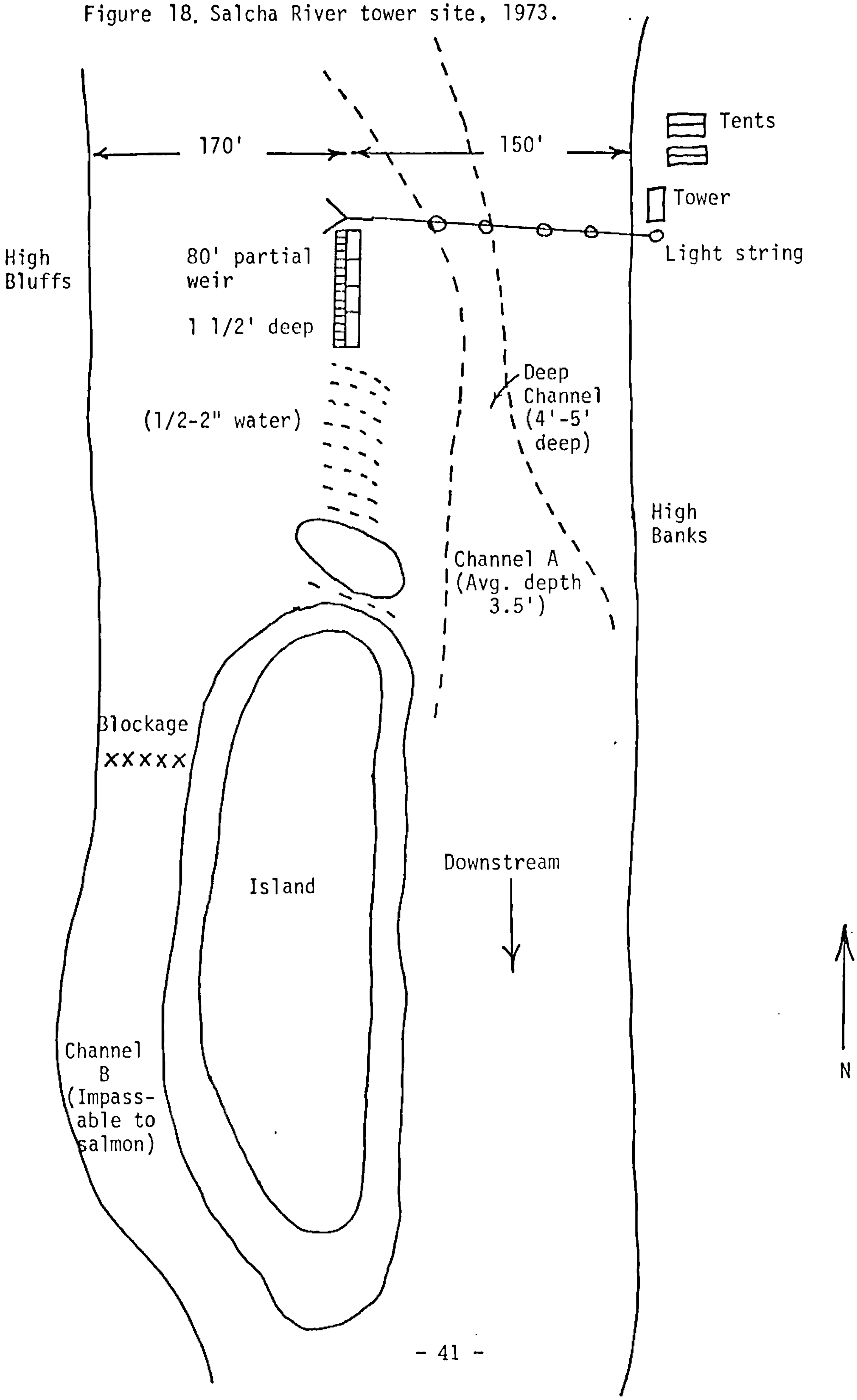
The announcement of plans to build the trans-Alaska hot oil pipeline across the Salcha River placed these studies in a high priority, due to the possibility of damage to the salmon stocks from construction activities associated with the buried pipeline or oil spills. If damage did occur, accurate data on population size and distribution would have to be available for mitigation and rehabilitation of the salmon runs.

In 1973 a comprehensive study was initiated on the Salcha River. The objectives of this study were to: (1) investigate the feasibility of using a counting tower to determine the daily and seasonal timing and magnitude of both the king and chum salmon runs, (2) evaluate aerial survey methods by comparing aerial counts to tower counts, (3) determine spawner distribution and major spawning areas in relation to the pipeline crossing, (4) determine the age, sex and size composition of the king and chum salmon escapement, (5) select a potential location for the operation of a salmon counting weir in the lower river, and (6) describe the physical, climatological and limnological characteristics of the Salcha River drainage.

Methods and Materials

A counting tower site was selected about 5 river miles above the Richardson Highway bridge (Figure 18). The river at this point was about

Figure 18. Salcha River tower site, 1973.



320 feet across. It consisted of two channels divided by a sandbar. One of the channels was very shallow and was not passable to salmon under normal water conditions. The second channel was partially weired off to reduce the counting area to about 150 feet. The average depth of this channel was approximately 3-1/2 feet. Large pieces of canvas were painted white, weighted with sandbags and dropped into the deepest part of the channel to improve visibility. A 22 foot prefabricated aluminum tower was erected on a 7 foot bank on the south side of the river (Figure 18).

A power line with four 300-watt incandescent light bulbs housed in 18-inch diamter reflectors was strung across the river to provide illumination during the hours of darkness. It was anchored to a large tree onshore and a tripod in the middle of the river. A 1500-watt generator provided electricity.

Each of the three crew members was scheduled to enumerate salmon for two 4-hour periods daily. Counts were recorded for hourly totals and the first 10 minutes of each hour. Salmon moving downstream were subtracted from the upstream total. Spawned-out salmon passing the tower were recorded, but not counted as moving downstream. The length of king salmon passing the tower was estimated by comparing them with models anchored to the river bottom. The lengths were > 50 mm (trout size), 50-60 mm (chum size), 60-80 mm (medium king) and < 80 mm (large king).

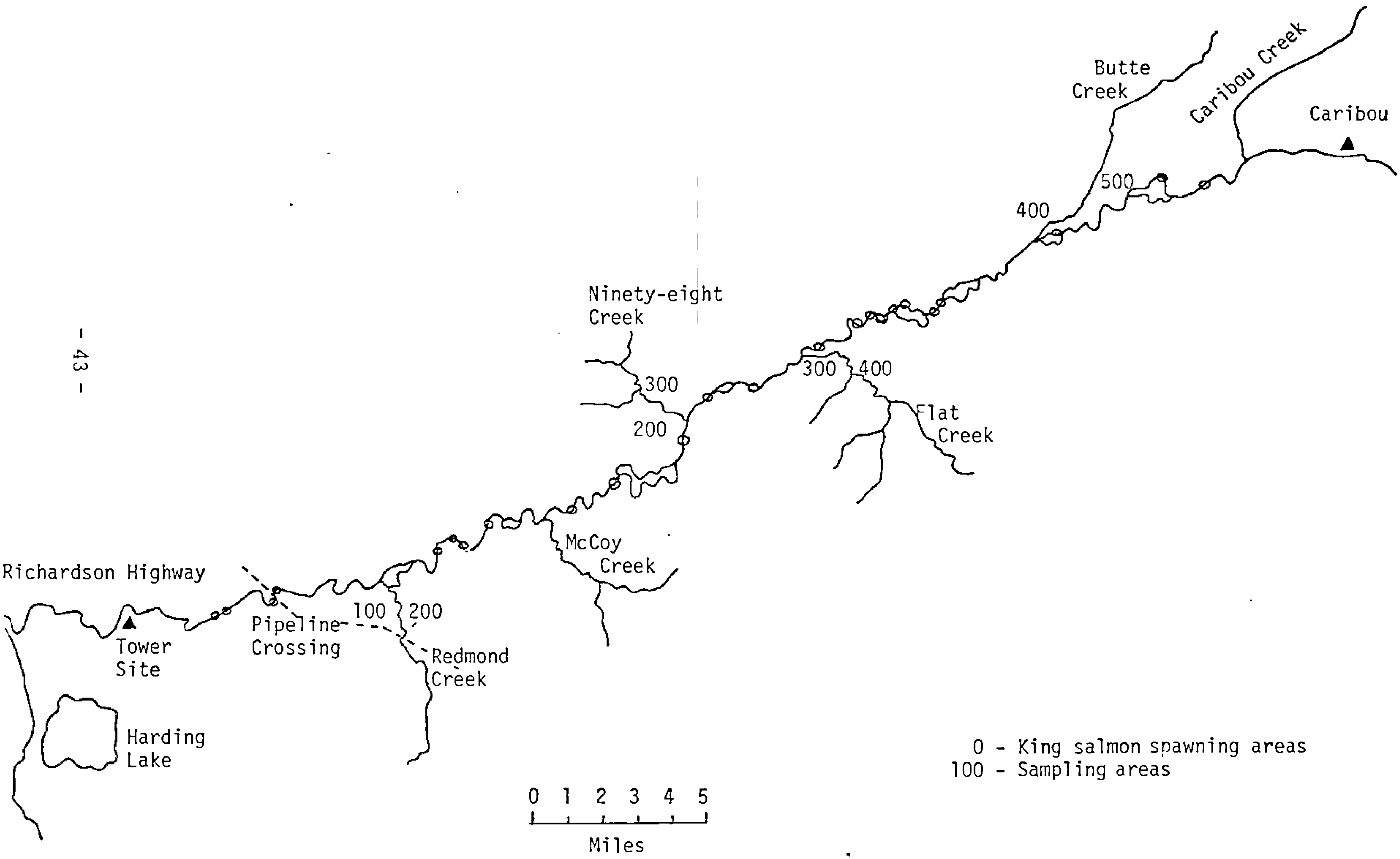
Two aerial surveys were made of the Salcha River near the peak of king salmon spawning. A Heliocourier aircraft was used on August 6 and a Bell Jet Ranger helicopter on August 7. The surveys covered the area between the river mouth and the North Fork of the Salcha.

A 24 foot outboard-jet powered riverboat was used to survey the 68 miles, where most of the spawning occurred, from the river mouth to Caribou Creek. King and chum salmon spawning areas were identified and plotted on a map.

Periodic carcass sampling and enumeration surveys were made by boat between August 1 and August 22. A scale smear was taken from each carcass examined and the length from mideye to fork of tail recorded. Spawning success was gauged by examining the gonads of carcasses. The location of all carcasses examined was recorded by sampling area (Figure 19).

Foot and boat surveys were made on the lower 1 to 1-1/2 miles of all the major tributaries of the Salcha. These surveys were made to obtain limnological data and to determine if king salmon fry and other species were using these streams for rearing areas. Water chemistry was determined with a Hach kit.

Figure 19. King salmon spawning areas, Salcha River, 1973.



Climatological data was recorded daily and limnological information periodically for the main river.

Results

The first adult king salmon was observed in the Salcha River on July 15. The water did not sufficiently clear to enumerate salmon from the tower, however, until July 18. After 35 hours of counting, a total of 48 king salmon and 6 chum salmon were enumerated past the tower. By 1100 hours on July 19, heavy rains and rising water conditions eliminated any possibility of further counts and this phase of the project was terminated.

Two hundred forty-nine king salmon and 290 chums were enumerated on the August 6 aerial survey and only 191 kings and 17 chums were enumerated on August 9 under poor survey conditions. Comparative aerial survey counts are presented in Appendix Tables 12 and 13.

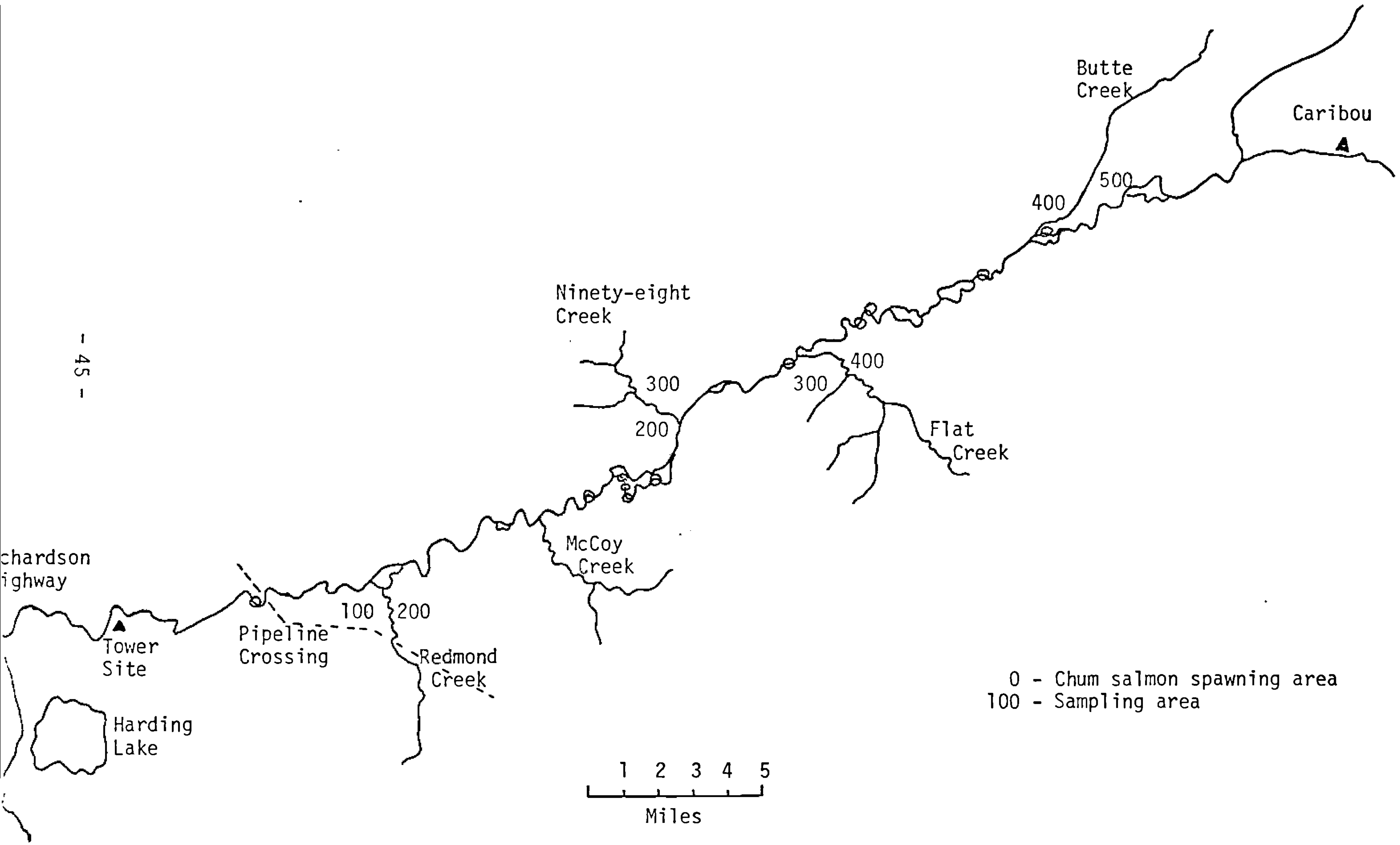
The location of king salmon and chum salmon spawning areas is shown in Figure 19 and 20 only. Seventeen percent of the king salmon spawning areas and 10 percent of the chum spawning areas were located below Redmond Creek (vicinity of Pipeline Crossing).

King and chum salmon carcass distribution by area of river is presented in Tables 11 and 12. Eighty-two percent of the king carcasses were found below Ninety-eight Creek. The majority of the chum carcasses were found in four areas--Keopke Slough, near Butte Creek, 1/2 mile below Flat Creek and 2 miles above Ninety-eight Creek.

Based on 93 carcass samples, the 1973 Salcha River king salmon escapement was made up of 63 percent males and 37 percent females (Table 13). Ages 4_2 through 7_2 were represented with ages 5_2, 6_2 and 7_2 composing 34 percent, 29 percent and 26 percent of the sample respectively. Examination of carcass gonads for post-spawning condition indicated that 93 percent of the male king salmon and 100 percent of the females were partially or completely spent (Table 14). An average of only 7.3 eggs was retained per female.

Based on 312 carcass samples, the 1973 Salcha River chum salmon escapement was composed of 45 percent males and 55 percent females (Table 15). Age class 3_1 to 5_1 were represented with age group 4_1 fish composing 76 percent of the sample. Eighty-three percent of the male chums and 91 percent of the female chums were partially or completely spent. An average of 242 eggs was retained per female chum (Table 14).

Figure 20. Chum salmon spawning areas, Salcha River, 1973.



- 45 -

Table 11. King salmon abundance and distribution, Salcha River, 1973.

Area[1/]	Aerial Survey (8/6)		Carcass Survey (8/1-8/22)						Boat Survey (8/1-8/22)	
			Males		Females		Combined		Redds	
	Number	%	Number	%	Number	%	Number	%	Number	%
100	19[2/]	8.0	36	51.0	9	21.0	45	40.0	4	17.0
200	59[3/]	24.0	25	36.0	24	55.0	49	42.0	7	29.0
300	-	-	5	7.0	6	14.0	11	10.0	2	8.0
400	141[4/]	56.0	2	3.0	2	5.0	4	4.0	7	29.0
500	30	12.0	2	3.0	2	5.0	4	4.0	4	17.0
TOTAL	249	100.0	70	100.0	43	100.0	113	100.0	24	100.0

1/ 100--River mouth to mouth of Redmond Creek.
200--Mouth of Redmond Creek to mouth of Ninety-eight Creek.
300--Mouth of Ninety-eight Creek to mouth of Flat Creek.
400--Mouth of Flat Creek to mouth of Butte Creek.
500--Mouth of Butte Creek to mouth of North Fork.

2/ To pipeline crossing two miles below Redmond Creek.

3/ To McCoy Creek.

4/ From McCoy Creek to Butte Creek

Table 12. Chum salmon abundance and distribution, Salcha River, 1973.

Area 1/	Aerial Survey (8/6)		Carcass Survey (8/1-8/22)						Boat Survey (8/1-8/22)	
			Males		Females		Combined		Spawning Areas	
	Number	%	Number	%	Number	%	Number	%	Number	%
100	110 2/	38.0	9	6.0	9	5.0	18	5.0	1	10.0
200	79 3/	27.0	44	28.0	47	26.0	91	27.0	4	40.0
300	-	-	40	25.0	33	18.0	73	21.0	1	10.0
400	101 4/	35.0	39	24.0	52	28.0	91	27.0	3	30.0
500	-	-	27	17.0	41	23.0	68	20.0	1	10.0
TOTAL	290	100.0	159	100.0	182	100.0	341	100.0	10	100.0

1/ 100--River mouth to mouth of Redmond Creek
200--Mouth of Redmond Creek to mouth of Ninety-eight Creek.
300--Mouth of Ninety-eight Creek to mouth of Flat Creek.
400--Mouth of Flat Creek to Butte Creek.
500--Butte Creek to North Fork.

2/ To pipeline crossing two miles below Redmond Creek.

3/ To McCoy Creek.

4/ From McCoy Creek to Butte Creek.

Table 13. Age, sex and size composition of king salmon carcass sample, Salcha River, 1973.

	4_2	5_2	6_2	7_2	Total
Males					
Number	10	29	11	8	58
Percent	11.0	31.0	12.0	9.0	63.0
Mean length (mm) 1/	680	740	920	980	800
Females					
Number	-	3	16	16	35
Percent	-	3.0	17.0	17.0	37.0
Mean length (mm)	-	810	900	960	919
Combined sexes					
Number	10	32	27	24	93
Percent	11.0	34.0	29.0	26.0	100.0
Mean length (mm)	680	746	908	970	843

1/ All lengths are from center of eye to fork of tail.

Table 14. Post spawning condition of Salcha River salmon carcasses, 1973.

