

ARCTIC YUKON KUSKOKWIM AREA
ANADROMOUS FISH INVESTIGATIONS
ANNUAL TECHNICAL REPORT, 1967

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FOREWORD

Several separate studies were conducted in the Arctic-Yukon-Kuskokwim area (A-Y-K) as part of this project during the 1967 field season. See Figure 1 for a map of the area.

Each study is listed below with an estimate of the percentage of total expenditures:

1. Yukon River Tag and Recovery Study (40%)
2. Salmon Subsistence Fishery Surveys (20%)
3. Kwiniuk River Counting Tower Study (15%)
4. Age, Sex and Size Compositions of Salmon (15%)
5. Kotzebue Sound Sheefish Study (10%)

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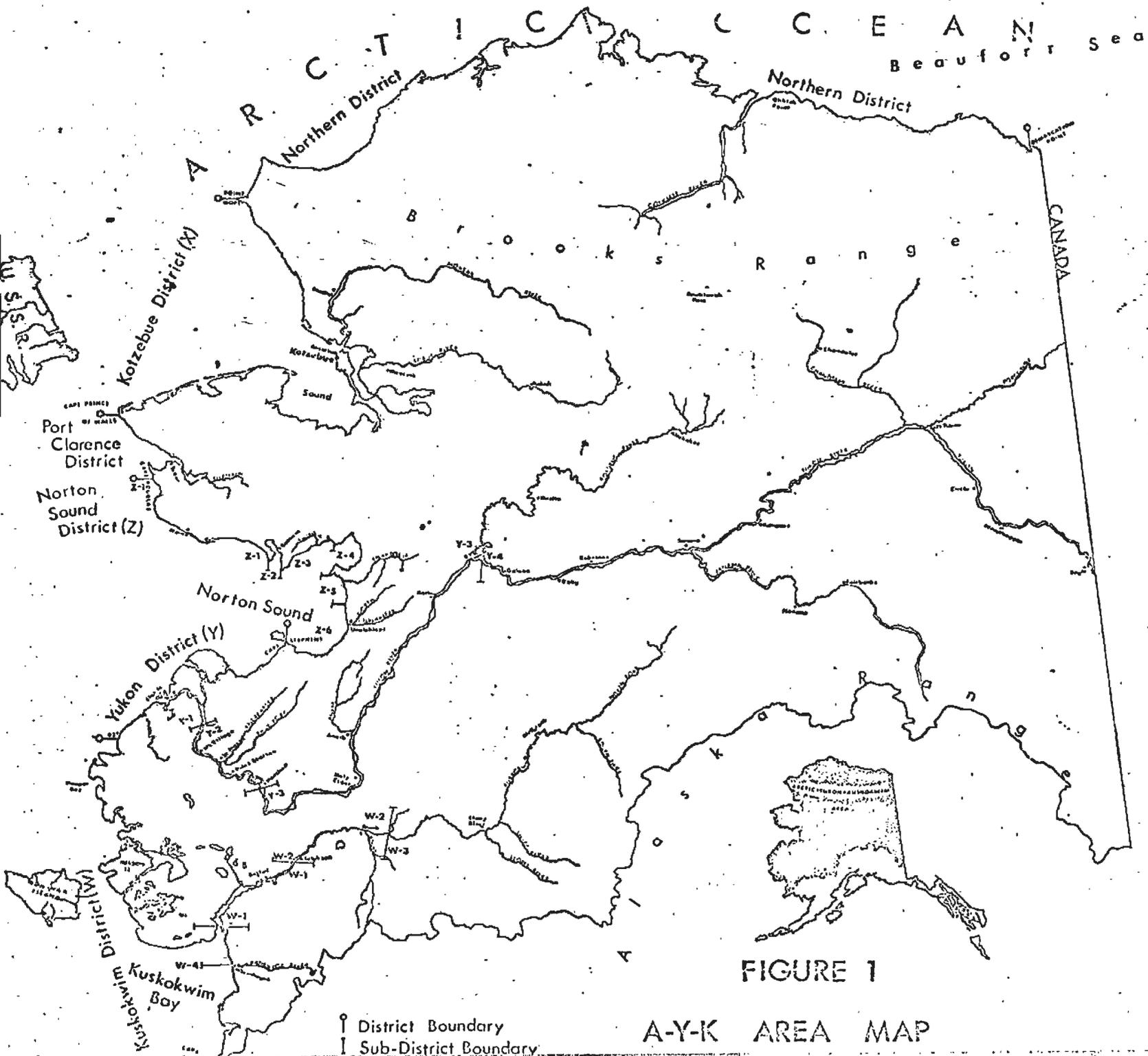


FIGURE 1

A-Y-K AREA MAP

YUKON RIVER TAG AND RECOVERY STUDY

INTRODUCTION

Salmon tag and recovery studies in the Yukon River date back to 1961 when a two-year crash program utilizing Federal funds for an investigation of chum salmon was initiated. Since 1963, tag and recovery studies have been mainly concerned with gathering information on the king salmon run which is more intensively harvested by commercial fishermen. Prior to 1967, a total of 7,600 chum and 2,270 king salmon had been tagged and released.

In 1967 king and chum salmon were tagged at two sites, Flat Island and Middle Mouth as part of the present study. Salmon have been tagged at the Flat Island site since 1963 which is located in the South Mouth approximately five miles northwest of Sheldon's Point. The Middle Mouth site, established in 1966, is located near Willie Moore's Camp in the Middle Mouth. Figures 2 and 3 are maps of the lower Yukon River showing locations of tagging sites, villages and commercial catch statistical areas.

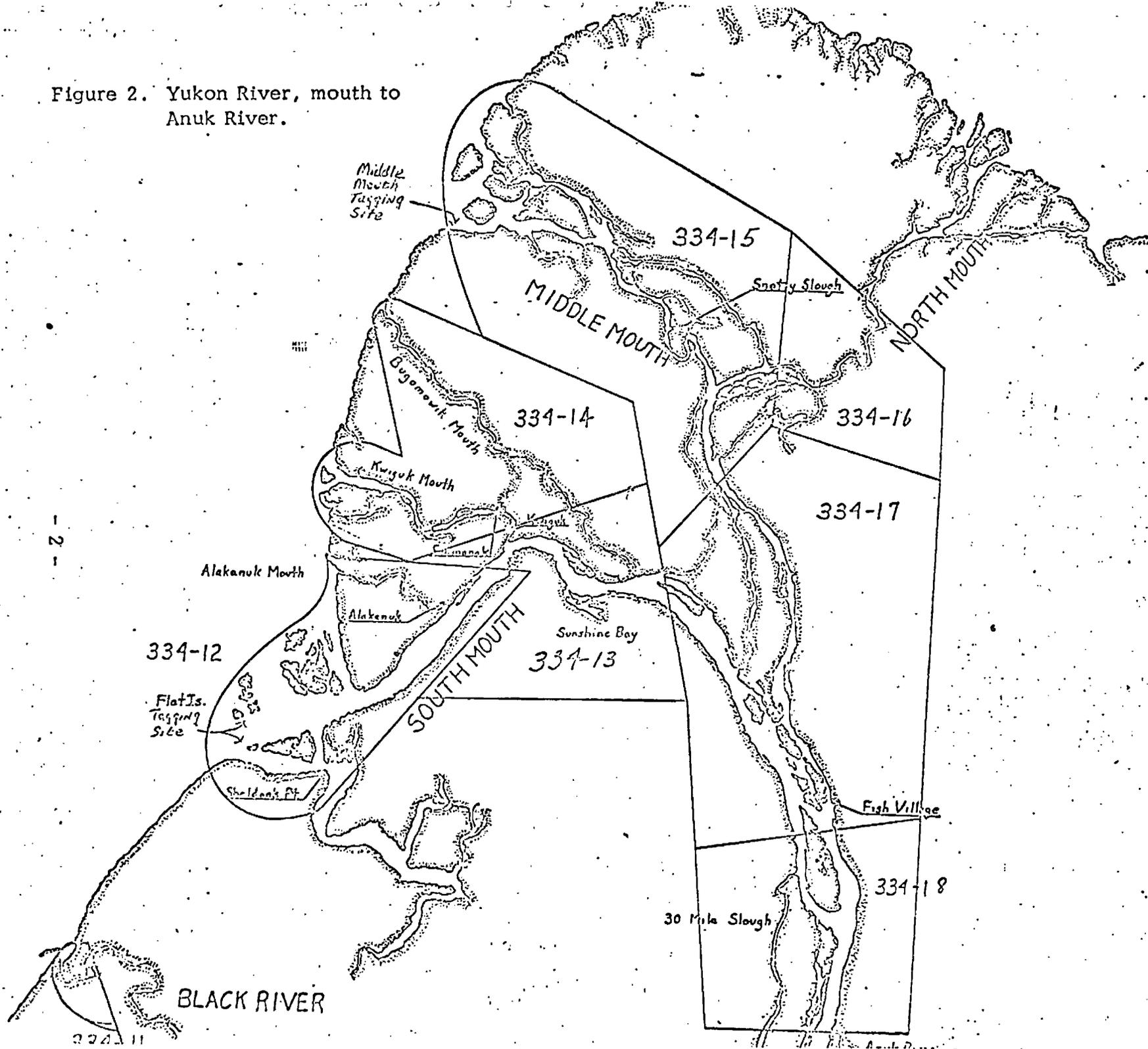
The objectives of this study were the determination of: (1) population size and percentage utilization by the commercial fishery of the king salmon run, (2) destination and timing of run segments or races in the king and chum salmon runs, and (3) abundance indices for king and chum salmon runs. Information relating to the third objective (abundance indices) as well as a discussion of capture gear efficiency will be presented in a future report.

METHODS

Set gill nets of varying mesh sizes (5-1/2", 7", 8-1/2" stretched measure) were fished for the purpose of capturing salmon for tagging at the Flat Island (South Mouth) site. In addition, a beach seine trap was experimentally fished for several days at the northwestern end of Flat Island. Fishing gear was operated at or near both shores of the South Mouth. Only set gill nets of 8-1/2" stretched mesh were operated at the Middle Mouth site.

