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Yukon River King and Chum Salmon Escapement Studies

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ABSTRACT

An expanded total of 201,277 chum salmon and 471 king salmon was enumerated as they migrated past the Anvik River tower between June 24 and July 19. High water forced termination of the counts on July 19. The post-spawning chum salmon carcass sample was composed of 78.9 percent age class 4_1 and 61 percent males. Male chums predominated in the carcass surveys before July 18 and females after that date.

During aerial and boat surveys, 1,857 king salmon and 3,510 chum salmon were enumerated in the Salcha River. Six percent of the chum salmon and 22 percent of the king salmon spawned in the area which would be affected by a break in the trans-Alaska hot-oil pipeline. The post-spawning king salmon carcass sample was composed of 44 percent 4_2 age class kings and 75 percent males. The chum salmon carcass sample was composed of 53 percent females and 77 percent age class 4_1 chums. Beaver dams prevented king salmon fry, adult chum salmon, and other species from utilizing four out of five major Salcha River tributaries.

A total of 273 king salmon was enumerated through the Whitehorse, Yukon Territory fishway. This was the second lowest escapement on record. The sample of kings taken for age and sex information was composed of 60 percent males. Age classes 4_2-7_2 were represented and age class 5_2 kings comprised 55 percent of the sample.

A total of 403 fall chum salmon were tagged in the Delta River. A total of 2,256 carcasses were examined for marks, and 151 tagged chums were recovered during carcass surveys. The average stream life for fall chums was 18 days for all three channels; male chums had an average stream life of 15 days and females 21 days. Male chum carcasses predominated in the first half of the post-spawning die-off and females in the last. This indicated that it was probably necessary to sample over the entire post-spawning die-off to obtain an unbiased estimate of the age and sex composition of a spawning population from carcass surveys. There was a significant reduction in average fecundity from 2,634 eggs in 1973 to 1,886 eggs per female in 1974. Aerial photographs of the Delta River spawning area, taken during the peak of spawning, indicated that the Peterson tag recovery population estimate was 61 percent greater than the actual population size. This error was probably the result of migration of tagged chums out of the spawning area. Major fall chum spawning areas were located in the Sheenjek and Chandalar rivers.

A test fishing site has been maintained at Flat Island since 1963. The 1974 catch per unit effort of 0.26 king salmon per gill net hour for 8-1/2" mesh

gill nets was well below the 8-year average and 1973 levels. The catch per unit effort of 4.14 chum salmon per gill net hour was the second highest on record and well above 1973 levels. Flat Island catches, however, 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 and subsistence catches of king salmon in the Yukon drainage were at their highest levels since 1968. Catches of other species of salmon, primarily chums, were at their highest levels since 1918.

Aerial surveys in the Yukon drainage enumerated a total of 5,266 king salmon, 7,008 coho salmon, 356,140 summer chum salmon and 149,265 fall chum salmon.

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 being the most abundant. King salmon rank second in abundance followed in order by coho, pink, and sockeye salmon. The latter two species are found in limited numbers and there is no significant fishery for them. It is believed that the Yukon River is the greatest single king and chum salmon producing system in Alaska.

Yukon chum salmon are composed of two distinct summer and fall stocks. The more abundant summer chums are distinguished in part from fall chums by: earlier upstream migration and spawning, utilization of lower river spawning areas and smaller body size.

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 six statistical areas for commercial fishery management and regulatory purposes. The major commercial fisheries are found in the lower 150 miles. 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.

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 salmon at their level of maximum yield. The project was funded in part by the Anadromous Fish Act (PL 89-304) from July 1, 1974 to June 30, 1975. This report will review all the pertinent data collected during the 1974 field season. In some cases, comparative data collected prior to the project period are included for reference. Due 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 1974, studies were conducted to develop estimates or indices of the magnitude of king and chum salmon escapements in the Anvik and Salcha rivers. King salmon escapement through the Whitehorse fishway was enumerated and sampled for the tenth consecutive year. A comprehensive program

FIGURE 1. Yukon River map.

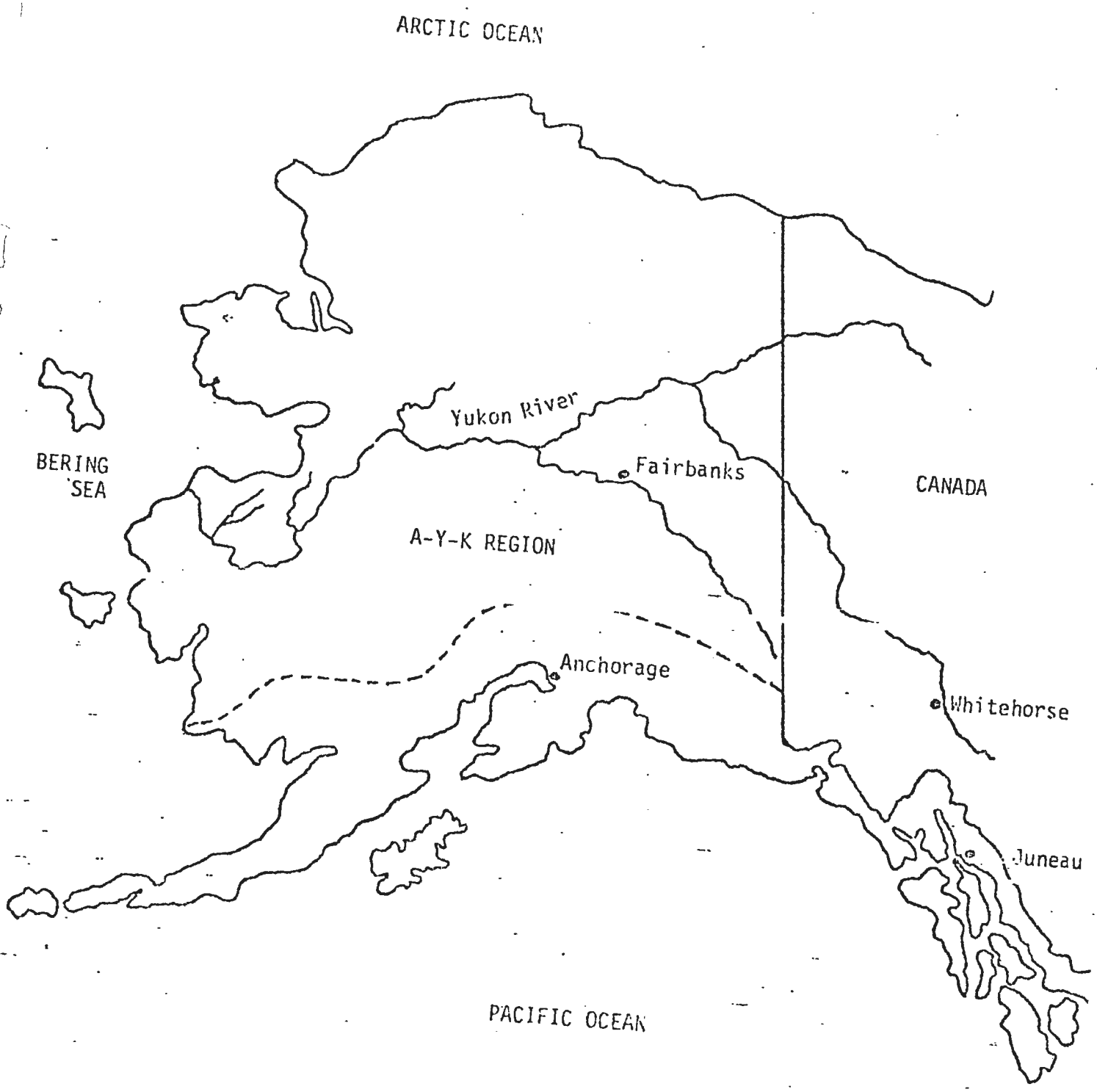


FIGURE 2. Lower Yukon River map.

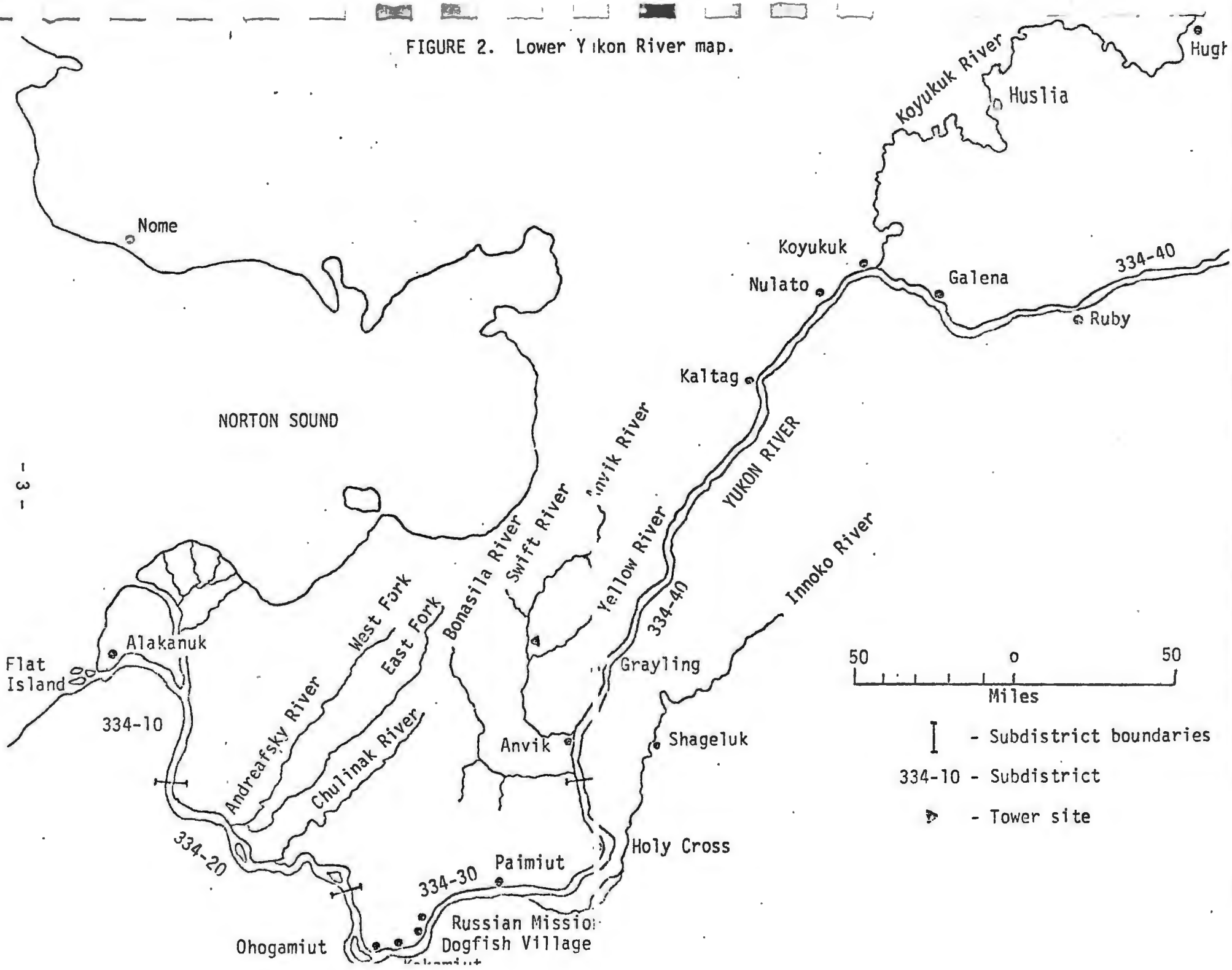
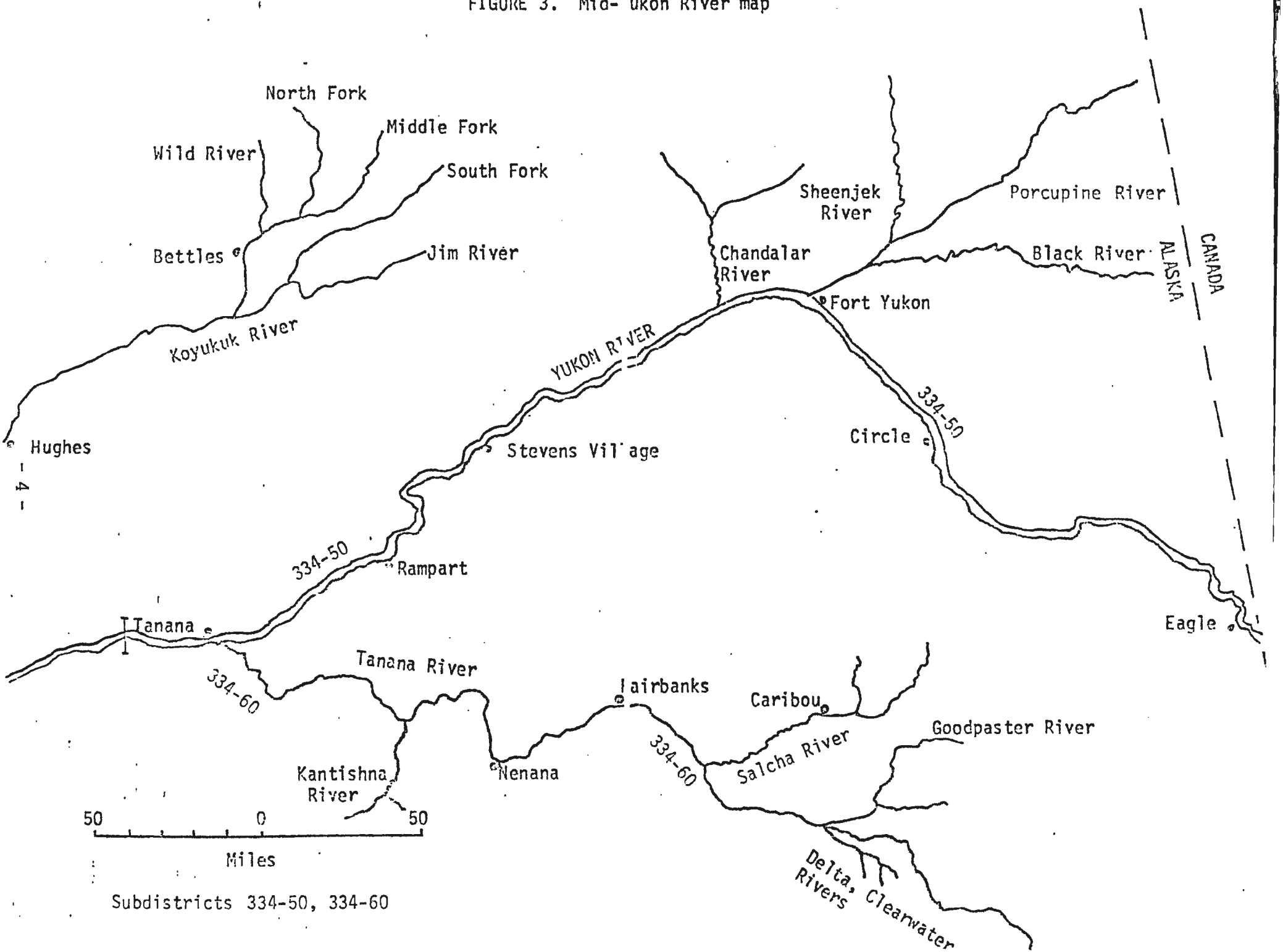
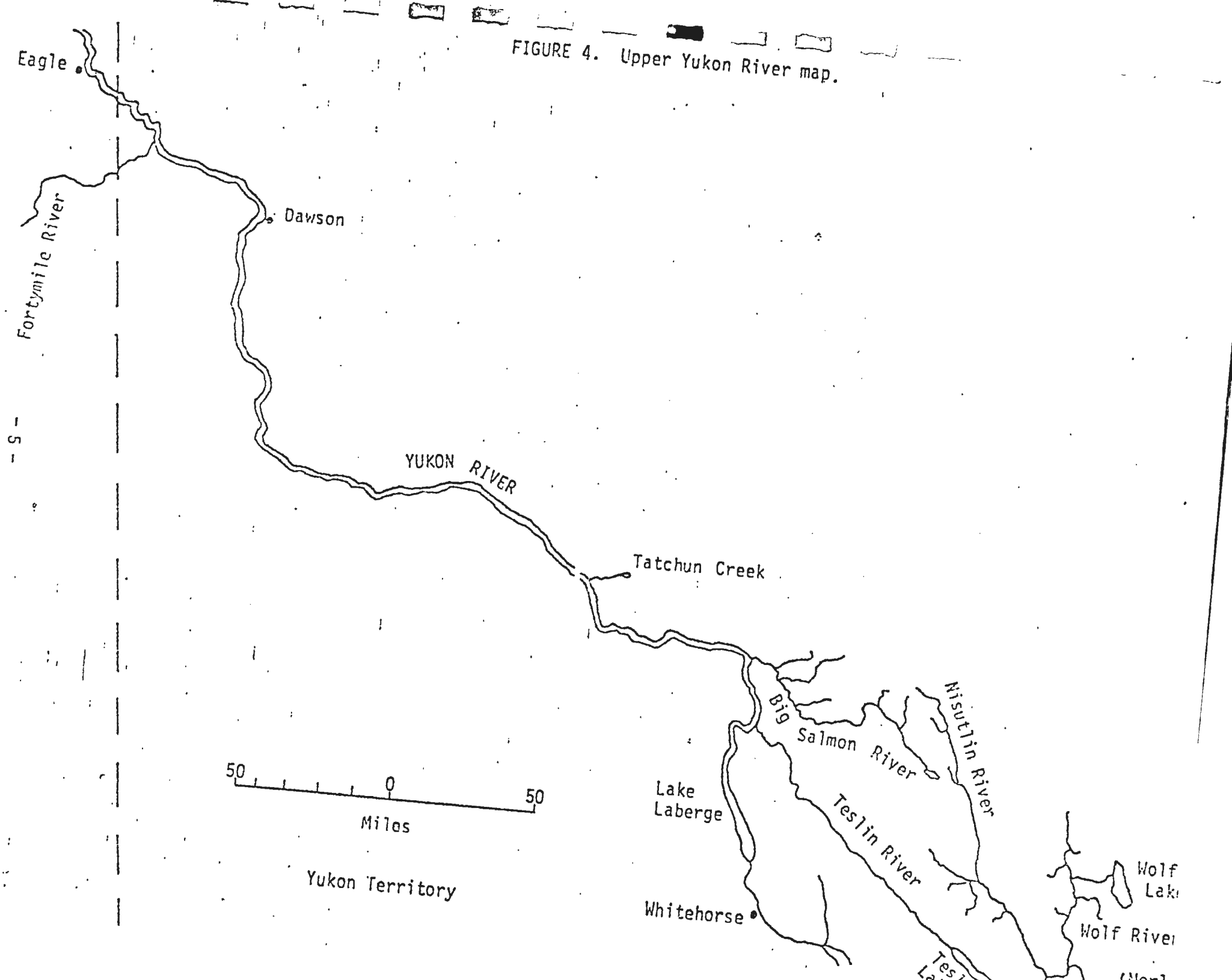


FIGURE 3. Mid-Yukon River map



Subdistricts 334-50, 334-60

FIGURE 4. Upper Yukon River map.



was initiated to study fall chum salmon in the upper Yukon drainage. An intensive tag 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.