KING SALMON

Males / Females

Date of Survey	Survey No.	Males: Spawned Out	Males: Partially Spent	Males: Did Not Spawn	Males: Total	Females: Spawned Out	Females: Did Not Spawn	Females: Partially Spent	Average No. of Eggs Retained Per Female	Females: Total
(8/1-8/5)	1	9 (13.0%)	1 (1.0%)	-	10 (15.0%)	3 (7.0%)	-	1 (2.0%)	2.0	4 (9.0%)
(8/7-8/10)	2	13 (19.0%)	17 (25.0%)	4 (6.0%)	34 (50.0%)	7 (16.0%)	-	2 (4.5%)	20.0	9 (21.0%)
(8/13-8/16)	3	9 (13.0%)	8 (12.0%)	-	17 (25.0%)	15 (34.0%)	-	1 (2.0%)	.7	16 (36.0%)
(8/18-8/22)	4	2 (3.0%)	4 (6.0%)	1 (1.0%)	7 (10.0%)	13 (30.0%)	-	2 (4.5%)	5.0	15 (34.0%)
Combined Surveys		33 (49.0%)	30 (44.0%)	5 (7.0%)	68 (100.0%)	38 (87.0%)	-	6 (13.0%)	7.3	44 (100.0%)

CHUM SALMON

Males / Females

Date of Survey	Survey No.	Males: Spawned Out	Males: Partially Spent	Males: Did Not Spawn	Males: Total	Females: Spawned Out	Females: Did Not Spawn	Females: Partially Spent	Average No. of Eggs Retained Per Female	Females: Total
-	1	-	-	-	-	-	-	-	-	-
(8/7-8/10)	2	3 (2.0%)	30 (18.0%)	5 (3.0%)	38 (23.0%)	29 (17.0%)	1 (.5%)	12 (7.0%)	77.0	42 (24.0%)
(8/13-8/16)	3	1 (1.0%)	4 (2.0%)	10 (6.0%)	15 (9.0%)	6 (3.0%)	5 (3.0%)	2 (1.0%)	969.0	13 (8.0%)
(8/18-8/22)	4	35 (21.0%)	63 (39.0%)	13 (8.0%)	111 (68.0%)	85 (49.0%)	10 (5.5%)	24 (14.0%)	221.0	119 (68.0%)
Combined Surveys		39 (24.0%)	97 (59.0%)	28 (17.0%)	164 (100.0%)	120 (69.0%)	16 (9.0%)	38 (22.0%)	242.0	174 (100.0%)

Table 15. Age, sex, and size composition of chum salmon carcass sample, Salcha River, 1973.

	3_1	4_1	5_1	Totals
Males				
Number	13	111	17	141
Percent	4.0	36.0	5.0	45.0
Mean length (mm) 1/	580	600	630	602
Females				
Number	20	129	22	171
Percent	6.0	42.0	7.0	55.0
Mean length (mm)	560	590	580	585
Combined sexes				
Number	33	240	39	312
Percent	11.0	76.0	13	100.0
Mean length (mm)	570	590	600	592

1/ All lengths are from center of eye to fork of tail.

Out of five major tributaries surveyed, four were found to contain king salmon fry (Appendix Table 15). Limnological and physical data for all major tributaries and the main river are presented in Appendix Table 14 and 15.

No suitable weir site was located in the lower 15 miles of the Salcha River.

Discussion

It is probably not feasible to successfully enumerate salmon from a counting tower in the lower Salcha River more often than one year out of four. The size of the lower river, combined with rapidly fluctuating water levels, is the primary problem. At the 1973 tower site, which was the optimum location on the lower river, the river was approximately 320' across with an average depth of 3.5 feet. Even at low water levels, it was difficult to see salmon in the deepest part of the channel. Brown stained water and frequent floods complicated the problem.

The August 6, 1973 aerial survey estimate of 249 adult king salmon was the second poorest count on record. It is only 21 percent of the 1972 aerial survey estimate of 1,193 king salmon (Lebida, 1972). Based on aerial survey estimates and boat surveys of the entire spawning area of the river, the 1973 escapement level was very low. It is felt that this poor escapement is the direct result of the severe flooding which occurred during the peak of spawning in August, 1967. The age composition of the 1973 king salmon run supports this. The 6_2 age group, which normally comprises the largest portion of the escapement, represented only 29 percent of the escapement in 1973. Age group 6_2 comprised 82 percent of the 1972 Salcha River carcass sample (A-Y-K Data Report, 1972). The age class 5_2 and 7_2 fish, which normally comprises less than 30 percent of the total catch sample in the Yukon River commercial catch sample, made up 60 percent of the Salcha River carcass sample in 1973. Assuming normal survival and age composition of the run, the Salcha will probably experience another poor escapement in 1979.

The August 6, 1973 aerial survey escapement estimate of 290 chums is only 30 percent of the 1972 estimate of 947 chums. However, the aerial survey data is not complete since 312 carcasses were examined on carcass surveys alone. The reason for this is that the aerial survey was flown before the peak of chum spawning which probably occurred in mid-August. A gross estimate of chum salmon escapement based on boat survey data and personal observations would be from 900-1,500 spawning chum salmon. This figure is below the average of 11 years of aerial survey estimates.

Due to chronic problems with the outboard jet units during the boat surveys and the tendency for spawned-out king salmon to drift long distances from the redd before dying, it is felt that the August 6 aerial survey was the best indicator of king salmon abundance and distribution in 1973. Based on the aerial survey estimates, 8 percent of the king salmon in the Salcha River drainage spawn below the trans-Alaska main river pipeline crossing and 32 percent below Redmond and McCoy creeks (Table 11). Redmond and McCoy creeks are important tributaries of the Salcha River, which enter the Salcha upstream from the pipeline crossing. In addition, both of these streams will be crossed by the pipeline above their confluence with the Salcha, and could convey oil into the Salcha in the event of an oil spill. The area affected by an oil spill could extend from the mouth of McCoy or Redmond Creek to the mouth of the Salcha. The 1973 aerial survey estimates agree very closely with the 1972 aerial survey estimates of 12 percent of the king salmon spawning below the main river pipeline crossing and 30 percent below McCoy Creek (Lebida, 1972).

The August 6, 1973 aerial survey indicated that 38 percent of the chums observed were below the pipeline crossing and 65 percent were below McCoy Creek. These were migrating fish, however, and the actual percentage of the total escapement was closer to 10 percent spawning below the main river pipeline crossing and 20 percent below McCoy Creek. This is based on observations of spawning chums made on the boat surveys (Table 12). No data on chum salmon distribution in the Salcha was available from 1972.

The age and sex composition of the 1973 Salcha River king salmon escapement sample was significantly different from the age and sex composition of the 1973 Emmonak commercial catch sample taken near the mouth of the Yukon River (Appendix Table 16). The Emmonak sample was composed of 53 percent male king salmon and 76 percent age class 6_2 king salmon. The Salcha sample was composed of 63 percent males and age class 6_2 only comprised 29 percent of the total sample. This difference in age and sex composition can be accounted for by the poor return of the 6_2 age class, which normally contains the largest percentage of female king salmon in the sample.

There was no significant difference between the age and sex composition of the Salcha River chum salmon escapement sample and the Emmonak commercial catch sample which was composed of 43 percent males and 65 percent age class 4_1 chum salmon (Regnart et al, 1973). This may indicate that the commercial fishery, which is known to be selective for the larger male chum salmon, did not have a significant effect on the age and sex composition of the chum run in 1973.

The presence of king salmon fry in Salcha River feeder streams had not been reported previously. Their presence indicates that they actively migrate into areas where no adults have ever been observed spawning. In two cases (Flat Creek and Redmond Creek) fry were captured several miles upstream from the main river. To reach these areas, the fry had to negotiate a very swift current. Their presence in these streams is very important in the light of plans for developing this area. Precautions will have to be taken to ensure the quality of these streams as rearing areas is preserved. Culvert size and stream modifications will have to be designed to allow passage of fry at all water levels.

Observations made during the 1973 field season indicate that it is probably not feasible to build a weir across the lower Salcha River with the resources currently available to the Yukon research staff. The lower Salcha is too wide, too swift and too deep to weir with any structure which could be erected without the use of heavy equipment. During the months of July and August heavy rains caused frequent periods of high water accompanied by logs, trees and debris. A conventional weir would have to be removed several times during a field season to avoid being washed out under these conditions.

Summary

1. The physical size of the lower Salcha River, the brown stained water and frequent periods of high water would make it impossible to successfully enumerate salmon from a counting tower in most years.

2. Two hundred forty-nine king salmon and 290 chums were enumerated on the August 6 aerial survey of the Salcha River.

3. Seventeen percent of the king salmon redds and 10 percent of the total chum salmon spawning areas were located below Redmond Creek.

4. Eighty-two percent of the king salmon carcasses were found below Ninety-eight Creek. Chum carcasses were found in four areas; Keopke Slough, Butte Creek, 1/2 mile below Flat Creek and two miles above Ninety-eight Creek.

5. The 1973 king salmon carcass sample was composed of 63 percent males. Ages 3_2 through 7_2 were represented, with ages 5_2, 6_2 and 7_2 comprising 34 percent, 29 percent and 26 percent of the sample.

6. The 1973 chum salmon carcass sample was made up of 45

percent males and 55 percent females. Age classes 3_1 to 5_1 were represented with age group 4_1 fish composing 77 percent of the sample.

7. Four of the five major tributaries of the Salcha River contained king salmon fry.

8. No suitable weir site was located on the lower Salcha River in 1973.

WHITEHORSE FISHWAY KING SALMON ESCAPEMENT STUDIES

Introduction

The Whitehorse dam fishway is located on the Yukon River, 1,745 miles upstream from the mouth (Figure 4). It is just outside the city of Whitehorse and is the farthest upstream king salmon escapement monitoring site on the Yukon River. Since 1969 the annual fishway counts and the age and sex composition of the run have been used as a possible indicator of the effects of the downriver fishery on king salmon escapement in the Canadian portion of the Yukon drainage.

As part of a cooperative data exchange and assistance program with the Canadian Department of Fisheries, the Alaska Department of Fish and Game supplied a technician to monitor the fishway in 1970, 1971, and 1973. The objectives of the study during these years have been to (1) obtain a daily and seasonal count of king salmon escapement through the fishway and (2) determine the age, sex and size composition of the Whitehorse escapement.

The Whitehorse fishway is a weir and pool-type fishway. It is a trough-like timber structure with baffles to create a series of stairway-like pools which the fish must negotiate to reach the impoundment above the dam. About two-thirds of the way up, there is a holding pool with a gate and a viewing window where the salmon can be counted and sampled before being released to continue through the fishway.

Methods and Materials

The holding pool was checked three times each day. Each time the pool was checked, the number and sex of king salmon in it was recorded. At least once a day all the kings in the pool were sampled as follows; each fish was removed with a dip net, the length from mideye to fork of tail measured, and a scale sample removed for age determination. The sex of all the king salmon in the sample and in the total escapement was determined from external morphological characteristics. A record was kept of all salmon which showed evidence of gill net marks. After sampling the salmon were released and allowed to complete passage of the fishway.

Results

A total of 228 king salmon was enumerated at the Whitehorse fishway in 1973 (Table 16). These fish were composed of 118 males (52 percent) and 110 females (48 percent).

Seventy-three king salmon were sampled for age, sex, and size composition, however, only 49 of the scale samples were legible. These fish were composed of 61 percent males and 39 percent females. Age classes 5_2 to 7_2 were represented with age classes 5_2 and 6_2 comprising 41 and 47 percent of the sample respectively (Table 17). One of the 73 kings in the sample showed evidence of net marks.

Discussion

The 1973 escapement was the poorest on record and was far below the 15-year escapement average of 680 kings. A comparison of the annual escapement counts since 1959 indicates that the Whitehorse run has experienced a gradual decline. The few Alaskan streams being monitored exhibit no strong trend of either decreasing or increasing escapements. Most of this information has been obtained from aerial surveys flown under highly variable weather conditions which may mask escapement trends.

Several factors exist which could contribute to the apparent decline in the Whitehorse run. These include: (1) the downriver fishery may be overharvesting the stock; (2) some of the salmon may not find or successfully negotiate the fishway; (3) some of the adult kings may be injured or exhausted in passage through the fishway; (4) a significant number of smolt may be killed or injured when they pass through the dam's turbines on their downstream migration.

There are indications that the downriver 8-1/2" gill net fishery, which is selective for the large 6_2 to 7_2 age class king salmon, may have affected the age and size composition of the Whitehorse king salmon escapement in some years. This was especially evident in 1970 when 87 percent of the

Table 16. Cumulative daily Whitehorse fishway king salmon counts, 1965-1973.

Date	1965	1966	1967 2/	1968	1969 1/	1970	1971	1972	1973
8/ 1	5	4	38	4					
2	9	10	53	5	8	1			1
3	16	24	67	11	16	4			2
4	30	40	87	18	28	5		1	3
5	49	54	106	43	43	6		3	3
6	58	74	121	70	99	12		9	8
7	93	97	136	107	118	18	3	20	20
8	124	120	172	152	149	24	5	24	24
9	150	139	196	173	181	47	7	31	29
10	197	188	233	173	187	77	10	33	41
11	282	214	263	174	210	108	27	47	50
12	382	248	306	180	239	136	36	61	56
13	510	304	344	205	260	202	60	105	64
14	542	357	397	239	273	284	87	139	84
15	583	388	417	267	297	313	127	184	97
16	630	427	429	290	316	346	195	233	110
17	670	478	454	339	322	415	287	269	120
18	688	500	478	359	324	436	358	293	130
19	728	518	494	363	324	511	447	300	150
20	785	532	506	369	324	560	493	316	167
21	817	536	516	376	328	576	534	347	187
22	843	548	520	389	328	595	607	355	203
23	864	554	526	392	328	610	643	369	211
24	883	557	530	405	328	617	683	382	214
25	893	560	532	405	331	622	727	386	220
26	898	562	532	405	334	624	762	386	220
27	902	562	533	405	334	625	788	388	224
28	903	562		405	334	625	812		224
29		563		406	334	625	835		224
30				406	334		841		227
31				406			842		
9/ 1				406			849		
2				407			855		
3				407					
4				407					
5				407					
Totals	903	563	533	407	334	625	856	392	228

1/ First fish on 7/23.
2/ First fish on 7/25.

Table 17. Age, sex and size composition of Whitehorse fishway king salmon escapement sample, 1973

	Age class			
	5_2	6_2	7_2	Totals
Males				
Number	23	7	-	30
Percent	47	14	-	61
Mean length (mm)	750	860	-	780
Females				
Number	2	16	1	19
Percent	4	33	2	39
Mean length (mm)	800	870	890	810
Combined				
Number	25	23	1	49
Percent	51	47	2	100
Mean length (mm)	750	870	890	810

escapement was male king salmon and 76 percent of these were in the 4_2 and 5_2 age groups (Lebida, 1970).

It cannot be determined that the 1973 escapement showed evidence of gear selectivity because the age and sex sample was biased toward male kings and this would affect the reported age and sex composition of the escapement. The sample was composed of 61 percent males and the total escapement of only 52 percent male king salmon. Variability in sampling, errors, interpretation of data, year class strength, and genetic characteristics may also influence the age and sex composition of the Whitehorse king salmon escapement.

Although no conclusive data is available on the effect of fishery mortality on the size of the Whitehorse escapement, the continuing high level of exploitation of Yukon River king salmon stocks by Japanese, Alaskans and Canadians indicates that it is probably a significant factor.

The Whitehorse dam may present an insurmountable obstacle to a certain percentage of the king salmon even with the fishway in operation. A study at Rock Island dam fishway on the Columbia River, Washington State, indicated that 23 (7%) out of 311 chinook salmon, which were destined for spawning streams above the dam, failed to make it through the fishway (Zimmer and Broughton, 1965). Other studies have indicated that a percentage of the salmon suffer injuries in negotiating a fish pass (Zimmer, et al). These injuries could result in delayed mortality or reduced spawning success. The lack of a strong current in the impoundment above the dam may disorient salmon resulting in failure to reach the grounds or spawn at the optimum times.

A significant percentage of the salmon smolt may be killed or injured as they pass through the dam's turbines on their downstream migration. In a study conducted by the Fisheries Division of Environment - Canada at Whitehorse in 1973, approximately 11 percent of the salmon smolt suffered injuries which would probably result in mortality (Walker, 1973). An unknown number of smolt may have suffered less obvious injuries which could result in delayed mortality.

The primary value of the Whitehorse escapements has been as an indicator of the effects of the downriver fishery on upper Yukon king salmon stocks. There is evidence to indicate that the Whitehorse king salmon escapement may be affected by factors other than fishery mortality. It is impossible to separate fishery mortality from the previously discussed deleterious effects of the Whitehorse dam. It is, therefore, recommended that an alternate escapement monitoring site be found in the upper Yukon drainage. This site should be located on a stream where accurate escapement enumeration is feasible, a substantial king salmon run occurs, and no factors other than fishery and natural mortality influence the size of the escapement.

Summary

1. A total of 228 king salmon was enumerated through the Whitehorse fishway in 1973.

2. The 1973 escapement was composed of 110 females (48%) and 118 (52%) males.

3. The age, sex and size samples was composed of age class 5_2 through 7_2 salmon. Age classes 5_2 and 6_2 comprised 51 percent and 47 percent of the sample respectively, and male kings composed 62 percent of the sample.

4. One of the 73 kings examined had gill net marks.

5. The Whitehorse run is apparently declining. This could be due to the effects of the downriver fishery and the dam itself.

6. It is recommended that an alternate site be found to monitor king salmon escapement in the upper Yukon.

UPPER YUKON DRAINAGE FALL CHUM SALMON STUDIES

Introduction

Fall chum salmon are a unique race of chum salmon which are distinguished from summer chum salmon by: (1) later entrance into spawning streams, (2) later spawning period, (3) larger size, and (4) greater fecundity (Bakkala, 1970).

In 1973 over 300,000 fall chums were taken in the Yukon River drainage by commercial and subsistence fishermen. Although fall chums have composed an increasingly important portion of the total Yukon River salmon catch, very little information regarding their life history, abundance, and distribution was available before 1972. In 1972 several important spawning areas were located and the number of spawning fall chums estimated.

The objectives of the 1973 fall chum studies were:

1. Determine the distribution, abundance, and timing of fall chum salmon spawning populations.

2. Determine the magnitude of the Delta River fall chum salmon spawning population.

3. Determine the stream residence (lifespan) of tagged chum salmon in the Delta River.

4. Determine the age, sex, and size composition of the Delta River fall chum salmon population.

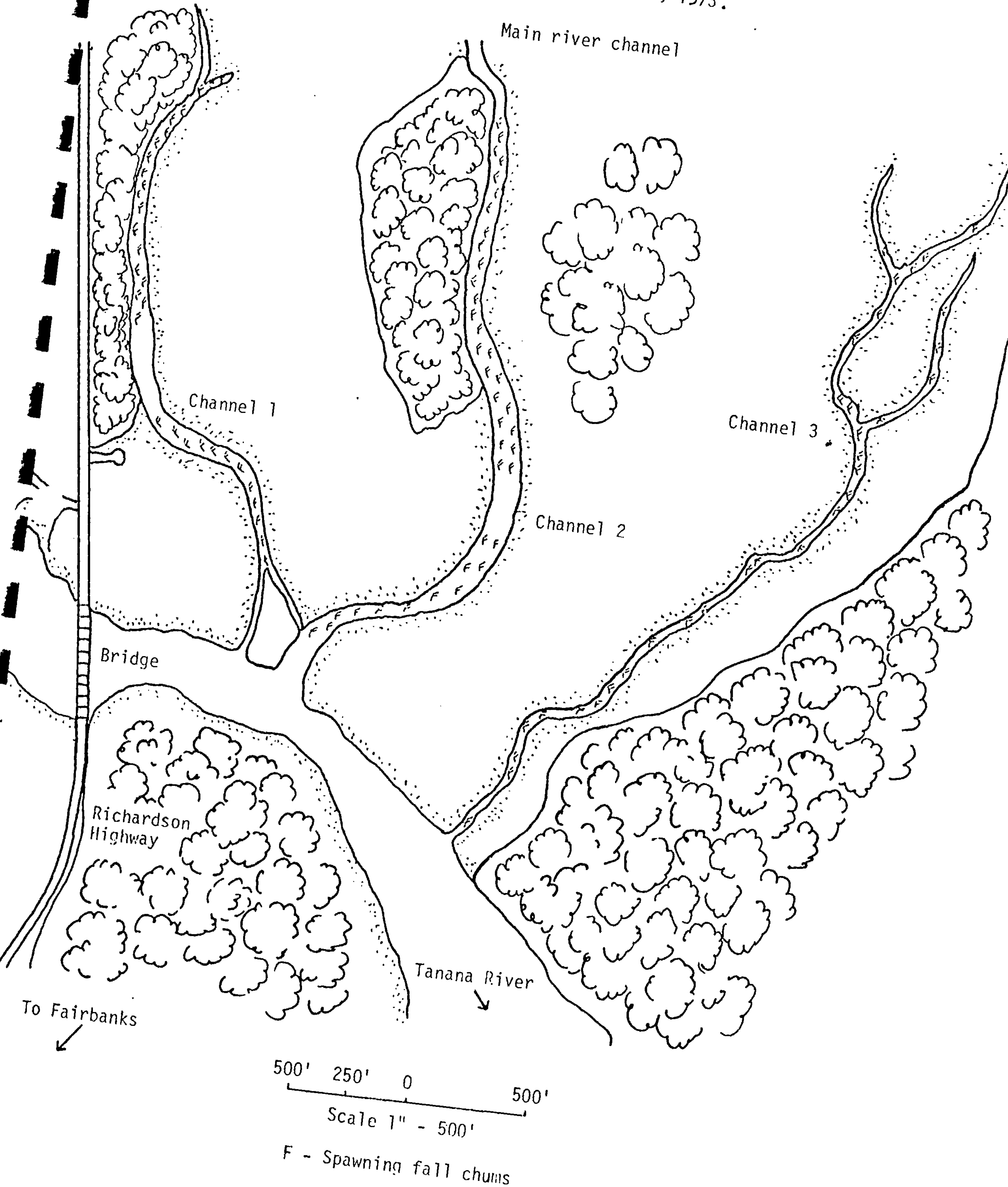
To accomplish these objectives, the aerial survey coverage was extended and an intensive study was initiated on the fall chum population which spawns in the lower Delta River, a tributary of the Tanana River. This area is accessible by road and is located adjacent to the Richardson Highway 1 mile west of the town of Big Delta. The spawning area consists of the three largest channels of the Delta River of which the first and third are not connected to the main river from October 1 to April 1 (Figure 21). The entire flow to all three channels during spawning (October 1 - December 15) is supplied by spring water. The second channel, which is the main river channel, is not utilized by spawning fall chums until mid-October when the main river freezes to the bottom above the spawning area and the flow of cold silty surface water stops. During spawning the channels are composed of a series of large, clear, shallow pools separated by very shallow riffles. These characteristics make it very easy to capture and observe spawning salmon. The riffles keep dead and dying salmon from drifting out of the study area.