Captured salmon were tagged with spaghetti tags consisting of 13 inch lengths of yellow plastic tubing, 1/16 inch in diameter. These tags were placed in the fish with a special needle applicator approximately one inch below and slightly forward of the insertion of the dorsal fin. The tag legend included reward information and the mailing address of the Anchorage office of the Alaska Department of Fish and Game.

Figure 2. Yukon River, mouth to Anuk River.



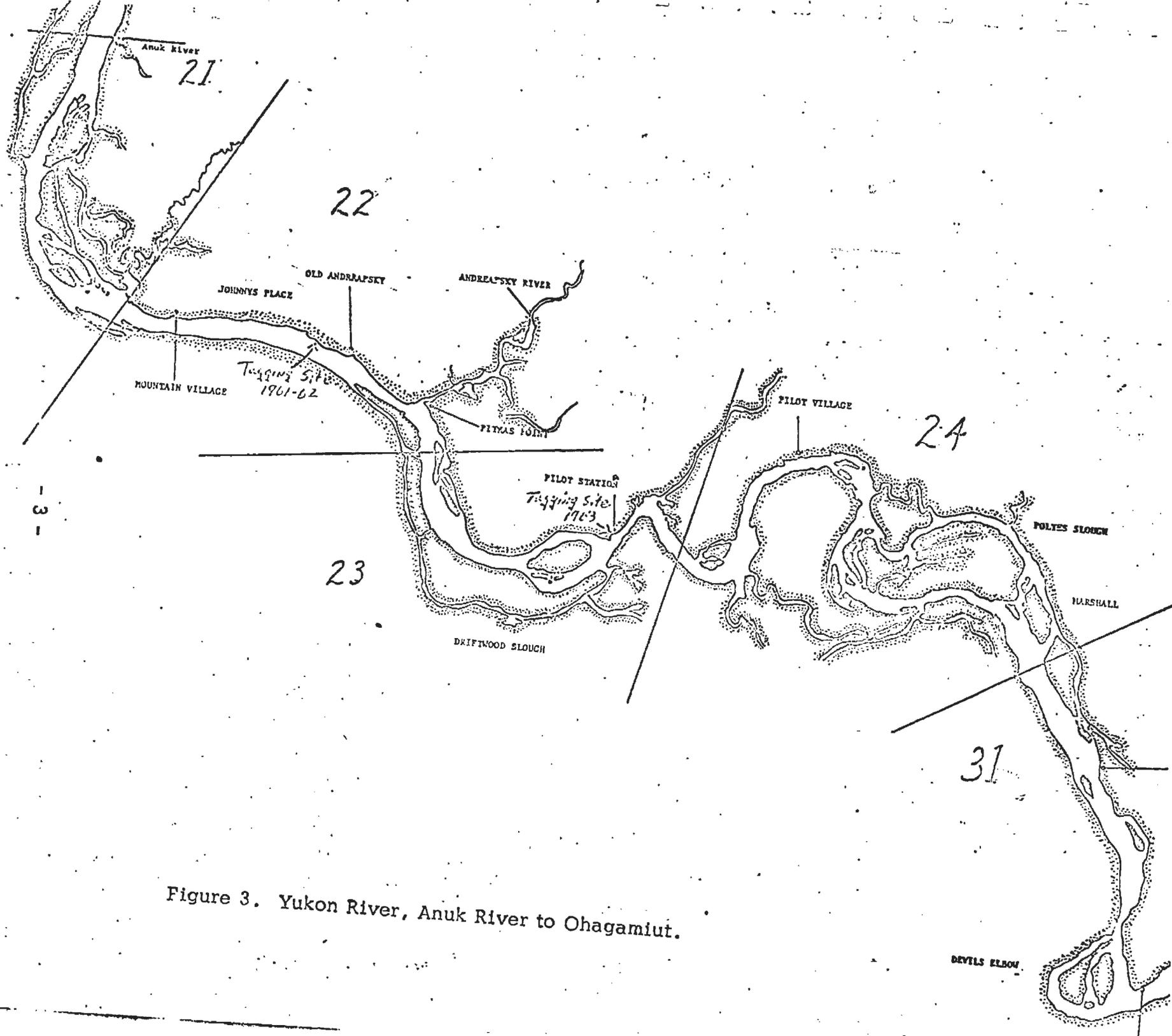


Figure 3. Yukon River, Anuk River to Ohagamiut.

DEVILS ELBOW

Recoveries of tagged salmon were obtained from commercial and subsistence fishermen throughout the drainage. A one-dollar reward was offered for each tag recovery and publicity notices were posted in every village throughout the Alaskan portion of the drainage. Canadian Department of Fisheries personnel collected tag recoveries in Yukon Territory. Most of the tag recoveries were attached to fish ticket copies that were turned in to the Department by various processors. These fish tickets are completed when salmon deliveries are made to tender boats or shore plants and show the fisherman's name, date of catch and statistical area of catch. Other recoveries were either collected by Department personnel or were mailed to the Anchorage office by fishermen.

The sex and snout to fork length were recorded for every salmon tagged. Each tagged salmon was classified as to its condition upon release. Fish classified as Category 1 were considered in good condition, Category 2 consisted of fish of questionable condition, and Category 3 fish were considered to have been released in poor condition. Salmon that were taken from the net in very poor condition, e.g., bleeding from the gills, were not tagged, but were sampled for age-sex-size information and then were given to local processors or subsistence fishermen.

RESULTS

King Salmon

As shown in Table 1, a total of 1,148 king salmon was captured at both tagging sites of which 724 were tagged. There were 383 king salmon tagged at the Flat Island site and 341 tagged at the Middle Mouth site. Table 1 also shows the numbers of recoveries made by tagging date.

The 1967 recovery rates were 30.0 percent (n=115) for Flat Island tags and 37.0 percent (n=126) for Middle Mouth tags for a combined value of 33.0 percent. Of the 241 recoveries, 228 or 95 percent were captured in king salmon gill nets (8-1/2 inch stretch mesh). This does not include recaptures made by tagging site gear.

Table 2 compares the percentages of tagged salmon released to commercial catches by fishing period. These data included tags out for both sites and commercial catches made in the vicinity of the tagging sites (statistical areas 334-12 and 334-15). This comparison shows that relatively few tagged salmon were released during the first two periods, but releases after June 7 generally reflected salmon abundance as indicated by commercial catches.

TABLE 1

NUMBERS OF YUKON RIVER KING SALMON TAGGED, CAPTURED AND RECOVERED
DURING 1967

Date	Flat Island Site			Middle Mouth Site			Combined Sites			Recoveries of Tags Out		
	Numbers Tagged	Numbers Untagged	Total Catch	Numbers Tagged	Numbers Untagged	Total Catch	Numbers Tagged	Numbers Untagged	Total Catch	Flat Island	Middle Mouth	Total
5/30	0	0	0				0	0	0	0		0
31	0	0	0				0	0	0	0		0
6/ 1	0	0	0				0	0	0	0		0
2	0	0	0				0	0	0	0		0
3	2	1	3				2	1	3	0		0
4	7	3	10				7	3	10	3		3
5	36	20	56	24	7	31	60	27	87	14	11	25
6	33	5	38	2	6	8	35	11	46	19	0	19
7	8	4	12	1	0	1	9	4	13	3	0	3
8	35	10	45	36	16	52	71	26	97	16	8	24
9	1	0	1	0	0	0	1	0	1	0	0	0
10	9	3	12	5	0	5	14	3	17	6	2	8
11	24	10	34	39	21	60	63	31	94	14	13	27
12	9	4	13	39	8	47	48	12	60	5	17	22
13	21	6	27	2	1	3	23	7	30	5	1	6
14	5	0	5	1	0	1	6	0	6	1	0	1
15	11	4	15	1	0	1	12	4	16	3	0	3
16	0	2	2	0	0	0	0	2	2	0	0	0
17	0	0	0	8	0	8	8	0	8	0	6	6
18	16	4	20	80	29	109	96	33	129	1	49	50
19	6	1	7	5	0	5	11	1	12	1	2	3
20	1	0	1	0	1	1	1	1	2	1	0	1
21	20	9	29	2	1	3	22	10	32	3	0	3
22	9	4	13	4	8	12	13	12	25	4	1	5
23	4	4	8	0	0	0	4	4	8	1	0	1
24	25	11	36	1	2	3	26	13	39	5	0	5
25	16	5	21	17	9	26	33	14	47	5	1	6
26	3	3	6	22	5	27	25	8	33	1	6	7
27	9	7	16	27	21	48	36	28	64	1	5	6

TABLE 1 (Continued)

NUMBERS OF YUKON RIVER KING SALMON TAGGED, CAPTURED AND RECOVERED
DURING 1967

Date	Flat Island Site			Middle Mouth Site			Combined Sites			Recoveries of Tags Out ^{1/}		
	Numbers Tagged	Numbers Untagged	Total Catch	Numbers Tagged	Numbers Untagged	Total Catch	Numbers Tagged	Numbers Untagged	Total Catch	Flat Island	Middle Mouth	Total
6/28	10	15	25	9	35	44	19	50	69	1	1	2
29	9	6	15	10	22	32	19	28	47	1	1	2
30	6	8	14	0	8	8	6	16	22	0	0	0
7/ 1	7	1	8	0	1	1	7	2	9	0	0	0
2	27	34	61	3	10	13	30	44	74	1	0	1
3	3	4	7	0	2	2	3	6	9	0	0	0
4	4	5	9	3	1	4	7	6	13	0	2	2
5	2	8	10	0	1	1	2	9	11	0	0	0
6	1	1	2	0	2	2	1	3	4	0	0	0
7	1	4	5				1	4	5	0		0
8	0	0	0				0	0	0	0		0
9	3	1	4				3	1	4	0		0
Totals	383	207	590	341	217	558	724	424	1,148	115 (30.0)	126 (37.0)	241 (33.3)

^{1/} Figures in parenthesis represent recovery percentages of tags out.