CATCH STATISTICS

Methods

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 personnel soon after the end of each fishing period. From these tickets total catch, catch per unit effort and number of fishermen are compiled and recorded on a master sheet. These data are readily available to compare with previous years' catches and allow the Yukon area management biologist at Emmonak to make management decisions.

In addition to commercial fishing a considerable number of salmon are taken for subsistence use on the Yukon River. Each year Department personnel conduct a survey by boat and aircraft of the entire river, stopping at each village, and interviewing the fishermen to obtain the total number of each species taken and other related data. Subsistence calendars are sent to each family in the spring on which 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.

Results

Commercial and subsistence salmon catches for 1974 are presented in Table 1. During 1974, the commercial salmon harvest was 996,319 as compared to an annual average of 441,180 during 1969-1973. Commercial fishing effort in terms of registered fishing vessels increased 55 percent from 498 in 1969 to 770 in 1974. 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.

Table 1. Commercial and subsistence catches, Yukon River, 1974[1/].

Species	Commercial catch	Subsistence catch	Total catch
King	99,116	20,565	119,681
Coho	16,825	---	16,825
Chum	880,378	291,102[2/]	1,171,480
Combined species	996,319	311,667	1,307,986

1/ Include small numbers taken in Yukon Territory, Canada.

2/ Includes small numbers of coho and pink salmon.

Although the subsistence salmon fishery had declined in importance in recent years, the subsistence catch increased significantly in 1974. In 1974 the salmon harvest was 311,667 compared to an average annual harvest of 216,857 during 1969-1973. It should be noted that all the subsistence and commercial catch data are preliminary and final catches may vary slightly from these figures.

AERIAL SURVEYS

Because of the vast distances involved and the large number of salmon spawning streams in the Yukon River system, salmon escapements are primarily documented by the aerial survey method. Index streams are chosen 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. Salmon escapement data obtained throughout the drainage in 1974 is presented in Appendix Table 1. Annual king and chum salmon escapement data are presented in Appendix Tables 2 and 3 respectively.

Aerial surveys in the Yukon River drainage enumerated a total of 5,266 king salmon, 7,008 coho salmon, 356,140 summer chum salmon and 149,265

fall chum salmon.

ANVIK RIVER SALMON ESCAPEMENT STUDIES

Introduction

For the third consecutive year a salmon enumeration project was conducted to yield indices to the magnitude of king and summer chum salmon escapements in the Anvik River system (Figure 5). The objectives of this project were to: (1) determine the daily and seasonal timing and magnitude of the salmon runs, (2) evaluate aerial survey methods by comparing aerial survey estimates with tower counts, (3) determine age, sex and size composition of the king and chum salmon escapement, (4) determine if there is a difference in the timing of the post-spawning die-off between male and female salmon, (5) evaluate an 18-hour counting period and (6) measure climatological and hydrological data.

Due to funding limitations in 1974, it was necessary to reduce the daily counting period from 24 to 18 hours. A decision was made to count during those hours in which the greatest percentage of chum migration was documented in 1973: 12 midnight to 0700, 1300-12 midnight. In 1973 these hours included 81 percent of the chum and 73 percent of the king salmon daily migration past the tower. Studies by Hurd (1979) indicated that the daily migration pattern for chum salmon did not change significantly from year to year.

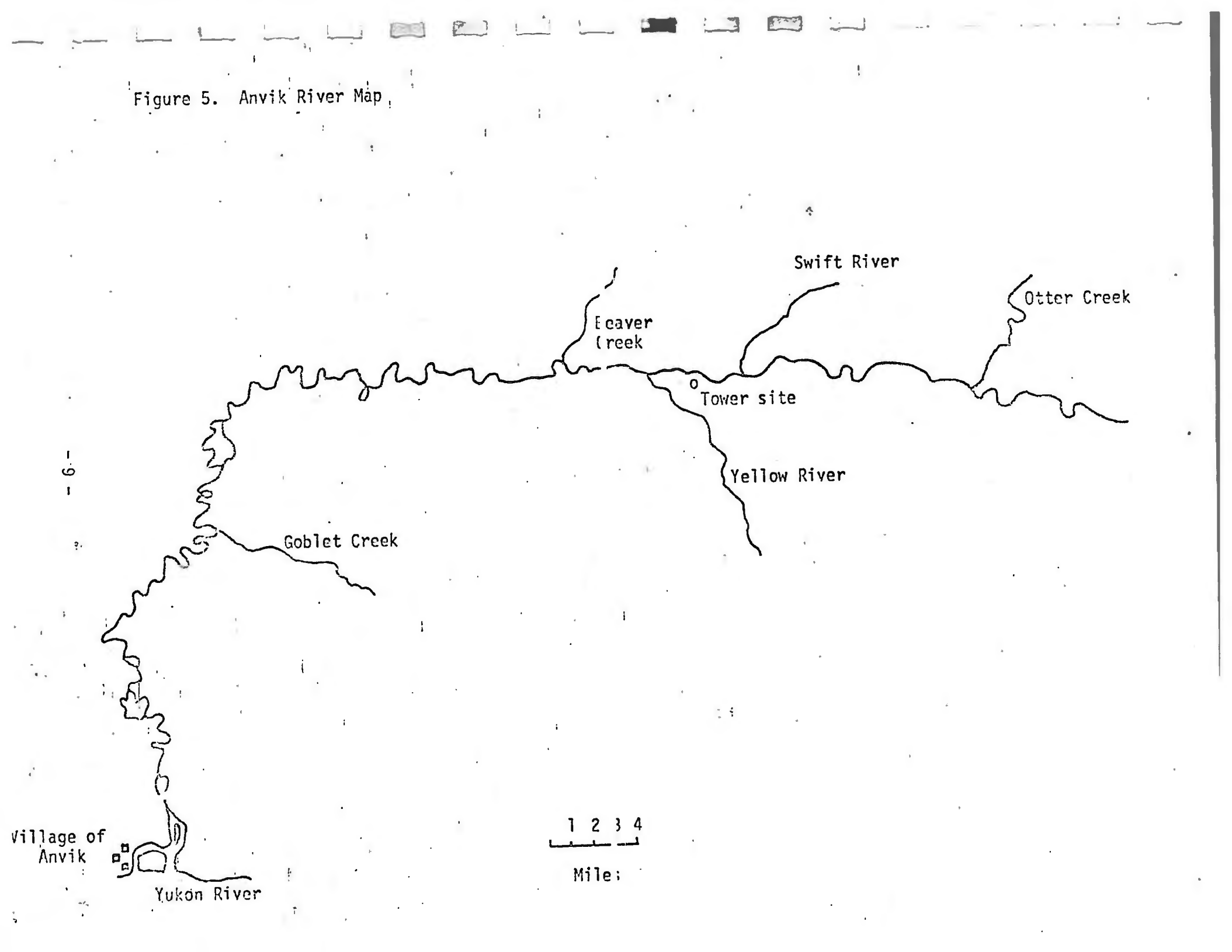
Methods and Materials

A 22-foot prefabricated aluminum tower was erected on the east bank of the Anvik River about 5-1/2 river miles upstream from its confluence with the Yellow River (Figure 6). 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.

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 panel of herculite upholster cloth across the stream bottom between the tower and the weir. The panel was attached to a cable running across the bottom and weighted down with sandbags.

Figure 5. Anvik River Map



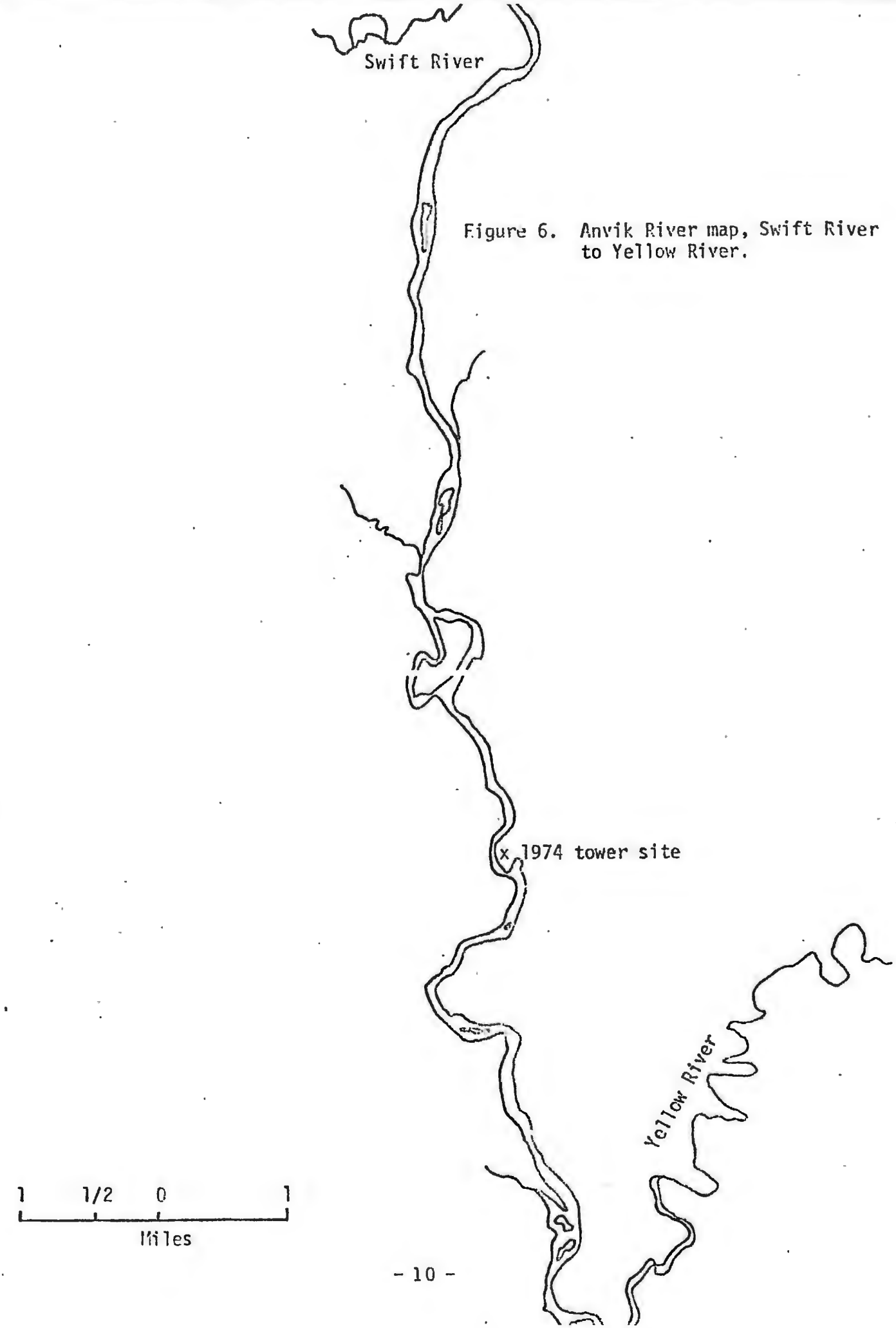


Figure 6. Anvik River map, Swift River to Yellow River.

A three-man crew began 18-hour counting operations on June 24. Operations were terminated on July 19 because of high water. Each crew member enumerated salmon for two 3-hour periods each day. No counts were made between 0700 and 1300 hours. Counts were recorded for both hourly totals and the first 10 minutes of each hour. Salmon swimming downstream were subtracted from the upstream migrants to obtain a net count.

Missing hourly counts were estimated by computing the percentage (P) of the total count made during the missing hour(s) for all other days over the entire season. This percentage (P) was subtracted from 100 percent (1-P) and divided into the daily count (A) to produce an expanded 18-hour total (E) or:

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

Hourly counts were calculated by taking the same percentage (P) of the expanded daily total and substituting it for the missing hourly counts (Appendix Table 4). The 1974 daily 18-hour count was then expanded by 27 percent for king and 19 percent for chum to give a 24-hour total.

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

Carcass sampling and enumeration surveys were conducted upstream and downstream of the tower site from July 11 to July 25. A scale smear for age determination was taken from each fish examined, the length (mideye to fork of tail) measured, and sex of each carcass was recorded. Spawning success was determined by examining the gonads of carcasses.

No aerial survey could be made of the Anvik River because of high water conditions during the peak of spawning. Climatological information was recorded daily. Stream flows and limnological data were taken periodically.

Results

Over the period June 24 to July 19, when counting was suspended due to high water, an expanded seasonal total of 201,277 chum salmon, 471 king salmon, and 167 pink salmon was enumerated past the Anvik River tower (Table 2, Appendix Tables 5 & 6). Estimates of hourly counts made from 10-minute counts (expanded by 6) were within 8 percent of the seasonal total for chum

Table 2. Daily expanded salmon counts, Anvik River[1/].

1974

Date	King		Chum	
	No.	% Total	No.	% Total
June 24	3	.6	1,166	.5
25	0	0	1,639	.8
26	0	0	3,001	1.5
27	0	0	2,410	1.2
28	0	0	2,736	1.3
29	0	0	4,216	2.1
30	0	0	5,711	2.8
July 1	1	-	7,185	3.6
2	3	.6	8,243	4.1
3	13	2.8	10,860	5.4
4	13	2.8	14,868	7.4
5	20	4.2	12,627	6.3
6	22	4.6	13,981	6.9
7	38	8.0	10,704	5.3
8	20	4.2	9,538	4.7
9	27	5.7	9,488	4.7
10	70	14.9	13,255	6.6
11	32	6.7	7,572	3.8
12	14	2.9	8,494	4.2
13	13	2.8	11,731	5.8
14	28	5.9	14,967	7.4
15	69	14.6	14,397	7.2
16	29	6.1	4,511	2.2
17	19	4.0	3,237	1.6
18	38	8.0	2,691	1.3
19	-		2,047	1.0
Total	471	100.0	201,277	100.0

1/ Expansion figures: King: 1.27
Chum: 1.19

salmon and 16 percent for king salmon (Table 3).

The summer chum migration peaked during July 4 through July 15 and king salmon migration peaked on July 10 and 15 (Figure 7). The daily chum migration, during the 18 hours counted, was greatest from 2100 to 0400 hours and the king migration from 1300 to 1700 hours (Figures 8 and 9).

The 402 chum salmon carcasses sampled were composed of 61 percent males. Age classes 3_1 to 6_1 [1/] were represented with age class 4_1 fish comprising 78.9 percent of the sample (Table 4). Male chums composed the greatest percentage of the sample before July 18 and females comprised a greater percentage after that date (Table 5).

Ninety-eight percent of the female and 94 percent of the male chum carcasses examined were partially or completely spent. An average of 46 eggs were retained per female (Table 6).

Based on size estimates made from the tower, the net upstream migration of king salmon was composed of 1.4 percent less than 50 cm in length, 34.4 percent between 50 to 60 cm, 41.9 percent between 60 and 80 cm, and 22.3 percent over 80 cm.

Climatological and limnological data are presented in Appendix Table 7.

Discussion

The 1974 expanded seasonal totals for chum and king salmon were the highest and lowest counts respectively in the 3 years the project has been conducted. Both of the totals would probably have been greater if high water had not forced suspension of the counts on July 19. In 1972, 4.6 percent of the expanded total chum migration and 36.6 percent of the king migration passed the Anvik tower after July 19 (Lebida, 1972). In 1973, 4.1 percent of the chums and 41.5 percent of the kings passed the tower after July 19 (Trasky, 1973). In view of this data, the expanded count for 1974 probably included most of the chum salmon. The expanded king salmon count may have been as much as 40 percent greater if counting could have been continued through July 31.

1/ Gilbert-Rich Formula - Total years of life at maturity (large type) - year of life at outmigration from fresh water (subscript).

Table 3. Comparison of hourly counts estimated from 10-minute counts (expanded by 6) with unexpanded hourly counts, Anvik River, 1974

	Chums			Kings		
	10 min.	expanded	actual	10 min.	expanded	actual
June 24	114	684	542	-	-	2
25	180	1,080	982	-	-	-
26	404	2,424	2,522	-	-	-
27	269	1,614	2,025	-	-	-
28	427	2,552	2,299	-	-	-
29	690	4,140	3,543	-	-	-
30	638	3,828	4,799	-	-	-
July 1	1,039	6,234	6,038	-	-	1
2	1,093	6,558	6,927	1	6	2
3	1,693	10,158	9,126	1	6	10
4	1,966	11,796	12,494	5	30	10
5	2,264	13,584	10,611	4	24	16
6	2,055	12,330	11,749	8	48	17
7	1,494	8,964	8,995	2	12	30
8	1,689	10,134	8,015	5	30	16
9	1,790	10,740	7,973	1	6	21
10	1,937	11,622	11,139	15	90	55
11	1,126	6,756	6,064	3	18	19
12	1,080	6,480	6,010	4	24	11
13	-	-	-	-	-	10
14	1,117	6,702	6,981	3	18	10
15	2,345	14,058	12,098	7	42	54
16	728	4,368	3,791	3	18	23
17	509	3,054	2,720	1	6	15
18	291	1,746	1,923	4	24	26
19	64	384	387	-	-	-
	27,000	162,000	149,753	67	402	348
			difference 12,247			difference 54
		percentage	difference 8%		percentage	difference 16%

Figure 7. Daily chum and king salmon migration, Anvik River, 1974.