Methods and Materials

Fall chum salmon were captured approximately 200 feet inside the mouth of the Delta River with a 150' x 4" x 2" beach seine. The fish were held in the seine while the length from mideye to fork of tail was measured, sex determined, and tags applied. Only silvery, healthy fish which were just entering the river were tagged. Each salmon was tagged with a numbered red Peterson disc tag in the muscular portion of the back anterior to the insertion of the dorsal fin. A scale smear was taken from a sample of the tagged salmon to determine age composition. Tagged salmon were held for a few minutes after tagging to insure they had not been injured before being released. No tag rewards were paid and the Delta River was closed to all sport fishing on October 18 to prevent harassment and removal of the spawning salmon.

Tag recoveries were made on a daily intensive carcass survey of the three channels comprising the Delta River spawning grounds. A record of the

Figure 21. Delta River fall chum salmon spawning area, 1973.



total number of carcasses by sex and location of recovery was kept each day. A log of all tag recoveries was kept by tag number, date, and location of recovery. A portion of the carcasses was sampled for age, sex, and size composition. Spawning success was gauged by examining the gonads of carcasses. To avoid resampling, all carcasses were removed from the water and thrown up on the bank.

Stream life was defined as that period of time from the date of tagging at the mouth of the river to the date the salmon was recovered on the carcass survey.

Unspawned salmon were killed and frozen for laboratory examination at a later time. They provided data on fecundity, average weight, and age composition. Scales and otoliths were used in age determination for these salmon. Eggs were boiled until hard and fecundity was determined volumetrically.

Two aerial surveys were made of the lower Delta River; the first on October 22 with a Heliocourier STOL aircraft, and the second on October 26 with a Bell Jet Ranger helicopter. Aerial surveys were made of all the known and suspected fall chum spawning areas in the Tanana, Porcupine, and Chandalar River drainages (Figure 22). A Heliocourier was used to fly all these surveys with the exception that a Bell Jet Ranger was used to fly a second survery of the upper Tanana River. Escapement counts from the Canadian portion of the Yukon drainage were received from the Fisheries Division of Environment Canada.

During tag and recovery operations on the Delta River, water temperatures and climatological data were recorded daily and limnological data periodically.

Results

The first chum salmon were observed in the Delta River on October 5. Between October 10 and October 20, a total of 303 fall chum salmon were tagged (Table 18).

A total of 3,999 carcasses was recovered on the spawning grounds and examined for tags (Table 19). A total of 113 tags was recovered by the survey crew (Table 20). Eight carcasses were also recovered which showed positive evidence of tag removal. During the study five of these tags were recovered from fishermen and two others were known to be in the possession of local residents. One tag remains unaccounted for.

... Upper Yukon fall chum and coho salmon spawning areas surveyed in 1973.

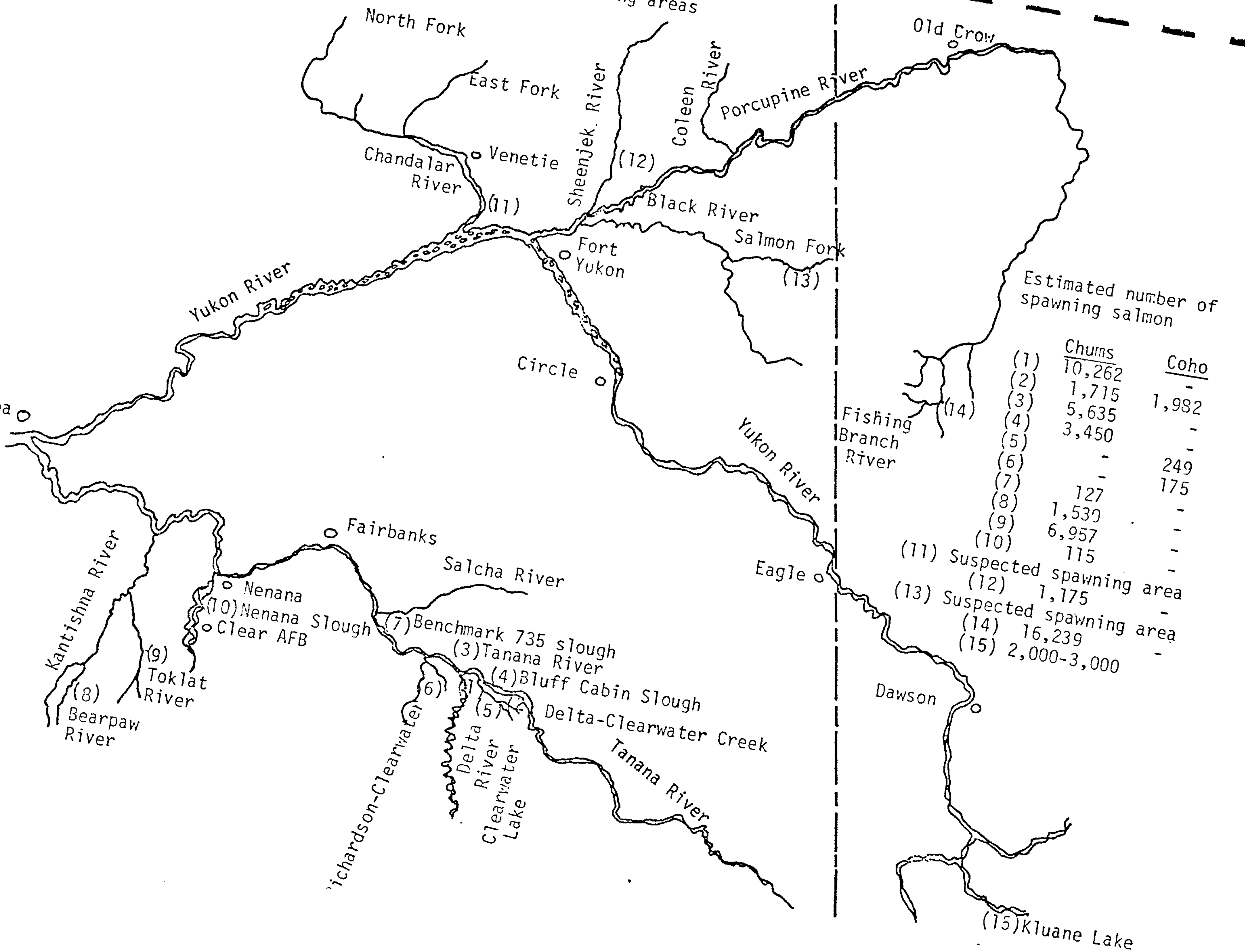


Table 18. Fall chum salmon tagged in the Delta River, by channel and date, 1973

Date	Channel 1 No. Tagged	Channel 2 No. Tagged	Channel 3 No. Tagged	Total Tagged
10/10	101	-	-	101
11	-	-	71	71
12	-	-	-	-
13	-	-	15	15
14	-	-	33	33
15	11	11	-	22
16	-	-	-	-
17	-	-	-	-
18	-	20	-	20
19	-	-	-	-
20	-	41	-	41
	112	72	119	303

Table 19 Summary of Delta River daily fall chum salmon carcass surveys, 1973.

Date	Channel 1		Channel 2		Channel 3		Total for Three Channels	
	Total no. of carcasses recovered	Number of tagged fish recovered	Total no. of carcasses recovered	Number of tagged fish recovered	Total no. of carcasses recovered	Number of tagged fish recovered	Total no. of carcasses recovered	Number of tagged fish recovered
10/15	127	0	0	0	0	0	127	0
16	- 1/	-	-	-	-	-	-	-
17	79	0	4	0	0	0	83	-
18	48	0	1	0	8	0	57	-
19	39	1	2	0	1	0	42	1
20	57	1	-	-	-	-	57	1
21	53	0	8	0	11	0	72	-
22	73	2	4	0	5	0	82	2
23	63	2	1	0	-	-	64	2
24	46	1	3	0	9	2	58	3
25	65	2	4	1	7	0	76	3
26	60	4	37	1	4	2	101	7
27	67	5	15	1	12	1	94	7
28	101	4	26	1	19	6	146	11
29	-	-	-	-	-	-	-	-
30	182	6	92	3	6	3	280	12
31	114	7	51	4	17	1	182	12
11/ 1	80	4	40	3	5	1	125	8
2	77	3	73	1	9	0	159	4
3	101	2	85	2	10	1	196	5
4	89	4	132	4	7	0	228	8
5	51	1	98	1	6	0	155	2
6	59	3	101	2	9	1	169	6
7	70	3	217	6	15	1	302	10
8	66	1	182	2	20	0	268	3
9	116	1	191	2	28	4	335	7
10	53	1	217	1	18	1	288	3
11	37	0	206	4	10	0	253	4
	1,973	58	1,790	39	236	24	3,999 3/	121 2/

2/ Includes eight fish recovered with V cut in back where tag was removed.
1/ - indicates that no survey was made on that day.
3/ 2,079 (52%) males and 1,920 (48%) females.

Table 20. Percentage of fall chums tagged and recovered in each Delta River channel, 1973.

Tags Applied		Recoveries							
		Channel 1		Channel 2		Channel 3		Total Recovered	
	No.	No.	Percent	No.	Percent	No.	Percent	No	Percent
Channel 1	112	45	76.2	12	20.4	2	3.4	59	100.0
Channel 2	72	3	15.8	16	84.2	0	-	19	100.0
Channel 3	119	6	17.1	10	28.6	19	54.3	35	100.0
Totals	303	54	48.0	38	34.0	21	18.0	113	100.0

A simple Peterson population estimate of 10,014 fall chums was made for the entire spawning area using the available data. The eight carcasses which showed evidence of tag loss were included as marked fish recovered in the estimate (Appendix Table 17).

Of the 303 chums tagged, 112 were tagged in chanel 1, 72 in channel 2, and 119 in channel 3 (Table 20). A significant portion of these chums were not recovered as carcasses in the channel where they were tagged. The percentage recovered in the other two channels was 23.8, 15.8, and 45.7 for channels 1, 2 and 3 respectively.

Based on daily tag recoveries from carcasses, the average stream life was 20.7 days in channel 1, 16.8 days in channel 2, and 21.9 days in channel 3. The average stream life for all three channels was 20.4 days (Appendix Table 18).

The age, sex, and size sample was composed of 493 fall chums. Age classes 3_1 to 6_1 were represented with age class 4_1, comprising 77 percent of the sample (Table 21). Males composed 56.7 percent of the sample, but male chums comprised just 52 percent of the 3,999 carcasses examined on the carcass survey (Table 19). The average length was 607 mm for males and 589 mm for female chum salmon.

Based on an examination of the gonads of 202 carcasses, 87 percent of the male and 97 percent of the female chums were partially or completely spent (Table 22). An average of 103 eggs was retained per female.

A sample of unspawned chum salmon consisted of four males and 14 females. The males were composed of one 5_1 and three 4_1 age class fish with a mean length of 622 mm and a mean weight of 4.0 Kg. The females were composed of one 5_1 and 13 4_1 age class fish with a mean length of 589 and a mean weight of 2.9 Kg. The mean fecundity was 2,634 eggs per female. The age determination was the same using otoliths and scales (Table 23).

The October 22 and 26 surveys of the Delta River enumerated 6,500 and 7,971 fall chums respectively. The results of all the aerial surveys are presented in Table 24. Few fish were seen on either the Porcupine or Chandalar River drainages with the exception of 1,175 chums which Ken Alt, a sport fish biologist, observed in the Sheenjek River on September 19.

Climatological and limnological data for the Delta River is presented in Appendix Tables 19 and 20.

Table 21. Age, sex, and size composition of Delta River fall chum salmon, 1973.

	3_1	4_1	5_1	6_1	Totals
Males					
Number	41	196	20	-	257
Percent	9.0	43.3	4.4	-	56.7
Mean Length 1/ (mm)	559	614	637	-	607
Females					
Number	22	153	20	1	196
Percent	4.9	33.8	4.4	.2	43.3
Mean Length (mm)	553	590	613	655	589
Combined					
Number	63	349	40	1	453
Percent	13.9	77.1	8.8	.2	100
Mean Length (mm)	556	603	625	655	599

1/ mideye to fork of tail

Table 22. Post-spawning condition of Delta River fall chum salmon carcasses, 1973.

Males				Females				
Spawned out	Partially spent	Did not spawn	Total	Spawned out	Partially spent	Did not spawn	Ave. no. of eggs retained females	Total
27 (23%)	76 (64%)	15 (13%)	118 (100%)	62 (74%)	19 (23%)	3 (4%)	103	84 (100%)

Table 23. Age, sex, and size of unspawned Delta River fall chums, 1973.

Males			Females		
Sample size	-	4	Sample size	-	14
Average length	-	622	Average length	-	589 mm
Average weight	-	4.0 kg	Average weight	-	2.9 kg
Age composition	-	1 (5_1) 3 (4_1) fish	Age composition	-	1 (5_1) 13 (4_1) fish
Ave. wt. of gonards	-	145 grams	Ave. wt. of ovaries	-	528 grams

Table 24. Comparison of fall chum and coho aerial survey counts, 1972-1973.

	1972			1973		
	Chums	Coho	Survey Rating	Chums	Coho	Survey Rating
Tanana River Drainage						
Bear Paw River	3/	-	-	1,530	-	fair
Toklat River	1,000	-	poor	6,957	-	good
Nenana River	3/	-	-	115	-	fair
Benchmark 735 Slough	5,255	-	fair	127 1/	-	fair
Richardson Clearwater	-	349	poor	-	175	fair
Delta River	3,650	-	good	7,971	-	fair
Tanana River 2/	8,350	-	fair	5,635	-	fair
Bluff Cabin Slough	6,040	-	fair	3,450	-	fair
Clearwater Creek and Lake	-	417	fair	-	249	poor
Delta Clearwater and Slough	-	434	poor	1,715	1,982	poor-good
Chandalar River Drainage						
Chandalar River	3/	-	-	4/	-	poor
East Fork Chandalar	3/	-	-	4/	-	poor
Porcupine River Drainage						
Black River	3/	-	-	4/	-	poor
Salmon Fork Black River	3/	-	-	4/	-	poor
Sheejek River	3/	-	-	1,175	-	poor
Salmon Trout River	3/	-	-	4/	-	poor
Yukon Territory Streams						
Fishing Branch River	35,000 5/	-	-	16,239 5/	-	-
Kluane River	-	-	-	3,000	-	-
Glacier Creek	150	-	very poor	3/	-	0

1/ survey made too early
2/ Richardson Highway Bridge to point four miles upstream
3/ not surveyed
4/ surveyed too late in season
5/ weir count

Discussion

Based on Robson and Regiers 1964 statistical analysis of sample size in Peterson mark and recapture experiments, the 1973 population estimate has a 95 percent chance of being within 25 percent of the actual population size. This means that, based on the data available, between 7,510 and 12,518 fall chums spawned in the Delta River in 1973.

The population estimate generally satisfied Rickers (1958) requirements for a valid Peterson estimate. One factor, however, could have caused the population to be too high. Three or four of the tagged salmon were seen in a Tanana River spawning area about 1/4 mile above the mouth of the Delta River. There is no way of determining how many tagged fish may have migrated out of the Delta River but no tag recoveries were made outside the Delta. It is probable that most of the chums entering the Delta River spawned there and although some migration did occur, it was not significant.

There are two factors which indicate the population estimate was reasonably accurate: (1) the peak aerial survey estimate of 7,971 chums was within the 95 percent confidence limits of the population estimate, and (2) when the project was terminated on November 15 over 1/2 of the spawning chums were still alive (based on observations of spawning density). This indicates that at least 8,000 chums spawned there since 3,999 carcasses had been recovered before November 15.

A significant number of salmon emigrated from the channel where they were tagged into one of the other two channels. The reason for this is unknown but could have been due to tagging shock, overcrowding or homing behavior. It is interesting to note that there was a relationship between the area of the spawning channel and the percentage of tagged salmon which emigrated. The third channel which had the smallest area available for spawning had the most emigration and the second channel which had the largest spawning area, the least emigration.

The average stream life in the Delta River (20.4 days) was similar to the 21.2 days found in the Fishing Branch River in 1973 (Elson, 1973). The Fishing Branch sample was composed of only 7 salmon but exhibited a range of stream life similar to the Delta River sample of 113 chums (Appendix Table 18).

Channel 2 chum salmon exhibited a significantly shorter average stream life (16.8 days) than either channel 1 or 3 chums. This was probably the result of delayed spawning since the chums did not enter channel 2 until October 17, 12 days after they entered the other two channels. The reason for this delay appeared to be the near freezing water temperatures in channel 2 before that date. When channel 2 froze to the bottom above the spawning area on October 16, the flow of 0° C surface water stopped. The water temperature in the remaining portion of channel 2 rose to 3.5° C and on October 17, the chums moved in and began spawning (Appendix Table 19). This behavior indicates that Delta River chums will not spawn until water temperatures approach 2-4°C.

The average fecundity of 2,634 eggs per Delta River female chum was similar to the 2,513 egg average for Fishing Branch River females (Elson, 1973). The fecundity for Delta River chums was significantly higher than the 2,323 egg average for Yukon River summer chums (Regnart, Fridgen, and Geiger, 1965) but was significantly lower than the 3,649 egg average for Amur River chums (Lovetskaya, 1948).

The mean length of Delta River 4_1 (599 mm) and 5_1 (625 mm) age group fall chums was slightly larger than the mean length for Salcha River 4_1 (590 mm) and 5_1 (600 mm) age group summer chums (Table 15). However, the mean length of Delta River chums was significantly larger than the mean length of 4_1 (550 mm) and 5_1 (570 mm) Anvik River summer chums (Table 6). Larger size is a characteristic of fall chum salmon but this may not be entirely genetic. Fall chums enter the Yukon River about a month after the summer chums and the additional month of ocean growth could account for the size difference.

The Delta River spawning population was composed of a greater percentage of 3_1 and 4_1 age group chums than either the Anvik or Salcha River summer chum samples (Tables 6 and 15). This is in direct disagreement with Russian studies which found that Amur River fall chums had a greater percentage of 4_1 and 5_1 age group fish than Amur River summer chums (Lovetskaya, 1948).

The timing of the upper Tanana fall chum migration, September 15 to November 15, was much later than the summer chum salmon which reach this area in July and August. Upper Tanana fall chums exhibited essentially the same run timing as fall chums which spawn in the Amur River in Russia. They did show significantly different timing, however, from the 1973 Fishing Branch run which peaked in mid-September.

The Delta River spawning area is fed by spring water which apparently flows at a relatively constant rate and temperature throughout the year. Extensive research indicates that Siberian fall chums spawn exclusively in spring water areas (Grigo, 1953). The constant flow and warmer temperatures inherent in springs insure high survival but severely limit distribution of stocks adapted to these conditions. Temperature data from the Delta River spawning grounds indicate that the springs flow at temperatures ranging from 3.3 to 4.4° C. This is unusually warm for an area where extensive permafrost zones exist and the source of this water should be investigated.

Four new fall chum salmon spawning areas were documented in the upper Yukon drainage in 1973 (Figure 22). The Bear Paw River, Nenana River slough, and Delta Clearwater slough were located in the Tanana River drainage. The Sheenjek River was located in the Porcupine River drainage. Aerial surveys in the Porcupine and Chandalar River drainages during November failed to locate any spawning salmon. This does not mean that large numbers of fall chums do not spawn there, however. A report from Ken Alt of the Sport Fish Division of the Alaska Department of Fish and Game, and interviews with local residents indicated that chum salmon spawned in the Sheenjek, Salmon Fork and Salmon Trout Rivers in September and October of 1973. This is earlier than fall chum salmon spawned in the Tanana but is approximately the same time they spawned in the Fishing Branch in 1973 (Elson, 1973).