TABLE 2

COMPARISONS OF PERCENTAGES OF
 SALMON TAGGED TO COMMERCIAL CATCHES
 BY FISHING PERIOD, 1967^{1/}

Fishing Period	Percentages of Catch : Tags Out ^{2/}	Percentages of Cumulative Catch : Cumulative Tags Out ^{2/}
6/1-6/3	5.0 : 0.0	5.0 : 0.0
6/5-6/7	39.0 : 18.0	44.0 : 18.0
6/8-6/10	4.0 : 14.0	48.0 : 32.0
6/12-6/14	19.0 : 22.0	67.0 : 54.0
6/15-6/17	3.0 : 3.0	70.0 : 57.0
6/19-6/21	19.0 : 21.0	89.0 : 78.0
6/22-6/24	9.0 : 7.0	98.0 : 85.0
6/26-6/27	2.0 : 15.0	100.0 : 100.0

^{1/} Includes both Flat Island and Middle Mouth tags. Includes commercial catches from area 334-12 and 334-15.

^{2/} Number of tags out at end of fishing period; for example, tags out for period 6/12-14 include tags out for 6/11-14.

Table 3 lists recoveries by area and tagging date. As shown in this table, recovery rates declined after June 21. For example, the recovery rate for both sites was 43 percent during June 1-20 and 16 percent during June 21-July 10. This decline was a result of the commercial fishery closure in the lower 150 miles of river that was effective June 27.

Differences Between Recovery Rates: Several differences were noted in the recovery data for each site:

1. A greater percentage of Middle Mouth tags was recovered compared to Flat Island tags, 37.0 percent versus 30.0 percent (Table 1).
2. A majority of the Flat Island tags was recovered below Fish Village (70%), while recoveries of Middle Mouth tags were divided nearly equally above and below Fish Village.
3. The ratio of Flat Island recoveries to catch differed more greatly for various areas of the river than the Middle Mouth recoveries (see Table 4).

Several factors probably caused the above differences:

1. Differential tagging mortality could affect the recovery rates. However, about 20 percent of the Flat Island releases would have had to sustain tagging mortality to account solely for the differences noted.
2. Commercial fishing is usually allowed for two 48-hour periods each week of the season. The timing of the runs to the various mouths of the river may vary several days which may result in differences of actual harvest rates.
3. A much greater amount of gear is fished in the South Mouth, especially near the Flat Island tagging site as compared to the Middle Mouth.

Distribution of Upriver Tag Recoveries by Tagging Date: It had been suspected but never shown that the Yukon king salmon run was composed of separate races bound for different spawning areas, each possibly differing in run timing, relative abundance, productivity, etc. A tag and recovery program is one possible method of identifying and separating these races, assuming they differ in timing and destination. Similar to those conditions found in other large river systems (Columbia, Sacramento Rivers), it was assumed that Yukon

TABLE 3

RECOVERIES OF YUKON RIVER TAGGED KING SALMON BY AREA AND TAGGING
DATE DURING 1967

General Recovery Area	Mileages From Tagging Sites	6/1-10		6/11-20		6/21-30		7/1-10		Total Recoveries		
		1/	2/	1/	2/	1/	2/	1/	2/	1/	2/	Both Sites
<u>South Mouth</u>												
Below Flat Island		5		4		1				10		10
Flat Island (Tagging Site)	0	20		9		3				32		32
Flat Island-Alakanuk	1-11	11		9		3			1	23	1	24
Alakanuk	17	1		1	1			1		3	1	4
Kwiguk-Emmonak	24	8		1						9		9
Aproka-Kwipak Passes	30-43	1								1		1
<u>Middle Mouth</u>												
Willie Moore's Camp (Tagging Site)	0		8		19		3				30	30
Willie Moore's Camp-Snotty Slough	2-15		2		2		1				5	5
Snotty Slough	20			1	3					1	3	4
Aproka Pass	25-40	2	1		16		4			2	21	23
New Hamilton	40				1						1	1
<u>Bugomowik Channel</u>												
Mouth			2		2						4	4
<u>Main River</u>												
Fish Village-Anuk River	52-63	8	3	3	23	4			1	15	27	42
Patsys Cabin-Mt. Village	71-90	1	2		4	3				4	6	10
Old Andreafsky	97		1		2	1				1	3	4
Mouth of Andreafsky River	104						1				1	1
Goose Island	109				2						2	2
Pilot Station	114-122	2		1	3	1	1			4	4	8

TABLE 3 (CONTINUED)

RECOVERIES OF YUKON RIVER TAGGED KING SALMON BY AREA AND TAGGING
DATE DURING 1967

General Recovery Area	Mileages From Tagging Sites	6/1-10		6/11-20		6/21-30		7/1-10		Total Recoveries		
		1/	2/	1/	2/	1/	2/	1/	2/	1/	2/	Both Sites
Pilot Village	130-138			1	1					1	1	2
Pilot Village-Marshall	142-150	1		1	1		1			2	2	4
Marshall	161				1		1				2	2
Paimiut	251				1	1				1	1	2
Holy Cross	261-279		1		1	1	2			1	4	5
Nulato	484					1	1			1	1	2
Ruby	581				1						1	1
Kokrines	606				1						1	1
Kallands	665					1				1		1
Rampart-Stevens Village	817				1	1				1	1	2
Fort Yukon	986-1002	1			1					1	1	2
<u>Innoko River</u>												
Shageluk	328					1				1		1
<u>Recovery Location Unknown</u>			1		1						2	2
Total Recoveries		61	21	31	88	22	15	1	2	115	126	241
Percentage Recovery of Tags Out		46.6	30.9	33.3	50.3	19.8	16.3	2.1	33.3	30.0	37.0	33.3

1/ Tagged at Flat Island

2/ " " Middle Mouth

TABLE 4

RELATION OF TAG RECOVERIES TO KING SALMON
 CATCHES FOR VARIOUS AREAS OF THE
 YUKON RIVER, 1967
 (INCLUDES YUKON TERRITORY CATCHES)

	Total Recoveries	Total Catch ^{1/}	Numbers of Recoveries: Catch	Percentage of Recoveries: Catch
<u>Flat Island Tags</u>				
334-12 through 334-13	78	33,508	1:430	69:31
334-17 through 334-24	28	55,736	1:1,990	25:52
334-31 through Holy Cross	2	8,489	1:4,244	2:8
Above Holy Cross	5	9,508	1:1,902	4:9
Totals	113	107,241	1:949	100:100
<u>Middle Mouth Tags</u>				
334-15	38	27,158	1:714	33:27
334-17 through 334-24	70	55,736	1:796	59:56
334-31 through Holy Cross	5	8,489	1:1,697	4:8
Above Holy Cross	5	9,508	1:1,902	4:9
Totals	118	100,891	1:855	100:100
<u>Total Tags, Total Catches</u>				
Mouths through 334-24	224	131,239	1:586	93:88
334-31 through Holy Cross	7	8,489	1:1,213	3:6
Above Holy Cross	10	9,508	1:951	4:6
Totals	241	149,236	1:619	100:100

^{1/} Includes both commercial and subsistence catches.

king salmon bound for the upper portions of the drainage may have migrated earlier in the season. The majority of salmon migrating above Mile 484 (Nulato) were believed to be bound for Canada and the Tanana and Koyukuk River drainages in Alaska.

Table 5 shows the number of recoveries made by tagging date (10-day periods) for the area above Mile 484 during 1962, 1963 and 1965 to 1967. The 1964 data was not used due to the unusual late season and entry of the run into the river that year. The 1963 and 1965 to 1967 data represent salmon tagged at the river mouth (Mile 0) while in 1962 salmon were tagged at Mile 96. For comparative purposes, the grouping of the 1962 recoveries was obtained by subtracting 5 days from each tagging date (assuming a migration rate of king salmon of about 20 miles a day). In addition, the percentages of total tags applied and total recoveries made above 484 during each tagging period are compared in Table 5.

Seven recoveries were made above Mile 484 in 1967. Of these, four were tagged during June 17 and 18, two were tagged on June 24 and one was tagged on June 8. Tagging dates for salmon recovered above Mile 484 have ranged from June 8 to June 30 during the five year period with the majority of recoveries having been tagged during June 11 to June 20. However, the limited data shows that the percentage of total recoveries for each tagging period was dependent on the numbers tagged, and there was no indication that king salmon bound for the upper river migrated early in the season.

Recovery of King Salmon Classified as to Condition: Table 6 compares upstream recoveries of tagged salmon according to their condition upon release. The data do not include those recoveries made at or below the tagging sites. Salmon classified as Condition 2 and 3 had lower recovery rates when compared to the Condition 1 group. This same tendency was evident in previous studies which indicated a higher mortality rate of Condition 2 and 3 tagged salmon after release. This should be taken into account in population estimates or harvest rate computations.

Population Estimate Considerations: Any population estimate of Yukon River king salmon using present methods must take the following into consideration:

1. Relatively small numbers were tagged and recovered. In addition, many salmon entering Kwiguk, Alakanuk, Bugomowik, North Mouth, etc., channels were not tagged.
2. Non-random tagging and recovery:

TABLE 5

TAGGING DATES OF YUKON RIVER KING SALMON RECOVERIES MADE
ABOVE MILE 484 DURING 1962, 1963 AND 1965-1967

Tagging Dates	Number of Recoveries						Percentage of	
	1962	1963	1965	1966	1967	Total	Total Recoveries ^{1/}	Total Tags ^{2/}
June 1-10	0	0	1	0	1	2	6.5	10.0
June 11-20	3	5	2	4	4	18	58.0	51.6
June 21-30	6	0	2	1	2	11	35.5	33.5
July 1-10	0	0	0	0	0	0	0.0	4.5
July 11-20	0	0	0	0	0	0	0.0	0.3
July 21 +	0	0	0	0	0	0	0.0	0.1
Totals	9	5	5	5	7	31	100.0%	100.0%

^{1/} Recoveries above Mile 484

^{2/} Total Tags applied at all tagging sites

TABLE 6

PERCENTAGE UPSTREAM RECOVERY FOR YUKON RIVER TAGGED KING SALMON
CLASSIFIED AS TO CONDITION DURING 1967 1/

Condition Classification	Numbers Tagged			Percentage Recovery		
	F.I.	M.M.	Total	F.I.	M.M.	Total
1	236	177	413	23.7	32.8	27.6
2	85	81	166	17.6	27.2	22.3
3	14	48	62	7.0	22.9	19.4
Unclassified	8	2	10	37.5	100.0	50.0
Totals	343	308	651	21.9	30.2	25.8

F.I. Flat Island Site

M.M. Middle Mouth Site

1/ Includes only those tags recovered above tagging sites (upstream recoveries)

- (a) Salmon were not always tagged in proportion to their relative abundance.
 - (b) Gear selectivity: Tagging site gear, mainly 8-1/2 inch mesh nets, sampled a somewhat different age, sex and size segment of the run than did the upper river fishwheel fishery.
 - (c) Tagged fish are more susceptible to capture in the lower river. This is a result of milling of tagged fish caused by their disorientation or weakened condition.
 - (d) Tagged fish may not be randomly distributed with the untagged portion of the population. This would be especially true for recoveries made in the vicinity of the tagging sites.
3. Mortality of tagged salmon: Although salmon with bleeding gills or in a very weakened condition were not tagged, it is probable that a few died as a result of the tagging and handling operation.
 4. Unreported tag recoveries.