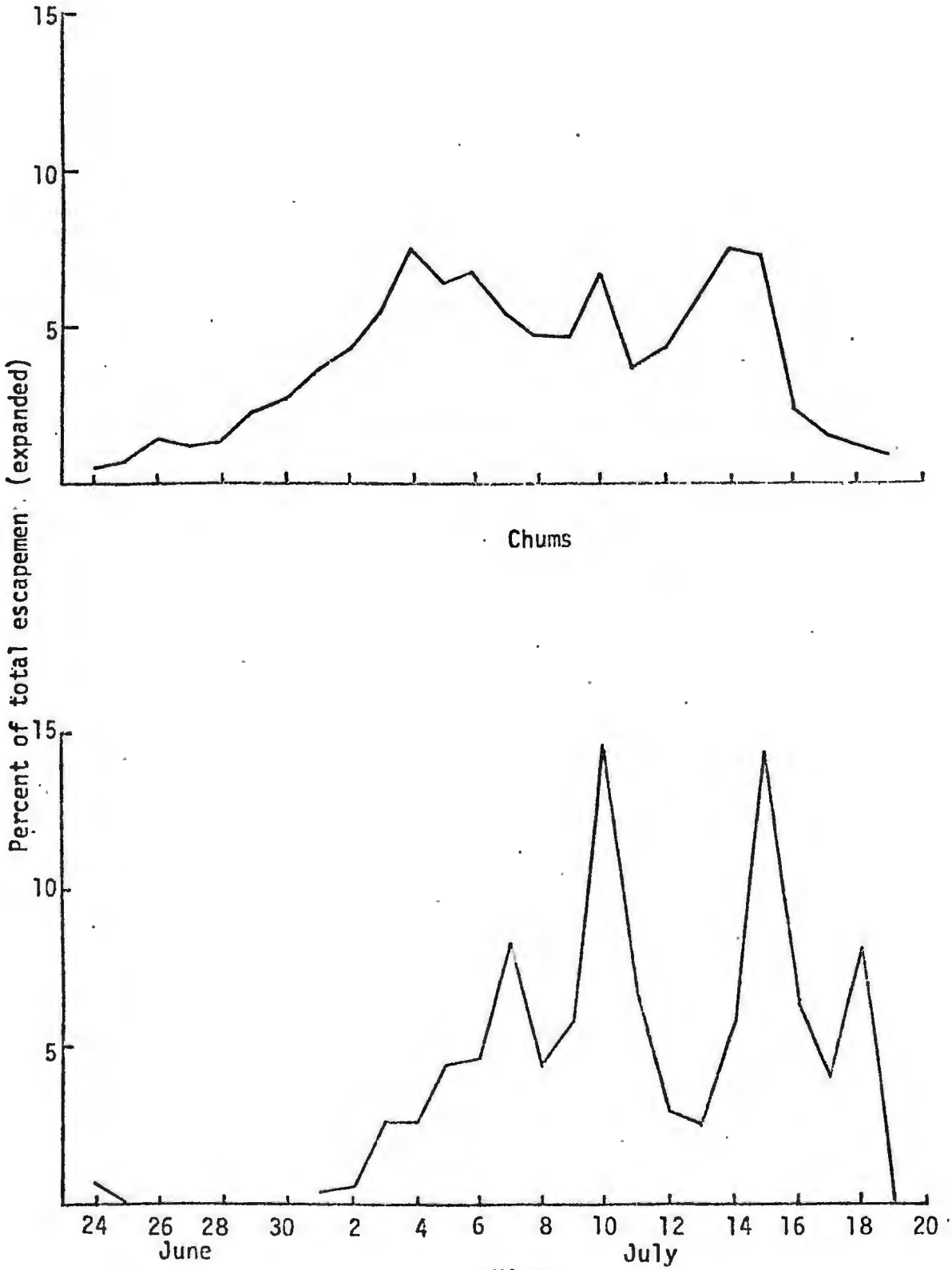
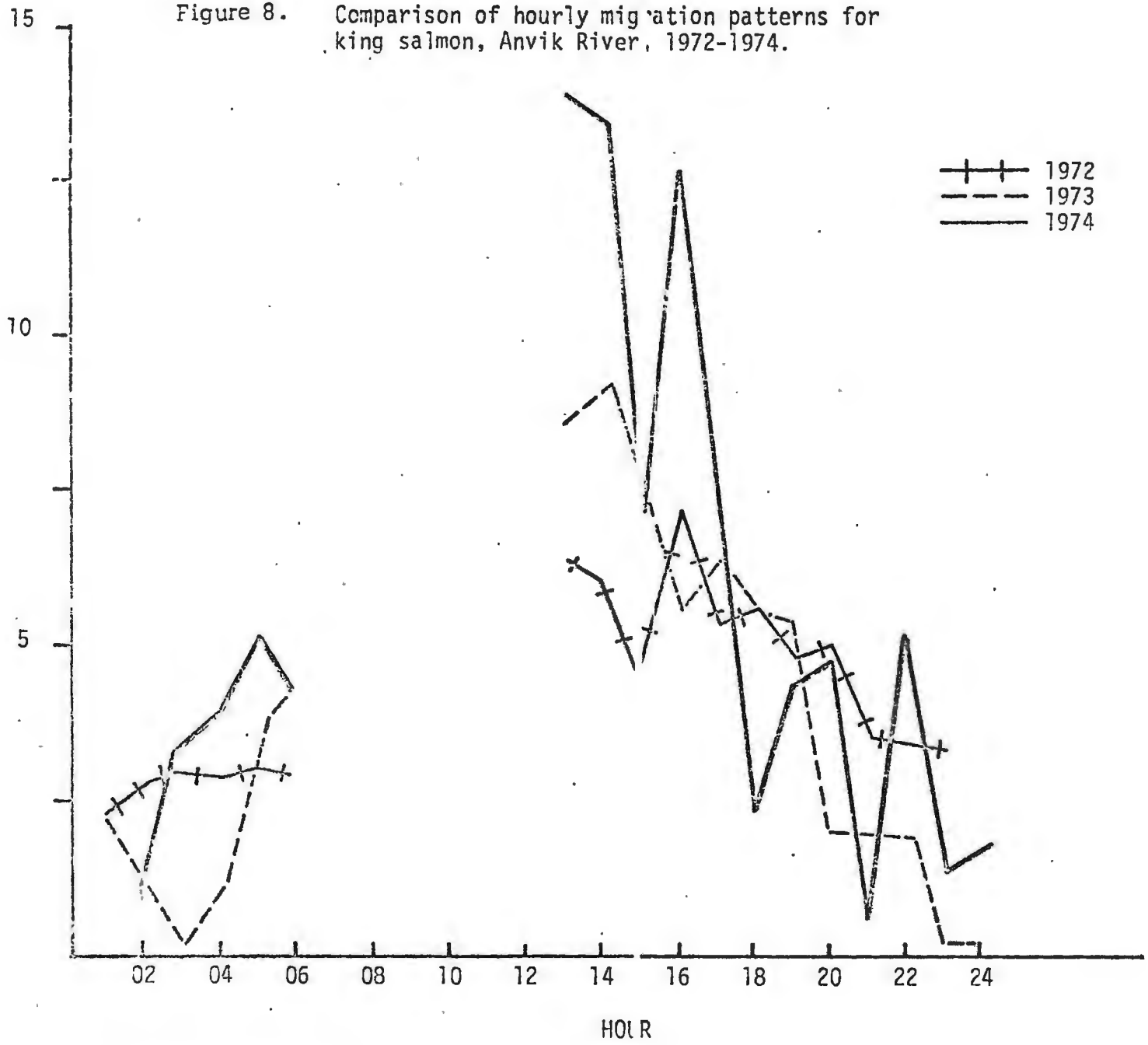
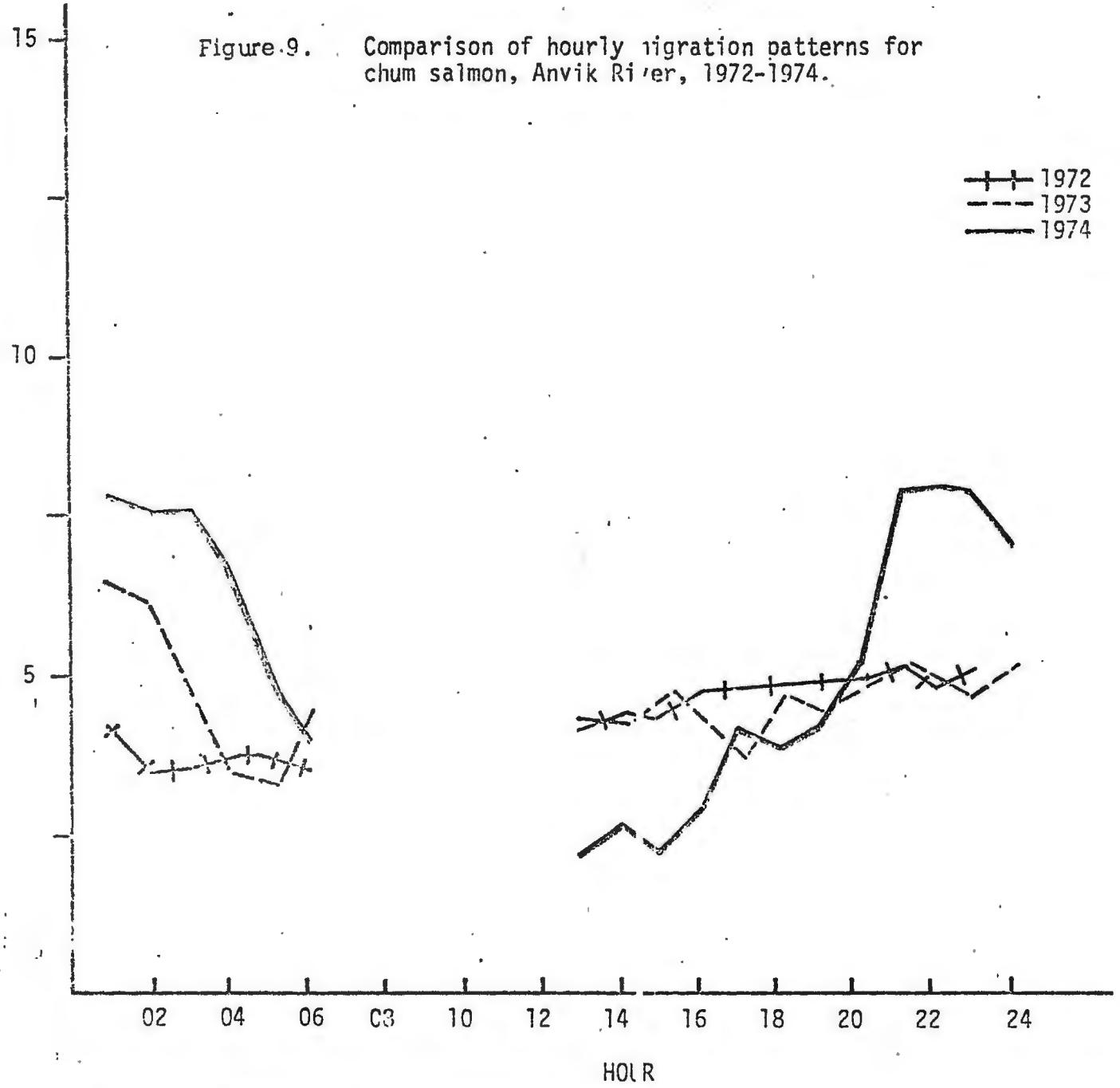


Figure 8. Comparison of hourly migration patterns for king salmon, Anvik River, 1972-1974.



1/ Based on expanded 18 hour percent.

Figure 9. Comparison of hourly migration patterns for chum salmon, Anvik River, 1972-1974.



1/ Based on expanded 18 hour percent.

Table 4. Age, sex and size composition of summer chum salmon, carcass sample, Anvik River, 1974.

	Age Class 1/				
	3_1	4_1	5_1	6_1	Totals
Males					
Number	12	197	34	2	245
Percent	3.0	49.0	8.5	.5	61.0
Mean length (mm) 2/	520	590	605	570	585
Females					
Number	24	120	12	1	157
Percent	6.0	29.9	3.0	.1	39.0
Mean length (mm)	515	545	560	580	540
Combined sexes					
Number	36	317	46	3	402
Percent	9.0	78.9	11.5	.6	100.0
Mean length (mm)	515	570	590	575	570

1/ Gilbert-Rich Formula - Total years of life at maturity (large type) - year of life at outmigration from freshwater (subscript).

2/ All lengths mideye to fork of tail measurement.

Table 5. Comparative sex composition of chum salmon carcass sample by date, Anvik River, 1974.

Date of survey	Males		Females	
	No.	Percent	No.	Percent
July 11	74	27	16	9
July 12	82	30	24	14
July 18	65	24	35	20
July 25	51	19	99	57
Total	272	100	174	100

Table 6. Post-spawning condition of summer chum salmon, Anvik River, 1974.

Sex	Spawned out	Partially spent	Did not spawn	Total	Average no. of eggs retained per female
Males	165 (61%)	91 (33%)	16 (6%)	272 (100%)	-
Females	140 (81%)	30 (17%)	3 (2%)	173 (100%)	46
Totals	305 (69%)	121 (27%)	19 (4%)	445 (100%)	-

The decision to reduce the daily counting period to 18 hours was partially based on data from other studies which indicate that the hourly chum and king migration pattern did not change significantly from year to year (Hurd, 1970). Based on 24-hour counts made in 1973, it was estimated that 27 percent of the kings and 19 percent of the chums passed the tower site during the time period 0700 to 1300. Limited data available from 1972 indicated that 21 percent of chum and 25 percent of king migration occurred during this time period.

In Figures 8 and 9 hourly migration patterns for the same 18-hour period during 1972, 1973 and 1974 are shown for king and chum salmon respectively. Slight variations between seasonal migration patterns can be noted.

The seasonal chum salmon migration pattern in 1974 was similar to that of 1973 which peaked during July 3-12. The seasonal migration pattern for king salmon could not be adequately determined due to early termination of counts. In 1973 the king salmon migration peaked during July 17-23.

Age composition of both 1973 and 1974 carcass samples were similar and dominated by the 4_1 age class; 77 percent in 1973 and 79 percent in 1974. The 1974 sample was composed of 61 percent males compared to 34 percent males in 1973 (Appendix Table 8). The average size of chum salmon sampled in 1974 was 570 mm and 550 mm in 1973.

The fact that male chum carcasses predominated in the early surveys and the females in the latter surveys may be significant since it indicates that in order to obtain an unbiased sex composition from carcasses, it may be necessary to sample during the entire post-spawning dieoff. It is recommended that this be investigated further in 1975.

Since the project was initiated in 1972, very few king salmon carcasses have been sampled and virtually no data has been obtained on the age, sex, and size composition of the Anvik run. The primary problem has been that Anvik River king salmon carcasses are not available in any numbers until the first week in August. Funding limitations have made it necessary to terminate the project before that date. As this information is important in the scientific management of the commercial fishery, it is recommended that a sampling crew be sent in to sample king salmon carcasses after August 1, in 1975.

Due to the lack of comparative data from a known age and total length sample, no age analysis was made of the estimated size (total length) of king salmon passing the Anvik tower in 1974. In 1974 22.3 percent of the king salmon observed were in the >80 cm size range, compared to 62.6 percent in 1973 (Appendix Table 9). This indicates that the portion of the 1974 run which was observed was composed of smaller, and possibly younger salmon than in 1973.

In 1974, heavy rainfall and rising water levels forced termination of the project on July 19 when it washed out the weir and threatened the counting tower. Since the high water coincided with the peak of chum spawning, it is also possible that it may have had a detrimental effect on spawning success.

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 (Figure 3). In 1972 and 1973 studies were conducted to determine the abundance and distribution of these stocks in this river. In 1974 these studies were continued and expanded to provide information on aspects of king and chum salmon life history which had not been investigated in the previous 2 years.

The objectives of the 1974 studies were: (1) Determine king and summer chum salmon abundance and distribution, (2) determine the age, sex, and size composition of the king and summer chum salmon escapement, (3) determine if there is a difference in the timing of the post-spawning dieoff between male and female salmon, (4) determine the distribution of king salmon fry in the Salcha River tributaries, (5) determine the physical and limnological characteristics of the Salcha River drainage and (6) locate major open water areas during winter months.

The Salcha River studies are especially timely and important since plans have been finalized to build the trans-Alaska hot-oil pipeline across the Salcha and two of its tributaries, Redmond and McCoy creeks, in the fall of 1975. In 1974 tentative plans were also announced to build a natural gas pipeline which would eventually cross the Salcha. Because the salmon stocks could be damaged by pipeline construction activities or by breaks in the pipeline, accurate information on salmon abundance and distribution will have to be available for possible mitigation and rehabilitation.

Methods and Materials

Helicourier aircraft were used to make aerial observations. The surveys covered the area between the river's mouth and the North Fork.

Periodic carcass sampling and enumeration surveys were conducted between August 6 and 22. A 24-foot jet outboard-powered riverboat was used

to survey the 73 river miles between the river's mouth and No Grub Creek where most of the spawning occurred.

Daily carcass surveys of the main river were conducted. All available king salmon carcasses and a portion of the chum salmon carcasses were sampled. A scale smear for age determination was taken from each carcass sampled and the length from mideye to fork of tail recorded. Spawning success was judged by examining the gonads of carcasses. The locations of all carcasses recovered were recorded by sampling area. All carcasses were thrown into the bank vegetation to avoid resampling.

Foot and boat surveys were made of the lower 1-1/2 miles of all the major tributaries of the Salcha. Minnow traps, 445 mm x 230 mm x 6 mm mesh, were baited with salmon eggs and placed in all of the tributaries (with the exception of Caribou Creek) to determine if king salmon fry and other species were present. Data on electro-fishing catches in the same streams was provided by the Sport Fish Division of the Alaska Department of Fish and Game.

Stream flow measurements were taken, and water chemistry was determined with a Hach AL 36-B Water Ecology Kit.

Results

Table 7 summarizes information regarding the abundance and distribution of live fish, carcasses and spawning redds for king salmon. Table 8 summarizes this same information for chum salmon except that redd counts were not made. Peak live fish counts of 1,857 kings (aerial survey) and 8,040 chums (boat survey) were obtained. The majority of king salmon redds observed during boat surveys were found in the main river between Redmond and Caribou creeks (Figure 10). Based on live fish counts made during boat surveys, the majority of chum salmon spawned between Redmond and Caribou creeks (Figure 11).

Based on 208 carcass samples, the king salmon escapement was composed of 75 percent males. Age classes 3_2 through 7_2 were represented with age class 4_2 fish comprising 44 percent of the sample (Table 9). Eighty-two percent of the male and all of the female king salmon carcasses examined were partially or completely spent (Table 10). An average of 26 eggs was retained per female. Neither male nor female kings predominated in any portion of the carcass surveys (Table 11).

Based on 480 carcass samples, the summer chum salmon escapement was composed of 53 percent females. Age classes 3_1 to 6_1 were represented with age class 4_1 comprising 77 percent of the sample (Table 12). Seventy-eight percent of the male and 96 percent of the female carcasses examined were

Table 7. King salmon abundance and distribution, Salcha River, 1974.

Area 1/	Aerial Survey (7/29) number	Aerial Survey (7/29) percent	Carcass Survey (8/8-8/18) number	Carcass Survey (8/8-8/18) percent	Boat Survey (8/8-8/18) number of redds	Boat Survey (8/8-8/18) percent
50	207	11.0	16	7.0	9	4.0
100	53	3.0	18	8.0	7	3.0
150	148	8.0	62	26.0	30	14.0
200	321	17.0	39	17.0	63	27.0
300	297	16.0	35	14.0	51	22.0
400	518	28.0	45	21.0	63	27.0
500	313 2/	17.0	17	7.0	8	3.0
Totals	1,857	100.0	232	100.0	231	100.0

1/ 50 - river mouth to pipeline crossing
100 - pipeline to mouth of Redmond Creek
150 - Redmond Creek to mouth of McCoy Creek
200 - mouth of McCoy 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 Caribou Creek

2/ Includes 30 kings enumerated above Caribou Creek.

Table 8. Chum salmon abundance and distribution, Salcha River, 1974.

Area 1/	Aerial Survey (7/29) number of live fish	percent	Carcass Survey (8/8-8/18): number of carcasses	percent	Boat Survey (8/8-8/18) number of live fish	percent
50	1,190	34.0	1	.2	200	2.0
100	365	10.0	6	1.1	-	-
150	600	17.0	162	30.0	325	4.0
200	352	10.0	43	7.9	2,115	26.0
300	275	8.0	63	11.7	1,700	22.0
400	624	18.0	205	38.0	1,200	15.0
500	104 2/	3.0	60	11.1	2,500	31.0
Totals	3,510	100.0	540	100.0	8,040	100.0

1/ 50 - river mouth to pipeline crossing
100 - pipeline to mouth of Redmond Creek
150 - mouth of Redmond Creek to mouth of McCoy Creek
200 - mouth of McCoy 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 Caribou Creek

2/ Includes 4 chums enumerated above Caribou Creek.