It is recommended that all aerial surveys in the Porcupine and Chandalar rivers be flown during September in 1974.

<u>Summary</u>

1. Fall chums spaned in the Delta River between October 5 and December 15 in 1973.

2. Betwen October 10 and October 20, 303 fall chum salmon were tagged at the mouth of the Delta River. A total of 3,999 chum carcasses was examined for marks and 121 marked carcasses were recovered.

3. A simple Peterson population estimate of 10,014 chums was made for the Delta River in 1973.

4. A significant number of chums emigrated from the channel where they were tagged and recovered as carcasses in one of the other two channels.

5. The average stream life for fall chums in the Delta River spawning area was 20.4 days.

6. The Delta River carcass sample was made up of 77 percent age 4_1 fish. Males dominated in the sample comprising 56.7 percent of the total.

7. Eighty-seven percent of the males and 90 percent of the female chum salmon carcasses sampled were completely spent. An

average of 103 eggs was retained per female (carcass sample).

8. The average length of fall chum males sampled was 607 mm and 589 mm for females.

9. The mean number of eggs per female fall chum was 2,637.

10. The ages of the fall chum salmon in the fecundity sample from the Delta River as determined from otoliths were the same as the ages determined from scale samples.

11. The first aerial survey of the Delta River on October 22 enumerated 6,500 fall chums and the second on October 27, 7,971 fish.

12. Four new fall chum salmon spawning areas were located in 1973. They were the Bear Paw River, Nenana River slough, Delta-Clearwater Creek slough and the Sheenjek River.

FLAT ISLAND TEST FISHERY PROGRAM

Introduction

A test fishery site has been maintained at Flat Island in the south mouth of Yukon River since 1963 (Figures 2 and 23). Flat Island is located below most of the commercial fishing gear on the Yukon River and the salmon run can be assessed before it reaches the commercial fishery. The data obtained from this site has been important in the in-season management of the fishery. It has also played an important part in assessing the long-term effects of the commercial fishery on the salmon runs. There have been two primary objectives to this study:

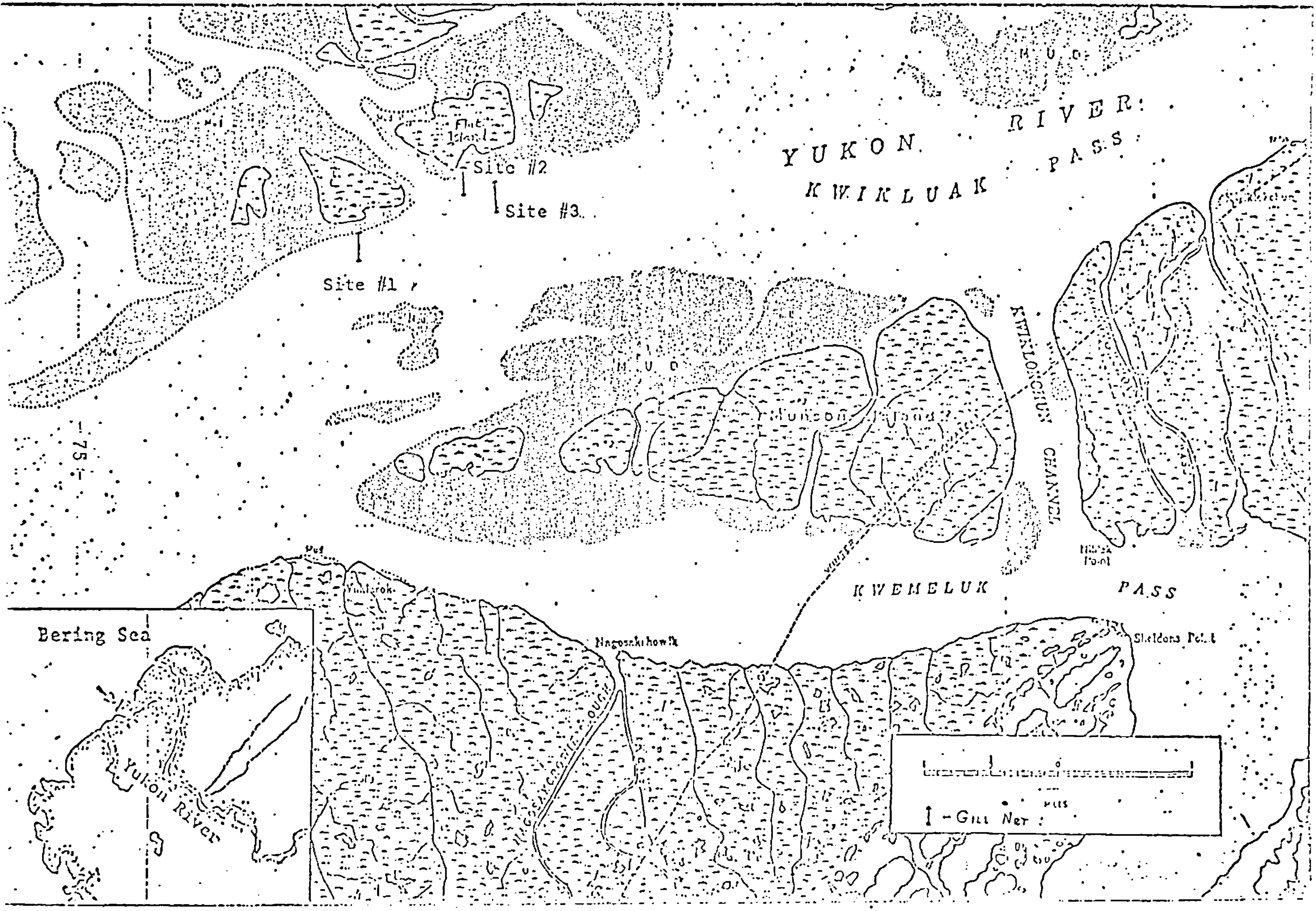
1. To obtain information regarding relative abundance, species composition and timing of the Yukon River salmon runs.

2. To obtain information on the effect of the selectivity of 8 1/2" (king salmon gear) and 5-1/2" (chum salmon gear) stretch mesh gill nets on the age, sex and size composition of the king and chum salmon runs.

Methods and Materials

Set gill nets of 5-1/2" and 8-1/2" stretched mesh nylon webbing with

Figu 23. Flat Island test fishing sites, Yukon R r, 1973.



standard floats and leadline are used to capture salmon at the Flat Island test fishing site. Each net is approximately 25 fathoms long by 28 meshes deep. The nets were fished 24 hours a day at index locations over the entire period. The nets were fished in areas of little current with one end attached to the bank and the other end anchored offshore in deeper water. Each net was checked three times each day. Each time the net was checked, the number of salmon captured by species and the number of hours fished were recorded. Periodically a sample of the catch from the 5-1/2" and 8-1/2" mesh gillnetswas taken to obtain age and sex composition.

Results

In 1973 the first recorded salmon was captured on June 5. Over a total of 2,466 gill net fishing hours, a total of 918 king salmon and 3,472 chum salmon was captured. Peak catches of king salmon occurred on June 15-18, June 24-25 and June 28. Peak catches of chum salmon occurred on June 16-18, June 23-26 and July 4-7. Test fishing catches are summarized in Table 25.

The sample of king salmon taken with 8-1/2" mesh gill nets was composed of age class 4_2 to 7_2 fish. Age classes 5_2 and 6_2 comprised 18.9 and 75.1 percent of the sample respectively. Males composed 74.6 percent of the sample. The 5-1/2" mesh catch sample was composed of 4_2 to 7_2 age class king salmon. Age classes 5_2 and 6_2 composed 27.0 percent and 60.3 percent of the sample respectively. Male king salmon composed 84.1 percent of the sample.

The chum sample taken in 8-1/2" mesh gill nets was composed of age classes 3_1 to 6_1. Age classes 4_1 and 5_1 comprised 52.5 percent and 43.7 percent of the sample respectively. Females composed 59.4 percent of the sample. The 5-1/2" mesh net chum salmon sample was composed of 3_1 to 6_1 fish. Age classes 4_1 and 5_1 composed 62.4 percent and 34.1 percent of the sample respectively. Females composed 56.9 percent of the sample. The age and sex composition of the Flat Island catch sample is presented in Table 26.

In 1973 the 8-1/2" gill nets captured 0.50 king salmon and 0.69 chum salmon per gill net hour. The 5-1/2" mesh gill net captured 0.15 king salmon and 2.82 chum salmon per gill net hour. Comparative gear efficiency for various types of gear which have been fished at Flat Island since 1965 is presented in Appendix Table 21.

Table 25. Daily test fishing catch data obtained at Flat Island, Yukon River, 1973.

Date	8 1/2 inch gill nets 1/			5 1/2 inch gill nets 2/		
	Gill net hours	King	Chum	Gill net hours	King	Chum
6/ 5	48	13	2	-	-	-
6	18	7	5	-	-	-
7	30	21	9	6	-	2
8	48	21	8	24	-	5
9	47	16	8	24	-	5
10	48	54	23	24	5	5
11	48	18	12	24	4	5
12	48	23	53	24	7	104
13	46	2	10	24	3	61
14	48	1	5	24	2	8
15	36	40	42	24	3	45
16	48	43	71	24	11	221
17	48	120	86	24	24	280
18	48	32	60	24	5	217
19	48	12	22	24	1	21
20	48	4	8	24	2	1
21	48	12	-	24	2	3
22	48	9	18	24	6	61
23	44	21	62	24	2	218
24	48	42	63	24	10	247
25	48	50	36	24	9	125
26	48	13	41	24	9	152
27	43	11	16	24	3	33
28	48	75	44	24	3	48
29	48	7	4	24	3	16
30	48	30	48	24	4	112
7/ 1	48	3	4	24	-	18
2	48	3	17	24	1	56
3	48	10	17	24	5	36
4	48	24	57	24	4	78
5	42	8	31	24	1	10
6	24	16	40	24	-	82
7	30	6	90	24	-	33
8	48	8	23	24	-	11
9	36	7	27	24	-	15
10	-	-	-	24	-	4
11	12	1	1	24	-	2
12	36	6	4	24	-	49
13	-	-	-	24	-	16
TOTALS	1,596	789	1,067	870	129	2,405

1/ Two 25 fathom set gill nets, sites #1 and #2.
2/ One 25 fathom set gill net, site #3.

Table 26. Age, sex and size composition of test fishing catch sample, Flat Island, 1973.

A. Age and sex composition of Yukon River king salmon, test fishing catch sample, taken with 8 1/2" mesh gill nets at Flat Island, 1973.

Combined Age Classes			Age 4_2		Age 5_2		Age 6_2		Age 7_2	
Sex	No.	%	No.	%	No.	%	No.	%	No.	%
Male	370	74.6	4	0.8	76	15.3	269	54.3	21	4.2
Female	126	25.4	0	-	18	3.6	103	20.8	5	1.0
TOTALS	496	100.0	4	0.8	94	18.9	372	75.1	26	5.2

B. Age and sex composition of Yukon River king salmon, test fishing catch sample, taken with 5 1/2" mesh gill nets at Flat Island, 1973.

Combined Age Classes			Age 4_2		Age 5_2		Age 6_2		Age 7_2	
Sex	No.	%	No.	%	No.	%	No.	%	No.	%
Male	53	84.1	7	11.1	16	25.4	29	46.0	1	1.6
Female	10	15.9	0	-	1	1.6	9	14.3	0	-
TOTALS	63	100.0	7	11.1	17	27.0	38	60.3	1	1.6

C. Age and sex composition of Yukon River chum salmon, test fishing catch sample, taken with 8 1/2" mesh gill nets at Flat Island, 1973.

Combined Age Classes			Age 3_1		Age 4_1		Age 5_1		Age 6_1	
Sex	No.	%	No.	%	No.	%	No.	%	No.	%
Male	104	40.6	3	1.2	52	20.2	47	18.4	2	0.7
Female	152	59.4	1	0.4	83	32.3	65	25.3	4	1.5
TOTALS	256	100.0	4	1.6	135	52.5	112	43.7	6	2.2

D. Age and sex composition of Yukon River chum salmon, test fishing catch sample, taken with 5 1/2" mesh gill nets at Flat Island, 1973.

Combined Age Classes			Age 3_1		Age 4_1		Age 5_1		Age 6_1	
Sex	No.	%	No.	%	No.	%	No.	%	No.	%
Male	279	43.1	4	0.6	176	27.2	95	14.7	4	0.6
Female	369	56.9	11	1.7	228	35.2	126	19.4	4	0.6
TOTALS	648	100.0	15	2.3	404	62.4	221	34.1	8	1.2

Discussion and Conclusions

A catch per unit effort for 8-1/2" mesh gill net of .50 king salmon per gill net hour in 1973 indicates that the Yukon River king salmon run size was slightly above 1972 levels. It was below the 8-year average (since 1966) of .65 king salmon per gill net hour. The 5-1/2" gill net catch per unit effort of 2.82 chums per gill net hour in 1973 was above the 1972 levels and well above the 8-year average of 1.78 chums per gill net hour. The high catch per unit effort would indicate a greater abundance of chum and king salmon at Flat Island in 1973 than in 1972. However, it is only an indication of abundance since test fishing catches at Flat Island are affected by tides, winds, fishing methods and other factors not necessarily connected with salmon abundance. It is also recognized that the salmon run enters all three mouths of the Yukon River and the proportion of the run using these mouths varies from year to year.

Based on the differences in age and sex composition of the test fishing catch, the 8-1/2" mesh gill nets were selective for age class 5_2 and 6_2 female king salmon. The 8-1/2" mesh gill net also had a tendency to take a larger percentage of 5_1 and 6_1 chum salmon than the 5-1/2" gear.

The 5-1/2" stretch mesh gill net was selective for 4_1 and 5_1 chum salmon. The 5-1/2" net also had a tendency to capture a greater percentage of male 4_2 and 5_2 king salmon than the 8-1/2" gear (Table 26).

The selectivity of these sizes of gill net for certain size fish could have an effect on the size composition of the Yukon River king and chum salmon runs over a long period of time.

Comparing catch per unit effort data since 1965 indicates that the 8-1/2" mesh gill nets are from 2.2 to 14 times more effective than 5-1/2" gear in capturing king salmon. Five and one-half inch mesh gill nets have ranged (since 1969) from 1.9 to 4.5 times more effective than 8-1/2" stretch mesh in capturing chum salmon (Appendix Table 21).

Flat Island test fishing catch data has been an important management tool for the Yukon River when used in conjunction with other indicators of chum and king salmon abundance. Flat Island catch data has serious limitations, primarily due to the fact that it is only sampling the portion of the run entering the south mouth of the Yukon. It is recommended, if funds become available, that test fishing sites be established in the other two mouths of the Yukon.

Summary

1. In 1973 the first salmon was captured at Flat Island on June 5.

2. Peak king salmon catches occurred on June 15-18, June 24-25 and June 28. Peak chum catches were made on June 16-18, June 23-26 and July 4-7.

3. The age and sex composition of the 1973 Flat Island test fishing catch sample was composed of:

   a. King salmon (8-1/2" mesh gill nets); age classes 4_2 to 7_2 were represented. Age classes 5_2 and 6_2 composed 18.9 and 75.1 percent of the sample respectively. Males composed 74.6 percent of the sample.

   b. King salmon (5-1/2" mesh gill nets); age classes 4_2 to 7_2 were represented. Age classes 5_2 and 6_2 composed 27.0 percent and 60.3 percent of the sample respectively. Males composed 84.1 percent of the sample.

   c. Chum salmon (8-1/2" mesh gill nets); age classes 3_1 to 6_1 were represented. Age classes 4_1 and 5_1 comprised 52.5 percent and 43.7 percent of the sample respectively. Females comprised 59.4 percent of the sample.

   d. Chum salmon (5-1/2" mesh gill nets); age classes 3_1 to 6_1 were represented. Age classes 4_1 and 5_1 comprised 62.4 percent and 34.1 percent of the sample respectively. Females comprised 56.9 percent of the sample.

4. In 1973 the 8-1/2" gill net captured .50 king salmon and .69 chum salmon per gill net hour. The 5-1/2" mesh gill net captured .15 king salmon and 2.82 chum salmon per gill net hour.

5. Eight and one-half inch gill nets were selective for 5_2 and 6_2 female king salmon and had a tendency to take a higher percentage of 5_1 and 6_1 chum salmon than 5-1/2" gill nets. Five and one-half inch gill nets were selective for 4_1 and 5_1 chum salmon and had a tendency to take a higher percentage of male 4_2 and 5_2 age class king salmon than 8-1/2" gear.

6. Eight and one-half inch gill nets are over twice as effective as 5-1/2" gill nets in capturing king salmon. Five and one-half inch gill nets are over 1.9 times as effective as 8-1/2" mesh gear in capturing chum salmon.

7. Test fishing sites should be established in the other two mouths of the Yukon River.

CATCH STATISTICS

Yukon River commercial fishery catch statistics are recorded on fish tickets when the fish are purchased from the fishermen. The fish tickets are collected from the processors by Department of Fish and Game personnel soon after the end of each fishing period and the total catch, catch per unit effort and number of fishermen are compiled and recorded on a master sheet. These data are readily comparable with previous years' catches and allow the Yukon area management biologist at Emmonak to make management decisions based on this information. Comparative salmon catches by species, subdistrict and gear are presented in Appendix Table 22.

In addition to commercial fishing, a considerable number of salmon are taken for subsistence use on the Yukon River. Each year, the Alaska Department of Fish and Game conducts a survey by boat of the entire river, stopping at each village and interviewing the fishermen there to obtain the total number of each species taken and other related data (Appendix Table 23). Subsistence calendars are sent to each family in the spring to record their catch during the summer fishing season. Fishermen who are not interviewed on the surveys are sent catch questionnaires after the fishing season ends.

Subsistence information is valuable because, as the catch of salmon for winter food and dog food decreases on the Yukon, more fish are available for the commercial fishery. The catch can be reapportioned as this information becomes available.

AERIAL SURVEYS

Because of the vast distances involved and the large number of salmon spawning streams in the Yukon River system, the aerial survey method is used to enumerate escapement in index streams which are felt to be indicative of overall escapement in that area of the Yukon basin. During peak of spawning, when water and light conditions are optimum for viewing, these streams are surveyed by Department biologists in single engine aircraft. While not precise, aerial surveys are an important management tool when no other means of assessing escapements are available. Aerial survey escapement counts for king and summer chum salmon are presented in Appendix Table 24.

ACKNOWLEDGMENTS

The Yukon Research Staff would like to thank the following individuals for their contribution to the 1973 studies: Mr. Al Davis of the Alaska Department of Fish and Game for providing the smolt traps and technical assistance on the Salcha River smolt project; John and Mary Hayes for their hospitality, interest and valuable assistance on the Salcha River studies; Mr. Kenneth Alt who provided the escapement data from the Sheenjek River and the entire Region III Sport Fish staff, who assisted us throughout the project; Mr. Alan Gibson, Garnet Jones and the entire Environment-Canada Fisheries Service staff for their cooperation and invaluable assistance in carrying out the Yukon Territory studies over the past 4 years.

LITERATURE CITED

Alt, K. T. 1973. Observations on salmon in the Porcupine River drainage. September 1973. Memorandum to Mike Geiger, Alaska Department of Fish and Game. 2 p.

Bakkala, R. G. 1970. Synopsis of biological data on the chum salmon Oncorhynchus keta (Walbaum). FAO Species Synopsis No. 41, pp. 4.

Elson, M. S. 1973. Fishing Branch studies, 1973. Memorandum to A. Gibson, Chief, Northern British Columbia and Yukon Division--Environment Canada.

Foerster, R. E. 1968. The sockeye salmon. Fisheries Research Board of Canada Bulletin No. 162. pp. 287-294.

Gissberg, J. G. and D. S. Benning. 1965. Yukon foundation studies summary report, 1965. U.S. Fish and Wildlife Service, SP 3.17. 52 pp.

Grigo, L. D. 1973. Morphological differences between the summer and the autumn chum salmon, Oncorhynchus keta (Walbaum), O. keta (Walbaum) infraspecies autumnalis Berg. Pacific Salmon. Israel Program for Scientific Translations. pp. 13-17.

Lebida, R. 1970. Annual technical report. Yukon anadromous fish investigations, Arctic-Yukon-Kuskokwim Region. Alaska Department of Fish and Game.

__________. 1972. Yukon River anadromous fish investigations, 1972 field season. A-Y-K Region Fishery Bulletin No. 20.

Lovetskaya, E. A. 1948. Data on the biology of the Amur chum salmon. Pacific Salmon. Israel Program for Scientific Translations. pp. 101-125.