A number of simple Petersen estimates of the 1967 run were made using different tag, recovery and catch data. Some of the different sets of data used were as follows:

1. All tags out and all recoveries; total commercial and subsistence catch for drainage (total catch).
2. All tags out; all subdistrict #1 recoveries and subdistrict #1 total catch.
3. Condition 1 and 2 tags only; all recoveries above tagging sites; total catch above tagging sites.
4. Same as number 3, but only recoveries and commercial catch by 8-1/2 inch gill nets in subdistrict #1.

The estimates varied from 397,000 to 600,000 king salmon. The low and high estimates resulted from methods 2 and 4 respectively. Similar estimates made for the 1966 run varied from 310,000 to 387,000. These population estimates are probably too high as a result of biases already mentioned (unreported tag recoveries, mortality of tagged fish, etc.).

Because of difficulties associated with the capture, tagging and recovery of salmon, the entire tag and recovery operation will be moved above the main commercial fishery in 1968. Salmon will be tagged and released in the vicinity of Ohagamut (Mile 185) and Department gear will be operated in the Russian Mission to Holy Cross area (Mile 213 - 279) for the purpose of obtaining tagged to untagged ratios. Commercial and subsistence catches in the latter area will also be closely monitored by Department personnel in order to obtain additional tagged to untagged ratios.

RESULTS

Chum Salmon

Most chum salmon were captured incidentally to king salmon as tagging site gear consisted mainly of 8-1/2 inch mesh gill nets. As shown in Table 7, a total of 1,293 chum salmon was captured at both sites of which 527 were tagged. There were 357 chum salmon tagged at the Flat Island site and 170 tagged at the Middle Mouth site.

Table 8 shows the area of recovery for all 1967 tag recoveries. A total of 27 or 5.1 percent of the tags out were recovered. Recovery rates for chum salmon tagged and released in the vicinity of the river mouth during the 1963-1967 period have ranged from 4.0 percent in 1966 to 11.9 percent in 1963.

Kuskokwim River Tagging

A pilot tagging study was also initiated on the Kuskokwim River king salmon in 1967. The results of the preliminary study have not yet been completely analyzed and will be incorporated in a later report.

SUMMARY

King Salmon

1. A total of 1,148 king salmon was captured at two tagging sites, Middle Mouth and Flat Island, of which 724 were tagged and released.
2. A total of 241 or 33.0 percent of the total tags out were recovered in the commercial and subsistence fisheries.

Table 7. Numbers of Yukon River Chum Salmon Tagged and Captured During 1967.

Date	Flat Island 1967			Middle Mouth 1967			Combined Sites		
	Tagged	Untagged	Total	Tagged	Untagged	Total	Tagged	Untagged	Total
June 5	1	0	1				1	0	1
6	2	0	2				2	0	2
7									
8	1	0	1				1	0	1
9									
10									
11									
12	3	1	4	0	1	1	3	2	5
13	3	1	4				3	1	4
14	1	1	2				1	1	2
15	4	6	10				4	6	10
16				0	1	1	0	1	1
17									
18	6	3	9	6	5	11	12	8	20
19	2	0	2	3	0	3	5	0	5
20				1	0	1	1	0	1
21	12	14	26	1	0	1	13	14	27
22	6	7	13	1	0	1	7	7	14
23	5	6	11				5	6	11
24	51	41	92	1	5	6	52	46	98
25	62	81	143	36	7	43	98	88	186
26	17	38	55	43	25	68	60	63	123
27	29	25	54	45	61	106	74	86	160
28	35	63	98	6	6	12	41	69	110
29	15	27	42	6	15	21	21	42	63
30	3	9	12	0	20	20	3	29	32
July 1	18	6	24	2	3	5	20	9	29
2	49	84	133	7	14	21	56	98	154
3	7	25	32	2	3	5	9	28	37
4	10	31	41	3	9	12	13	40	53
5	6	36	42	5	14	19	11	50	61
6	1	15	16	2	4	6	3	19	22
7	4	27	31				4	27	31
8	1	11	12				1	11	12
9	3	15	18				3	15	18
Total	357	573	930	170	193	363	527	766	1293

Table 8. Recoveries of Yukon River Tagged Chum Salmon by Area
1967

<u>Area of Recovery</u>	<u>Mileages from Tagging Site</u>	<u>No. of Recoveries</u>
<u>SOUTH MOUTH</u>		
Below Flat Island		
Flat Island Tagging Site	0	3
Flat Island - Alakanuk	1 - 11	1
Alakanuk	17	-
Kwiguk-Emmonak	24	2
Apokra - Kwipak Passes	30 - 43	2
<u>MIDDLE MOUTH</u>		
Snotty Slough	20	
Apokra Pass	35	
<u>MAIN RIVER</u>		
Fish Village	52 - 63	6
Mouth, Andreafsky River	104	1
Pilot Station	122	3
Ohagamut	185	1
Russian Mission	213	3
Holy Cross	279	1
Anvik & Vicinity	317-366	1
Nulato	484	1
Ruby	581	1
Rampart		
<u>PORCUPINE RIVER</u>		
Old Crow	1259	1
<u>TOTAL RECOVERIES</u>		<u>27</u>

3. The recovery rates for salmon tagged at the Middle Mouth site was 37.0 percent compared to 30.0 percent for salmon tagged at the Flat Island site. Recoveries of Middle Mouth tags were randomly distributed among catches for various areas of the river, while Flat Island tags were not.
4. Several factors that probably affected tag recoveries are differential tagging mortality, distribution and amount of fishing (recovery) gear and timing of the runs at each site.
5. Tag recovery data indicated that the early segment of the king salmon run was not bound for the upper portion of the drainage. There was no relationship between number of recoveries and tagging period for those recoveries made in the upper river (above Mile 484).
6. Tagged salmon were classified as to their condition (1:good, 2:fair or questionable, 3:poor) upon release. Salmon classified as Condition 2 and 3 had lower upstream recovery rates (22.3 and 19.4 % respectively) when compared to the Condition 1 group (27.6%). This indicated greater mortalities for the Condition 2 and 3 groups.
7. Population estimates (Petersen method) using different sets of data varied from 397,000 to 600,000 king salmon for 1967. These estimates are believed to be high due to suspected biases such as small numbers tagged and recaptured, non-randomness of tagging and recovery effort, unreported tag recoveries and mortality of tagged fish.

Chum Salmon

1. A total of 1,293 chum salmon was captured incidentally at both tagging sites of which 527 were tagged and released.
2. A total of 27 or 5.1 percent of all tags out were recovered.

SALMON SUBSISTENCE FISHERY SURVEYS

INTRODUCTION

The subsistence fishery still represents the most important utilization

of salmon in the Arctic-Yukon-Kuskokwim area. Chum salmon have always been the backbone of the subsistence fishery, with most of the catch being fed to sled dogs. King salmon are reserved almost exclusively for human consumption, although substantial numbers of chum salmon are also eaten. Minor utilization of pink, coho and red salmon is made.

The Alaska Department of Fish and Game has conducted systematic surveys of the Kuskokwim and Yukon River subsistence fisheries since 1960 and 1961 respectively. During 1967 comprehensive surveys were also conducted in the Norton Sound district and in certain Kotzebue district villages where only limited surveys had been made in the past.

The subsistence fishery surveys are conducted for the following reasons:

1. The documentation of catches and associated fishery data (amount of gear, number of fishermen, etc.) may indicate relative run magnitudes, escapements and trends in the dependence on subsistence fishing which are useful in fishery management.
2. Tag recoveries from both river and high seas projects are collected. The surveys are insurance against a large number of unreported tag recoveries by subsistence fishermen.
3. Documentation of subsistence catches is required in order that these northern salmon stocks continue to qualify under the abstention principle of the I.N.P.F.C. Treaty, i.e., full utilization.

METHODS

Most of the subsistence fishery data obtained during 1967 was from personal interviews of fishermen and direct counts of salmon. Some catches were obtained from return of special catch forms or questionnaires that were distributed to fishermen prior to the fishing season. This latter method has been used extensively for obtaining subsistence catch data in Norton Sound and, to a lesser degree, in the Kotzebue district prior to 1967.

Two-man crews, traveling by boat, surveyed the Yukon and Kuskokwim Rivers, while the other subsistence fisheries were surveyed by biologists traveling in single engine aircraft. The Whitehorse office of the Canadian Department of Fisheries supplied catch information for the Canadian portion

of the Yukon River drainage. The term "small salmon" used in this report refers to species of salmon other than king salmon.

RESULTS

Tables 9 through 13 show 1967 subsistence catches by village in each of the following districts: Kuskokwim, Yukon, Norton Sound, Port Clarence and Kotzebue. A total catch of 81,539 kings and 585,958 other species, mostly chums, were recorded in the Arctic-Yukon-Kuskokwim area during 1967.

Table 14 compares subsistence catches for the Kuskokwim, Yukon and Kotzebue districts during those years that Department surveys were made. Norton Sound subsistence catch information dates back to 1964, but is not comparable. With the exception of a record king salmon catch and an above-average catch of small salmon in the Kuskokwim district, the other district catches were average or below-average in 1967.