Figure 10. Numbers and distribution of king salmon spawning redds, Salcha River, 1974.

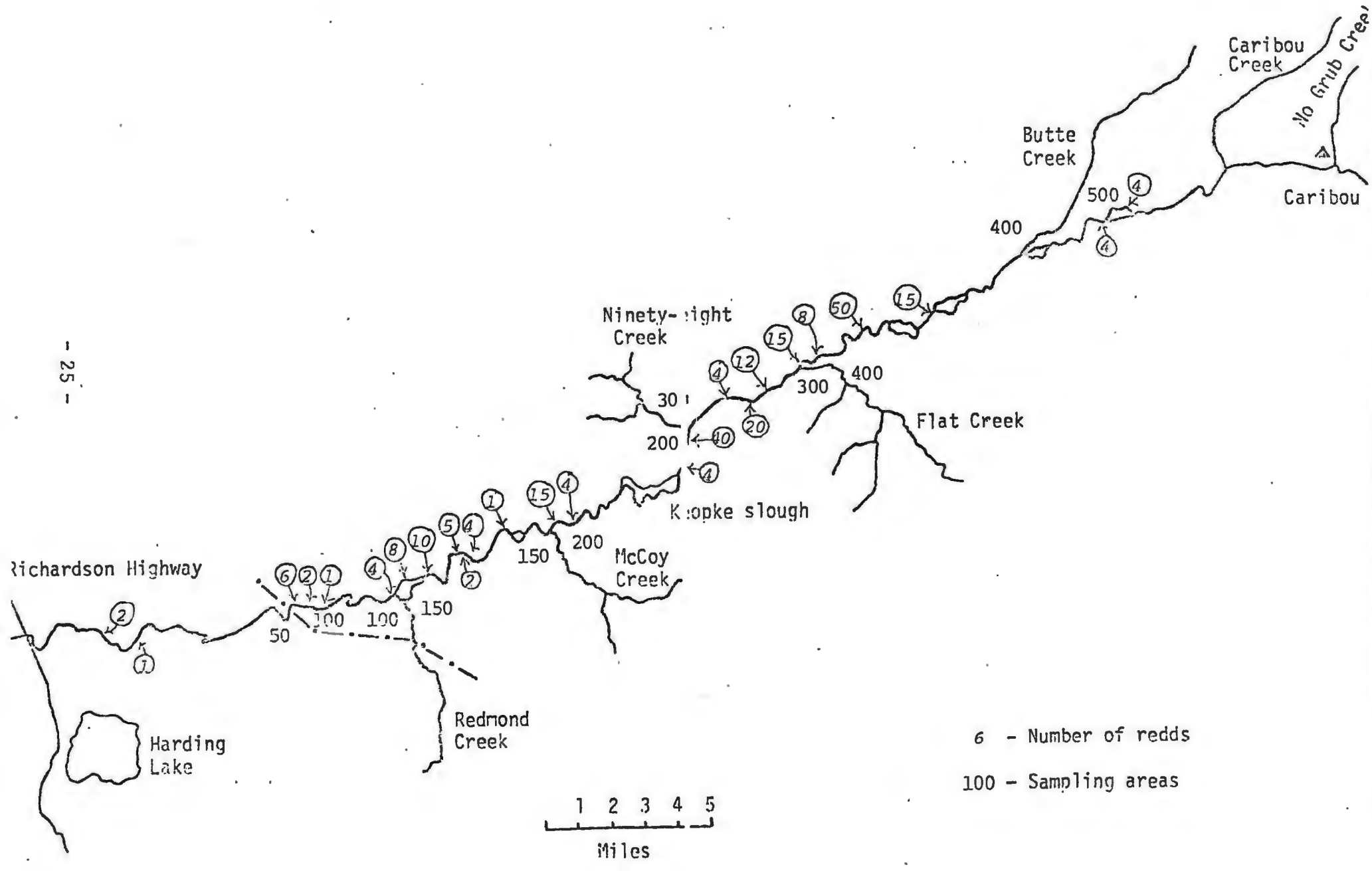


Figure 11. Numbers and distribution of spawning chum salmon, Salcha River, 1974.

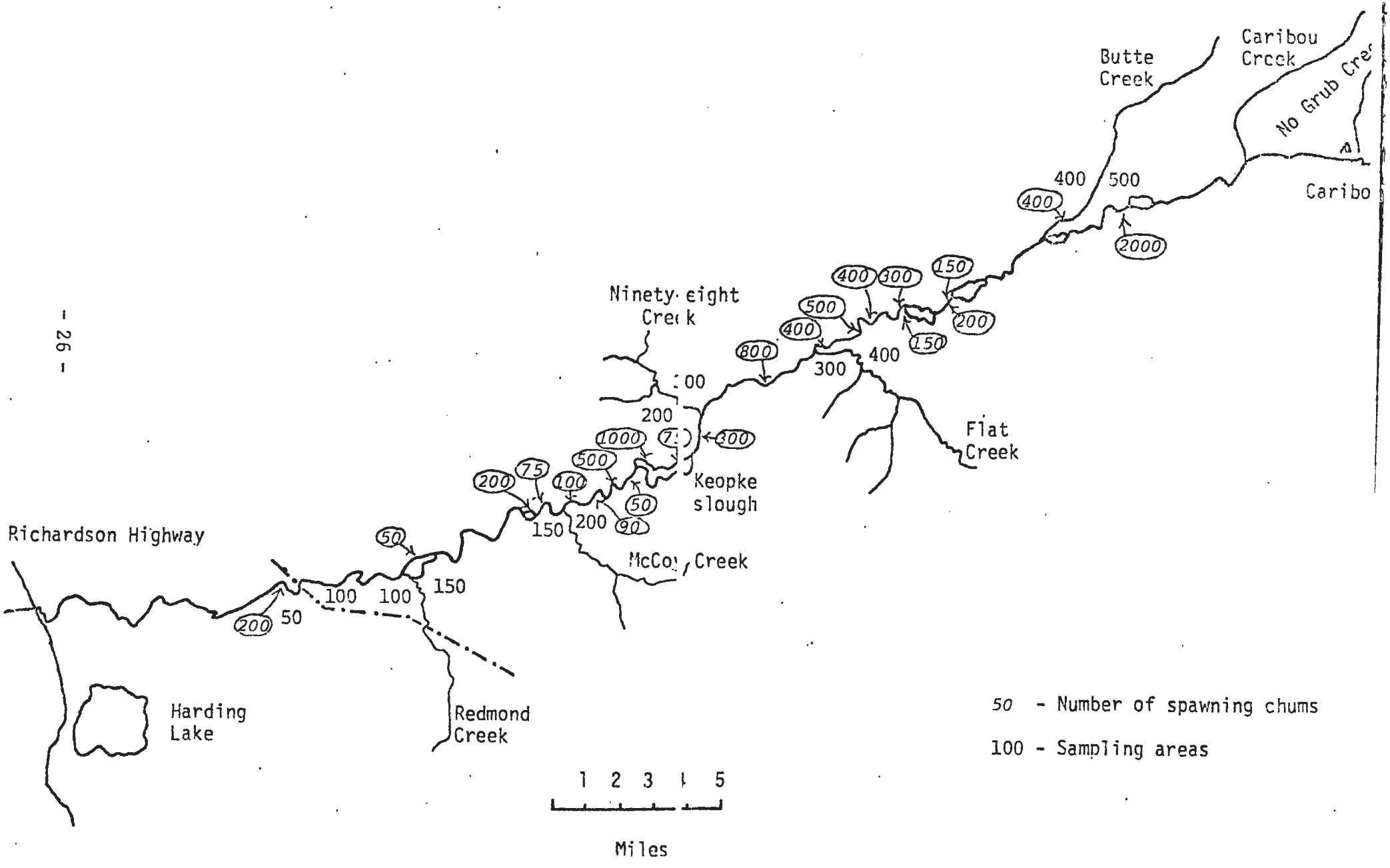


Table 9. Age, sex, and size composition of king salmon carcass sample, Salcha River, 1974.

	Age Class					
	3_2	4_2	5_2	6_2	7_2	Total
Males						
Number	2	91	21	39	4	157
Percent	1.0	44.0	10.0	18.0	2.0	75.0
Mean length (mm) 1/	370	570	690	880	940	760
Females						
Number	-	-	3	47	1	51
Percent	-	-	1.0	23.0	1.0	25.0
Mean length (mm)	-	-	840	870	880	870
Combined						
Number	2	91	24	86	5	208
Percent	1.0	44.0	11.0	41.0	3.0	100.0
Mean length (mm)	370	570	710	870	930	780

1/ All lengths from mideye to fork of tail.

Table 10. Post-spawning condition of king salmon carcasses, Salcha River, 1974.

Sex	Spawned out	Partially spent	Did not spawn	Total	Average no. of eggs retained per female
Males	87 (62%)	29 (20%)	26 (18%)	142 (100%)	-
Females	28 (70%)	12 (30%)	- -	40 (100%)	26
Totals	115 (63%)	41 (23%)	26 (14%)	182 (100%)	-

Table 11. Comparative sex composition of king salmon carcass sample by 3-day period, Salcha River, 1974 1/.

Date	Males		Females	
	No.	Percent	No.	Percent
8/8 - 8/10	86	48	26	48
8/11 - 8/13	63	36	20	37
8/14 - 8/16	21	12	3	6
8/17 - 8/18	8	4	5	9
Total	178	100	54	100

1/ Survey started several days after post-spawning dieoff began.

Table 12. Age, sex and size composition of summer chum salmon carcass sample, Salcha River, 1974.

	Age Class				
	3_1	4_1	5_1	6_1	Totals
Males					
Number	18	171	32	2	223
Percent	4.0	35.6	7.0	0.4	47
Mean Length (mm) 1/	560	580	590	630	580
Females					
Number	18	203	35	1	257
Percent	4.0	41.8	7.0	0.2	53
Mean Length (mm)	540	550	570	610	550
Combined					
Number	36	374	67	3	480
Percent	8.0	77.4	14.0	0.6	100
Mean Length (mm)	550	560	580	620	560

1/ All lengths from mideye to fork of tail.

partially or completely spent (Table 13). An average of 117 eggs was retained per female. Male chums predominated in the carcass surveys from August 8-13 and females from August 14-18 (Table 14).

Stream flows and water chemistry for six major tributaries and the main Salcha River are presented in Appendix Table 10.

A March 15 aerial survey was made to locate open water areas which are indicative of the presence of ground water. The only ice free areas were observed at Keopke Slough and at the mouth of Butte Creek (Figure 10).

Discussion

The July 29 king salmon aerial survey estimate is the third highest count on record for this river (Appendix Table 2). The chum aerial count, made before the peak of spawning, was quite low. The boat survey estimate of 8,040 spawning chums is the greatest ever recorded for the Salcha (Appendix Table 3).

Aerial, boat and carcass surveys produced widely varying estimates of chum and king salmon spawning distributions in the Salcha. Carcass surveys are not a good index of spawning distribution because of the tendency of dying salmon to drift long distances before hanging up on a sandbar. Changes in water level also affect carcass distribution.

The July 29 aerial survey was probably the best indicator of king salmon spawning distribution. Boat surveys started after the peak of spawning when many spawners had already died. Aerial survey counts indicated that 11 percent of the king salmon spawners were located downstream of the main river pipeline crossing and 22 percent downstream of McCoy Creek (Figure 10). Aerial survey counts in 1973 indicated that 8 percent of the spawning kings were downstream of the main river pipeline crossing and 32 percent downstream of McCoy Creek (Trasky, 1973).

The boat surveys were the best indicator of the 1974 chum salmon distribution since the aerial surveys were flown at least 2 weeks before the peak of chum spawning. Two percent of the spawning chum salmon were observed during boat surveys downstream of the main river pipeline crossing and 6 percent downstream of McCoy Creek. In 1973 these figures were 10 percent and 20 percent for the respective locations. Approximately the same number of chums utilized the spawning areas below McCoy Creek in both years, but greater numbers of chums and hence a greater percentage of the total spawning population utilized the upriver spawning areas in 1974.

The age and sex composition of the king salmon carcass sample was unusual since it was composed of 75 percent males and 44 percent 4_2 age class

Table 13. Post-spawning condition of chum salmon carcasses, Salcha River, 1974.

Sex	Spawned out	Partially spent	Did not spawn	Total	Average no. of eggs retained per female
Males	122 (50%)	69 (28%)	55 (22%)	246 (100%)	-
Females	236 (87%)	23 (9%)	10 (4%)	269 (100%)	117
Totals	358 (70%)	92 (17%)	65 (13%)	515 (100%)	-

Table 14. Comparative sex composition of summer chum salmon carcass sample by 3-day period, Salcha River, 1974.

	Males		Females	
Date	Number	Percent	Number	Percent
8/8 - 8/10	64	14	41	8
8/11 - 8/13	229	51	240	47
8/14 - 8/16	131	28	181	36
8/17 - 8/18	32	7	49	9
Total	456	100	511	100

fish. The age and sex composition of the Salcha sample differed from the Emmonak commercial catch sample which was composed of only 0.5 percent 4_2 age class fish (68.5% were 6_2's) and 54.5 percent males (Appendix Table 11). The reason for the high proportion of 4_2 Salcha River kings is not completely understood but was probably influenced by selectivity of the commercial gill net fishery for larger fish. Also the high percentage of this age group may indicate good survival or early maturity of the 1970 year class.

Carcass survey data did not show any significant difference in the rate of king salmon post-spawning dieoff by sex. The data may not be indicative of what actually happened, however, since carcasses had accumulated for several days before the surveys started. In 1972 female kings predominated in the early carcass surveys (Lebida, 1972).

The age, sex and size composition of the chum salmon carcass sample was essentially the same as the Emmonak commercial catch sample, the Anvik carcass sample, and the 1973 carcass sample (Appendix Table 12). For early carcass surveys, male chums were slightly more numerous than females. This would seem to indicate that males begin to die off sooner than the females. The data available is not conclusive since the surveys covered 73 miles and the spawning areas could not be sampled each day. To accurately assess post-spawning dieoff an index area should be established and sampled each day over the entire post-spawning dieoff.

In 1973 king salmon fry were captured with a dip net in Redmond, Flat, Ninety-Eight, and McCoy creeks. Although minnow traps were set in the aforementioned streams in 1974, the only fry catches made were in McCoy and Ninety-Eight creeks. Minnow traps may not be an effective method of determining fry distribution and abundance. The minnow trap in Butte Creek did not capture fry, but several fry were captured in the area of the trap with an electroshocker.

All of the tributary streams surveyed, with the exception of McCoy and Caribou creeks, were blocked by beaver dams within 1 mile of their confluence with the Salcha. Limited observations indicated that these dams may act as barriers to migrating fish. On Flat Creek approximately 500 chum spawners were kept from reaching upstream spawning areas by a beaver dam. Salmon fry were not observed or captured in locations upstream from these dams. Whitefish and grayling were observed moving upstream after a portion of a dam on Ninety-Eight Creek was removed.

WHITEHORSE FISHWAY KING SALMON ESCAPEMENT STUDIES

Introduction

The Whitehorse dam fishway is located on the Yukon River, 1,745 river miles upstream from the mouth (Figure 4). It is just outside the city of Whitehorse and is one of the farthest upstream king salmon escapement monitoring sites 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 1970-71 and 1973-74. 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 facility is a weir and pool-type fishway. It is a trough-like timber structure with baffles to create a series of elevated pools which the fish must negotiate to reach the impoundment above the dam. About two-thirds of the way upstream a holding pool with a gate and viewing window are built into the fishway. Salmon are counted and sampled at this point 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 (mid-eye to fork of tail) measured, and a scale sample removed for age determination. The sex of all the king salmon in the sample 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

Two-hundred and seventy-three king salmon were enumerated at the Whitehorse fishway in 1974. These fish were composed of 168 males (62 per-

cent) and 105 females (38 percent). Annual cumulative counts for 1965-1974 are shown in Appendix Table 13.

Ninety-one king salmon were sampled for age, sex and size. Eighty-six of the scale samples were legible. Age classes 4_2 through 7_2 were represented with age class 6_2 comprising 55 percent of the sample (Table 15). This sample was 60% male. Comparative data on the age and sex composition of the Whitehorse run since 1970 is presented in Appendix Table 14.

Thirty-seven (41 percent) of the kings sampled had injuries from lampreys or predators, but none showed evidence of net marks.

Discussion

In 1974, the escapement of 273 king salmon through the fishway was the second lowest on record and was far below the 16-year annual average of 652. An examination of the annual escapement counts since 1959 indicates that the Whitehorse run has experienced a gradual decline. Possible reasons for the decline are discussed in detail in the 1973 Yukon River Anadromous Fish Investigations Report (Trasky, 1973).

The 1974 Whitehorse escapement sample was composed of a greater percentage of 4_2 and 5_2 age class kings than the commercial catch sample from Emmonak (Appendix Table 11). This has been characteristic of the age structure of the Whitehorse escapement since 1970. Two possible explanations for this are: (1) the age and sex composition of downstream catch samples from 8-1/2 inch gill nets is not completely representative of the actual age and sex composition of the king salmon run as the fishery is selective for the larger 6_2 and 7_2 age class kings; (2) in some years large numbers of king salmon mature early (lower River approximately 80% age 6_2 and 7_2) and join the spawning run in the 4th or 5th year of life, a high percentage of these may be upper Yukon stocks.

In 1970 and also in 1972-1974, the Whitehorse escapement samples were composed of a greater percentage of 5_2 and 6_2 age class kings and a smaller percentage of 4_2 age class king than the Salcha River sample (Appendix Table 11). A plausible reason for this difference may be inherent genetic differences in the stocks involved.

Table 15. Age, sex and size composition of king salmon escapement sample, Whitehorse, 1974.

	Age group					Total
	3_2	4_2	5_2	6_2	7_2	
Males						
Number	-	12	19	19	2	52
Percent	-	14.0	22.0	22.0	2.0	60.0
Mean length (mm) 1/	-	600	670	790	910	710
Females						
Number	-	-	3	28	3	34
Percent	-	-	4.0	33.0	3.0	40.0
Mean length	-	-	790	800	930	810
Combined						
Number	-	12	22	47	5	86
Percent	-	14.0	26.0	55.0	5.0	100.0
Mean length	-	600	700	800	920	750

1/ All lengths mid-eye to fork of tail.

UPPER YUKON DRAINAGE FALL CHUM STUDIES

Introduction

Fall chum salmon are unique stocks of chum salmon which are distinguished from summer chum by: (1) later river entry and spawning dates; (2) utilization of upriver spawning areas and (3) larger size. All of the known fall chum spawning areas in the Yukon drainage are located upstream of the mouth of the Tanana River (Figure 3). In most instances fall spawning areas are believed to be affected by upwelling ground water, generally maintaining winter water temperatures above 34° F.