Regnart, R. I., P. J. Fridgen and M. F. Geiger. 1965. 1965 annual report, Arctic-Yukon-Kuskokwim Area. Alaska Dept. of Fish and Game, Division of Commercial Fisheries. 157 pp.

____________, M. Geiger, L. Trasky and C. Yanagawa. 1972. Arctic-Yukon-Kuskokwim Region Data Report No. 5.

____________, et al. 1973. Arctic-Yukon-Kuskokwim Region Data Report No. 6.

Ricker, W. E. 1958. Handbook of computations for biological statistics of fish populations. Fisheries Research Board of Canada, Bulletin No. 119, pp. 81-110.

Robson, D. C. and H. A. Regier, 1964. Sample size in Peterson mark-recapture experiments. Transactions of the American Fisheries Society. Vol. 93, No. 3. pp. 215-226.

Walker, C. E. 1973. Assessment of fish stocks at Whitehorse Dam in 1973. Memorandum to A. Gibson, Chief, Northern B.C. and Yukon Division, Environment Canada. 23 pp.

Zimmer, P. and J. Broughton. 1965. Annual fish passage report. Rock Island dam, Columbia River, Washington, 1965. USFWS, Bureau of Commercial Fisheries. Spec. Scientific Rep. No. 533. 24 pp.

APPENDIX

Appendix Table 1. King salmon smolt catch enumeration log,[1/] Salcha River, 1973.

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	Actual Total	Expanded Total [3/]	Percent
5/16	(.70)[2/]	(.60)	(.50)	(.60)	(.70)	(.70)	(.30)	(.20)	(.20)	(.50)	(.50)	(.60)	1.00	(.40)	(.40)	(.40)	-	(.30)	(.30)	(.30)	-	(.30)	(.40)	(.40)	1.00	10.31	1.30
17	(.80)	(.70)	(.70)	(.70)	(.70)	(.90)	(.30)	1.00	-	1.00	1.00	1.00	-	-	1.00	1.00	-	-	-	-	-	-	.33	.33	6.66	11.45	1.40
18	.33	-	-	.33	.33	.33	(.20)	(.10)	(.10)	(.30)	(.30)	(.40)	(.30)	(.20)	(.20)	.33	.33	.33	-	-	-	.65	.66	.65	4.29	6.41	.80
19	(.30)	(.20)	(.20)	(.30)	(.30)	(.30)	(.10)	-	-	-	-	-	-	.66	.66	.65	-	-	-	-	-	-	(.20)	(.20)	1.93	4.08	.50
20	(.45	(.40)	(.37)	(.42)	(.42)	-	-	-	-	-	-	.66	.66	.66	.66	.66	.66	-	-	-	-	-	(.30)	(.30)	3.95	6.60	.80
21	(.60)	(.50)	(.50)	-	-	-	.66	.66	.66	-	-	-	.66	.66	.66	-	-	-	.75	.75	.75	.75	-	-	6.96	8.60	1.10
22	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00	2.00	2.00	1.00	1.00	1.00	.33	.33	.33	2.70	2.70	2.70	2.00	2.00	2.00	33.09	33.10	4.20
23	1.00	1.00	1.00	1.00	1.00	1.00	.75	.75	.75	.75	-	-	(2.10)	4.60	4.60	4.60	1.50	1.50	1.20	1.20	1.20	1.20	8.60	8.60	47.80	49.90	6.20
24	8.60	2.50	2.50	2.50	2.50	2.50	2.50	-	-	-	-	-	1.00	1.00	1.00	1.50	1.50	(1.00)	(.90)	(1.00)	(.90)	(.90)	(1.40)	(1.30)	25.60	33.80	4.20
25	1.00	1.00	1.00	1.00	1.00	1.00	1.00	-	-	-	.50	.50	.50	.50	-	-	-	4.66	4.66	4.66	4.25	4.25	4.25	4.25	38.93	38.93	4.90
26	28.10	28.10	28.10	28.10	28.10	28.10	3.33	3.33	3.33	.50	.50	.50	.50	2.50	2.50	2.50	2.50	1.50	1.50	2.75	2.75	2.75	2.75	-	204.59	214.60	26.00
27	(3.70)	(3.20)	(3.10)	(3.40)	(3.40)	4.33	4.33	4.33	1.66	1.66	1.66	1.50	1.50	1.66	1.66	1.66	.66	.66	.66	2.00	2.00	2.00	1.50	1.50	36.93	52.83	6.60
28	.86	.85	.85	.86	.86	.86	.86	-	-	-	.66	.66	.66	.33	.33	.33	.33	.33	.33	.33	.33	.33	2.00	2.00	14.97	14.97	1.90
29	1.20	1.20	1.20	1.20	1.20	1.20	-	-	-	-	.25	.25	.25	.25	.33	.33	.33	-	-	.33	.33	.33	-	-	11.18	11.20	1.40
30	.83	.83	.83	.83	.83	.83	-	-	-	-	-	-	-	-	-	-	-	-	.25	.25	.25	.25	-	-	6.93	6.93	.90
31	.14	.14	.14	.14	.14	.14	.14	-	-	-	-	-	.14	.14	.14	.14	.14	.14	.14	-	-	-	-	-	1.96	1.96	.20
1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	.75	.75	.75	.75	.17	.17	.17	.17	.17	.17	-	-	-	-	-	-	4.02	4.02	.50
3	-	-	-	-	-	-	-	-	-	-	-	-	.33	.33	.33	.33	.33	.33	-	-	-	-	-	-	1.93	1.93	.20
4	-	-	-	1.70	1.70	1.70	.33	.33	.33	14.30	14.30	14.30	12.00	(2.90)	(3.00)	(3.00)	(2.30)	(2.50)	(2.40)	-	(2.40)	(2.40)	(3.60)	-	60.99	85.60	10.80
5	(4.00)	(3.50)	-	(3.70)	-	(4.10)	(1.70)	-	(1.10)	(2.60)	(2.80)	6.00	1.00	1.00	1.50	1.50	2.00	2.00	3.50	3.50	3.00	3.00	3.00	3.70	34.73	53.22	7.30
6	3.70	3.70	1.60	1.60	1.60	2.40	2.40	2.40	2.40	3.70	3.70	3.70	2.30	2.30	2.30	2.30	2.30	2.30	1.70	1.70	1.70	2.00	2.00	2.00	57.80	57.80	7.30
7	1.00	1.00	1.00	4.00	4.00	4.00	2.30	2.30	2.30	4.00	4.00	4.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	-	-	-	2.00	2.00	51.90	51.90	6.50
8	.20	.20	.20	.20	.20	.20	.20	.20	.20	.20	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	(1.10)	(1.20)	(1.10)	(1.00)	(1.60)	(1.50)	31.60	39.20	4.90
TOTAL	48.00	41.50	39.40	44.40	44.40	49.50	19.80	16.30	13.40	30.70	33.00	39.50	29.40	23.50	24.50	24.00	18.80	20.00	19.40	20.20	19.30	19.50	29.10	27.00	693.92		
Actual Percent	6.90	6.00	5.70	6.40	6.40	7.10	2.90	2.30	1.90	4.40	4.80	5.70	4.20	3.40	3.50	3.50	2.70	2.90	2.80	2.90	2.80	2.80	4.20	3.90			
Expanded Catch	58.50	50.60	44.90	54.10	50.00	55.60	22.40	16.60	14.80	32.30	36.60	40.50	31.80	27.00	27.10	27.40	21.10	23.80	24.10	22.70	23.70	24.10	35.60	30.70		797.02	
Percent	7.30	6.40	5.60	6.90	6.30	7.00	2.80	2.10	1.90	4.10	4.60	5.10	4.00	3.40	3.40	3.40	2.60	3.00	3.00	2.80	3.00	3.00	4.60	3.90		100.00%	

1/ Average catch per hour
2/ Missing counts in parentheses.
3/ Missing counts estimated by calculating percent of total run caught during those hours over season and substituting this percent of the daily estimated total catch for those hours.

Appendi: able 2. Salcha River bridge station climatoloc il and stream observations.

ALASKA DEPARTMENT OF FISH AND GAME

Climatological and Stream Observations

STATION Salcha Bridge MONTH May YEAR 1973

Date	Sky		Precip. 24 Hours			Wind Dir.-Vel.		Time Obsd.	Air Temp. °C	Water Temp. °C	Water Gauge	C.F.S.	Water Color	Remarks
	am	pm	am	pm	Amt.	am	pm		Max.-Min.	Max.-Min.				
5/16	1	1	0	0	0.0"	-	-		20.0-7.2	3.9-4.4	+2.0"	-	4	
5/17	2	3	-	A	2.0"	-	-	1600	16.7-7.2	4.4-4.4	-2.0"	-	4	
5/18	3-	2	A	A	2.0"	S	W	1500	17.8-6.7	4.4-5.0	-3.0"	8099	3	
5/19	4	2	A	A	.4"	-	-	1700 0700	16.7-6.7	5.6-4.4	+1.0"	-	3	
5/20	2	3	0	0	0.0"	-	-	0800 1500	14.4-6.7	5.0-4.4	-2.0"	-	3	
5/21	4	4	0	A	.4"	-	-	0930 1900	9.4-8.9	5.0-5.0	-3.0"	-	3	
5/22	1	3	0	A	.1"	-	-	0500 1500	14.4-3.3	5.6-4.4	-2.0"	-	3	Frost
5/23	3	2	A	A	.1"	-	-	1100 1800	13.3-9.4	6.7-5.6	-4.0"	-	2	
5/24	1	1	0	0	0.0"	-	-	0800 1600	14.4-11.1	6.7-6.1	-3.0"	-	2	
5/25	4	2	B	0	1.0"	-	-	0730 1900	20.6-10.0	7.7-7.7	+8.0"	-	3	Raining hard in a.m.
5/26	2	1	0	0	0.0"	E-5	E-5	0730 1900	18.9-7.7	8.9-6.7	+16.0"	6075	4	River up and colored Lots of debris
5/27	2	2	0	0	0.0"	-	-	0800 1600	20.0-12.2	8.9-6.1	-5.0"	-	4	
5/28	4	4	0	0	0.0"	W-10	W-3	1600 0800	15.6-14.4	7.7-7.7	-6.0"	-	2	
5/29	2	2	0	0	0.0"	N-5	N-10	1400 0900	6.7-14.4	7.7-7.7	-2.0"	-	2	

CODE:

SKY
0. No observation made.
1. Clear sky, cloud covering not more than 1/10 of sky.
2. Cloud covering not more than 1/2 of sky
3. Cloud covering more than 1/2 of sky.
4. Completely overcast.
5. Fog or thick haze.

PRECIPITATION
A. Intermittent rain.
B. Continuous rain
C. Snow.
D. Snow and rain mixed.
E. Hail.
F. Thunderstorm w/ or w/o precip.

WATER COLOR
1. Clear
2. Light brown
3. Brown
4. Dark brown
5. Murky or glacial

Appendix able 2. (cont.)

ALASKA DEPARTMENT OF FISH AND GAME

Climatological and Stream Observations

STATION Salcha Bridge MONTH May-June YEAR 1973

Date	Sky am	Sky pm	Precip. 24 Hours am	Precip. 24 Hours pm	Precip. 24 Hours Amt.	Wind Dir.-Vel. am	Wind Dir.-Vel. pm	Time Obsd.	Air Temp. °C Max.-Min.	Water Temp. °C Max.-Min.	Water Gauge	C.F.S.	Water Color	Remarks
5/30	2	2	0	AE	.1"	-	S-3	1600 0900	14.4-13.3	9.4-7.2	-1.0"	-	2	Clearing and dropping
5/31	2	-	0	0	-	W-2	-	0800	20.0-8.9	10.6-7.7	-1.0"	-	1	Clearing and dropping
6/ 1	3	4	0	0	-	-	-	0900 1700	21.6-10.0	11.1-10.0	-1.0"	-	1	Rising in late p.m.
6/ 2	4	4	A	B	.2"	-	-	0600 1700	10.0-8.3	8.9-8.9	+2.0"	-	2	Rising slowly all day
6/ 3	4	3	A	0	-	-	-	0900 1800	11.1-7.7	8.3-7.7	+3.5" +4.0"	-	2	Debris increasing a little
6/ 4	2	3	0	0	-	W-3	W-3	0800 1800	16.7-7.2	5.0-5.0	+5.0"	8079	4	River peaked approximately 6 p.m., lots of small debri
6/ 5	2	3	0	A	-	-	-	0800 1800	16.7-7.2	5.6-5.0	-3.5"	-	3	
6/ 6	2	4	0	A	.2"	-	-	0900 1800	17.8-12.2	7.7-7.2	-2.0"	-	3	River clearing and droppinc
6/ 7	3	1	0	0	-	E-3	S-5	0900 1900	20.6-12.2	10.0-7.7	-1.0"	-	2	River clearing and droppinc
6/ 8	NO DATA													

CODE:

SKY
0. No observation made.
1. Clear sky, cloud covering not more than 1/10 of sky.
2. Cloud covering not more than 1/2 of sky
3. Cloud covering more than 1/2 of sky.
4. Completely overcast.
5. Fog or thick haze.

PRECIPITATION
A. Intermittent rain.
B. Continuous rain
C. Snow.
D. Snow and rain mixed.
E. Hail.
F. Thunderstorm w/ or w/o precip.

WATER COLOR
1. Clear
2. Light brown
3. Brown
4. Dark brown
5. Murky or glacial

Appendix Table 3. Correlation between water level and expanded smolt catch, Salcha River, 1973.

	X (catch)	X^2	Y (level)[1/]	Y^2	XY
5/23	50	2,500	3.0	9.0	150.0
24	34	1,156	0.0	0.0	0.0
25	39	1,521	8.0	64.0	312.0
26	205	42,025	24.0	576.0	4,920.0
27	54	2,916	19.0	361.0	1,026.0
28	15	225	13.0	169.0	195.0
29	11	121	11.0	121.0	121.0
30	7	49	10.0	100.0	70.0
31	2	4	9.0	81.0	18.0
6/ 1	0	0	8.0	64.0	0.0
2	4	16	10.0	100.0	40.0
3	2	4	14.0	196.0	28.0
4	86	7,396	19.0	361.0	1,634.0
5	58	3,364	15.5	240.3	899.0
6	58	3,364	13.5	182.3	783.0
7	52	2,704	12.5	156.3	650.0
	ΣX 677	ΣX^2 67,365	ΣY 189.5	2,780.9	10,846.0
	ΣX^2 = 458,329		ΣY^2 35,911.0		

$$r = \frac{N\Sigma XY - (\Sigma X)(\Sigma Y)}{\sqrt{[N\Sigma X^2 - (\Sigma X)^2][N\Sigma Y^2 - (\Sigma Y)^2]}}$$

$$r = \frac{(16)(10{,}846) - (677)(189.5)}{\sqrt{[(16)(67{,}365) - (458{,}329)][16(2{,}780.9) - (35{,}910.3)]}}$$

$$r = \frac{45{,}245}{\sqrt{(619{,}511)(8{,}584.1)}}$$

$$r = \frac{45.245}{72{,}924} \qquad \underline{\underline{r = .62}} \qquad \text{good correlation}$$

1/ For the purpose of this exercise, the water level on May 24 will be considered the base of zero.

Appendix Table 4. Chum salmon upstream hourly enumeration log, Anvik River tower, 1973.1/

Date	Hour 00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Totals	Percent of Total
6/28				No Fish														1	16	-	-	6	16	34	73	0.0
29	24	33	24	-	4	27	15	2	14	16	1	8	4	16	31	26	15	29	147	5	28	48	39	87	643	.8
30	68	93	94	107	18	21	19	9	7	2	3	2	12	66	28	29	61	42	12	33	153	127	118	124	1243	1.6
7/ 1	143	214	219	138	67	116	48	54	38	50	22	24	26	38	73	89	117	112	84	35	61	114	226	371	2479	3.2
2	383	432	538	169	117	83	46	20	60	47	47	32	44	104	135	286	328	329	218	19	60	157	254	229	4137	5.3
3	281	284	201	159	149	97	107	68	67	81	89	74	79	195	244	349	363	408	571	476	501	693	523	226	6285	8.0
4	259	259	353	163	189	179	252	333	197	202	163	230	174	302	312	404	293	231	309	365	43	71	98	181	5562	7.2
5	236	326	257	182	109	77	100	70	59	138	56	127	112	122	122	176	250	132	233	345	317	253	295	261	4415	5.6
6	251	298	201	223	151	166	241	174	203	110	140	116	142	152	184	108	99	63	96	84	157	134	111	72	3676	4.7
7	103	135	129	97	89	72	79	56	37	47	38	39	43	74	25	44	44	20	54	71	77	89	139	145	1752	2.2
8	110	152	164	146	121	142	186	171	110	115	79	64	84	125	146	155	109	105	157	109	162	156	189	214	3271	4.2
9	294	365	291	231	202	189	182	170	151	213	243	168	188	286	170	231	224	309	277	317	461	388	431	150	6181	7.9
10	251	356	349	251	206	242	237	339	397	320	303	219	244	309	295	244	98	94	94	214	251	294	248	148	6003	7.7
11	165	224	396	368	293	355	569	540	473	324	327	277	381	391	324	389	467	303	263	299	278	312	339	330	8387	10.7
12	366	422	341	385	286	255	291	278	150	150	150	150	162	179	169	178	128	62	150	127	80	175	125	110	4869	6.2
13	203	196	164	123	195	185	206	148	150	170	111	129	111	255	249	262	98	74	165	124	194	179	183	88	3962	5.2
14	134	230	168	122	127	143	281	77	75	78	68	71	144	156	151	129	64	81	84	85	144	182	104	120	3018	3.9
15	161	147	76	121	119	124	95	102	84	92	66	80	145	122	156	127	53	87	116	101	83	79	94	67	2497	3.2
16	86	95	94	53	48	68	39	28	57	36	63	33	29	14	28	31	36	30	67	76	49	182	109	69	1420	1.8
17	140	187	226	188	123	99	124	63	124	81	40	52	81	79	48	24	37	24	58	95	95	93	89	43	2213	2.8
18	134	169	71	72	72	59	78	65	61	72	59	66	51	82	73	92	42	29	38	93	23	36	33	35	1605	2.1
19	66	42	42	35	44	34	23	21	38	29	40	43	38	30	34	17	24	20	33	35	47	59	86	69	949	1.2
20	52	58	43	36	24	17	29	12	14	8	30	16	18	22	13	16	9	10	25	55	43	71	18	27	666	.9
21	72	38	45	22	27	11	23	14	18	16	12	16	7	15	12	23	7	21	54	22	43	62	54	53	693	.9
22	47	40	44	44	21	14	11	18	26	31	34	18	10	8	23	9	11	14	28	19	20	17	24	30	561	.7
23	26	24	32	34	10	7	14	24	17	13	10	12	11	15	19	14	5	17	14	8	10	11	7	15	369 3/	.5
24	10	12	11	7	5	12	14	11	2	1	8	4	10	4	1	-	-	(6)	(8)	(8)	(8)	(10)	(9)	23	135(184)	.2
25	12	5	(9)	(7)	(5)	(5)	(6)	(5)	(6)	(5)	(4)	(4)	(5)	(6)	(6)	(7)	(6)	(5)	(6)	(7)	(6)	(8)	(7)	(6)	17(147)	.2
26	(6)	(7)	(6)	(5)	(4)	(4)	(4)	(4)	(4)	(3)	(3)	(3)	(3)	(4)	(4)	(5)	(4)	(4)	(5)	(5)	(5)	(5)	(5)	(5)	-(107)2/	.1
27	(4)	(4)	(4)	(3)	(3)	(2)	(3)	(3)	(2)	1	7	4	3	1	2	1	5	(2)	-	2	5	-	(3)	(3)	31 (67)	0.0
28	-	-	(10)	(8)	(7)	(6)	(7)	(7)	(6)	(6)	-	2	4	-	(3)	2	6	10	22	14	14	17	(9)	(7)	91(167)	.2
29	(18)	(20)	(19)	(15)	(12)	(12)	(14)	(12)	18	24	20	10	22	14	8	7	3	7	4	4	(13)	(17)	(15)	(14)	141(322)	.4
30	(6)	(8)	(8)	(6)	(5)	(4)	(5)	(5)	-	8	4	8	6	2	4	1	6	(4)	(5)	(5)	(5)	(6)	(6)	(5)	39(122)	.2
31	(7)	(8)	(8)	(6)	(5)	(4)	(6)	(5)	1	6	6	5	10	2	3	3	5	5	7	4	(6)	(7)	(7)	(6)	[illegible]	.2
Actual total2/	4566	4279	4562	3529	2871	2782	3295	2856	2627	2440	2187	2052	2337	3156	3063	3451	2977	2647	3363	3210	3375	3973	3952	[illegible]	[illegible]	(23/7/72)
Actual percent	5.3	6.3	5.9	4.6	3.7	3.6	4.3	3.7	3.4	3.2	2.8	2.7	3.0	4.1	4.0	4.5	3.9	3.4	4.4	4.2	4.4	5.2	5.1	4.3	[illegible]	
Expanded total	4129	4943	4637	3566	2857	2831	3354	2908	2665	2495	2246	2106	2403	3190	3095	3479	3077	2690	3420	3261	3442	4043	4013	3368	(78132)	100.0
Expanded percent	5.2	6.3	5.9	4.6	3.7	3.6	4.3	3.7	3.4	3.2	2.9	2.7	3.1	4.0	4.0	4.4	3.9	3.4	4.4	4.2	4.4	5.2	5.1	4.3	(100.0)	

1/ Estimated counts in parenthesis.
2/ Count on 7/26 estimated by averaging counts on 7/25 and 7/27.
3/ Actual total to 7/23.