DISCUSSION

The recorded subsistence catches represent minimum figures for the following reasons:

1. Catches made late in the season after completion of surveys are not always recorded.
2. Some salmon consumed prior to the time of survey are not always recorded.
3. Information is incomplete or lacking for some villages: coastal villages between Yukon and Kuskokwim Rivers, St. Lawrence Island villages, Mekoryuk, Nome, St. Michaels, Teller, Goodnews.

Although difficult to document, it is estimated that between 80-90 percent of the actual Arctic-Yukon-Kuskokwim area subsistence salmon harvest has been tabulated by the Department during recent years.

Subsistence catches are influenced by salmon abundance and fishing effort. Several factors affect fishing effort and include the following:

TABLE 9

KUSKOKWIM DISTRICT SUBSISTENCE CATCH DATA, 1967^{1/}

Fishing Unit	Date of Survey	Fishing Families	Dogs	Snow Travelers	Salmon Catch		Units of Gear		
					Kings	Small Salmon	Chum Nets	King Nets	Fish-Wheels
Quinnagak	7/13	19	76	?	1,349	6,023	17	16	
Kwigillingok	7/22	6	33	1	957	2,846	5	6	
Eek	7/20	30	194	7	4,572	2,917	18	27	
Tuntatuliag	7/21	28	164	4	3,462	15,625	25	24	
Kasigluk	7/26	20	80	2	2,766	2,309	20	24	
Nunapitchuk	7/26	28	185	8	1,926	6,278	56	34	
Napakiak	7/23	44	239	7	3,895	14,052	33	42	
Napaskiak	7/24	32	169	2	2,998	8,325	27	28	
Oscarville	7/25	9	40	1	1,127	1,983	7	10	
Bethel	7/28	113	342	13	13,925	16,629	77	122	
Kwethluk	8/1	61	319	14	6,993	24,294	60	65	
Akiachak	8/2	45	209	9	5,543	13,936	34	39	
Akiak	8/3	28	177	6	3,660	9,085	23	26	
Tuluksak	8/4	23	109	8	1,709	10,458	22	17	
Kalskag Area	8/5	31	207	6	3,567	24,626	32	25	3
Aniak	8/6	20	139	4	1,280	16,158	14	7	6
Russian Mission	8/7	7	28	1	217	7,253	4	2	3
Napaimuit	8/7	3	15	2	60	5,862	4	0	23/
Crooked Creek	8/9	11	76	1	585	13,894	12	1	5
Sleetmute	8/18	13	85	1	343	6,951	15	2	3
Stony River Village	8/11	10	82		303	9,488	8	0	9
Deacon's		1			50	500			
McGrath					25	50			
Medfra		2			20	750			22/
Nickolai					10	900			
Telida		1			0	0			
Totals		588	2,950	97	61,342	221,192	513	517	31

1/ Some fishing in all villages after survey 2/ Not included in data 3/ Plus one trap

10. YUKON DISTRICT SUBSISTENCE CATCH DATA, 1967 (Includes Canadian Catches).

Fishing Families	Dogs	Snow Travelers	Kings	Chums ^{1/}	Pinks	Total Salmon	Units of Gear		
							Chum Net	King Net	Fish Wheel
	126	34	287	9,843	121	10,251	66	2	0
	60	7	755	2,729	28	3,512	14	3	0
	145	17	541	15,248	66	15,855	54	6	0
	53	9	959	7,852	58	8,859	19	2	0
	48	13	162	7,225	26	7,413	21	1	0
	130	24	1,345	8,080	225	9,650	39	6	0
	174	14	993	9,572	218	10,783	31	3	0
	135	7	1,534	5,803	717	8,054	30	12	0
	118	6	306	3,012	58	3,376	24	6	0
	85	1	2,019	4,889	8	6,916	16	7	0
	109	7	2,876	22,334	7	25,217	25	21	0
	104	12	54	20,785	8	20,847	14	1	0
	110	7	199	22,851	1	23,051	7	4	0
	217	9	199	26,871	157	27,227	15	3	0
	314	5	578	22,519	2	23,099	38	4	0
	145	4	262	4,613	0	4,875	14	4	0
	75	5	210	2,650	0	2,860	3	3	0
	92	4	820	10,690	0	11,510	3	2	0
	137	1	151	11,938	0	12,029	0	0	0
	84	0	368	15,763	0	16,131	0	1	0
	78	2	534	3,145	0	3,679	0	4	0
	34	1	210	4,292	0	4,502	1	1	0
	124	2	692	8,983	0	9,675	0	0	0
	3/	3/		3/			3/		
	"	"	30	"		30	"	1	
	"	"	600	"		600	"	1	
	"	"	600	"		600	"	9	

UKON DISTRICT SUBSISTENCE CATCH DATA, 1967 (Includes Canadian Catches).

Hunting Traps	Dogs	Snow Travelers	Kings	Chums ^{1/}	Pinks	Total Salmon	Units of Gear		
							Chum Net	King Net	Fish Whale
	3/ "	3/ "	1,200	3/ "		1,200	3/ "	8	
	"	"	250	"		250	"	1	
	"	"	180	"		180	"	3	
	"	"	60	"		60	"	1	
	2,724 +	191 +	18,974	251,687	1,700	272,361	434 +	120	8
	80	8	7	5,489	0	5,496	16	0	
	76	3	65	5,837	0	5,902	15	0	
	22	0	0	170	0	170	1	0	
	108	2	70	3,929	0	3,999	33	0	
	286	13	142	15,425	0	15,567	65	0	
	18	0	0	22	0	22	0	0	
	10	1	252	3,517	0	3,769	0	0	
	28	1	252	3,539	0	3,791	0	0	
	97	2	0	2,626	0	2,626	10	0	

) . YUKON DISTRICT SUBSISTENCE CATCH DATA, 1967 (Includes Canadian Catches).

g	Dogs	Snow Travelers	Kings	Chums ^{1/}	Pinks	Total Salmon	Units of Gear		
							Chum Net	King Net	Fish Wheel
	97	2	0	2,626	0	2,626	10	0	
	3,135 +	207	19,368	273,277	1,700	294,345	509 +	120	87

TABLE 11.

NORTON SOUND DISTRICT SUBSISTENCE CATCHES, 1967

Village	Number of Fishermen Interviewed	Kings	Cohos	Pinks	Chums	Total Salmon
Unalakleet	43	428	329	9,890	2,951	13,598
Shaktoolik	13	262	387	2,010	4,436	7,095
Koyuk	13	12	14	1,097	2,945	4,068
Elim	15	39	116	1,322	9,913	11,390
Golovin	10	2	86	1,084	898	2,070
White Mountain	9	1	99	1,690	3,905	5,695
Nome	11	11	36	349	627	1,023
St. Michael	<u>5</u>	<u>62</u>	<u>155</u>	<u>74</u>	<u>1,132</u>	<u>1,423</u>
DISTRICT TOTAL	119	817	1,222	17,516	26,807	46,362

TABLE 12.

PORT CLARENCE DISTRICT SUBSISTENCE CATCHES, 1967

Area	Number of Fishermen	Kings	Reds	Cohos	Pinks	Chums	Total Salmon
Pilgrim River	4	7	51	4	5	21	88
Salmon Lake	<u>9</u>	<u>0</u>	<u>286</u>	<u>2</u>	<u>0</u>	<u>0</u>	<u>288</u>
TOTAL PILGRIM RIVER DRAINAGE	13	7	337	6	5	21	376
Teller	<u>6</u>	<u>5</u>	<u>1,731</u>	<u>226</u>	<u>762</u>	<u>1,052</u>	<u>3,776</u>
DISTRICT TOTAL	19	12	2,068	232	767	1,073	4,152

TABLE 13.

KOTZEBUE DISTRICT SUBSISTENCE CATCHES, 1967

Village	Number of Fishermen Interviewed	Chum Salmon
Noorvik	26	2,350
Kiana	21	1,489
Ambler	14	679
Shungnak	12	1,500
Kobuk	5	175
KOBUK RIVER TOTAL	78	6,193
Noatak	29	26,512
Kotzebue	20	4,032
Deering	6	3,098
Buckland	8	162
Candle	2	11
Shishmaref	1	100
DISTRICT TOTAL	144	40,108

TABLE 14.

COMPARISONS OF SUBSISTENCE CATCHES FOR KUSKOKWIM,
YUKON AND KOTZEBUE DISTRICTS
1960-1967

Year	Kuskokwim District		Yukon District		Kotzebue District
	Kings	Small Salmon ^{1/}	Kings	Small Salmon ^{1/}	Small Salmon ^{1/}
1960	19,457	337,067			
1961	28,898	185,301	23,719	407,814	
1962	13,596	164,417	19,910	358,441	100,000
1963	34,615	140,890	32,656	421,625	31,069
1964	30,853	214,942	22,817	485,630	29,762
1965	25,043	250,878	19,723	458,379	30,500
1966	49,280	180,054	14,017	214,236	35,588
1967	61,342	221,192	19,368	274,977	40,108

^{1/} Mostly chum salmon

1. Adverse weather and river conditions.
2. Immediate employment situation (short-term construction projects and firefighting).
3. Decline in dependence on subsistence fishing. Increased welfare payments and more employment opportunities have resulted in a general decline in fishing effort throughout the A-Y-K area. Also snow vehicles are beginning to replace sled dogs and this is expected to speed up the decline of the subsistence fishery in the future.

Subsistence catches of Yukon River chum salmon have declined markedly during the past two seasons. Although adverse fishing conditions and the immediate employment situation have had some effect, the decline is largely the result of a decline in the dependence on subsistence fishing. As shown below there has been a decline in fishermen, sled dogs and the number of fishwheels for the Yukon River:

Year	Number of Fishing Families	Number of Dogs Owned	Number of Fishwheels Operated
1961	624	4,806	169
1963	597	4,155	156
1965	541	3,974	127
1967	517	3,135	87

Effort and dependence on subsistence fishing has remained relatively stable during recent years for the Kuskokwim River. Large catches of king salmon made during the 1966 and 1967 season are a result of the abundance of this species.

There is some evidence that subsistence fishing effort has declined in the Kotzebue district since 1962. Still, the large chum salmon catch recorded in 1962 was largely the result of run magnitude.