In 1974 over 305,000 fall chums were taken in the Yukon drainage by commercial and subsistence fishermen. Although fall chums have comprised 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 and 1973 several important spawning areas were located in which the numbers of spawning fall chums were estimated. An intensive study was begun in 1973 on the Delta River fall chum population which provided information on life history and physical characteristics of the spawning area. In 1974 aerial survey coverage was extended to all known and suspected spawning areas and the Delta River studies were continued. The objectives of the 1974 studies were:

(1) Determine the distribution, abundance, and timing of fall chum salmon populations in the upper Yukon drainage.

(2) Compare various methods of estimating the size of the Delta River fall chum salmon spawning population.

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

(4) Determine the age, sex and size composition of the Delta, Tanana, Sheenjek, and Toklat River fall chum populations.

(5) Determine if there is a difference in timing of post-spawning dieoff between male and female fall chums.

The Delta River drains the Alaska Range and empties into the Tanana River just downstream from the Richardson Highway bridge. The Delta River during the summer is a typical glacial stream with silt-laden water and braided channels. During freeze-up, the surface waters gradually diminish, eventually

cease, and ground water seepage forms the spawning area under study which is located in the lower mile of the floodplain (Figure 12). During the last 2 years, spawning occurred in three major channels which consist of a series of large, clear shallow pools separated by riffles during October to early May. These characteristics make it very easy to capture and observe spawning salmon. The shallow riffles keep dead and dying salmon from drifting out of the study area.

Methods and Materials

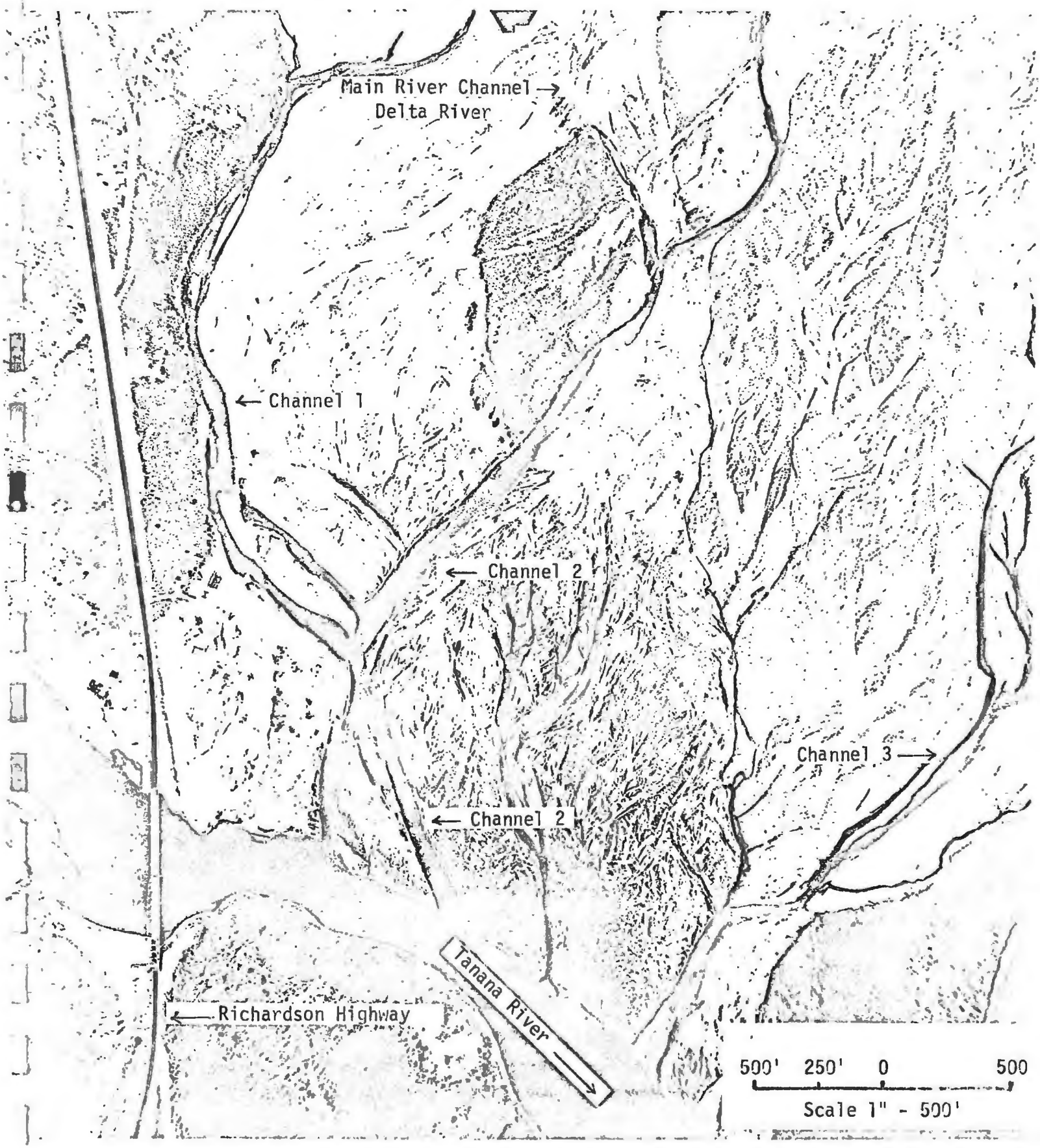
Fall chum salmon were captured approximately 200 feet inside the mouth of the Delta River with a 150 foot x 4 foot x 2 inch mesh beach seine. The fish were held in the seine while the length from mid-eye to fork of tail was measured, sex determined, and tags applied. Only silvery, healthy fish which 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 each of the tagged fish for use in the later determination of the age composition of the spawning population. Tagged salmon were held for a few minutes after tagging to insure they had not been injured before release. No tag rewards were paid for these fish.

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

A sample of unspawned female chums was killed, weighed, a scale smear taken, and the length from mid-eye to fork of tail determined. The ovaries were removed and preserved in a 30 percent formaldehyde solution for laboratory examination at a later date. Fecundity was determined volumetrically.

On October 29 and 31, near the peak of spawning, two aerial survey estimates were made of the Delta River spawning population. A heliocourier STOL aircraft was used with a different observer for each survey. Two biologists made estimates of the spawning population on foot surveys of the Delta spawning area on November 1. On November 1 aerial photographs of the entire spawning area were taken with a Kargl camera with a 12-inch focal length. The camera was mounted in a Cessna 180 aircraft which was flown at 80 mph and an altitude of 600 feet. Kodiak double x estar base film was used. A series of

Figure 12. Delta River fall chum salmon spawning area, November 1, 1974.



negatives, with a 10 percent end lap and a 9 inch x 9 inch frame size, were produced for each spawning channel. The scale for the negatives was 1 inch equaling 50 feet. The negatives were placed on a light table and examined for the presence of salmon. Counts were made of the number of chums in each spawning channel.

During tag and recovery operations on the Delta River, water temperatures and climatological data were recorded daily and limnological data periodically. Ryan thermographs were used to obtain continuous temperature records in all three channels of the Delta River during the study period.

Aerial surveys were made of other known and suspected fall chum spawning areas in the Alaskan portion of the Upper Yukon drainage. A helio-courier aircraft was used to fly most surveys. A helicopter was used to fly a survey of the Tanana River in the area of the Trans-Alaska pipeline crossing. Additional escapement information was received from the Sport Fish Division of the Alaska Department of Fish and Game and the Environment-Canada Fisheries Service. Carcass samples were also taken from fall chum salmon spawning areas on the Tanana, Toklat, and Sheenjek rivers to provide comparative data on age, sex, and size composition.

Results

Fall chum salmon began entering the Delta River on October 8 and small numbers of live fish were still present on November 17 when the study was terminated.

A total of 403 fall chums was tagged between October 11 and 28 (Appendix Table 15). A total of 2,256 carcasses was recovered from the spawning channels and examined for tags (Appendix Table 16). A total of 151 tags was recovered from carcasses by the survey crew (Table 16). In addition, eight tags were either recovered from fishermen or were found loose in the spawn-area (tag loss, fish killed by predators). These tags and fish were not included in the stream life estimates but were utilized in the population estimate.

Of the 403 chums tagged, 65 were tagged in channel 1, 274 in channel 2, and 64 in channel 3. A substantial portion of the chums tagged were not recovered as carcasses in the channel where they were tagged. Recoveries made in the other two channels were 17, 6 and 33 percent for fish tagged in channels 1, 2 and 3 respectively (Table 16).

Based on daily tag recoveries from carcasses, the average stream life was 19, 17, and 19 days respectively for channels 1, 2, and 3. The average

Table 16. Fall chum salmon tagged and recovered in each Delta River channel, 1974.

Tags applied		Recoveries 1/							
		Channel 1		Channel 2		Channel 3		Total recovered	
	No.	No.	Percent	No.	Percent	No.	Percent	No.	Percent
Channel 1	65	24	83.0	5	17.0	-	-	29	100.0
Channel 2	274	6	6.0	95	94.0	-	-	101	100.0
Channel 3	64	3	14.0	4	19.0	14	67.0	21	100.0
Totals	403	33	22.0	104	69.0	14	9.0	151	100.0

1/ Does not include 3 predator-killed chums, 1 broken tag, and 4 tags turned in by fishermen.

stream life for all three channels was 18 days. Male chums had an average stream life of 15 days and females 21 days in 1974 (Table 17).

The seven hundred sixty chums from the combined Delta River channels were examined for age, sex and size. Age classes 3_1 to 5_1 were represented with age class 3_1 comprising 54 percent of the sample (Table 18). Male chum composed 63 percent of the above sample. Male chums composed 51 percent of the 2,256 carcasses examined for sex only (Appendix Table 16). The average length was 580 mm for males and 570 mm for females.

Based on gonad examinations of 496 carcasses, 96 percent of the male and 95 percent of the female chums were partially or completely spent (Table 19). An average of 139 eggs was retained per female. Male carcasses predominated in the daily carcass surveys from October 13-November 18 and females from November 9-17 (Figure 13).

The fecundity sample was composed of 18 female chums with an average weight of 2.2 kg and an average length of 560 mm. Age classes 3_1 and 4_1 were represented with age class 3_1 fish composing 72 percent of the sample. The mean fecundity was 1,886 eggs per female (Table 20).

Various estimates of the spawning population magnitude are presented in Table 21. A Peterson population estimate of 5,718 was obtained. Peak counts resulting from aerial surveys, foot surveys and examination of aerial photographs ranged from 1,906 (foot survey) to 4,010 (aerial survey). A total of 2,256 carcasses were collected through November 17.

Climatological and limnological data for the Delta River is presented in Appendix Tables 17 and 18.

The age, sex and size composition of the Delta River tagging sample and the Delta, Tanana, Toklat and Sheenjek River carcass samples is presented in Appendix Table 19.

The results of all the aerial surveys of the upper Yukon drainage are presented in Appendix Table 20. Large spawning concentrations of fall chums were located in the Sheenjek and Chandalar rivers.

Discussion

In 1973 and 1974 chum salmon entered channel 2 approximately 10-13 days later than the other two channels. This delay was apparently due to the colder surface water runoff still present in this channel in early October (Trasky, 1973).

Table 17. Stream life by channel, Delta River, 1974.

Stream life days 1/	Channel 1.			Channel 2			Channel 3			Combined		
	males	females	comb.	males	females	comb.	males	females	comb.	males	females	comb
2	-	-	-	1	-	1	1	1	2	2	1	3
3	-	-	-	-	-	-	-	-	-	-	-	-
4	-	-	-	2	-	2	-	-	-	2	-	2
5	1	1	2	-	-	-	-	-	-	1	1	2
6	-	-	-	1	-	1	-	-	-	1	-	1
7	-	-	-	-	1	1	-	-	-	-	1	1
8	-	-	-	1	-	1	1	-	1	2	-	2
9	-	-	-	-	-	-	-	-	-	-	-	-
10	1	-	1	4	-	4	1	1	2	6	1	7
11	-	-	-	8	2	10	-	-	-	8	2	10
12	-	-	-	6	-	6	1	-	1	7	-	7
13	-	2	2	6	2	8	1	-	1	7	4	11
14	-	-	-	2	1	3	-	-	-	2	1	3
15	1	-	1	7	3	10	-	-	-	8	3	11
16	1	-	1	5	3	8	-	-	-	6	3	9
17	3	1	4	4	4	8	1	-	1	8	5	13
18	3	-	3	6	8	14	-	-	-	9	8	17
19	-	1	1	4	5	9	1	1	2	5	7	12
20	2	1	3	3	3	6	-	-	-	5	4	9
21	-	2	2	3	2	5	-	1	1	3	5	8
22	-	3	3	2	-	2	2	-	2	4	3	7
23	-	1	1	1	-	1	-	1	1	1	2	3
24	-	1	1	-	-	-	-	1	1	-	2	2
25	-	-	-	-	-	-	-	-	-	-	-	-
26	1	3	4	1	-	1	-	1	1	2	4	6
27	-	-	-	-	-	-	1	-	1	1	-	1
28	-	-	-	-	-	-	-	1	1	-	1	1
29	-	-	-	-	-	-	-	1	1	-	1	1
30	-	-	-	-	-	-	-	1	1	-	1	1
31	-	-	-	-	-	-	-	-	-	-	-	-
32	-	-	-	-	-	-	-	-	-	-	-	-
33	-	-	-	-	-	-	-	1	1	-	1	-
34	-	-	-	-	-	-	-	-	-	-	-	-
35	-	-	-	-	-	-	-	-	-	-	-	-
36	-	-	-	-	-	-	-	-	-	-	-	-
37	-	-	-	-	-	-	-	-	-	-	-	-
Total Number	13	16	29	67	34	101	10	11	21	90	61	15
Average 2/ Stream life days	17	20	19	15	21	17	15	22	19	15	21	1

1/ stream life between date of tagging and date of recovery on carcass survey

2/ does not include 3 predator-killed chums, 1 broken tag, and 4 tags turned in by fishermen

Table 18. Age, sex and size composition of fall chum salmon, combined carcass tagging sample, Delta River, 1974.

	Age Class			Total
	3_1	4_1	5_1	
Males				
Number	277	189	11	477
Percent	37.0	25.0	1.0	63.0
Mean length (mm) 1/	560	600	630	580
Females				
Number	131	146	6	283
Percent	17.0	19.0	1.0	37.0
Mean length (mm)	560	590	610	570
Combined				
Number	408	335	17	760
Percent	54.0	44.0	2.0	100.0
Mean length (mm)	560	600	620	580

1/ All lengths mid-eye to fork of tail.

Table 19. Post spawning condition of fall chum salmon carcasses, Delta River, 1974.

	Spawned out	Partially spent	Did not spawn	Total	Average no. of eggs retained per female
Males	197 (62%)	107 (34%)	13 (4%)	317 (100%)	-
Females	151 (84%)	19 (11%)	9 (5%)	179 (100%)	139
Totals	348 (70%)	126 (25%)	22 (5%)	496 (100%)	-

Figure 13. Comparative sex composition of fall chum salmon carcass sample, by 3-day period, Delta River, 1974.

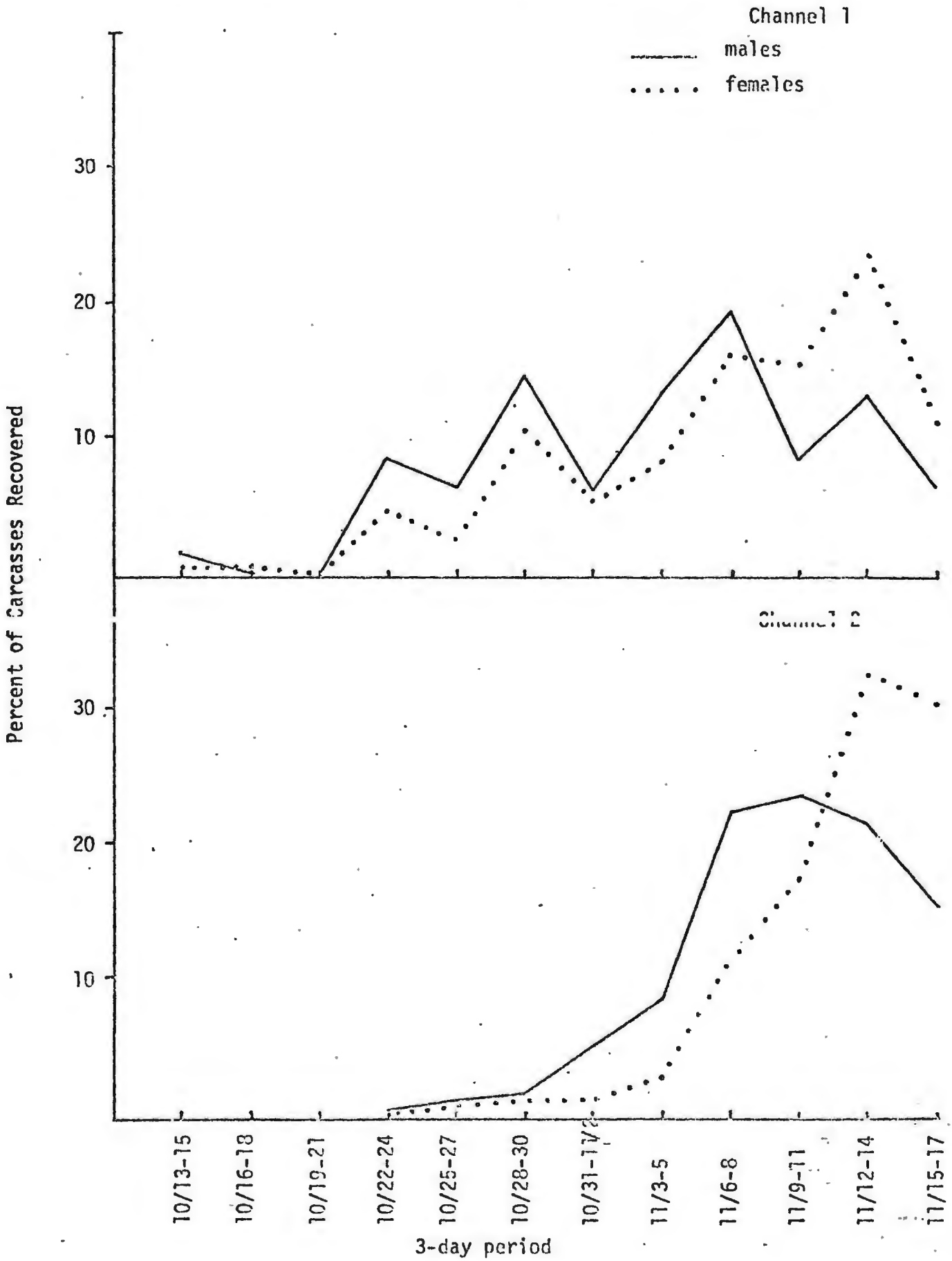


Table 20. Age, size and fecundity of Delta River fall chum salmon samples, 1974.