Appendix Table 5. Chum salmon downstream hourly enumeration log, Anvik River tower, 1973.[1/]

Date	Hour 00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Totals	Percent of Total
6/28						No Fish												(-)	(-)	(-)	(-)	(-)	(-)	(-)	00	0.0
29	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	2	-	-	-	1	-	-	-	-	4	0.0
30	-	3	-	-	-	-	-	5	-	-	1	1	-	-	2	2	1	4	1	-	-	-	-	1	21	.3
7/ 1		2	1	5	2	-	-	2	1	3	4	5	2	1	5	3	7	6	4	2	4	5	-	-	64	1.0
2	-	9	5	5	2	2	3	2	13	9	8	11	15	18	10	28	6	4	10	3	-	4	2	2	171	2.5
3	2	4	6	-	-	-	1	-	8	5	4	27	7	27	17	17	10	11	8	11	4	6	4	1	180	2.7
4	6	8	21	3	-	-	3	1	6	7	17	21	22	27	42	61	44	31	23	19	23	10	12	5	412	6.1
5	6	26	16	3	-	3	1	5	9	18	19	37	10	14	22	20	7	10	31	14	6	10	14	17	318	4.7
6	6	23	5	8	-	5	18	6	10	15	22	13	13	10	19	15	4	1	4	5	18	13	7	13	253	3.8
7	10	22	21	11	1	2	8	6	10	6	15	4	9	16	4	6	-	4	4	7	10	11	4	2	193	2.9
8	5	24	36	9	1	3	5	-	9	20	7	13	7	19	24	24	3	5	2	6	8	4	8	4	246	3.7
9	22	39	38	28	-	2	1	6	14	11	8	20	26	43	31	15	2	6	6	14	30	69	27	23	481	7.2
10	5	12	18	31	2	1	-	7	8	12	9	34	28	77	129	242	349	117	93	134	164	142	57	37	1708	25.5
11	3	11	21	24	3	4	-	2	9	7	12	4	18	24	8	20	6	2	-	3	7	19	18	10	235	3.5
12	4	14	8	15	1	-	1	7	10	10	10	10	13	10	12	14	6	-	5	4	5	10	10	10	189	2.8
13	9	27	17	4	4	3	5	3	15	4	3	5	6	13	12	22	1	15	4	8	14	8	10	11	223	3.3
14	1	24	35	14	-	2	8	4	10	12	10	5	19	18	5	16	-	3	4	2	13	19	15	4	243	3.6
15	7	16	8	11	-	1	4	6	7	14	11	8	26	14	23	28	4	4	2	2	7	4	5	7	219	3.3
16	24	31	28	14	-	-	-	1	24	10	18	13	10	6	1	9	4	1	7	4	13	25	16	17	276	4.1
17	27	35	46	43	-	2	3	-	15	14	10	13	10	5	5	2	4	-	23	10	11	27	25	15	345	5.1
18	33	45	18	18	4	2	-	-	3	10	5	2	5	5	12	6	6	6	4	8	3	4	1	5	205	3.1
19	1	4	6	3	3	3	2	-	5	3	7	12	2	2	3	2	-	2	4	7	10	11	14	14	120	1.8
20	14	12	9	6	4	-	2	1	4	2	11	5	1	2	5	5	-	1	7	15	8	14	-	2	130	1.9
21	12	4	9	2	-	-	-	-	5	4	1	2	1	7	6	6	-	-	11	2	8	18	12	6	116	1.7
22	12	8	12	7	-	1	-	1	4	-	4	3	-	-	5	3	-	1	3	2	4	6	2	1	79	1.2
23	3	9	8	10	-	-	-	-	2	1	1	1	3	4	3	2	-	1	-	-	2	-	1	1	52[3/]	.8
24	-	2	-	2	-	-	-	1	1	2	-	-	1	3	-	-	-	(-)	(1)	(1)	(1)	(1)	(1)	(-)	12(17)	.3
25	3	-	(2)	(1)	(-)	(-)	(-)	(-)	(1)	(1)	(1)	(2)	(1)	(2)	(2)	(3)	(2)	(1)	(1)	(2)	(2)	(2)	(1)	(1)	3(31)	.5
26	(1)	(1)	(1)	(1)	(-)	(-)	(-)	(-)	(-)	(-)	(1)	(1)	(1)	(1)	(1)	(2)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(-)	(18)[2/]	.3
27	(-)	(1)	(1)	(-)	(-)	(-)	(-)	(-)	(-)	-	-	1	-	-	-	-	1	-	-	1	-	-	(-)	(-)	3(5)	.1
28	(1)	(2)	(2)	(1)	-	-	-	-	(1)	(1)	-	-	-	-	-	-	-	4	8	3	3	7	(1)	(1)	25(35)	.5
29	(3)	(6)	(5)	(4)	(-)	(-)	(1)	(1)	11	7	6	2	12	3	2	3	-	2	1	2	(5)	(6)	(4)	(3)	51(89)	1.3
30	(-)	(1)	(1)	(1)	(-)	(-)	(-)	(-)	-	1	-	2	1	-	-	2	1	(-)	(1)	(1)	(1)	(1)	(1)	(-)	7(15)	.2
31	(-)	(1)	(1)	(1)	(-)	(-)	(-)	(-)	1	2	1	-	1	1	1	-	1	-	-	-	(1)	(1)	(1)	(-)	8(14)	.2
Actual totals[3/]	212	412	392	274	27	36	65	65	201	193	217	259	253	362	405	570	464	235	260	283	372	439	264	203	6435[3/]	
Actual percent	3.3	6.4	6.0	4.2	.4	.6	1.0	1.0	3.1	3.1	3.3	4.1	3.9	5.6	6.2	8.8	7.2	3.6	4.0	4.4	5.7	6.8	4.1	3.2	100	
Expanded total	220	426	405	285	27	36	66	67	215	212	226	277	270	372	411	580	470	243	273	294	385	453	274	213	(6707)	100.0
Expanded percent	3.3	6.4	6.0	4.2	.4	0	1.0	1.0	3.2	3.2	3.4	4.2	4.0	5.6	6.1	8.6	7.0	3.6	4.2	4.4	5.8	6.8	4.2	3.2	100	

1/ Estimated counts in parenthesis.
2/ Count on 7/26 estimated by averaging counts on 7/26 and 7/27.
3/ Actual total to 7/23.

Appendix Table 6. King salmon upstream hourly enumeration log, Anvik River tower, 1973. 1/

Date	Hour 00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Totals	Percent of Total
6/28					No Fish													-	-	-	-	-	-	-	0	
29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1	.1
30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0.0
7/ 1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0.0
2	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	-	-	-	-	-	2	.3
3	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	2	-	-	-	-	-	-	-	-	3	.4
4	-	1	-	-	-	1	-	-	-	-	-	1	2	1	-	-	-	-	-	-	-	-	-	-	6	.9
5	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	3	.4
6	-	-	-	1	-	1	-	-	-	1	-	-	-	-	1	-	-	-	1	-	1	1	-	-	7	1.0
7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	2	.3
8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	2	3	-	7	1.0
9	-	2	-	-	-	1	-	1	1	-	-	-	2	3	2	1	-	1	2	-	1	-	-	-	17	2.5
10	-	3	-	-	-	1	2	-	3	2	2	4	2	1	1	1	1	-	1	-	-	-	-	-	24	3.7
11	-	-	1	1	2	-	2	2	1	3	2	1	1	2	3	-	1	2	1	1	-	-	1	-	27	4.0
12	-	1	1	-	1	-	1	1	2	2	2	2	1	3	2	8	1	1	-	-	-	-	-	-	29	4.3
13	-	1	-	-	1	-	2	3	-	2	-	2	1	5	4	4	1	-	2	1	1	-	-	-	30	4.6
14	-	-	-	-	1	1	3	1	-	3	2	3	1	5	2	2	2	-	1	-	-	1	-	-	28	4.2
15	1	1	-	-	1	1	2	-	-	-	-	4	1	4	1	-	2	1	1	1	2	1	2	2	28	4.2
16	-	-	-	-	-	1	1	1	-	-	-	-	2	2	1	1	3	2	-	1	-	-	-	-	15	2,3
17	1	-	-	1	-	-	2	1	3	2	4	1	6	7	10	6	3	1	1	-	-	-	1	-	50	7.5
18	-	3	-	-	2	2	1	1	1	-	6	6	5	3	5	3	3	8	3	4	3	1	-	-	60	9.0
19	1	1	-	-	-	1	1	-	-	1	4	2	3	7	4	1	-	1	1	3	1	3	4	2	41	6.2
20	1	1	-	-	-	3	1	4	1	-	3	2	5	3	1	1	3	4	3	2	2	1	-	-	41	6.2
21	-	-	1	-	-	2	1	2	-	7	3	2	2	5	3	1	4	2	1	2	-	-	-	-	38	5.7
22	-	1	-	-	2	-	4	2	2	1	1	2	2	-	7	4	1	2	3	3	-	2	-	-	39	5.8
23	-	-	2	-	1	3	1	-	2	3	2	2	4	-	2	3	1	4	3	6	1	-	1	-	41 3/	6.1
24	-	1	-	-	-	2	1	1	-	1	2	-	-	-	-	-	3	-	(1)	(1)	(-)	(-)	(-)	-	11(13)	1.9
25	1	-	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(-)	(-)	(-)	(-)	1(12)	1.8
26	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(-)	(-)	(-)	(-)	(11) 2/	1.6
27	(-)	(-)	(-)	(-)	(-)	(-)	(1)	(1)	(-)	1	1	-	1	-	-	-	3	(1)	-	1	-	-	(-)	(-)	7(10)	1.5
28	-	-	(-)	(-)	(-)	(1)	(1)	(1)	(1)	(2)	1	-	-	2	(3)	2	1	2	7	6	1	-	(1)	(-)	22(32)	4.8
29	(-)	(-)	(-)	(-)	(-)	(1)	(1)	(1)	-	2	2	1	-	-	1	3	1	3	2	3	(1)	(1)	(1)	(-)	18(24)	3.7
30	(-)	(-)	(-)	(-)	(-)	(1)	(1)	(1)	-	-	-	1	3	1	4	1	-	(1)	(1)	(1)	(1)	(-)	(-)	(-)	10(17)	2.5
31	(-)	(-)	(-)	(-)	(-)	(1)	(1)	(1)	1	-	2	-	-	-	-	2	2	-	-	-	(-)	(-)	(-)	(-)	7(10)	1.5
Actual total 3/	4	15	5	3	11	19	24	19	17	28	31	34	40	52	49	40	25	32	25	24	13	12	12	4	539	
Actual percent	.7	2.8	.9	.6	2.0	3.5	4.5	3.5	3.2	5.2	5.8	6.3	7.4	9.6	9.1	7.4	4.8	5.9	4.6	4.5	2.4	2.2	2.2	.7	To 7/27	
Expanded total	4	16	5	3	11	25	31	25	19	36	41	38	46	57	59	50	33	41	38	38	16	13	14	4	(658)	100.0
Expanded percent	.6	2.4	1.3	.5	1.7	3.8	4.5	3.8	2.9	5.4	6.2	5.7	6.9	8.6	8.9	7.5	5.7	6.2	5.6	5.3	2.4	2.0	2.1	.6	100.0	

1/ Estimated counts in parenthesis.
2/ Count on 7/26 estimated by averaging counts on 7/25 and 7/27.
3/ Actual total to 7/23.

Appendix Table 7. King salmon downstream hourly enumeration log, Anvik River tower, 1973. [1/]

Date	Hour 00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Totals	Percent
6/28					No Fish													-	-	-	-	-	-	-	0	0.0
29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0.0
30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0.0
7/ 1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0.0
2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0.0
3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0.0
4	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	2	1.3
5	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	.7
6	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	.7
7	-	-	-	-	-	-	1	-	-	-	-	1	-	-	-	-	-	-	-	-	1	-	-	-	3	2.0
8	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1	.7
9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1	.7
10	-	-	-	-	-	-	-	1	-	-	-	1	1	-	2	2	-	-	-	-	-	-	-	-	7	4.6
11	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	-	-	-	-	-	-	2	1.3
12	-	-	1	-	-	-	-	-	-	-	-	2	-	-	-	-	1	-	-	-	-	-	-	-	4	2.6
13	-	-	-	-	-	-	-	-	-	1	3	1	-	-	-	-	-	2	-	-	-	-	-	-	7	4.6
14	-	-	-	1	-	1	-	-	1	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	5	3.4
15	-	-	-	-	-	-	-	-	-	1	-	-	2	1	3	-	-	-	1	-	2	-	-	-	10	6.6
16	-	1	-	-	-	-	1	-	-	-	-	-	-	2	-	-	-	1	-	-	-	-	-	-	5	3.3
17	-	-	-	-	-	-	1	-	1	-	1	1	-	-	1	3	-	-	-	-	-	-	-	-	8	5.3
18	-	-	-	-	1	1	1	-	-	-	-	-	1	-	2	-	1	-	-	-	2	2	-	-	11	7.3
19	1	-	1	-	-	-	-	1	1	-	2	-	2	1	-	-	-	-	-	-	-	-	1	-	10	6.6
20	1	-	-	-	-	-	-	1	-	1	1	1	3	-	-	-	-	-	-	-	-	-	-	-	8	5.3
21	-	-	1	-	-	-	-	-	2	1	-	2	3	-	-	1	-	-	-	1	-	-	-	-	11	7.3
22	-	-	-	-	-	-	1	1	-	-	1	-	-	-	-	-	-	-	1	-	-	1	1	2	8 [3/]	5.3
23	-	-	-	-	-	-	2	-	-	-	2	2	-	1	-	-	-	-	-	-	-	-	-	-	7.	4.6
24	-	-	-	-	-	-	-	-	-	-	1	1	-	-	2	-	-	(1)	(-)	(-)	(-)	(-)	(-)	(-)	4(5)	3.4
25	1	-	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(1)	(1)	(1)	(-)	(-)	(-)	(-)	(-)	(-)	(-(	(-)	(-)	(-)	(-)	1(4)	2.6
26	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(1)	(-)	(1)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(2) [2/]	1.3
27	(-)	(-)	(-)	(-)	(-)	(-)	(1)	(-)	(-)	-	(1)	(1)	-	-	-	-	-	-	-	1	-	-	(-)	(-)	3(4)	2.6
28	-	-	(-)	(-)	(-)	(-)	(1)	(1)	(-)	(-)	-	1	-	1	-	-	1	-	1	-	-	-	(-)	(-)	4(6)	4.0
29	(-)	(-)	(-)	(-)	(-)	(-)	(1)	(1)	-	-	-	-	2	1	2	1	-	-	1	-	(1)	(-)	(-)	(-)	7(10)	6.6
30	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(1)	-	-	-	-	1	-	-	-	-	(-)	(-)	(-)	(-)	(-)	(-)	(-)	1(2)	1.3
31	(-)	(-)	(-)	(-)	(-)	(-)	(1)	(1)	-	-	-	1	-	2	1	-	-	-	-	-	(-)	(-)	(-)	(-)	4(6)	4.0
Actual total [3/]	2	1	3	1	2	4	7	4	5	5	12	11	12	6	8	7	3	4	2	1	5	3	2	2	112	
Actual percent	1.7	.9	2.7	.9	1.7	3.6	6.3	3.6	4.5	4.5	10.7	9.8	10.7	5.4	7.1	6.3	2.7	3.6	1.8	.9	4.5	2.7	1.7	1.7	100	
Expected total	3	1	3	1	2	4	11	8	5	5	16	16	17	10	13	8	4	5	4	2	6	3	2	2	(151)	100%
Expected percent	2.0	.7	2.0	.7	1.3	2.6	7.3	5.3	3.3	3.3	10.6	10.6	11.3	6.6	8.6	5.3	2.6	3.3	2.6	1.3	4.0	2.0	1.3	1.3	(100)	

1/ Estimated counts in parenthesis.
2/ Count on 7/26 estimated by averaging counts on 7/25 and 7/27.
3/ Actual total to 7/23.

Appendix Table 8. Pink salmon upstream hourly enumeration log, Anvik River tower, 1973.[1/]

Date	Hour 00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Totals	Percent of Total
6/28						No Fish												-	-	-	-	-	-	-	0	0.0
29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0.0
30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0.0
7/ 1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0.0
2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0.0
3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	2	.6
4	-	1	1	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	1.1
5	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	3	.9
6	-	1	3	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	6	1.7
7	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	3	.9
8	-	1	-	1	-	1	1	1	-	-	-	-	-	-	1	-	-	-	-	-	1	1	6	1	15	4.3
9	3	-	1	-	-	1	-	-	-	2	1	1	-	1	-	-	-	-	3	3	1	1	2	1	21	6.0
10	1	-	1	5	3	3	4	2	-	-	-	-	-	-	-	4	-	3	1	4	3	2	2	2	40	11.4
11	-	-	2	4	4	7	6	4	1	1	1	-	-	-	2	4	1	1	-	5	2	1	2	2	50	14.1
12	3	1	2	5	-	3	1	1	-	-	-	3	-	-	4	1	-	-	2	3	-	2	2	-	33	9.4
13	5	1	-	-	3	3	2	3	1	3	1	-	1	1	3	4	1	2	1	-	1	-	2	-	38	10.7
14	3	-	-	1	-	1	-	-	-	1	1	-	2	-	2	-	-	-	-	-	-	1	2	1	15	4.3
15	1	-	1	-	-	1	-	1	1	-	1	1	1	1	1	2	-	1	-	1	1	-	1	2	18	5.1
16	-	-	-	-	-	1	-	-	-	-	1	-	-	-	1	-	-	-	3	1	2	4	3	2	18	5.1
17	1	-	3	2	-	1	1	1	1	3	-	1	2	1	1	1	-	-	1	-	1	-	1	-	22	6.2
18	1	2	-	2	1	-	-	2	1	-	-	-	-	1	-	-	-	-	-	-	-	2	1	-	13	3.7
19	-	2	-	-	1	-	1	-	-	-	-	2	-	-	-	1	-	-	-	1	2	-	-	-	10	2.8
20	1	2	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	6	1.7
21	-	1	-	-	-	1	1	-	-	1	-	1	1	2	-	1	1	1	-	2	-	1	1	-	15	4.3
22	-	-	-	-	-	-	1	-	-	-	-	-	-	-	2	-	-	-	-	-	-	1	-	-	4 3/	1.1
23	1	-	-	1	-	1	-	-	-	1	-	-	-	2	-	-	-	-	1	-	-	2	-	-	9	2.6
24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(-)	(-)	(-)	(-)	(-)	(-)	(-)	0	0.0
25	-	-	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(0)	0.0
26	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(0)2/	0.0
27	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	-	-	-	-	-	-	-	-	(-)	-	-	-	-	(-)	(-)	(0)	0.0
28	-	-	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	-	-	-	-	(-)	-	-	-	-	-	-	-	(-)	(-)	(0)	0.0
29	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	-	-	1	-	-	-	-	-	-	-	-	-	(-)	(-)	(1)	(-)	1(2)	.6
30	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	-	-	-	-	-	-	-	-	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	0(0)	0.0
31	(-)	(-)	(-)	(-)	(-(	(1)	(-)	(-)	-	-	-	-	-	-	1	1	1	-	-	-	(-)	(-)	(1)	(-)	3(5)	1.4
Actual total 2/	21	12	14	21	13	26	21	16	5	12	7	9	7	9	18	19	4	8	13	22	15	18	25	13	(349)	
Actual percent	6.1	3.4	4.0	6.0	3.7	7.4	6.1	4.6	1.4	3.4	2.0	2.6	2.0	2.6	5.3	5.4	1.1	2.3	3.8	6.3	4.3	5.2	7.4	3.7	100%	
Expanded total	21	12	14	21	13	27	21	16	5	12	7	9	7	9	18	19	4	8	13	22	15	18	28	13	(352)	100.0%
Expanded percent	5.9	3.4	4.0	5.9	3.7	7.7	6.0	4.5	1.4	3.4	2.0	2.6	2.0	2.6	5.1	5.4	1.1	2.3	3.7	6.3	4.3	5.1	8.0	3.7	100%	

1/ Estimated counts in parenthesis.
2/ Count on 7/26 estimated by averaging counts on 7/25 and 7/27.
3/ Actual count to 7/23.