SUMMARY

1. A minimum total subsistence catch of 81,539 kings and 585,958 other species, mostly chums, were recorded in the Arctic-Yukon-Kuskokwim area during 1967.
2. With the exception of a record king salmon catch and an above average catch of small salmon in the Kuskokwim district, the other district catches were average or below-average in 1967.
3. Yukon River chum salmon catches have declined markedly during the past two seasons as a result of a decline in the dependence on subsistence fishing. Subsistence fishing effort and dependence has been relatively stable for the Kuskokwim district.

KWINIUK RIVER COUNTING TOWER STUDY

INTRODUCTION

In the Norton Sound district of northwestern Alaska, chum salmon are the most abundant species of salmon and are harvested for commercial and subsistence utilization. It is the goal of fisheries management to allow maximum harvest of salmon that are excess to spawning ground requirements. Estimates of escapement levels are important in the day-to-day management of Norton Sound fisheries and are based mainly on aerial survey counts of key salmon spawning streams.

Objectives of this study, initiated in 1965, are as follows:

1. Evaluate the accuracy of aerial surveys of spawning salmon by comparing aerial counts to tower counts.
2. Evaluate different tower counting methods, e.g., comparison of counts made ten minutes out of each hour to total counts.
3. Determine daily and seasonal timing and magnitude of the runs and environmental factors that may influence salmon behavior.

Studies involving similar objectives have been conducted in Bristol Bay on red salmon primarily. It was decided to conduct this study because of the

importance of chum and pink salmon in Norton Sound and the possibility that these species may exhibit different migration patterns than that for red salmon.

METHODS AND MATERIALS

An aluminum tower was erected during mid-June on a high bank five miles above the mouth of the Kwiniuk River which is located 110 miles east of Nome (Figure 4). Continuous hourly counts (24 hours per day) were made throughout the salmon runs to obtain the total escapement. Ten-minute counts were also made each hour to determine if a reliable estimate of the total escapement could be obtained by counting for shorter time periods.

Daily water temperatures and river depths were measured by the tower crew. Air temperature, precipitation, wind direction and wind velocity were furnished by the FAA station at Moses Point.

Aerial surveys of the river were made with a single engine aircraft, Cessna-180, at an altitude of about 500-700 feet. Two different observers, management biologists, made the counts. Counts were recorded in units of 1, 10, or 100. Surveys were usually made without prior knowledge of the tower counts.

RESULTS

Estimation of Escapements from Tower Counts: In 1967 a total of 26,661 chums, 3,587 pinks, and 13 kings were counted past the tower. Daily and total escapements for the years 1965-1967 are presented in Table 15. The total escapement is the total tower count minus the number of salmon taken above the tower by subsistence fishermen. As a result of high water in mid-June and mid-July and a different path of migration of salmon passing the tower, counts in 1967 were probably not as accurate compared to the 1966 and 1965 counts.

Chum salmon peaked on June 30 and during the period July 5 to July 13 in 1967, but due to high water during July 15-19, large numbers of chums may have moved upstream uncounted. Similarly, it was difficult to determine the peak of the pink salmon run in 1967. During 1966 and 1965 the pink run peaked on or after July 15. Similar to past years, all of the kings in 1967 passed the tower prior to July 15.

TABLE 15.

KWINIUK RIVER DAILY SALMON ESCAPEMENTS, 1965-67

DATE	CHUMS			PINKS			KINGS		
	1965	1966	1967	1965	1966	1967	1965	1966	1967
6/18	6								
6/19		24							
6/20		26							
6/21		108							
6/22		348							
6/23		253							
6/24		289							
6/25		-451*	5						
6/26		463	19						
6/27		129	53						
6/28	212	508	193	174					1
6/29	765	71	45	86			1	1	
6/30	1,593	412	1,140	-40*			1		3
7/1	869	3,548	693	56		1	1	1	
7/2	4,296	1,891	591	38	11	2	3		1
7/3	1,053	435	288	35	18	1	1		
7/4	1,194	1,996	464	47	288	2			1
7/5	1,062	1,908	2,156	-8*	200				
7/6	1,028	1,226	510	2	16				
7/7	524	519	3,448	22	35	12		1	
7/8	833	2,000	3,403	146	39	27			1
7/9	389	1,800	2,683	92	66	476	2	2	2
7/10	1,806	-31*	2,822	170	10	197			2
7/11	3,517	2,079	2,974	300	39	564	4		
7/12	3,671	4,998	1,972	406	36	644	3		1
7/13	673	2,676	2,706	127	59	759	1		1
7/14	2,953	354	308	1,203	81	453			
7/15	1,582	1,025	22	1,632	307	22	1		
7/16	4,164	-268*	37	2,813	-197*	70		-1*	
7/17	247	508	52	155	198	118		1	
7/18	66	1,121	14	115	565	32			
7/19	358	1,619	27	1,097	1,498	26	1	1	
7/20		570	6		625	26			
7/21		244	50		296	135			
7/22		325	-20*		1,368	20			
7/23		215			1,219				
7/24		92			1,066				
7/25		107			2,172				
7/26		16			676				
7/27		31			107			1	
7/28		-2*			66				
Total Tower Count:	32,861	33,182	25,661	8,668	10,864	3,587	19	7	13
Caught Above Tower by Subsistence Fishermen:	6,227	396	2,217	367	235	79	5	0	0
ESCAPEMENTS:	26,634	32,786	24,444	8,301	10,629	3,508	14	7	13

* Fish moved downstream past tower.

Estimate of Total Escapements by 10-Minute Counts: In 1967 ten-minute tower counts of migrating salmon were made each hour for the purpose of comparing the total season estimate of escapements based on hourly and 10-minute counts. Results from a previous 1966 experiment indicated that 10-minute counts may provide a reliable estimate of the season escapement. A summary of the 1966 results are shown below:

1966 EXPERIMENT

	Total Actual Hour Counts	Total Expanded 10-Minute Counts	Relative Error
Chums	27,261	29,692	+ 8.92%
Pinks	10,138	10,770	+ 6.23%

Although the tower counting conditions were extremely unfavorable in 1967, the expanded 10-minute counts provided an estimate of the total escapement that was within acceptable limits when compared to the total hourly counts of the observed escapement. Results of the 1967 experiment are summarized below:

1967 EXPERIMENT

	Total Actual Hour Counts	Total Expanded 10-Minute Counts	Relative Error
Chums	26,520	26,100	- 1.58%
Pinks	3,397	2,982	- 12.22%

The 1966 and 1967 experiments demonstrated that 10-minute counts taken each hour resulted in a reliable estimate of the observed total season escapement. However, ten-minute counts did not provide a reliable estimate of the daily escapement. Therefore, hourly counts were required to obtain an accurate estimate of the daily escapements for the purpose of evaluating the aerial surveys.

Observations of Salmon Behavior: In 1967 the majority of the salmon passing the tower site followed along the opposite shore in contrast to the migration pathway observed in 1966 and 1965. As a result, tower counts were not as accurate as in other seasons when salmon passed close to the tower.

On July 8 during the 1967 season a temporary counting tower was erected along the opposite shore so that the run could be enumerated more effectively. Possible changes in the channel of the river resulting from high levels of discharge in early June may have influenced the migration route of the salmon.

As in 1966 and 1965, chum salmon passed the tower primarily during the mid-afternoon to early morning hours throughout the season. Comparative daily timing of chums passing the tower for the years 1965-67 is illustrated in Figure 5. Pink salmon showed similar patterns of daily migration timing.

Downstream movements of adult salmon past the tower in 1967 was not as pronounced as in 1966. Downstream movements in 1967 occurred mainly during the late morning hours. In 1966 the majority of salmon moving downstream was associated with changes in precipitation levels.

Aerial Surveys: The tower counts recorded during 1967 were probably low due to an undetermined number of salmon passing the tower during unfavorable counting conditions. The number and accuracy of aerial surveys were also limited by unfavorable weather and stream conditions.

Only one aerial survey (July 8) was made under what was considered good counting conditions. On July 8 a total of 15,000 chum salmon was counted as compared to a cumulative tower count of 9,700 for the same date. The very large differences between these two counts indicated that either there were more chum salmon in the river than recorded by the tower crew or that the aerial counts were extremely over estimated.