Sample no.	Age class	Length (mm)	Weight (Kg)	Fecundity (No. of eggs)
1	4_1	580	-	1,348
2	4_1	570	-	1,724
3	3_1	540	-	1,986
4	3_1	570	2.2	2,350
5	3_1	520	2.2	2,178
6	4_1	585	2.4	1,960
7	3_1	555	2.2	1,407
8	4_1	610	2.7	2,350
9	3_1	550	1.8	1,557
10	4_1	630	2.8	1,686
11	3_1	565	2.0	1,623
12	3_1	545	2.2	2,187
13	3_1	585	2.3	2,220
14	3_1	500	1.6	1,830
15	3_1	540	1.9	1,751
16	3_1	565	2.4	2,178
17	3_1	560	2.3	1,339
18	3_1	550	2.2	2,275
Average		560	2.2	1,886

Table 21. Comparative population estimates, Delta River, 1974.

Method	Date	Survey rating	Number of Fall Chums: Channel 1	Channel 2	Channel 3	Total
Aerial Photography	11/1	-	397	1,800	164	2,361
Aerial Surveys (1)	10/29	fair	545	2,550	122	3,217
(2)	10/31	fair	-	-	215	4,010
Foot Surveys (1)	11/1	-	389	1,455	91	1,935
(2)	11/1	-	450	1,235	221	1,906
Carcass Survey	11/17	-	595	1,590	71	2,256
Peterson Population Estimate	-	-	-	-	-	5,718

In 1973 and 1974 substantial numbers of salmon emigrated from the channel in which they were tagged into one of the other two channels. In both years channel 3, which was the smallest, had the greatest emigration and channel 2, which was the largest, the least. In addition to the fish that migrated between channels, several tagged salmon were observed during both years in a Tanana River spawning area 1/4 mile upstream from the mouth of the Delta River. The reasons for the observed emigration are not known but could be attributed to either tagging shock or normal homing behavior. Overcrowding can probably be eliminated as a factor in 1974 because of the relatively small number of spawners present in channels 1 and 3 which exhibited the greatest emigration.

Average stream life for tagged fish was 20 days in 1973 and 18 days in 1974. The average stream life of fish tagged in channel 2 was less than that for fish tagged in the other channels, probably due to the aforementioned delay in river entry. Males exhibited shorter stream lives than females by 1 and 5 days for 1973 and 1974 respectively. Female sockeye salmon have also been found to have longer stream lives than males (Foerster, 1968).

The several survey methods employed in 1974 produced widely varying estimates of population size. The accuracy of aerial survey counts is greatly influenced by the observer's ability to enumerate large numbers of both schooled and spawning fish in small areas during a short period of time. Foot survey accuracy is influenced by difficulties in counting milling fish in the wider and deeper portions of the channels (e.g. lower channel 2). The poor quality of some of the aerial photographs reduced the efficiency of this method. The peak aerial survey count of 4,010 made October 31 was substantially greater than the 2,361 count made from examination of aerial photographs taken November 1. The peak foot survey count made November 1 was 1,935.

These survey methods yield minimum estimates of the total spawning population since later arriving fish are not counted and spawned out carcasses, even if counted, are removed by predators at unknown rates. The Peterson tag-recovery estimate of 5,718 was substantially greater than any of the survey counts. However, this estimate was considered too high due to the emigration of an unknown number of tagged fish out of the study area.

Since carcass counts were made daily, the cumulative count should give a reasonably accurate estimate of the total spawning population. A total of 2,256 carcasses was counted through November 17. An estimated total of 600 live fish was present November 17 which accounts for a total of 2,856 fish. This number does not include possible removal of unknown numbers of fish and carcasses by predators and fishermen.

For purposes of this report and for use in subsequent spawning escapement comparisons, the 1974 Delta River spawning population is considered to be 3,300 fish. This figure is approximately midway between the range of all counts and is similar to the cumulative carcass and live fish count of November 17.

The 1974 Delta River carcass sample was dominated by the 3_1 age group which comprised 54 percent of the sample. The 1973 sample was comprised of 74 percent 4_1 age class chums. The 3_1 age group ranged from 45 to 73 percent fall chum samples from other locations in 1974 (Appendix Table 19). Reasons for changes in year class dominance between years is not known but may be related to faster growth and earlier maturity or unusually good brood year survival.

In 1973 and 1974 the Delta River escapement sample were composed of a greater percentage of 3_1 age class fish than either the Anvik or Salcha River summer chum samples. In 1973 and 1974 fall chums were larger than summer chums in the same age class with the exception of the 1973 summer chum 3_1 age class which were slightly larger than 3_1 fall chums for that year. In general, 1974 fall chums were as large as summer chums in the next older year class. Data from Japanese studies indicates that Asian fall chums were composed of a greater percentage of 3_1 age class fish than summer chums (Bakkala, 1971). Larger size is a characteristics used to distinguish fall chums from summer chums. Fall chums enter the Yukon River at least a month after the summer chums. Additional ocean growth coupled with genetic factors would account for the increase in size.

Male fall chum salmon dominated the early carcass samples whereas females dominated the later samples taken in the Delta River. This would indicate that it may be necessary to sample over the entire post-spawning dieoff to obtain an unbiased estimate of the sex composition of a spawning population. The same differential dieoff between male and female summer chums, was also observed in the Anvik River and Salcha River in 1974. The difference in post-spawning dieoff may account for the differences in sex composition between the Sheenjek and Toklat samples. The Sheenjek and Toklat samples were taken during a single day.

The average fecundity of the 1974 sample (1,886 eggs per female), was substantially less than the average fecundity (2,634 eggs per female) found in 1973 (Trasky, 1973). The 1974 females were smaller (560 mm) and weighed less (2.2 kg) than the 1973 females which averaged 589 mm in length and 2.9 kg in weight. Fecundity in chums has been found to increase with length and weight hence the smaller size of the 1974 fish could account for the decrease in fecundity (Bakkala, 1971).

In 1974 two major fall chum spawning areas were located in the Sheenjek and Chandalar rivers by aerial surveys. Smaller spawning areas were also located in the McKinley River, Nenana River, Salmon Fork of the Black River, Salmon Trout River, and Kevinjek Creek (Appendix Table 1). Escapement levels for 1974 in index streams were two to five times higher than 1973 levels in the lower Tanana drainage and slightly below 1973 levels in the upper Tanana (Appendix Table 20). All known fall chum spawning areas in the upper Yukon are shown in Figure 14.

Other potential fall chum spawning areas which should be investigated include the upper Tanana above the Gerstle River, the upper White River, the main Yukon above Fort Yukon, the upper Kantishna, the Koyukuk River drainage and the Anvik River.

The peak of spawning by drainage was essentially the same in 1973 and 1974. In the Porcupine and Chandalar River drainages the peak of spawning occurred during mid-September, in the lower Tanana, except for Moose Creek, the first week in October, and the upper Tanana and Moose Creek, the last of October.

Limnological and water temperature data from the Delta River exhibited essentially the same patterns in 1973 and 1974. Observations made during carcass surveys on the Tanana, Sheenjek and Toklat rivers indicated that these areas were also fed by upwelling spring water and are similar to the Delta River spawning area.

FLAT ISLAND TEST FISHERY PROGRAM

Introduction

A test fishing site has been maintained at Flat Island in the south mouth of Yukon River since 1963 (Figure 15). 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 for in-season management an in assessing the long-term effects of the commercial fishery on the king and summer chum salmon runs. There have been two primary objectives to this study:

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

Upper Yukon fall chum salmon spawning areas, 1974.

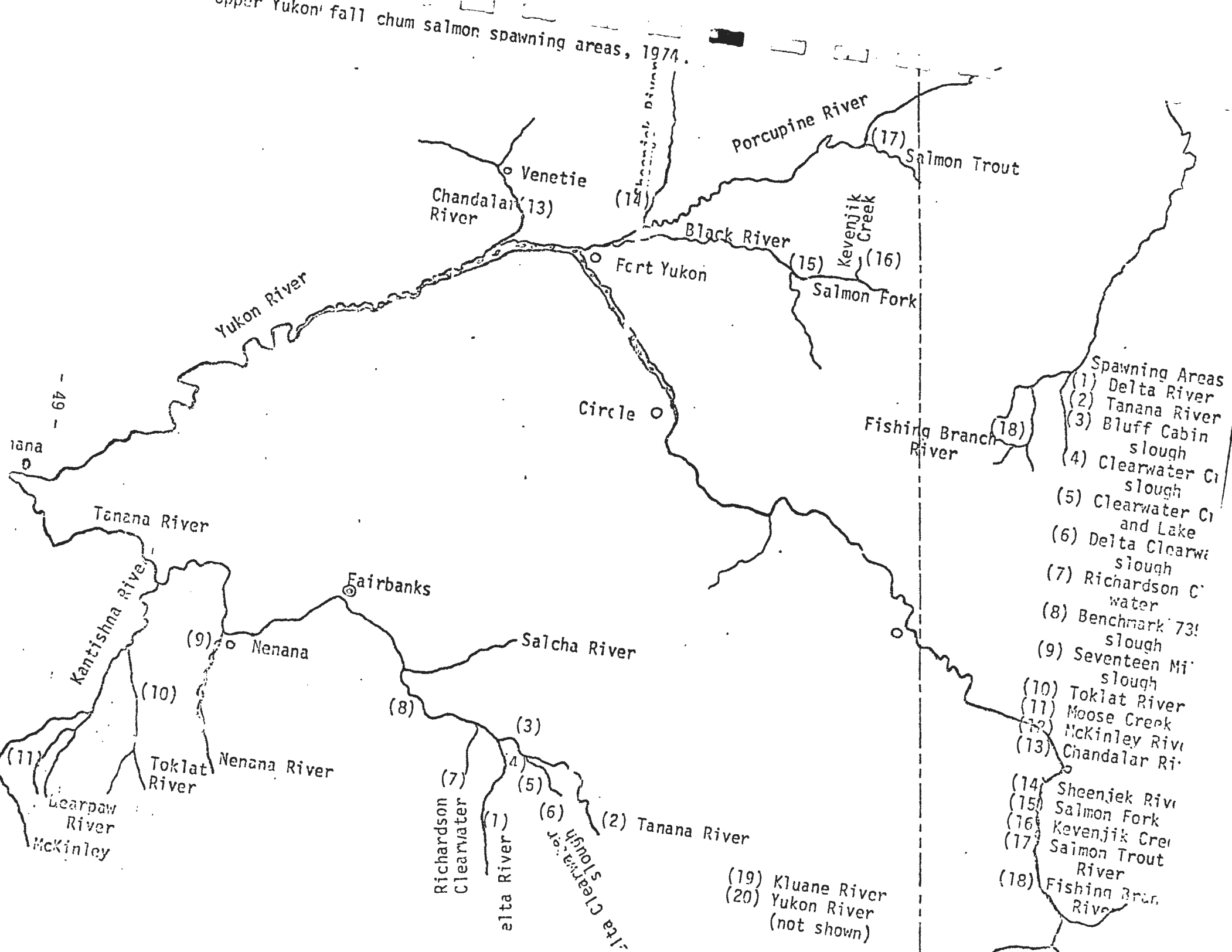
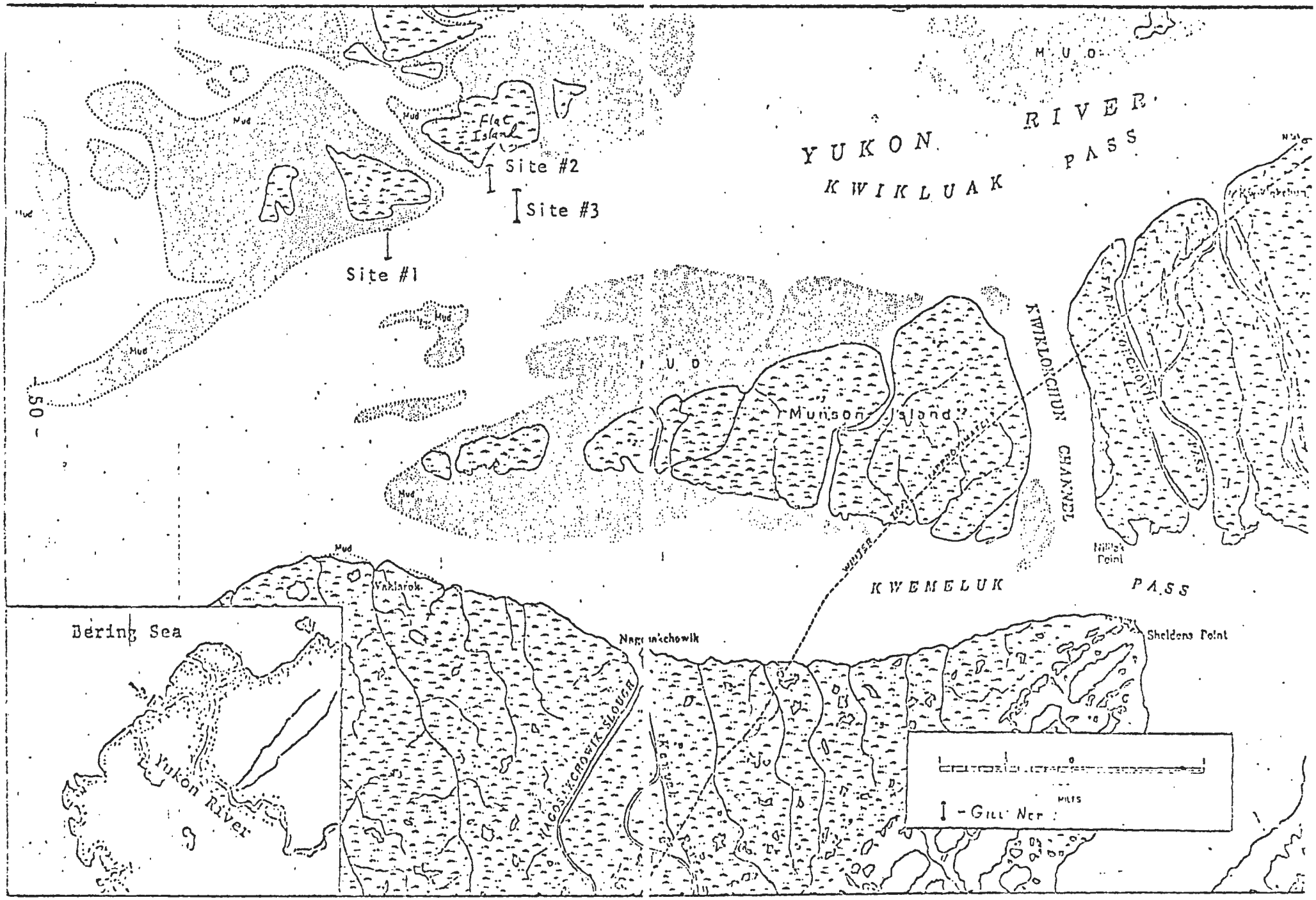


Figure 15. Flat Island test fishing sites, Yukon River, 1974.



Methods and Materials

Set gill nets of 5-1/2" and 8-1/2" stretched mesh nylon webbing with standard floats and leadline have been used to capture salmon at the Flat Island test fishing site. Each net is 25 fathoms long by 28 meshes deep. The nets were fished 24 hours a day at index locations over the entire commercial fishing 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 and the numbers 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 gill nets was taken to obtain age and sex composition.

Results

In 1974 the first recorded salmon was captured on May 30. Over a total of 2,849 gill net fishing hours, 587 king salmon and 5,924 summer chum salmon were captured. Peak catches of king salmon occurred on June 8-11, and June 16-18. Peak catches of summer chum salmon occurred on June 12-13, June 25-26, and July 7-8. Test fishing catches are summarized in Table 22.

In 1974 the 8-1/2 inch mesh gill nets captured 0.26 king salmon and 0.05 summer chum salmon per gill net hour. The 5-1/2 inch mesh gill nets captured 0.11 king salmon and 4.14 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 23 presents age and sex composition for king and summer chum salmon captured with 5-1/2 and 8-1/2 inch stretched mesh set gill nets.

Discussion

The catch per unit effort of 0.26 king salmon per gill net hour for 8-1/2 inch gill nets was 52 percent of the 1973 catch per unit effort and 41 percent of the 8-year average of 0.64 king salmon per gill net hour. The catch per unit effort of 4.14 summer chum salmon per gill net hour was the second highest on record and well above the 7-year average of 1.88 chums per gill net hour.

The catch data indicated a lesser abundance of king salmon and a greater abundance of summer chum salmon in 1974 than in 1973. Preliminary data indicated that total catches of king and summer chum salmon in the Yukon drainage were 19 percent and 55 percent greater than 1973 catches. King and

Table 22. Daily test fishing catch data obtained at Flat Island, Yukon River, 1974.

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
5/30	4	0	0			
31	18	2	0			
1	8	2	1	8	0	1
2	24	7	0	24	2	1
3	24	1	6	24	5	5
4	39	1	5	24	2	11
5	48	17	40	24	6	42
6	48	38	54	24	1	91
7	48	26	67	24	2	156
8	46	24	75	24	0	91
9	48	43	82	24	3	109
10	48	65	72	24	8	126
11	48	32	13	24	1	39
12	7	2	11	24	18	165
13	39	36	19	24	11	135
14	48	11	21	24	4	67
15	48	7	3	24	3	52
16	48	35	22	24	2	115
17	48	18	50	24	11	144
18	48	11	129	24	10	157
19	48	2	63	24	1	114
20	48	5	46	24	1	128
21	48	1	7	24	1	23
22	48	25	97	16	6	206
23	48	4	7	6	0	8
24	48	6	57	24	2	62
25	48	10	115	24	2	476
26	48	2	16	24	0	150
27	42	2	12	24	1	48
28	24	0	1	24	0	11
29	42	8	73	24	2	88
30	48	8	80	24	3	118
7/ 1	48	7	44	24	3	140
2	48	2	26	24	0	102
3	48	1	9	24	1	47
4	42	1	6	24	0	121
5	24	0	2	24	0	96
6	42	2	28	24	0	131
7	48	5	156	24	0	282
8	42	2	56	24	0	39
9	24	0	6	24	0	15
10	42	0	53	24	1	38
11	42	1	17	24	0	48
12	3/	-	-	3/	-	-
13	60	1	54	48	0	130
14	48	1	45	24	0	70
Totals	1,835	474	1,726	1,014	113	4,198

1/ Two 25 fathom set gill nets, sites #1 and #2.
2/ One 25 fathom set gill net, sit #3.
3/ Stormy, unable to check nets.

Table 23. Age and sex composition of test fishing catch sample, Flat Island, 1974.

A. Age and sex composition of Yukon River king salmon, test fishing catch sample taken with 8 1/2" mesh gill nets, Flat Island, 1974.

Combined Age Classes			Age 4_2		Age 5_2		Age 6_2		Age 7_2	
Sex	No.	%	No.	%	No.	%	No.	%	No.	%
male	74	74.7	2	2.0	9	9.1	54	54.5	9	9.1
female	25	25.3	2	2.0	3	3.0	17	17.3	3	3.0
total	99	100.0	4	4.0	12	12.1	71	71.8	12	12.1

B. Age and sex composition of Yukon River king salmon, test fishing catch sample taken with 5 1/2" mesh gill nets, Flat Island, 1974.

Combined Age Classes			Age 4_2		Age 5_2		Age 6_2		Age 7_2	
Sex	No.	%	No.	%	No.	%	No.	%	No.	%
male	29	78.4	14	37.9	6	16.2	5	13.5	4	10.8
female	8	21.6	4	10.8	3	8.1	1	2.7	-	-
total	37	100.0	18	48.7	9	24.3	6	16.2	4	10.8

C. Age and sex composition of Yukon River chum salmon, test fishing catch sample taken with 8 1/2" mesh gill nets, Flat Island 1974.