Appendix Table 9. Pink salmon downstream hourly enumeration log, Anvik River tower, 1973.

Date	Hour 00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Totals	Percent (est.)
6/28					No Fish													-	-	-	-	-	-	-	0	0.0
29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0.0
30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0.0
7/ 1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0.0
2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0.0
3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0.0
4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0.0
5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1	1.5
6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0.0
7	-	-	-	-	-	-	-	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	2	3.0
8	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1.5
9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	1.5
10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	2	3	-	-	1	4	1	1	-	14	21.3
11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	1.5
12	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	1	-	-	-	-	3	4.5
13	-	-	-	-	-	-	-	-	-	2	-	-	-	-	1	-	-	-	-	-	-	-	-	-	3	4.5
14	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1.5
15	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1	1.5
16	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1	1.5
17	-	-	1	-	-	-	-	1	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	4	6.1
18	-	-	-	-	-	1	3	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	7	10.7
19	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	3.0
20	-	-	-	-	-	1	1	-	-	-	-	1	-	-	1	-	-	-	-	2	-	1	-	-	7	10.7
21	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	1	1	1	-	-	-	5	7.6
22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	4	6.1
23	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	3 3/	4.5
24	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	(-)	(-)	(1)	(-)	(-)	(-)	-	2(3)	4.5
25	-	-	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	0(0)	0.0
26	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	-(0) 2/	0.0
27	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	-	-	-	-	-	-	-	-	-	-	-	-	-	(-)	(-)	0(0)	0.0
28	-	-	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	-	-	-	-	-	-	-	-	-	-	-	-	(-)	(-)	0(0)	0.0
29	(-)	(-)	(-)	(-)	(-)	(-)	(1)	(-)	-	-	-	-	-	-	-	-	1	-	-	-	(-)	(-)	(-)	(-)	1(2)	3.0
30	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	-	-	-	-	-	-	-	-	-	(-)	(-)	(-)	(-)	(-)	(-)	(-)	0(0)	0.0
31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0.0
Actual total 2/	0	0	1	0	0	2	6	4	1	3	0	3	2	2	10	8	3	0	1	5	5	4	1	0	61	
Actual percent	0	0	1.6	0	0	3.3	9.8	6.6	1.6	4.9	0	4.9	3.3	3.3	16.4	13.1	4.9	0	1.6	8.2	8.2	6.6	1.6		100%	
Expanded total	1	0	1	0	0	2	7	4	1	3	0	3	3	2	10	8	4	0	1	6	5	4		0	(66)	100.0 %
Expanded percent	1.5	0	1.5	0	0	3.0	10.6	6.1	1.5	4.5	0	4.5	4.5	3.0	15.2	12.1	6.1	0	1.5	9.1	7.6	6.1	1.5	0	(100%)	

1/ Estimated counts in parenthesis.
2/ Count on 7/26 estimated by averaging counts on 7/25 and 7/27.
3/ Actual counts to 7/23.

Appendix Table 10. Anvik River aerial survey counts by area of river, 1973

Area Surveyed	Kings No.	Kings %	Chums No.	Chums %
Mouth to Goblet Creek	-	-	1,930	7.0
Goblet Creek to Yellow River	-	-	5,560	21.0
Yellow River to Counting Tower	96	43.0	7,700	29.0
Counting Tower to Swift River	36	16.0	3.325	13.0
Swift River to Otter Creek	54	25.0	6,643	25.0
Otter Creek to McDonald Creek	36	16.0	998	5.0
Above McDonald Creek	-	-	-	-
Totals	222	100.0	26,156	100.0

Appendix Table 11. Climatological and limnological information recorded at Anvik River tower site, 1973.

Date	Time recorded	Precip. 24 hrs.	Air Temp. °C	Water Temp. °C	Water Gauge	C.F.S.	Water Color	D.O. (mg/l)	pH	Free Acidity (gr/gal $CaCO_3$)	Total Acidity (gr/gal $CaCO_3$)	Alkalinity: Methyl Orange (gr/gal $CaCO_3$)	Alkalinity: Phenol-phthalien	Hardness (gr/gal $CaCO_3$)
6/27	-	-	-	-	3/	-	4/	-	-	-	-	-	-	-
28	-	-	16.7-12.2	16.1	-2'6"	-	1	-	-	-	-	-	-	-
29	1600	-	22.8-3.3	15.0	-2'6"	-	1	-	-	-	-	-	-	-
30	1200	-	18.9-6.7	13.3	-2'7"	-	1	-	-	-	-	-	-	-
7/ 1	1200	A 1/	20.0-2.2	14.4	-2'7"	-	1	-	-	-	-	-	-	-
2	1200	-	22.8-7.7	15.0	-2'7"	-	1	-	-	-	-	-	-	-
3	1200	A	23.3-10.0	16.7	-2'6"	-	1	-	-	-	-	-	-	-
4	1200	-	17.8-2.2	14.4	-2'7"	-	1	-	-	-	-	-	-	-
5	1200	-	18.3-1.7	14.4	-2'8"	-	1	-	-	-	-	-	-	-
6	1200	A	11.1-5.6	13.3	-2'8"	-	1	-	-	-	-	-	-	-
7	1200	A	11.1-3.9	10.0	-2'8"	1333	1	-	-	-	-	-	-	-
8	1200	A	12.2-5.6	10.0	-2'5"	-	1	-	-	-	-	-	-	-
9	1200	-	19.4-6.1	10.6	-2'5"	-	1	-	-	-	-	-	-	-
10	1200	-	20.0-6.1	12.8	-2'6"	-	1	10	8.5	0	.66	4	0	4
11	1200	-	20.0-5.6	13.3	-2'7"	-	1	-	-	-	-	-	-	-
12	1200	-	19.4-6.1	12.2	-2'7"	-	1	-	-	-	-	-	-	-
13	1200	A	17.2-3.9	12.2	-2'8"	1333	1	-	-	-	-	-	-	-
14	1200	-	15.6-6.7	12.8	-2'9"	-	1	-	-	-	-	-	-	-
15	1200	-	12.2-1.6	10.0	-2'9"	-	1	-	-	-	-	-	-	-
16	1200	-	20.5-8.9	10.0	-2'11"	1433	1	-	-	-	-	-	-	-
17	1200	-	14.4-7.7	12.2	-2'10"	-	1	-	-	-	-	-	-	-
18	1200	A	14.4-4.4	10.6	-2'10"	-	1	11	8.0	0	.33	4	0	4
19	1200	-	17.8-5.0	12.2	-2'10"	1708	1	-	-	-	-	-	-	-
20	1200	-	21.6-14.4	12.8	-2'10"	-	1	-	-	-	-	-	-	-
21	1200	-	23.9-5.6	12.8	-2'11"	1485	1	-	-	-	-	-	-	-
22	1200	-	21.1-9.4	12.8	-2'11"	-	1	-	-	-	-	-	-	-
23	1200	A	17.2-8.3	12.2	-3'0"	-	1	-	-	-	-	-	-	-
24	1200	A	15.6-10.0	12.2	-3'0"	-	1	-	-	-	-	-	-	-
25	1200	B 2/	13.3-6.1	11.7	-2'5"	-	2	10	8.0	0	0	3	0	3
26	1200	A	16.1-3.9	10.0	-2'2"	1125	3	-	-	-	-	-	-	-
27	1200	A	14.4-5.6	12.8	-2'0"	-	1	-	-	-	-	-	-	-
28	2100	B	14.4-5.0	10.0	-2'4"	-	1	-	-	-	-	-	-	-
29	1200	-	15.6-6.1	11.7	-2'3"	-	1	12	8.2	0	.33	3	0	3
30	1200	-	15.0-4.4	10.6	-2'3"	-	1	-	-	-	-	-	-	-
31	1200	A	-	10.6	-2'4"	-	1	-	-	-	-	-	-	-

1/ A. Intermittent rain.

2/ B. Continuous rain.

3/ Zero was determined on 6/15; by 6/28, the river dropped 2'6".

4/ Water color: 1--clear; 2--light brown; 3--brown.

Appendix Table 12. Comparative Yukon River drainage king salmon escapement counts, 1959-1973.1/

Year	Andreafsky River (East Fork)	Andreafsky River (West Fork)	Anvik River
1960	1,020	1,220	1,950
1961	1,003	-	1,226
1962	675 2/	762 2/	-
1963	-	-	-
1964	867	705	-
1965	-	355 2/	650 2/
1966	361	303	638
1967	-	276 2/	336 2/
1968	380	383	297 2/
1969	231 2/	274 2/	296 2/
1970	665	574 2/	368 2/
1971	1,904	1,284	-
1972	798	582 2/	1,172 4/
1973	825	788	613 4/

Year	Salcha River	Nisutlin River (Sidney-100 Mile Cr.)	Whitehorse Dam Fishway
1959			1,054
1960	1,660		660
1961	2,878		1,068
1962	937		1,500
1963	-		484
1964	450		587
1965	408		903
1966	800		563
1967	-		533
1968	735	407	407
1969	461 2/	105	334
1970	1,882	615	625
1971	159 2/	640 3/	856
1972	1,193	317	392
1973	249	36 2/	228

1/ With exception of Whitehorse fishway counts, the data was obtained from aerial surveys which were made only of the main stem of each river listed.
2/ Incomplete survey or poor survey conditions resulting in a very minimal count.
3/ Canadian Department of Fisheries survey.
4/ Combination tower counts and aerial survey estimate.

Appendix Table 13. Comparative Yukon River drainage chum salmon escapement estimates, 1958-1973.

Year	SUMMER CHUMS					FALL CHUMS		
	Andreafsky River (East Fork)	Andreafsky River (West Fork)	Anvik River	Chena River	Salcha River	Tanana River	Delta River	Fishing Branch River
1958	-	-	100-200,000					
1959	-	-	200,000					
1960	3,830	-	11,110		670			
1961	8,110	-	-		1,152			
1962	18,040	19,530	20,600	402	1,161	862	46 1/	
1963	-	-	-	898	- -			
1964	-	12,810	12-14,000 1/		250 1/			
1965	-	14,670 1/	100,000		2,375			
1966	25,619	18,145	37,500		2,200			
1967	-	14,495 2/	116,000		-			
1968	17,600 2/	74,600 2/	51,580 1/		3,790			
1969	119,000	159,500	-		425 1/			
1970	84,090	91,710 1/	232,780		7,879	800	800	
1971	98,095	71,745	-		306 1/	-	-	115,000+
1972	41,460	25,573	245,857 3/	670	947 1/	19,657	3,650	35,326 4/
1973	10,149 1/	51,835	86,665 3/	79	290	9,365	10,262 6/	16,239 5/

1/ Poor survey conditions.
2/ Includes some pinks.
3/ Combined tower and aerial survey estimates.
4/ Combined weir count and population estimate.
5/ Weir count.
6/ Population estimate

Appendix Table 14. Salcha River field site limnological observations, 1973.

Date	Time	Temp. (°C)	D.O. (mg/l)	CO (mg/l)	pH	Free Acidity	Total Acidity 1/	Hardness (gr/gal)	Alkalinity 2/	
									Methyl Orange	Phenol-phthalien
6/28	1314	12°	11	≤3	7.5	0	.33	4	4	0
7/4	1255	12°	11	≥3	7.7	0	.11	4	5	0
7/12	1230	13°	10	≥2	7.7	0	.66	5	3	0
7/18	1130	11°	11	≥5	7.7	0	.66	4	3	0
7/26	1220	13°	10	≥8	7.5	0	.66	4	3	0

1/ ppm $CaCO_3$

2/ gr/gal CaCO3

Appendix Table 15. Limnological survey data from five tributaries of the Salcha River, 1973.

	Date	D.O. (ppm)	CO_2 (mg/l)	pH	Hardness (gr/gal)	Alkalinity (Methyl Orange, gr/gal $CaCO_3$)	Free Acidity	Total Acidity ($CaCO_3$)	Water Temp. (C)	Flow	Velocity	Bottom Type	Fish	Comments
Redmond Creek	6/16													
Lower Creek		11	12ppm	7.5	6	5	0	.66ppm	12°	35cfps	1.4fps	gravel	K.S.fry grayling sculpin round white-fish	Many fry present; lower creek slow and silty; spruce and willow veg; brown water
Upper Creek	8/9	-	-	-	-	-	-	-	8°	28cfps	2.0fps	gravel		
McCoy Creek	8/22	10	10ppm	7.7	5	4	0	0.00ppm	10°	74cfps	1.1fps	silt (lower 1 mi)	K.S. fry grayling	Fry present lower creek; slow & silt Tundra creek; stained water
Ninety-eight Creek	8/10	11	5ppm	8.0	9	5	0	.66ppm	9°	51cfps	3.0fps	gravel	K.S. fry	Many king salmon fry present; fast: comes out of hills swift
Flat Creek	8/20 & 8/12	7	10ppm	6.5	4	4	0	3.00ppm	5°	173cfps	3.1fps	gravel	Adult chums K.S.fry & chum fry	Swift; comes out c high ground
Butte Creek	8/14	13	10ppm	7.5	6	4	0	.66ppm	5°	123cfps	3.0fps	rocks	-	Very swift; very cold; comes out o hills; no fish se

Appendix Table 16. Age and sex composition of Yukon River king salmon, sampled at various locations, 1973.

Area (Gear)	Combined Age Classes Sex	No.	%	Age 3_2 No.	%	Age 4_2 No.	%	Age 5_2 No.	%	Age 6_2 No.	%	Age 7_2 No.	%
Flat Island 1/ (8 1/2" mesh gill net)	Male	370	74.6	-	-	4	0.8	76	15.3	269	53.4	21	4.2
	Female	126	25.4	-	-	-	-	18	3.6	103	20.8	5	1.0
	Subtotal	496	100.0	-	-	4	0.8	94	18.9	372	75.1	26	5.2
Flat Island 1/ (5 1/2" mesh gill net)	Male	53	84.1	-	-	7	11.1	16	25.4	29	46.0	1	1.6
	Female	10	15.9	-	-	-	-	1	1.6	9	14.3	-	-
	Subtotal	63	100.0	-	-	7	11.1	17	29.0	38	60.3	1	1.6
Emmonak 2/ (8 1/2" mesh gill net)	Male	544	53.3	-	-	3	0.3	166	16.3	347	34.0	28	2.7
	Female	477	46.7	-	-	1	0.1	19	1.9	424	41.5	33	3.2
	Subtotal	1,021	100.0	-	-	4	0.4	185	18.2	771	75.5	61	5.9
Emmonak 2/ (5 1/2" mesh gill net)	Male	95	54.9	-	-	9	5.3	16	9.1	63	36.0	7	4.0
	Female	79	45.1	-	-	-	-	1	0.6	69	39.7	9	5.3
	Subtotal	174	100.0	-	-	9	5.3	17	9.7	132	75.7	16	9.3
Ruby & Rampart 2/ (Set nets and fish-wheels)	Male	10	62.5	-	-	2	12.5	4	25.0	3	18.9	1	6.0
	Female	6	37.5	-	-	2	-	-	-	6	37.6	-	-
	Subtotal	16	100.0	-	-	2	12.5	4	25.0	9	56.5	1	6.0
Nenana 2/ (fishwheel)	Male	34	97.1	2	5.7	5	14.3	22	62.8	4	11.4	1	2.9
	Female	1	2.9	-	-	-	-	1	2.9	-	-	-	-
	Subtotal	35	100.0	2	5.7	5	14.3	23	65.7	4	11.4	1	2.9
Salcha River 3/ (carcass survey)	Male	58	62.4	-	-	10	10.8	29	31.2	11	11.8	8	8.6
	Female	35	37.6	-	-	-	-	3	3.2	16	17.2	16	17.2
	Subtotal	93	100.0	-	-	10	10.8	32	34.4	27	29.0	24	25.8
Anvik River 3/ (carcass survey)	Male	6	60.0	-	-	1	10.0	-	-	5	50.0	-	-
	Female	4	40.0	-	-	-	-	-	-	3	30.0	1	10.0
	Subtotal	10	100.0	-	-	1	10.0	-	-	8	80.0	1	10.0
Whitehorse Dam 3/ (fish pass)	Male	30	61.2	-	-			23	46.9	7	14.3	-	-
	Female	19	38.8	-	-			2	4.1	16	32.7	1	2.0
	Subtotal	49	100.0	-	-			25	51.0	23	47.0	1	2.0

1/ Test fishing catch sample.
2/ Commercial catch sample.
3/ Escapement sample.

Appendix Table 17. Peterson mark and recapture estimate of fall chum salmon in the Delta River spawning area, 1973.

$$\text{Population} = \frac{\text{marked fish x number of fish examined for marks}}{\text{marked fish recovered}}$$

$$10{,}014 = \frac{(303)(3{,}999)}{121} \quad \underline{1/}$$

1/ Includes eight carcasses which showed evidence of tag loss by a V-incision in their backs.

Appendix Table 18. Stream life of Delta River fall chum salmon between date of tagging and date recovered on a carcass survey, 1973.

Stream Life Days	Channel 1 No. of Fish	Channel 2 No. of Fish	Channel 3 No. of Fish	Total
8	-	1	-	1
9	1	-	1	2
10	1	1	-	2
11	-	2	1	3
12	2	1	-	3
13	2	2	-	4
14	2	-	-	2
15	-	1	1	2
16	4	-	2	6
17	2	1	6	9
18	4	1	-	5
19	-	2	3	5
20	8	2	1	11
21	8	1	2	11
22	5	2	-	7
23	2	-	3	5
24	3	2	1	6
25	4	-	2	6
26	3	-	2	5
27	3	-	3	6
28	3	-	1	4
29	2	-	4	6
30	-	-	1	1
31	-	-	1	1
	59	19	35	113
Average stream life days	20.7	16.8	21.9	20.4

Appendix Table 19. Delta River fall chum salmon spawning area temperature data, 1973.

Date	Air Temperature °C Max.	Air Temperature °C Overnight Min.	Water Temperature °C Channel 1	Water Temperature °C Channel 2	Water Temperature °C Channel 3
10/10	(.5)	(-9.4)	4.4	-	-
11	(-2.2)	(-6.1)	-	-	3.9
12	(-6.1)	(-10.0)	2.0	-	2.0
13	(-5.5)	(-12.2)	2.5	-	2.5
14	(-4.4)	(-10.5)	3.0	-1.0	3.0
15	(-5.5)	(-8.8)	3.0	-	2.0
16	(-4.4)	(-18.8)	3.0	-0.5	2.5
17	(1.1)	(-6.6)	4.0	3.5	2.0
18	(.5)	(-3.8)	3.5	2.0	3.0
19	(-3.8)	(-5.5)	-	-	-
20	(-4.4)	(-7.7)	3.5	3.0	3.0
21	(-5.0)	(-7.7)	3.9	2.8	3.9
22	(-2.7)	(-19.4)	2.0	-	-
23	(-2.7)	(-14.4)	-	-	-
24	(-2.7)	(-22.7)	1.7	3.9	1.7
25	(-2.7)	(-10.5)	1.7	3.3	1.1
26	(-1.1)	(-8.3)	1.7	3.9	1.7
27	(1.1)	(-12.7)	3.3	2.2	2.8
28	(-1.1)	(-6.6)	3.3	3.9	3.4
29	(-1.1)	(-12.2)	-	-	-
30	(-3.8)	(-6.6)	3.3	3.9	1.7
31	(-5.5)	(-7.2)	3.3	3.9	1.7
11/ 1	(-6.1)	(-13.8)	3.3	3.9	1.1
2	(-8.3)	(-11.1)	3.3	3.3	0.6
3	(-8.3)	(-18.3)	1.7	2.2	0.6
4	(-11.6)	(-21.6)	2.2	2.8	0.6
5	(-9.4)	(-21.1)	1.7	2.2	0.6
6	(-11.1)	(-22.2)	1.7	1.7	0.6
7	(-12.7)	(-21.1)	0.6	2.2	0.6
8	(-8.3)	(-21.1)	2.8	3.3	1.7
9	(-11.6)	(-21.6)	2.8	1.1	2.8
10	(-10.0)	(-18.8)	1.7	2.8	0.6
11	(-10.0)	(-25.0)	0.6	2.8	0.6

Appendix Table 20. Limnological data from Delta River spawning area, 1973-1974.