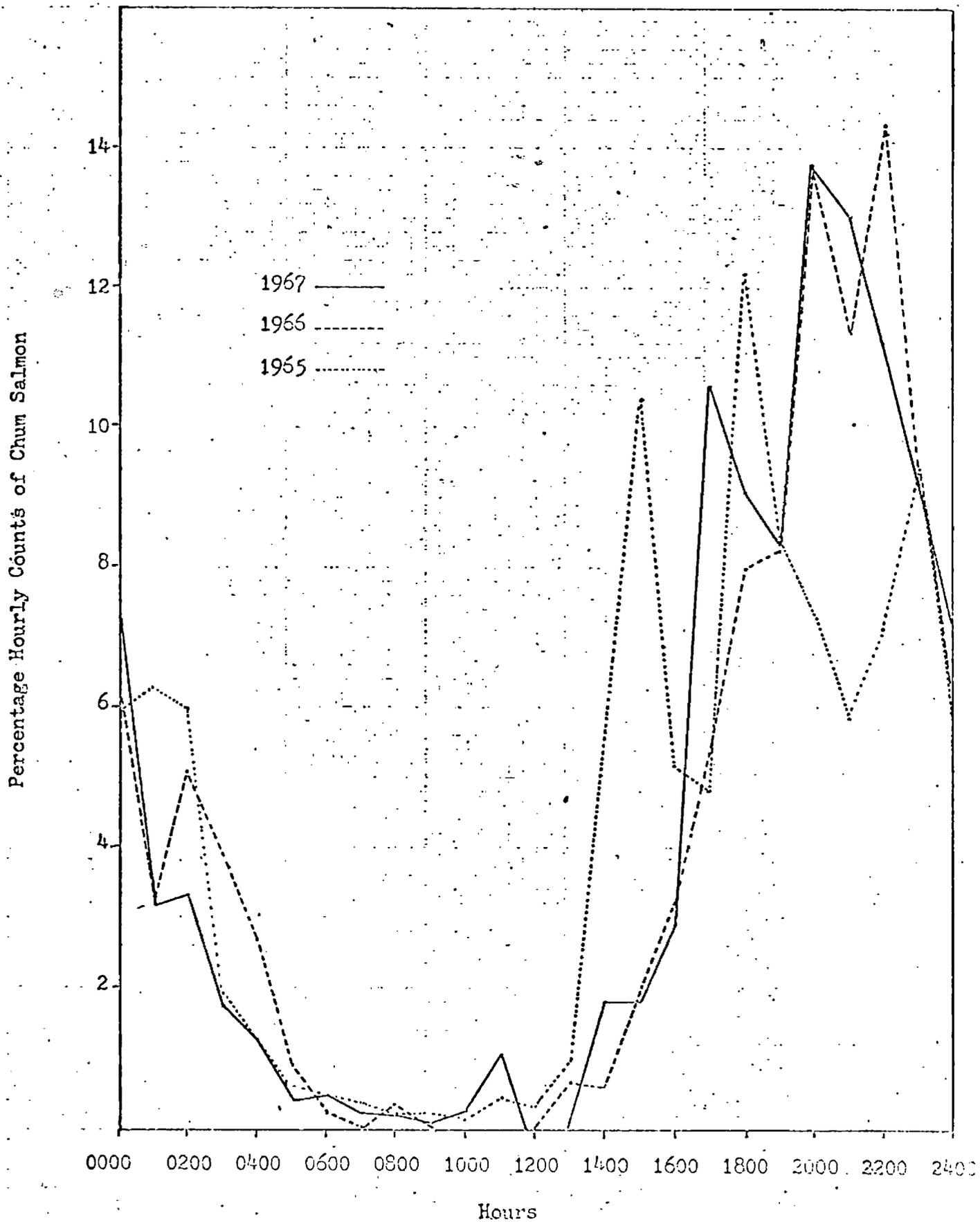
Two other aerial surveys were made on July 17 and July 22 under unfavorable conditions which included heavy sky overcast, slightly turbid water, and on one occasion, the observer encountered a severe case of air-sickness. The small salmon counts (pink and chum salmon combined) obtained during both of these surveys were about one-half that of the recorded tower counts.

DISCUSSION

Due to the very poor tower counting conditions previously mentioned, it was not possible to adequately evaluate the aerial survey method of estimating Kwiniuk River salmon escapements during 1967. As a consequence, little new information was obtained from the 1967 study in regards to providing suggestions for evaluating and improving aerial survey methods.

FIGURE 5.

TIMING OF DAILY MOVEMENTS OF CHUM SALMON PASSING
KWINIUK RIVER COUNTING TOWER, 1965 - 1967



Results of the previous studies (1966 season) indicated that even during good counting conditions, aerial surveys tended to underestimate the actual escapement as indicated by tower counts. In 1966 seven aerial surveys were flown of the Kwiniuk River during various stages of the salmon runs from the early migrating schools to the onset of peak spawning activity. The best survey was made during the latter period when the aerial count represented 74.5 percent of the accumulated tower count of salmon. All surveys in 1966 underestimated the actual number of salmon in the river. The high count or estimate of salmon escapement, usually made near the peak of spawning, is considered as the best index of the total escapement.

As a result of the similarity of the Kwiniuk River to other Norton Sound streams, the run timing and escapement data obtained from this project can generally be applied to the entire Norton Sound district.

SUMMARY

1. For the third year a counting tower project on the Kwiniuk River was operated primarily for the purpose of obtaining an estimate of the total salmon escapement so that aerial survey methods of estimating escapements could be evaluated.
2. Hourly and ten-minute tower counts per hour were made throughout the season.
3. A total of 26,661 chums, 3,587 pinks, and 13 kings were counted passing the tower in 1967.
4. Ten-minute tower counts per hour were shown to provide a reliable estimate of the observed season escapement of chum and pink salmon when compared to the total hourly counts.
5. High, turbid water, inclement weather and a different migration route of salmon passing the tower site were believed to have substantially decreased the accuracy of the tower counts in 1967. In addition, aerial counts were limited by unfavorable counting conditions. As a result, it was not possible to properly evaluate the 1967 aerial survey escapement counts.
6. Results from previous 1966 studies indicated that aerial survey counts tended to underestimate the actual escapement as indicated by tower counts.

7. The 1967 chum salmon migration peaked on June 30 and during the period July 5-13 but due to high water, it was difficult to pinpoint the peak of the pink salmon migration timing which peaked on or about July 15 during previous years.
8. In 1967, as in 1966 and 1965, salmon passing the tower traveled mainly during the mid-afternoon to early morning hours.

AGE, SEX AND SIZE COMPOSITION OF SALMON

INTRODUCTION

The Arctic-Yukon-Kuskokwim area catch and escapement sampling program, initiated in 1964, was expanded in 1967. A larger number of samples was obtained from all species, except pink salmon, than in any previous year. However, due to the vast size of the study area and the large number of salmon runs, comprehensive age determinations are either lacking or incomplete for the following: Kuskokwim River chum and red salmon, Yukon River fall chum and coho salmon and Norton Sound king and coho salmon.

The objective of this program is to provide such basic management information as age, length, weight and sex composition of the various salmon runs. This information can be used in assessing the effects of a fishery upon run productivity and may be eventually used in making run predictions.

METHODS

Samples were obtained from commercial, subsistence and Department test fishing and tagging site catches. A few samples were also obtained from salmon carcasses found on various spawning grounds. Scale samples were taken from the area of the first or second scale row above the lateral line and located on a diagonal line down from the insertion of the dorsal fin to the origin of the anal fin.

With the exception of Kuskokwim River tagging and test fishing site catches, all lengths were taken from mid-eye to the fork of the caudal fin.

Salmon captured in Kuskokwim River tagging and test fishing nets were measured from the snout to the caudal fin fork. Sex was determined by examining the gonads of each fish sampled.

For purposes of this report, a 4₂ salmon returning to spawn in 1967 would be the progeny of the 1963 run that migrated from freshwater to the ocean in the spring of 1965. Chum salmon do not over-winter in fresh water so only their total ages are shown in this report.

It has been impossible to determine whether a few king salmon scale samples (usually less than 10%) have one or two freshwater annuli. This cannot be resolved until adequate samples of smolt are obtained for age and size analyses.

KUSKOKWIM RIVER KING SALMON

Commercial Catch Samples: Table 16 shows the age composition of 610 Kuskokwim River king salmon, representing commercial catches taken mainly with 8-1/2 inch gill nets, that were sampled throughout the run. A majority of the fish sampled were 6₂'s (73.4%) followed by the 7₂ (15.9%), 5₂ (10.2%) and 4₂ (.5%) age classes. The sex ratio of the sample was nearly equal, 47.4 percent males and 52.6 percent females.

Appendix Tables A and B show the age-length and age-weight data respectively for the 1967 sample. The average weight per fish (combined sexes) of the sample was 27.2 pounds and the average length (mid-eye to caudal fin fork) was 88.4 centimeters.

Department Test Fishing and Tagging Site Catches: Table 17 shows the age compositions of king salmon captured in test fishing and tagging site gill nets of varying mesh size. The age composition of the 8-1/2 inch mesh sample was very similar to that of the commercial catch sample shown in Table 16. The sample from the 5-1/2 inch mesh net contained much greater percentages of the 4₂ and 5₂ age classes. A total of 42 fish or 43.3 percent of the sample was composed of the 4₂ age group. The smaller sample from the 9-1/2 inch mesh net had an age composition similar to that of the 8-1/2 inch mesh sample.

Appendix Table C shows the fork length frequencies of all king salmon captured by test fishing and tagging site gear. This table also includes those salmon that were tagged and released.

Aniak River: On July 18-21 a total of 42 carcasses was sampled on the

Table 16. Age Composition of Kuskokwim River Commercial King Salmon Catches Sampled During June 1-23, 1967^{1/}

Age Class	<u>MALES</u>		<u>FEMALES</u>		<u>COMBINED SEXES</u>	
	Number	Percentage	Number	Percentage	Number	Percentage
4 ₁₋₂	3	0.5	0	0.0	3	0.5
5 ₂	47	7.7	15	2.5	62	10.2
6 ₂	200	32.8	248	40.6	448	73.4
7 ₂	39	6.4	58	9.5	97	15.9
COMBINED AGES	289	47.4	321	52.6	610	100.0

^{1/} Majority of king salmon captured with 8-1/2 inch stretched mesh drift gill nets.

Table 17. Age Composition of Kuskokwim River King Salmon Captured by Department Tagging and Test Fishing Nets of Varying Mesh Size, 1967.

Mesh Size	Age	MALES		FEMALES		COMBINED SEXES	
		No.	Percent	No.	Percent	No.	Percent
5-1/2"	4 ₂	42	43.3	0	0.0	42	43.3
	5 ₂	23	23.7	5	5.2	28	28.9
	6 ₂	9	9.3	12	12.3	21	21.6
	7 ₂	<u>2</u>	<u>2.1</u>	<u>4</u>	<u>4.1</u>	<u>6</u>	<u>6.2</u>
	Totals	76	78.4	21	21.7	97	100.0
8-1/2"	4 ₂	1	1.1	0	0.0	1	1.1
	5 ₂	7	7.4	0	0.0	7	7.4
	6 ₂	29	30.9	41	43.6	70	74.5
	7 ₂	<u>6</u>	<u>6.4</u>	<u>10</u>	<u>10.6</u>	<u>16</u>	<u>17.0</u>
	Totals	43	45.8	51	54.2	94	100.0
9-1/2"	4 ₂	3	5.2	0	0.0	3	5.2
	5 ₂	5	8.8	1	1.8	6	10.6
	6 ₂	19	33.3	19	33.3	38	66.6
	7 ₂	<u>5</u>	<u>8.8</u>	<u>5</u>	<u>8.8</u>	<u>10</u>	<u>17.6</u>
	Totals	32	56.1	25	43.9	57	100.0

spawning grounds of the upper Aniak River, tributary to Kuskokwim River. The age composition of this sample was 7.1, 11.9 and 81.0 percent for the 4₂, 5₂ and 6₂ age groups respectively. The sex ratio of this sample was 27 males and 15 females.