Combined Age Classes			Age 3_1		Age 4_1		Age 5_1		Age 6_1	
Sex	No.	%	No.	%	No.	%	No.	%	No.	%
male	95	51.6	13	7.0	73	39.7	9	4.9	-	-
female	89	48.4	4	2.2	78	42.4	7	3.8	-	-
total	184	100.0	17	9.2	151	82.1	16	8.7	-	-

D. Age and sex composition of Yukon River chum salmon, test fishing catch sample taken with 5 1/2" mesh gill nets, Flat Island, 1974

Combined Age Classes			Age 3_1		Age 4_1		Age 5_1		Age 6_1	
Sex	No.	%	No.	%	No.	%	No.	%	No.	%
male	155	52.2	17	5.7	128	43.1	10	3.4	-	-
female	142	47.8	8	2.7	119	40.1	14	4.7	1	.3
total	297	100.0	25	8.4	247	83.2	24	8.1	1	.3

summer chum salmon aerial survey escapement counts for index streams were well above 1973 levels in some streams but below in others. These surveys were flown under highly variable weather and stream conditions, and in some cases may not be indicative of actual escapement levels. Based on the best available data, the 1974 summer chum run was judged the largest in recent years and the king run near average.

Flat Island test fishing catches are only an indication of abundance since they 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 the mouths of the Yukon River and the proportion of the run using these mouths varies from year to year.

Based on the age and sex composition of the test fishing catches, the 8-1/2 inch mesh gill nets were selective for age class 6_2 king salmon and the 5-1/2 inch mesh gill nets for age class 4_2 and 5_2 kings. There was no significant difference in the age and sex composition of the summer chum salmon catch samples from either 5-1/2 inch or 8-1/2 inch mesh gill nets..

Comparing catch per unit effort data since 1965 indicates that the 8-1/2 inch mesh gill nets are from 2.2 to 14 times more effective than 5-1/2 inch nets in capturing king salmon. Five and one-half inch mesh gill nets have ranged (since 1969) from 1.93 to 4.5 times more effective than 8-1/2 inch nets in capturing summer chum.

Flat Island test fishing catch data has been an important management tool for the Yukon River when used in conjunction with other indicators of salmon abundance. This data has serious limitations, primarily due to the fact that it represents information only on 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.

ACKNOWLEDGMENTS

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LITERATURE CITED

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

Foerster, R.E. 1968. The Sockeye Salmon. Fisheries Research Board of Canada. Bulletin No. 162, p. 115.

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.

Hurd, C. 1970. Kwiniuk River counting tower report, 1970. A-Y-K Region Fishery Bulletin No. 5.

Lebida, R. 1972. Yukon River Anadromous Fish Investigations, 1972 Field Season. A-Y-K Region Fishery Bulletin No. 20.

Trasky, L. 1973. Yukon River Anadromous Fish Investigations, 1973 Field Season. A-Y-K Region Fishery Bulletin.

APPENDIX

Appendix Table 1. Salmon escapement data, Yukon River, 1974[1/].

Stream (drainage)	Date	Survey rating	Kings	Cohos	Summer chums	Fall chums
Andreafsky River						
West Fork	7/14	Fair	285	-	33,578	-
East Fork	7/14	Poor	50	-	3,215	-
Subtotal			335		36,793	
Anvik River						
(Anvik River tower count)	7/19	-	506	-	208,815	-
Innoko River drainage						
Dishna River	7/15	Poor	7	-	2,886	-
Rodo River	7/14	Good	10	-	16,137	-
Kaltag River	7/14	Fair	13	-	1,584	-
Nulato River	7/13	Fair-Good	78	-	51,160	-
Koyukuk River drainage						
Gisasa River	7/14	Fair-Good	161	-	22,022	-
Kateel River	7/14	Fair	14	-	1,661	-
South Fork Koyukuk	8/ 9	Fair	14	-	59	-
Middle Fork Koyukuk	8/ 9	Fair	11	-	-	-
Slate Creek[2/]	8/13	-	13	-	-	-
Subtotal			213		23,742	
Tozitna River	8/ 6	Fair	-	-	1,823	-
Tanana River drainage						
Baker Creek[3/]	8/15		42	-	-	-
Tolovana River drainage						
Chatanika River	8/ 1	Fair	69	-	487	-
Kantishna River drainage						
Toklat River	10/11	Fair	-	-	-	34,310
Bear Paw River	7/28-8/1	Fair	96	-	15	-

(Continued)

Appendix Table 1. Salmon escapement data, Yukon River, 1974 1/ (cont.).

Stream (drainage)	Date	Survey rating	Kings	Cohos	Summer chums	Fall chums
Glacier Creek	7/28-8/1	Fair	12	-	-	-
Moose Creek	10/20	Fair	-	-	-	2,996
McKinley River	10/20	Fair-Poor	-	-	-	405
Subtotal			108		15	37,711
Nenana River	10/10	-	-	13	-	23
Seventeen mile slough	10/10	Fair	1	20	-	1,570
Slough (5 miles below Clear AFB)	10/11	Fair	-	828	-	-
Slough (1 mile below Anderson)	10/11	Fair	-	900	-	-
Subtotal			1	1,761		1,593
Chena River 4/	7/30-8/8	-	1,039	-	4,349	-
Salcha River 5/	7/29	Good	1,857	-	8,040	-
Upper Tanana River						
Big Tanana slough 6/	10/21	Poor	-	87	-	-
Benchmark 735 slough	10/31	Poor	-	-	-	1,450
Richardson Clearwater 7/	10/29	Fair-Poor	-	235	-	125
Delta River	10/31	Fair	-	15	-	4,010
Near Richardson Hwy bridge 6/	11/13	Good	-	22	-	4,567
Blue Creek	11/13	Good	-	64	-	1
Goodpaster River	7/ 29	Fair	97	-	113	-
Bluff Cabin slough	10/31	Good	-	-	-	4,840
Clearwater Creek slough	10/31	Fair	-	-	-	496
Clearwater Creek and Lake	10/24	Fair	-	560	-	10
Delta Clearwater Creek 6/	10/14	-	-	3,950	-	-
Delta Clearwater Slough	10/31	Fair	-	-	-	1,235
Subtotal			97	4,933	113	16,734
Volkmar						100 150
Big Salt River	8/ 6	Good	-	-	196	-
Chandalar River	9/18	Fair	-	-	-	17,455

(Continued)

Appendix Table 1. Salmon escapement data, Yukon River, 1974[1/] (cont.).

Stream (drainage)	Date	Survey rating	Kings	Cohos	Summer chums	Fall chums
Porcupine River drainage						
Sheenjek River	9/18	Fair	-	-	-	-
Black River						
Salmon Fork	9/19	Poor	-	-	-	444
Kevenjik Creek	10/13	Fair	-	-	-	1,625
Salmon Trout River	9/19	Good	-	-	-	6
Subtotal				14		42,582
Yukon Territory Streams[8/]						
Tachun Creek[9/]		-	192	-	-	-
Nisutlin River[10/]		Fair-Good	150	-	-	-
Big Salmon River[11/]		Poor	70	-	-	-
Miner River	8/ 9	Fair-Good	89	-	-	-
Klondike River[11/]		Fair-Good	44	-	-	-
Kluane River[11/]		Fair-Good	-	-	-	300-500
McQueston River[9/]		-	40	-	-	-
Mayo River[11/]		Fair-Good	2	-	-	-
Yukon River[11/]		Fair-Good	30	-	-	190
Whitehorse Fishway[12/]	7/26-8/26	-	273	-	-	-
Fishing Branch River[13/]		-	-	200-300	-	32,500
Subtotal			890	300		33,190
Total for Yukon drainage:			5,266	7,008	356,140	149,265

1/ Aerial survey peak counts (including carcasses) unless otherwise indicated.
2/ Communication from Bob Hallock, JFWAT.
3/ Foot survey.
4/ Boat surveys by Don Ross, USF&W.
5/ Combination aerial and boat survey.
6/ Helicopter survey conducted by Sport Fish Division, ADF&G.
7/ Coho survey conducted on 10/24, fall chums on 10/31.
8/ Survey data supplied by Environment-Canada Fisheries Service. Klondike, Big Salmon, Mayo and Nisutlin rivers.
9/ Foot survey.
10/ Count includes redds.
11/ Combination aerial and ground surveys.
12/ Weir count (preliminary data).

Appendix Table 2. Comparative Yukon River drainage king salmon escapement counts, 1959-1974.

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 1/	762 1/	-
1963	-	-	-
1964	867	705	-
1965	-	355 1/	650 1/
1966	361	303	638
1967	-	276 1/	336 1/
1968	380	383	297 1/
1969	231 1/	274 1/	296 1/
1970	665	574 1/	368 1/
1971	1,904	1,284	-
1972	798	582 1/	1,172 3/
1973	825	788	613 3/
1974	50 1/	285	471 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 1/	105	334
1970	1,882	615	625
1971	159 1/	640 2/	856
1972	1,193	317	392
1973	249	36 1/	228
1974	1,857	150 2/	273

1/ Incomplete survey or poor survey conditions resulting in a very minimal count.
2/ Canadian Department of Fisheries survey.
3/ Combination tower counts and aerial survey estimate.
4/ Tower count only.

Appendix Table 3. Comparative Yukon River drainage chum salmon escapement counts, 1958-1974 (aerial surveys unless otherwise indicated).

	SUMMER CHUMS					FALL CHUMS		
Year	Andreafsky River (East Fork)	Andreafsky River (West Fork)	Anvi Rive	Chena River	Salcha River	Tanana River	Delta River	Fishing Branc River
1958	-	-	100-20(	,000				
1959	-	-	20(	,000				
1960	3,830	-	1:	,110	670			
1961	8,110	-	-		1,152			
1962	18,040	19,530	2(	,600	402 1,161	862	46 1/	
1963	-	-	-		898 -			
1964	-	12,810	12- 1	,000 1/	250 1/			
1965	-	14,670 1/	10(	,000	2,375			
1966	25,619	18,145	3:	,500	2,200			
1967	-	14,495 2/	11(	,000	-			
1968	17,600 2/	74,600 2/	5:	,580 1/	3,790			
1969	119,000	159,500	-		425 1/			
1970	84,000	91,710 1/	23:	,780	7,879	800	800	
1971	98,095	71,745	-		306 1/	-	-	115,000
1972	41,460	25,573	24:	,857 3/	670 947 1/	19,657	3,650	35,326 4/
1973	10,149 1/	51,835	8(	,665 3/	79 290	9,365	10,262 6/	16,239 5/
1974	3,215 1/	33,578	20:	,277 7/	4,349 8/ 8,040 8/	4,567	4,010	32,500

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.
7/ Tower count.
8/ Boat survey.

Appendix Table 4. Model calculations - expansion of Anvik River tower counts: (1) missing daily counts, (2) missing hourly counts, (3) expanded daily counts.

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(1) A = Actual daily count
E = Missing daily count for 6-24 chum salmon
P = Percent of total count 1/

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

Example for chum salmon, June 24:

$$E = \frac{542}{1-0.447} = \frac{542}{0.553} = 980$$

(2) Hourly = 980 X .72 = 71

(3) Daily total chum salmon, 6-24 = 18 hour count X expansion factor

980 X 1.19 = 1,166

1/ See text page 11 and Appendix Table 4 for further explanation and base data.

Appendix Table 5: Chum salmon hourly enumeration log, Anvik River, 1974 1/.

Date	Hour 00	01	02	03	04	05	06	13	14	15	16	17	18	19	20	21	22	23	Actual -Total	Expanded to 18 hr. Total	Percent
6/24	(71)	(75)	(73)	(73)	(63)	(46)	(37)	-4	7	35	38	32	30	27	14	80	156	127	542	(980)	.6
25	105	50	104	57	-1	15	-3	(32)	(33)	(32)	(45)	(55)	(55)	(61)	(82)	138	253	264	982	(1,377)	.8
26	173	273	240	252	180	66	101	18	40	17	100	66	44	82	112	256	220	282	2,522	2,522	1.5
27	210	191	145	137	157	181	75	2	3	5	9	16	26	75	118	128	339	208	2,025	2,025	1.2
28	449	278	200	121	45	27	25	-	3	-	67	25	17	76	52	215	304	395	2,299	2,299	1.4
29	343	405	417	561	187	120	30	24	2	22	-6	9	19	64	150	386	339	471	3,543	3,543	2.1
30	426	326	367	279	186	120	149	75	99	34	95	117	61	220	329	790	536	590	4,799	4,799	2.8
7/1	469	480	602	326	444	241	251	34	26	21	54	90	108	173	479	860	749	631	6,038	6,038	3.7
2	608	476	610	567	359	398	226	112	102	53	59	57	135	257	324	1,031	836	637	6,927	6,927	4.1
3	644	920	825	925	742	532	296	52	59	104	248	175	186	273	509	1,115	707	814	9,126	9,126	5.4
4	669	911	857	1,082	856	625	450	158	240	295	603	384	377	691	966	1,655	869	806	12,494	12,494	7.4
5	698	712	1,121	997	807	534	441	124	89	105	392	411	265	486	806	895	1,013	715	10,611	10,611	6.3
6	890	1,122	1,048	939	776	622	414	240	189	220	262	557	492	613	700	881	699	1,085	11,749	11,749	6.9
7	1,077	1,062	825	389	550	309	189	316	356	315	368	293	208	290	222	446	948	854	8,995	8,995	5.3
8	638	784	626	700	454	289	165	241	287	257	218	301	310	373	482	500	716	674	8,015	8,015	4.7
9	791	420	322	323	393	242	95	114	75	56	182	576	734	348	564	576	1,148	1,024	7,973	7,973	4.7
10	295	647	544	605	892	706	479	253	230	126	495	798	944	721	924	681	916	683	11,139	11,139	6.6
11	181	300	239	775	425	267	242	(146)	(153)	188	294	428	436	450	523	510	470	336	6,064	(6,363)	3.8
12	(514)	195	387	409	652	730	942	594	678	574	327	124	112	45	19	300	-73	(614)	6,010	(7,138)	4.2
13	(710)	(759)	(729)	(729)	(631)	(473)	(375)	(227)	(237)	(227)	(325)	(394)	(394)	(434)	(591)	(868)	(907)	(848)	-	(9,858)	5.8
14	1,284	(968)	(931)	(931)	(805)	(604)	(478)	(289)	(302)	(289)	297	584	333	400	622	826	1,434	1,201	6,981	(12,576)	7.4
15	351	1,128	1,028	1,080	998	899	799	523	614	496	272	454	434	560	578	515	732	637	12,098	12,098	7.2
16	129	310	213	217	315	130	123	203	212	199	187	276	484	128	129	137	230	169	3,791	3,791	2.2
17	103	98	103	127	121	113	147	195	233	221	121	130	129	128	188	171	207	185	2,720	2,720	1.6
18	103	168	148	107	(145)	(108)	(88)	105	102	125	173	106	118	158	145	125	92	129	1,923	(2,262)	1.3
19	(124)	121	135	131	(110)	(83)	(65)	(40)	(41)	(49)	(57)	(69)	(69)	(76)	(103)	(151)	(158)	(147)	387	(1,720)	1.0
Actual total	10,716	11,597	11,106	11,306	9,528	7,165	5,635	3,378	3,625	3,468	4,655	6,009	6,002	6,638	8,955	13,217	13,835	12,917	149,753		
Actual percent	7.2	7.7	7.4	7.4	6.4	4.8	3.8	2.3	2.4	2.3	3.3	4.0	4.0	4.4	6.0	8.3	9.2	8.6	100		
Expanded total	12,135	13,399	12,839	12,839	11,282	8,479	6,677	4,112	4,391	4,056	5,282	6,527	6,520	7,209	9,731	14,236	14,900	14,526		(169,140)	
Expanded percent	7.2	7.9	7.6	7.6	6.7	5.0	3.9	2.4	2.6	2.4	3.1	3.9	3.8	4.3	5.8	8.4	8.8	8.6	100 +	19% 3/	
																				201,277	

1/ All counts are net (upstream count minus dying and dead fish drifting downstream) - hours 07 through 12 not counted.
2/ Estimated counts in parenthesis.
3/ Percentage of net total chum salmon migration during 0700-1300 in 1973.

Appendix Table 6. King salmon hourly enumeration log, Anvik River, 1974 1/

Date	Hour 00	01	02	03	04	05	06	13	14	15	16	17	18	19	20	21	22	23	Actual Total	Expanded 18 hr. Total	Percent
6/24	(-)	(-)	(-)	(-)	(-)	(-)	(-)	-	-	-	2	-	-	-	-	-	-	-	2	3	.8
25	-	-	-	-	-	-	-	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	-	-	-	-	-	-
26	-	-	-	-	-	--	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
28	-	-	-	-	-	-	-	-	-	-	--	-	-	-	-	-	-	-	-	-	-
29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7/1	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	.3
2	-	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-	-	-	2	2	.5
3	-	-	2	-	-	4	2	1	-	-	1	-	-	-	-	-	-	-	10	10	2.7
4	-	-	1	-	-	3	2	-	-	-	2	1	-	-	1	-	-	-	10	10	2.7
5	-	-	2	1	1	-	4	-	-	1	2	1	-	1	3	1	-	-1	16	16	4.3
6	-	1	-	5	-	1	2	1	2	-	3	-	-	1	-	1	-	-	17	17	4.6
7	2	1	-1	1	-	-	-	12	7	5	1	1	1	-	-	-	-	-	30	30	8.1
8	2	2	-	1	1	-	-	2	1	2	1	2	-1	2	-	-	-	1	16	16	4.3
9	-	1	-	-	2	1	1	4	3	1	1	2	1	-	-	1	2	1	21	21	5.7
10	-	-	-	-	5	4	1	5	3	5	7	6	4	8	1	-	3	3	55	55	14.8
11	-	-	-	-	-	1	1	(3)	(3)	2	2	4	5	4	-	-	-	-	19	25	6.7
12	(-)	-	-	-	2	-	-	-1	3	4	1	-	1	-	1	-	-	(-)	11	11	3.0
13	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(2)	(2)	(1)	(1)	(1)	(1)	(1)	(-)	(-)	(-)	(-)	10	10	2.7
14	1	(1)	(-)	(1)	(1)	(1)	(1)	(3)	(3)	(2)	4	-1	1	1	-	1	3	-	10	22	5.9
15	1	2	-1	4	-	-	-	11	7	5	5	9	3	2	3	1	2	-	54	54	14.6
16	1	-1	1	-	1	-	1	2	6	3	4	2	3	-	-	-	-	-	23	23	6.2
17	-	1	-	-	-	-	-	3	6	2	1	1	1	1	-	-1	2	-2	15	15	4.0
18	-	1	-	-	(1)	(2)	(1)	3	2	4	3	4	5	1	-	2	1	-	26	30	8.1
19	(-)	-	-	-	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	-	-	-
Actual total	7	8	4	12	13	15	14	43	40	34	40	33	24	21	9	6	13	2	338		
Actual percent	2.1	2.4	1.2	3.6	3.8	4.4	4.1	12.7	11.8	10.1	11.8	9.8	7.1	6.2	2.7	1.8	3.8	.6			
Expanded total	7	9	4	13	15	19	16	51	48	37	41	34	25	22	9	6	13	2		(371)	
Expanded percent	1.9	2.4	1.1	3.5	4.0	5.1	4.3	13.7	12.9	10.0	11.2	9.2	6.7	6.0	2.4	1.6	3.5	.5		+ 27% 3/	
																				471	

1/ All counts are net (upstream count minus dying and dead fish drifting downstream) - hours 07 through 12 not counted.
2/ Estimated counts in parenthesis.
3/ Percentage of net total king salmon migration during 0700-1300 in 1973.