	Date	Dissolved oxygen	pH	CO_2	Total hardness	Free Acidity	Total Acidity	Alkalinity		Air temp. °C	Water temp. °C	Velocity	Stream flow
								Methyl Orange	Phenol-phthalien				
Channel 1	4/5/73 1/	15ppm	8.0	13ppm	-	-	-	-	-	6.1°	3.8°	-	-
	10/12/73	13ppm	8.2	10ppm	7 gr/gal	0	0	6 gr/gal	0	-	6.6°	1.7fps	23.1cfps
	3/14/74	13ppm	8.5	6ppm	8 gr/gal	0	0	-	-	-6.1°	4.4°	1.3fps	15.6cfps
Channel 2	4/5/73	12ppm	8.0	13ppm	-	-	-	-	-	6.1°	3.8°	2.7fps	172.6cfps
	10/14/73	13ppm	8.5	10ppm	9 gr/gal	0	0	6 gr/gal	-	-3.8°	6.6°	4.5fps	837.0cfps
	3/14/74	10ppm	8.5	6ppm	8 gr/gal	0	0	-	-	-6.1°	5.0°	3.8fps	200.0cfps
Channel 3	4/5/73	15ppm	8.0	13ppm	-	-	-	-	-	6.1°	3.8°	0.7fps	6.0cfps
	10/14/73	12ppm	8.5	10ppm	8 gr/gal	0	0	5 gr/gal	0	-3.8°	6.6°	2.1fps	27.1cfps
	3/14/74	12ppm	8.5	7ppm	8 gr/gal	0	0	-	-	-6.1°	4.4°	2.7fps	4.0cfps

1/ Channel connected with channel 2 in spring of 1973.

Appendix Table 21. Relative gear efficiency for various types of fishing gear operated at Flat Island, Yukon River, 1965-1973.

Year	Types of gear	Gill net hours 2/ (Fishwheel hours) 1/	Catch per gill net hour 2/ King Salmon	Chum Salmon
1965	10" mesh gill net	376	0.22	
	8 1/2" mesh gill net	456	1.44	
	7" mesh gill net	128	0.91	
	8 1/2" mesh gill net	216	1.58	
	Fishwheel	(503)	0.23	
	Gill net (all mesh sizes)	2,037	0.49	
1966	7" mesh gill net	117	0.26	
	8 1/2" mesh gill net	198	0.76	
1967	5 1/2" mesh gill net	196	0.28	1.30
	8 1/2" mesh gill net	431	0.41	0.42
1968	5 1/2" mesh gill net	628	0.26	0.30
	8 1/2" mesh gill net	616	0.72	0.43
1969	5 1/2" mesh gill net	368	0.33	4.18
	8 1/2" mesh gill net	792	0.72	0.93
1970	5 1/2" mesh gill net	601	0.20	2.92
	8 1/2" mesh gill net	1,275	0.74	0.78
1971	5 1/2" mesh gill net	422	0.15	1.85
	8 1/2" mesh gill net	899	0.89	0.78
1972	5 1/2" mesh gill net	721	0.03	0.83
	8 1/2" mesh gill net	1,453	0.42	0.43
1973	5 1/2" mesh gill net	846	0.15	2.82
	8 1/2" mesh gill net	1,530	0.50	0.69

1/ Data includes only those days that both types of gear were operated; also, chum salmon catch data was not recorded during 1965-66.
2/ Gill net hour is one 25 fathom by 3 1/2 fathom gill net fished for one hour, or one fishwheel fished for one hour.

Appendix Table 22. Commercial salmon catches by species, subdistrict and gear, Yukon district, 1973.

Subdistrict	Kings		Cohos		Chums		Total	
334-10								
Set gill net	50,200	(88.1%)	31,145	(89.3%)	340,411	(86.1%)	421,756	(86.5%)
Drift gill net	6,781	(11.9%)	3,715	(10.7%)	55,016	(13.9%)	65,512	(13.5%)
Subtotal	56,981	(100.0%)	34,860	(100.0%)	395,427	(100.0%)	487,268	(100.0%)
334-20								
Set gill net	5,468	(39.5%)	887	(49.8%)	23,048	(21.1%)	29,403	(23.6%)
Drift gill net	8,391	(60.5%)	894	(50.2%)	85,993	(78.9%)	95,278	(76.4%)
Subtotal	13,859	(100.0%)	1,781	(100.0%)	109,041	(100.0%)	124,681	(100.0%)
334-30								
Set gill net	2,165	(67.6%)			463	(100.0%)	2,628	(71.7%)
Drift gill net	1,039	(32.4%)					1,039	(28.3%)
Subtotal	3,204	(100.0%)			463	(100.0%)	3,667	(100.0%)
334-40								
Set gill net	759	(58.0%)			4,372	(33.6%)	5,131	(35.8%)
Drift gill net	9	(0.7%)			12	(0.1%)	21	(0.2%)
Fishwheel	541	(41.3%)			8,619	(66.3%)	9,160	(64.0%)
Subtotal	1,309	(100.0%)			13,003	(100.0%)	14,312	(100.0%)
District 334								
Set gill net	58,592	(77.8%)	32,032	(87.4%)	368,294	(71.3%)	458,918	(72.9%)
Drift gill net	16,220	(21.5%)	4,609	(12.6%)	141,021	(27.2%)	161,850	(25.7%)
Fishwheel	541	(0.7%)			8,619	(1.5%)	9,160	(1.4%)
Total	75,353	(100.0%)	36,641	(100.0%)	517,934	(100.0%)	629,928	(100.0%)

Appendix Table 23. Yukon River drainage commercial and subsistence salmon catches, 1903-1973.

Commercial Catch

Year	Alaska King	Alaska Coho	Alaska Chum	Alaska Total	Yukon Territory King	Yukon Territory Chum	Yukon Territory Total	Total King	Total Coho	Total Chum	Total Total
1903							4,666[8]				4,666
1904											
1905											
1906											
1907											
1908							7,000				7,000
1909							9,238				9,238
1910											
1911											
1912											
1913							12,133				12,133
1914							12,573				12,573
1915							10,466				10,466
1916							9,566				9,566
1917											
1918	12,239	26,144	73,921	112,304			7,066	12,239	26,144	73,921	119,370
1919	104,822	37,070	327,898	469,790			1,800	104,822	37,070	327,898	471,590
1920	58,467		155,655	214,122			12,000	58,467		155,655	226,122
1921	69,646	1,000	111,098	181,744			10,840	69,646	1,000	111,098	192,584
1922	16,825			16,825			2,420	16,825			19,245
1923	13,393			13,393			1,833	13,393			15,226
1924	27,375			27,375			4,560	27,375			31,935
1925							3,900				3,900
1926							4,373				4,373
1927							5,366				5,366
1928							5,733				5,733
1929							5,226				5,226
1930							3,660				3,660
1931							3,473				3,473
1932	4,739			4,739			4,200	4,739			8,939
1933	8,829			8,829			3,333	8,829			12,162
1934	25,365			25,365			2,000	25,365			27,365
1935	7,265			7,265			3,466	7,265			10,731
1936	20,963			20,963			3,400	20,963			24,363
1937	6,226			6,226			3,746	6,226			9,972
1938	13,727			13,727			860	13,727			14,587
1939	9,987			9,987			720	9,987			10,707
1940	18,053			18,053			1,153	18,053			19,206
1941	29,905			29,905			2,806	29,905			32,711
1942	22,487			22,487			713	22,487			23,200
1943	27,650			27,650			609	27,650			28,259
1944	14,232			14,232			986	14,232			15,218
1945	19,727			19,727			1,333	19,727			21,060
1946	22,782			22,782			353	22,782			23,135
1947	54,026			54,026			120	54,026			54,146
1948	33,842			33,842				33,842			33,842
1949	36,379			36,379				36,379			36,379
1950	41,808			41,808				41,808			41,808
1951[3]	56,278			56,278				56,278			56,278
1952	38,637	10,868		49,505				38,637	10,868		49,505
1953	58,859		5,977[5]	64,836				58,859		5,977	64,836
1954	64,545		14,375[5]	78,920				64,545		14,375	78,920
1955	55,925			55,925				55,925			55,925
1956	62,208	1	10,742[5]	72,951				62,208	1	10,742	72,951
1957	63,623			63,623				63,623			63,623
1958	63,735			63,735	3,000	1,500	4,500[7]	66,735		1,500	68,235
1959	78,370			78,370	2,477	1,098	3,575	80,847		1,098	81,945
1960[6]	67,597			67,597	4,085	5,493	9,578	71,682		5,493	77,175
1961	119,664	2,855	42,577[5]	165,096	3,446	3,278	6,724	123,110	2,855	45,855	171,820
1962	94,746	23,339	53,766[5]	171,851	4,027	936	4,963	98,773	23,339	54,702	176,814
1963	117,108	5,575[5]		122,683	2,223	2,192	4,415	119,331	5,575	2,192	127,098
1964	93,587	2,430	8,347	104,364	3,208	1,929	5,137	96,795	2,430	10,276	109,501
1965	118,014	661	23,211[5]	141,886	2,265	2,071	4,336	120,279	661	25,282	146,222
1966	93,315	19,254	71,058[5]	183,627	1,942	3,157	5,099	95,257	19,254	74,215	188,726
1967	129,430	11,047	49,412[5]	189,889	2,187	3,343	5,530	131,617	11,047	52,755	195,419
1968	106,526	13,303	67,375	187,204	2,212	435	2,647	108,738	13,303	67,810	189,851
1969	90,720	15,076	192,582	298,378	1,640	2,279	3,919	92,360	15,076	194,861	302,297
1970	79,301	13,188	347,348[5]	439,837	2,611	2,479	5,090	81,912	13,188	349,827	444,927
1971	110,507	12,203	289,685[5]	412,395	3,178	1,761	4,939	113,685	12,203	291,446	417,334
1972	92,840	22,233	287,844	402,917	1,769	2,532	4,301	94,609	22,233	290,376	407,218
1973	75,353	36,641	518,035[5]	630,029	1,871	2,228	4,099	77,224	36,641	520,263	634,128

Subsistence Catch

Year	Alaska[1] King	Alaska Other Salmon[2]	Alaska Total	Yukon Territory King	Yukon Territory Other Salmon[2]	Yukon Territory Total	Total King	Total Other Salmon[2]	Total Total
1918		1,400,000	1,400,000					1,400,000	1,400,000
1919		269,000	269,000					269,000	269,000
1920	20,000	860,000	880,000				20,000	860,000	880,000
1922	15,000	330,000	345,000				15,000	330,000	345,000
1923	17,500	435,000	452,500				17,500	435,000	452,500
1924		1,130,000	1,130,000					1,130,000	1,130,000
1925	15,000	259,000	274,000				15,000	259,000	274,000
1926	20,500	555,000	575,500				20,500	555,000	575,500
1927		520,000	520,000					520,000	520,000
1928		670,000	670,000					670,000	670,000
1929		537,000	537,000					537,000	537,000
1930		633,000	633,000					633,000	633,000
1931	26,693	565,000	591,693				26,693	565,000	591,693
1932	23,160	1,092,000	1,115,160				23,160	1,092,000	1,115,160
1933	19,950	603,000	622,950				19,950	603,000	622,950
1934		474,000	474,000					474,000	474,000
1935	20,400	537,000	557,400				20,400	537,000	557,400
1936	22,750	560,000	582,750				22,750	560,000	582,750
1937	5,528	346,000	351,528				5,528	346,000	351,528
1938	19,244	340,450	359,694				19,244	340,450	359,694
1939	18,050	327,650	345,700				18,050	327,650	345,700
1940	14,400	1,029,000	1,043,400				14,400	1,029,000	1,043,400
1941	17,703	438,000	455,703				17,703	438,000	455,703
1942		197,000	197,000					197,000	197,000
1943		200,000	200,000					200,000	200,000
1953		380,000	380,000					380,000	380,000
1958	11,890	337,500	349,390	8,000		8,000	19,890	337,500	357,390
1959				5,957	2,000[7]	7,957	5,957	2,000	7,957
1960				6,965	8,429	15,394	6,965	8,429	15,394
1961	21,488	407,089	428,577	10,376	5,800	16,176	31,864	412,889	444,753
1962	11,110	349,141	360,251	10,500	8,500	19,000	21,610	357,641	379,251
1963	24,862	396,075	420,937	8,108	25,500	33,608	32,970	421,575	454,545
1964	16,171	481,449	497,620				16,171	481,449	497,620
1965	16,608	448,861	465,469	3,000	9,800	12,800	19,608	458,661	478,269
1966	11,572	213,186	224,758	2,700	8,600	11,300	14,272	221,786	236,058
1967	16,448	274,977	291,425	3,000	13,600	16,600	19,448	288,577	308,025
1968	12,106	181,024	193,130	2,900	11,100	14,000	15,006	192,124	207,130
1969	14,000	210,772	224,772	1,000	5,500	6,500	15,000	216,272	231,272
1970	14,310	225,528	239,838	2,100	1,200	3,300	16,410	226,728	243,138
1971	22,451	201,533	223,984	2,800	14,000	16,800	25,251	215,533	240,784
1972	17,931	133,102	151,033	1,657	8,000	9,657	19,588	141,102	160,690
1973	20,099	179,241	199,340	2,116	6,938	9,054	22,215	186,179	208,394

Total Utilization

Year	Alaska King	Alaska Other Salmon[2]	Alaska Total	Yukon Territory King	Yukon Territory Other Salmon[2]	Yukon Territory Total	Total King	Total Other Salmon[2]	Total Total
1903						4,666			4,666
1908						7,000			7,000
1909						9,238			9,238
1913						12,133			12,133
1914						12,573			12,573
1915						10,466			10,466
1916						9,566			9,566
1918	12,239	1,500,065	1,512,304			7,066	12,239	1,500,065	1,519,370
1919	104,822	633,968	738,790			1,800	104,822	633,968	740,590
1920	78,467	1,015,655	1,094,122			12,000	78,467	1,015,655	1,106,122
1921	69,646	112,098	181,244			10,840	69,646	112,098	192,584
1922	31,825	330,000	361,825			2,420	31,825	330,000	364,245
1923	30,893	435,000	465,893			1,833	30,893	435,000	467,726
1924	27,375	1,130,000	1,157,375			4,560	27,375	1,130,000	1,161,935
1925	15,000	259,000	274,000			3,900	15,000	259,000	277,900
1926	20,500	555,000	575,500			4,373	20,500	555,000	579,873
1927		520,000	520,000			5,366		520,000	525,366
1928		670,000	670,000			5,733		670,000	675,733
1929		537,000	537,000			5,226		537,000	542,226
1930		633,000	633,000			3,660		633,000	636,660
1931	26,693	565,000	591,693			3,473	26,693	565,000	595,166
1932	27,899	1,092,000	1,119,899			4,200	27,899	1,092,000	1,124,099
1933	28,779	603,000	631,779			3,333	28,779	603,000	635,112
1934	23,365	474,000	497,365			2,000	23,365	474,000	499,365
1935	27,665	537,000	564,665			3,466	27,665	537,000	568,131
1936	43,713	560,000	603,713			3,400	43,713	560,000	607,113
1937	12,154	346,000	358,154			3,746	12,154	346,000	361,900
1938	32,971	340,450	373,421			860	32,971	340,450	374,281
1939	28,037	327,650	355,687			720	28,037	327,650	356,407
1940	32,453	1,029,000	1,061,453			1,153	32,453	1,029,000	1,062,606
1941	47,608	438,000	485,608			2,806	47,608	438,000	488,414
1942	22,497	197,000	219,497			713	22,427	197,000	220,210
1943	27,650	200,000	227,650			609	27,650	200,000	228,259
1944	14,232		14,232			986	14,232		15,218
1945	19,727		19,727			1,333	19,727		21,060
1946	22,782		22,782			353	22,782		23,135
1947	54,026		54,026			120	54,026		54,146
1948	33,842		33,842				33,842		33,842
1949	36,379		36,379				36,379		36,379
1950	41,808		41,808				41,808		41,808
1951	56,278		56,278				56,278		56,278
1952	38,637	10,868	49,505				38,637	10,868	49,505
1953	58,859	385,977	444,836				58,859	385,977	444,836
1954	64,545	14,375	78,920				64,545	14,375	78,920
1955	55,925		55,925				55,925		55,925
1956	62,208	10,743	72,951				62,208	10,743	72,951
1957	63,623		63,623				63,623		63,623
1958	75,625	337,500	413,125	11,000	1,500	12,500	86,625	339,000	425,625
1959	78,370		78,370	8,434	3,098	11,532	86,804	3,098	89,902
1960	67,597		67,597	11,050	13,922	24,972	78,647	13,922	92,569
1961	141,152	452,521	593,673	13,822	9,078	22,900	154,974	461,599	616,573
1962	105,856	426,246	532,102	14,537	9,436	23,973	120,393	435,682	556,075
1963	141,970	401,650	543,620	10,331	27,692	38,023	152,301	429,342	581,643
1964	109,758	492,226	601,984	3,208	1,929	5,137	112,966	494,155	607,121
1965	134,622	472,733	607,355	5,265	11,871	17,136	139,887	484,604	624,491
1966	104,887	303,498	408,385	4,642	11,757	16,399	109,529	315,255	424,784
1967	145,878	335,436	481,314	5,187	16,943	22,130	151,065	352,379	503,444
1968	118,632	261,702	380,334	5,112	11,535	16,647	123,744	273,237	396,981
1969	104,720	418,430	523,150	2,640	7,779	10,419	107,360	426,209	533,569
1970	93,611	586,064	679,675	4,711	3,679	8,390	98,322	589,743	688,065
1971	132,958	503,421	636,379	5,978	15,761	21,739	138,936	519,182	658,118
1972	110,771	443,179	553,950	3,426	10,532	13,958	114,197	453,711	567,908
1973	95,452	733,917	829,369	3,587	9,166	13,153	99,439	743,083	842,522

1/ Does not include subsistence catches from the village of Stebbins, a coast village located northeast of the Yukon River mouth.
2/ Mostly chum salmon, but includes small numbers of pink and coho salmon.
3/ Data source for Alaska commercial catches: USF&S Stat. Digest No. 50 for the years 1951-59, unless otherwise indicated.
4/ Data source: Alaska Fisheries and Fur-Seal Industry Report for 1954.
5/ Includes small numbers of pink or red salmon (less than 300).
6/ Data source for Alaska commercial catches: ADF&G Stat. Leaflets for years since 1960.
7/ Data source: Environment Canada, Fisheries Service (Whitehorse).
8/ Catch data for years 1903-1947 obtained by dividing total poundage of mixed salmon by an arbitrary weight of 15 pounds. Species breakdown is unknown. Figures considered conservative (data collected by Royal Canadian Mounted Police).

Appendix Table 24. Aerial survey salmon escapement counts,[1/] Yukon district, 1973.

Stream (Drainage)	Date	Survey Rating	Kings	Cohos	Chums
Andreafsky River					
West Fork	7/21	Fair	788		51,835
East Fork	7/27;				
	8/27	Poor-Fair	825		10,149
Subtotal					
Anvik River	7/27	Poor	222		26,156
(Anvik River Tower Count)			517	286 pinks	71,475
Tanana River Drainage					
Nenana River (slough near Clear Air Force Base)	10/15	Fair			115+
Kantishna River					
Toklat River	10/23	Good			6,957
Bear Paw River	10/23	Fair			1,530
Subtotal					8,487
Chena River	8/7	Good	21		79
Salcha River	8/6;				
	8/9	Fair;Poor	249		290
Salcha River[2/]	8/10	Excellent	391		
Goodpaster River	8/7	Fair	14		52
Richardson-Clearwater Creek	10/15	Fair		350-400	4
Delta River	10/26	Fair			7,971
(Delta River Population Estimate)					10,014
Clearwater Lake and Stream	10/15			551	
Delta-Clearwater River	10/15			3,322	40
Delta-Clearwater Slough	10/26				1,720
Upper Tanana River					
Benchmark #735 Slough	10/22				127
Near Richardson Highway Bridge	10/26				5,635
Bluff Cabin Slough	10/26				3,450
Near mouth Delta-Clearwater River	10/26				153
Subtotal					9,365
Porcupine River Drainage					
Sheenjek River	9/19				1,175
Fishing Branch River[3/]				8	16,239
Subtotal				8	17,414

Appendix Table 24.(cont.) Aerial survey salmon escapement counts, Yukon District, 1973.

Stream (Drainage)	Date	Survey Rating	Kings	Cohos	Chums
Yukon Territory Streams					
Nordenskiold River 4/	8/29		1		
Bear Feed Creek 4/	9/11		1		
Tatchun Creek 4/	8/26		99		
Little Salmon River	9/5	Poor	27		
Little Salmon River 4/	9/28				21
Big Salmon River	8/24	Poor	75		
Kluane River	10/25				2-3,000
Yukon River (Main Stem)	9/5		27		
Yukon River (Main Stem) 4/	10/2-4				252
Nisutlin	8/24	Very Poor	42		
Subtotal			272		3,273

1/ Peak counts listed only. Salmon carcasses included.
2/ Helicopter survey by Division of Sport Fish.
3/ Weir count.
4/ Foot survey.