Appendix Table 7. Limnological record Anvik River, 1974.

Date	Water Temp. (°F)	O_2 mg/l	CO_2 mg/l	pH	Alkalinity (gr/gal $CaCO_3$)		Acidity (gr/gal $CaCO_3$)		Total Hardness (gr/gal $CaCO_3$)	Water Color	Water Velocity (fps)	Flow (Cfps)
					Phenolphthalien	methyl orange	free	total				
6/16	51	11	> 5	8.5	-	3	-	-	3	clear		
17	51											
18	52										5	
19	49											
20	56											
21	58											
22	58											
23	60	12	> 5	8.5	-	3	-	-	3	clear	-	
24	56											
25	56											
26	58											
27	-											
28	60											
29	62											
30	62	11	> 5	7.5	-	4	-	-	3	clear	-	
7/1	61											
2	65											
3	64											
4	66											
5	64											
6	-											
7	60	11	> 5	8.0	-	4	-	-	4	clear	3.6	
8	58											
9	60											
10	57											
11	-											
12	54											
13	56											
14	60	10	> 5	8.5	-	3	-	-	3	clear	4	
15	60											
16	56											
17	52											
18	52											
19	52											
20	52											
21	-	12	5	8.5	-	3	-	-	3	muddy	5.7	

Appendix Table 8. Comparative age and sex composition chum salmon carcass samples, Anvik River 1972-1974

Year	sample size	percent males	percent females	Age Group (Percent) 3_1	4_1	5_1	6_1
1972	320	52.2	47.3	4.6	46.0	49.0	.4
1973	783	34.0	66.0	6.0	77.0	16.0	1.0
1974	402	61.0	39.0	9.0	78.9	11.4	.7

Appendix Table 9. Estimated size[1/] of king salmon migrating upstream past the Anvik River tower, 1973 and 1974.

Year	Estimated Size									
	< 50 mm		50-60 mm		60-80 mm		> 80 mm		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
1973	19	4.1	46	9.7	112	23.6	297	62.6	474	100.0
1974	5	1.4	123	34.4	150	41.9	80	22.3	358	100.0

1/ total length

Appendix Table 10. Limnological record, Salcha River and tributaries, 1974.

	Date	Water temp.	O_2 mg/l	CO_2 mg/l	ph	Alkalinity (gr/gal $CaCO_3$)		Acidity (gr/gal $CaCO_3$)		Total Hardness (gr/gal $CaCO_3$)	Water Color	Water velocity (fps)	flow (Cfps)
						Phenolphthalein	methyl orange	free	total				
Salcha River	8/21	52°	10	<3	7.5	-	3	-	-	3	brown	-	-
Redmond Creek	8/17	50°	11	<3	7.5	-	5	-	-	5	stained	.55	16.0
McCoy Creek	8/15	52°	10	<3	7.5	-	3	-	-	4	stained	3.3	36.6
Ninety-Eight Creek	8/8	52°	11	5	7.5	-	5	-	-	6	clear	1.4	62.6
Flat Creek	8/11	49°	11	<3	7.5	-	2	-	-	3	clear	1.5	38.8
Butte Creek	8/14	42°	8	<3	8.0	-	4	-	-	4	clear	2.4	54.0
Caribou Creek	8/19	40°	7	<5	8.5	-	3	-	-	5	clear	-	-

Appendix Table 11. Age and sex of king salmon sampled at various locations, Yukon River drainage, 1974.

Area	Combined Age Classes			Age 3_2		Age 4_2		Age 5_2		Age 6_2		Age 7_2	
	Sex	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Salcha River (carcass survey)	male	157	75.0	2	1.0	91	44.0	21	10.0	39	18.0	4	2.0
	female	51	25.0	-	-	-	-	3	1.0	47	23.0	1	1.0
	subtotal	208	100.0	2	1.0	91	44.0	24	11.0	86	41.0	5	3.0
Emmonak (8 1/2" gill nets)	male	571	54.5	-	-	5	.5	187	18.0	324	31.0	55	5.0
	female	482	45.5	-	-	0	-	24	2.0	398	37.5	60	6.0
	subtotal	1,053	100.0	-	-	5	.5	211	20.0	722	68.5	115	11.0
Whitehorse (fishway escapement sample)	male	52	60.0	-	-	12	14.0	19	22.0	19	22.0	2	2.0
	female	34	40.0	-	-	-	-	3	4.0	28	33.0	3	3.0
	subtotal	86	100.0	-	-	12	14.0	22	26.0	47	55.0	5	5.0

Appendix Table 12. Age and sex of summer chum salmon sampled at various locations, Yukon River drainage, 1974.

Area	Combined Age Classes			Age 3[1]		Age 4[1]		Age 5[1]		Age 6[1]	
	Sex	No.	%	No.	%	No.	%	No.	%	No.	%
Anvik River (carcass sample)	male	245	61.0	12	3.0	197	49.0	34	8.5	2	.5
	female	157	39.0	24	6.0	120	29.9	12	3.0	1	.1
	subtotal	402	100.0	36	9.0	317	78.9	46	11.5	3	.6
Salcha River (carcass sample)	male	223	47.0	8	4.0	171	35.6	32	7.0	2	.4
	female	257	53.0	8	4.0	203	41.8	35	7.0	1	.2
	subtotal	480	100.0	16	8.0	374	77.4	67	14.0	3	.6
Emmonak (5 1/2 + 8 1/2" gill net commercial catch sample)	male	388	56.5	11	1.6	329	47.9	46	6.8	2	.2
	female	299	43.5	15	2.2	265	38.6	18	2.6	1	.1
	subtotal	687	100.0	26	3.8	594	86.5	64	9.4	3	.3

Appendix Table 13. Cumulative daily Whitehorse fishway king salmon counts, 1965-1974.

Date	1965	1966	1967[2/]	1968	1969[1/]	1970	1971	1972	1973	1974[3/]
8/1	5	4	38	4						18
2	9	10	53	5	8	1			1	31
3	16	24	67	11	16	4			2	36
4	30	40	87	18	28	5		1	3	43
5	49	54	106	43	43	6		3	3	57
6	58	74	121	70	99	12		9	8	70
7	93	97	136	107	118	18	3	20	20	79
8	124	120	172	152	149	24	5	24	24	94
9	150	139	196	173	181	47	7	31	29	103
10	197	188	233	173	187	77	10	33	41	115
11	282	214	263	174	210	108	27	47	50	123
12	382	248	306	180	239	136	36	61	56	149
13	510	304	344	205	260	202	60	105	64	189
14	542	357	397	239	273	284	87	139	84	199
15	583	388	417	267	297	313	127	184	97	211
16	630	427	429	290	316	346	195	233	110	231
17	670	478	454	339	322	415	287	269	120	243
18	688	500	478	359	324	436	358	293	130	258
19	728	518	494	363	324	511	447	300	150	260
20	785	532	506	369	324	560	493	316	167	265
21	817	536	516	376	328	576	534	347	187	267
22	843	548	520	389	328	595	607	355	203	270
23	864	554	526	392	328	610	643	369	211	270
24	883	557	530	405	328	617	683	382	214	271
25	893	560	532	405	331	622	727	386	220	271
26	898	562	532	405	334	624	762	386	220	273
27	902	562	533	405		625	788	388	224	
28	903	562		405			812	392	224	
29		563		406			835		224	
30				406			841		227	
31				406			842		228	
9/1				406			849			
2				407			855			
3							856			
4										
5										
Totals	(903)	(563)	(533)	(407)	(334)	(625)	(856)	(392)	(228)	(273)

1/ First fish on 7/23
2/ First fish on 7/25
3/ First fish on 7/26

Appendix Table 14. Age and sex of king salmon sampled at Whitehorse fishway, 1970-1974

Year	Combined Age Classes			Age Group									
				3_2		4_2		5_2		6_2		7_2	
	Sex	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
1970	male	86	86.8	-	-	29	29.3	46	46.4	9	9.1	2	2.0
	female	13	13.2	-	-	-	-	6	6.1	6	6.1	1	1.0
	total	99	100.0	-	-	29	29.3	52	52.5	15	15.2	3	3.0
1971	male	132	48.7	-	-	1	0.4	90	33.2	40	14.7	1	0.4
	female	139	51.3	-	-	-	-	28	10.3	111	41.0	-	-
	total	271	100.0	-	-	1	0.4	118	43.5	151	55.7	1	0.4
1972	male	24	46.2	-	-	-	-	7	13.5	15	28.9	2	3.8
	female	28	53.8	-	-	-	-	3	5.8	23	44.2	2	3.8
	total	52	100.0	-	-	-	-	10	19.3	38	73.1	4	7.6
1973	male	30	61.0	-	-	-	-	23	47.0	7	14.0	-	-
	female	19	39.0	-	-	-	-	2	4.0	16	33.0	1	2.0
	total	49	100.0	-	-	-	-	25	51.0	23	47.0	1	2.0
1974	male	52	60.0	-	-	12	14.0	19	22.0	19	22.0	2	2.0
	female	34	40.0	-	-	-	-	3	4.0	28	33.0	3	3.0
	total	86	100.0	-	-	12	14.0	22	26.0	47	55.0	5	5.0

Appendix Table 15. Fall chum salmon tagged in the Delta River, by channel and date, 1974.

Date	Channel 1 No. tagged	Channel 2 No. Tagged	Channel 3 No. tagged	Total tagged
10/11	2	-	2	4
12	-	-	3	3
13	-	-	3	3
14	6	-	28	34
15	6	-	19	25
16	9	-	9	18
17	-	-	-	-
18	17	-	-	17
19	23	-	-	23
20	-	33	-	33
21	-	17	-	17
22	-	11	-	11
23	2	3	-	5
24	-	-	-	-
25	-	43	-	43
26	-	114	-	114
27	-	17	-	17
28	-	36	-	36
Total	65	274	64	403

Appendix Table 16. Comparative composition of fall chum salmon carcass sampled by sex and 3-day period, Delta River, 1974.

period	Channel 1				Channel 2				Channel 3				Total
	males		females		males		females		males		females		
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	
10/13-15	5	1.6	1	.3	-	-	-	-	-	-	3	6.9	9
16-18	-	-	1	.3	-	-	-	-	1	3.6	-	-	2
19-21	-	-	-	-	-	-	-	-	1	3.6	-	-	1
22-24	26	8.6	14	4.8	1	.1	-	-	-	-	-	-	41
25-27	20	6.5	8	2.8	9	1.1	8	1.0	6	21.4	4	9.4	55
28-30	45	14.8	30	10.4	16	1.9	13	1.7	4	14.3	2	4.7	110
10/31-11/2	19	6.2	17	5.9	41	5.1	10	1.3	-	-	1	2.3	88
3-5	41	13.4	25	8.6	71	8.6	23	3.0	2	7.1	1	2.3	163
6-8	61	19.9	47	16.3	187	22.6	91	11.9	4	14.2	7	16.3	397
9-11	27	8.8	45	15.6	196	23.7	136	17.8	4	14.4	3	7.0	411
12-14	41	13.4	69	23.8	176	21.3	251	32.9	2	7.1	12	27.9	551
15-17	21	6.8	32	11.2	129	15.6	232	30.4	4	14.3	10	23.2	428
Totals	306	100.0	289	100.0	826	100.0	764	100.0	28	100.0	43	100.0	2,256

Appendix Table 17. Limnological record Delta River, 1974.

Channel 1

Date	Water temp.	O_2 mg/l	CO_2 mg/l	pH	Alkalinity (gr/gal $CaCO_3$)		Acidity (gr/gal $CaCO_3$)		Total Hardness (gr/gal $CaCO_3$)	Water Color	Water velocity (fps)	Flow (cfs)
					phenolphthalein	methyl orange	free	total				
10/10	40°	10	10	7.5	-	-	-	-	11	clear	.78	16
10/17	40°	10	10	8.0	-	6	-	.6	9	clear	-	-
10/24	40°	12	10	9.0	-	7	-	.6	10	clear	1.20	21 1/
11/3	40°	10	10	9.0	-	8	-	.6	8		-	-
11/16	34°	10	10	9.0	-	7	-	.6	9	clear	-	-
Channel 2												
10/19	38°	11	10	8.0	-	6	-	.6	9	clear	-	-
10/26	41°	11	10	9.0	-	7	-	.6	10	clear	-	-
11/3	42°	10	10	9.0	-	5	-	.6	8	clear	1.74	45
11/16	40°	10	10	9.0	-	6	-	.6	8	clear	-	-
Channel 3												
10/11	38°	11	10	8.5	-	6	-	.6	15	clear	1.17	31
10/18	38°	14	10	8.5	-	6	-	.6	9	clear	-	-
10/25	38°	11	10	9.0	-	7	-	.6	9	clear	.77	19
11/13	35°	10	10	9.0	-	6	-	.6	9	clear	-	-
11/16	35°	10	10	9.0	-	6	-	.6	9	clear	-	-

1/ flow taken near mouth

Appendix Table 18. Water temperature and level by date, Delta River, 1974.

	Channel 1		Channel 2		Channel 3		
	Water Temp. (°F)	Water Level (inches)	Water Temp. (°F)	Water Level (inches)	Water Temp. (°F)	Water Level (inches)	Air Temp. (°F)
10/10	41	0[1/]	-	-	41	0	-
11	38	0	-	-	34	0	-
12	38	0	32	-	34	0	-
13	38	0	32	-	34	0	-
14	40	0	34	-	38	0	-
15	38	0	32	6	38	0	-
16	39	-.5	32	5	38	-.5	-
17	38	0	31	5	38	0	24
18	38	0	33	-7	36	-.5	21
19	38	-.5	38	-13	38	-.5	24
20	38	-.5	38	-14	38	-.5	12
21	38	-.5	40	-15	38	-.5	18
22	38	-1	40	-17[2/]	38	-.5	20
23	38	-1	40	-17	38	-.5	20
24	38	-1	40	-17	38	-.5	34
25	40	-1	38	-15	38	-.5	28
26	40	-1	38	-15	38	-.5	28
27	40	-1	40	-15	38	-.7	28
28	40	-1	40	-15	38	-.7	24
29	40	-1	42	-15	38	-1	34
30	40	-1	42	-17	38	-1	38
31	40	-1	42	-17	38	-1	36
11/1	40	-1	42	-17	37	-1	26
2	40	-1	42	-17	38	-1	26
3	40	-1	42	-17	38	-1	31
4	-	-	-	-	-	-	-
5	40	-1	41	-17	38	-1	12
6	40	-1	42	-17	38	-1	14
7	40	-1	42	-17	37	-1	10
8	39	-1	42	-17	38	-1	10
9	40	-1	42	-17	38	-1	-10
10	40	-1	41	-17	36	-1	-12
11	38	-1	41	-17	37	-1	16
12	38	-1	40	-17	36	-1.5	39
13	39	-1	40	-17.5	36	-1.5	21
14	39	-1	40	-17.5	35	-1.5	25
15	39	-1	40	-17.5	35	-1.5	20
16	34	-1	40	-17.5	34	-1.5	12

1/ water level stake set at base of zero
2/ level stake moved, adjusted water level after 10/22

Note: Chums entered channel 2 on 10/18

Appendix Table 19. Age and sex composition of fall chum salmon sampled at various locations, 1974.

Sample	Sex	Average length	Age Class 3₁ No.	3₁ %	4₁ No.	4₁ %	5₁ No.	5₁ %	6₁ No.	6₁ %	Total No.	Total %
Delta River carcass sample	males	580	157	36.0	28	29.0	9	2.0	-	-	294	67.0
	females	570	63	14.0	78	18.0	3	1.0	-	-	144	33.0
	combined	580	220	50.0	206	47.0	12	3.0	-	-	438	100.0
Delta River tagging sample	males	590	120	37.0	61	19.0	2	1.0	-	-	183	57.0
	females	570	68	21.0	68	21.0	3	1.0	-	-	139	43.0
	combined	580	188	58.0	129	40.0	5	2.0	-	-	322	100.0
Delta River combined sample	males	580	277	37.0	89	25.0	11	1.0	-	-	477	63.0
	females	570	131	17.0	146	19.0	6	1.0	-	-	283	37.0
	combined	580	408	54.0	335	44.0	17	2.0	-	-	760	100.0
Sheenjek River carcass sample	males	578	40	29.0	16	12.0	3	2.0	-	-	59	43.0
	females	553	51	37.0	25	18.0	1	1.0	1	1.0	78	57.0
	combined	564	91	66.0	41	30.0	4	3.0	1	1.0	137	100.0
Toklat River carcass sample	males	556	82	43.0	18	9.0	-	-	-	-	100	52.0
	females	556	57	30.0	33	17.0	1	1.0	-	-	91	48.0
	combined	556	139	73.0	51	26.0	1	1.0	-	-	191	100.0
Tanana River carcass sample	males	590	38	29.0	42	31.0	4	3.0	-	-	84	63.0
	females	580	22	16.0	24	18.0	4	3.0	-	-	50	37.0
	combined	580	60	45.0	66	49.0	8	6.0	-	-	134	100.0

Appendix Table 20. Comparative aerial survey counts, fall chum salmon, 1972-1974[1/].

	1972	1973	1974
Tanana River drainage			
Bear Paw River	2/	1,530	2,996
Toklat River	1,000[3/]	6,957	34,310
Benchmark 735 slough	5,255	127[4/]	1,450
Delta River	3,650	7,971	4,010
Tanana River[7/]	8,350	5,635	4,567
Bluff Cabin slough	6,040	3,450[3/]	4,840
Delta Clearwater slough	2/	1,720[3/]	1,235
Chandalar River	2/	5/	17,455
Porcupine River drainage			
Sheenjek River	2/	1,175[3/]	40,507
Yukon Territory Steams			
Fishing Branch River, Porcupine River	35,326[6/]	6,239[6/]	32,500

1/ all surveys rated fair - good unless rated otherwise
2/ not surveyed
3/ poor survey
4/ surveyed too early
5/ surveyed too late
6/ weir count
7/ Richardson Highway Bridge to Blue Creek

Appendix Table 21. Relative efficiency for various types of fishing gear operated at Flat Island, Yukon River, 1965-1974.

Year	Types of gear	Gill net hours (Fishwheel hours) 1/	Catch per gill net hour 1/	
			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" 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	0.85
	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
1974	5 1/2" mesh gill net	1,014	0.11	4.14
	8 1/2" mesh gill net	1,813	0.26	0.95

1/ Data includes only those days that both types of gear were operated; also, chum salmon catch data was not recorded during 1965-1966.