Discussion: Table 18 compares age compositions of commercially caught king salmon sampled during the last four years. A few fish were tentatively assigned to the 5₃, 6₃, 7₃, and 8₃ age groups during 1964-1965. These age groups have been included in the 4₂, 5₂, 6₂ and 7₂ age groups respectively in Table 18 for comparative purposes.

These comparisons indicated very good survival and production of 1960 brood year fish during the 1964-1967 period. The Kuskokwim River king salmon runs have been above average in magnitude during the last three years which is probably, in part, due to the strong return of 1960 brood year fish.

OTHER SPECIES - KUSKOKWIM AND KANEKTOK RIVERS

As time allowed, limited samples of red, coho and chum salmon were obtained from the Kuskokwim and Kanektok Rivers. Age compositions of these samples are shown in Appendix Tables D and E.

The Kanektok River empties into Kuskokwim Bay about 30 miles south of the Kuskokwim River mouth. Salmon were taken by commercial fishermen operating in the Bay adjacent to the mouth of the Kanektok River. A majority of the salmon captured in this area are thought to be of Kanektok River origin, but a few Kuskokwim River salmon are probably intercepted here.

YUKON RIVER KING SALMON

Lower Yukon Catch Sample: Table 19 shows the age composition by sex of 991 king salmon representing commercial catches and Department tagging and test fishing site catches made with 8-1/2 inch mesh gill nets. The Department gill nets were operated in the same manner as commercial nets, and, therefore, the sample was representative of the commercial catch made in the lower Yukon River (subdistrict #1). The 6₂ age class represented 73.1 percent of the sample followed by the 7₂ (13.2%), 5₂ (10.0%) and 7₃ (2.3%) age groups. The sample contained 49.2 and 50.8 percent males and females respectively.

Table 18. Percent Age Composition of Kuskokwim River Commercial King Salmon Catches, 1964-1967^{1/}

Age	Percentages			
	1964	1965	1966	1967
4 ₂	1.8	0.0	0.4	0.5
5 ₂	22.3	50.3	12.1	10.2
6 ₂	66.2	36.5	85.2	73.4
7 ₂	9.4	13.2	2.3	15.9
8 ₂	0.2	0.0	0.0	0.0

^{1/} Majority of catches taken with 8-1/2 inch mesh drift gill nets.

Table 19. Age Composition by Sex of Yukon River King Salmon Captured With 8-1/2 Inch Stretched Mesh Gill Nets During June 2-July 8, 1967.

Age Class	MALES		FEMALES		COMBINED SEXES	
	No.	Percent	No.	Percent	No.	Percent
4 ₂	7	.7	1	.1	8	.8
5 ₂	72	7.2	28	2.8	100	10.0
6 ₂	335	33.8	389	39.3	724	73.1
6 ₃	3	.3	0	0.0	3	.3
7 ₂	66	6.7	64	6.5	130	13.2
7 ₃	4	.4	19	1.9	23	2.3
8 ₃	<u>1</u>	<u>.1</u>	<u>2</u>	<u>.2</u>	<u>3</u>	<u>.3</u>
Combined Sexes	488	49.2	503	50.8	991	100.0

As in previous years, four and five-year old fish were composed of a majority of males while the older age groups were composed of a near equal sex ratio or a slight majority of females.

In Table 20 the sample is divided into three different sampling periods which show trends in age and sex composition during the season. Considering all age classes, males declined in abundance during the season. For example, the first sampling period (June 1-11) contained 53 percent males while the last sampling period (June 22-July 8) contained only 44 percent males. There were no distinct trends in changing age composition as the season progressed with the exception of a decline in the abundance of the 5₂ age class.

Appendix Table F presents the mean lengths by sex for each age class. The mean length for the entire sample, sexes combined was 85.0 centimeters. Weight data is not presented because the instrument scales used to take individual weights were found to be inaccurate after the sampling program was underway.

Other samples: Table 21 presents age compositions of samples taken in locations upstream from the main commercial fishery. Age data is shown for carcasses sampled in the Andreafsky, Anvik and Teslin Rivers and fishwheel subsistence catches taken at Rampart.

Although about 15 man days of effort was expended only 45 carcasses were located and sampled during boat and foot surveys of the Andreafsky and Anvik Rivers. This is probably due to small escapements and large numbers of bear which may selectively seek out king salmon carcasses.

The Andreafsky-Anvik River sample differed from the Teslin River sample in being composed of greater percentages of 4₂ and 5₂ fish and smaller percentages of 6₂ and 7₂ fish. The sex ratio in percentage of males was 68 percent and 13 percent for the Andreafsky-Anvik River and Teslin River samples respectively. The 6₂ age group was dominant in both samples.

Egg retention was determined for 67 female Teslin River carcasses. The numbers of eggs retained per carcass ranged from 0 to 100 and averaged 9.4 eggs.

The Rampart sample was composed of 5₂, 6₂, 4₂, and 7₂ fish in order of abundance. Prior studies by the Department have determined that fishwheels are selective to the smaller sized king salmon.

Discussion: Age compositions of Lower Yukon catches taken with 8-1/2 inch mesh nets have differed only slightly during the 1964-1967 period. With

Table 20. Age Composition of Yukon River King Salmon Captured with 8-1/2 Inch Stretched Mesh Gill Nets by Period, June 2 - July 8, 1967.

Period	Number of Samples	Percent Sex Composition	MALES						
			Age (Percentages)						
			4 ₂	5 ₂	6 ₂	6 ₃	7 ₂	7 ₃	8 ₃
6/1 - 11	158	52.7	0.0	12.0	35.0	.3	4.4	1.0	.0
6/12 - 21	187	50.7	1.4	7.8	32.0	.5	8.4	.3	.3
6/22-7/8	143	44.4	.6	2.2	34.8	.0	6.8	.0	.0
TOTALS	488	49.2	.7	7.2	33.8	.3	6.7	.4	.1

FEMALES									
Period	Number of Samples	Percent Sex Composition	4 ₂	5 ₂	6 ₂	6 ₃	7 ₂	7 ₃	8 ₃
6/1 - 11	142	47.3	.0	1.3	38.0	.0	6.0	1.7	.3
6/12 - 21	182	49.3	.0	4.3	36.6	.0	7.0	1.1	.3
6/22 - 7/8	179	55.6	.3	2.5	43.5	.0	6.2	3.1	.0
TOTALS	503	50.8	.1	2.8	39.3	.0	6.5	1.9	.2

COMBINED SEXES									
Period	Number of Samples	Percent Sex Composition	4 ₂	5 ₂	6 ₂	6 ₃	7 ₂	7 ₃	8 ₃
6/1 - 11	300	100.0	.0	13.3	73.0	.3	10.4	2.7	.3
6/12 - 21	369	100.0	1.4	12.1	68.6	.5	15.4	1.4	.6
6/22 - 7/8	322	100.0	.9	4.7	78.3	.0	13.0	3.1	.0
TOTALS	991	100.0	.8	10.0	73.1	.3	13.2	2.3	.3

Table 21. Age Composition of Yukon River King Salmon Taken from Several Locations, 1967.

Location	Age	MALES		FEMALES		COMBINED SEXES	
		No.	Percent	No.	Percent	No.	Percent
Andreafsky & Anvik River (carcasses) ^{1/}	4 ₂	7	17.1	0	0.0	7	17.1
	5 ₂	8	19.5	1	2.4	9	21.9
	6 ₂	11	26.8	12	29.3	23	56.1
	7 ₂	2	4.9	0	0.0	2	4.9
	Totals	28	68.3	13	31.7	41	100.0
Teslin River (carcasses) ^{2/}	4 ₂	0	0.0	0	0.0	0	0.0
	5 ₂	2	2.6	2	2.6	4	5.2
	6 ₂	5	6.4	48	61.5	53	67.9
	7 ₂	3	3.8	18	23.1	21	26.9
	Totals	10	12.8	68	87.2	78	100.0
Rampart (fishwheel catches) ^{3/}	4 ₂	4	16.0	0	0.0	4	16.0
	5 ₂	7	28.0	3	12.0	10	40.0
	6 ₂	4	16.0	5	20.0	9	36.0
	7 ₂	1	4.0	1	4.0	2	8.0
	Totals	16	64.0	9	36.0	25	100.0

^{1/} Samples taken 7/27-8/11; age could not be assigned to 2 males and 2 females.

^{2/} Samples taken 8/31, 9/1, 9/10; age could not be assigned to 2 males and 3 females.

^{3/} Samples taken 7/13-14.

only minor exceptions, age composition of the 1967 sample was similar to that of past samples.

Most of the 3₂, 4₂ and 5₂ age classes in the Yukon River run are composed of males. Due to the selectivity of the commercial fishery for the larger king salmon (6₂ and 7₂ age classes), it was speculated that spawning ground sex ratios would be in favor of males. The age composition of the Andreafsky-Anvik River sample seems to confirm this. The Teslin River sample differed greatly in age composition which may be a result of racial differences between these stocks. Until larger, more representative samples can be obtained, this cannot be accurately determined.

LOWER YUKON RIVER CHUM SALMON

Table 22 compares age, sex and size compositions of chum salmon captured by 5-1/2 inch mesh and 8-1/2 inch mesh gill nets. These samples were taken from commercial catches, tagging and test fishing catches in the lower Yukon River during June 6 to August 2. It was estimated that sampling occurred only during about one-half of the fall chum salmon run.

A total ^{of} 1,359 samples was obtained and, as in most previous years, four-year olds were the most abundant age group (75.2%) followed by five-year olds (20.6%), three-year olds (3.9%) and six-year olds (0.3%).

The data shown in Table 22 indicated that the 8-1/2 inch mesh nets "selected out" five-year old males and the 5-1/2 inch mesh nets "selected out" three and four-year old females. Nets of both mesh sizes were not always fished during the same time and so Table 23 compares samples taken from gear (5-1/2 and 8-1/2 inch mesh) fished during a similar period of time. This comparison shows the same degree of selectivity noted above.

Although not shown in any table in this report, definite changes in age and sex composition occurred as the season progressed. The abundance of the five-year old age class and males in all age classes declined during the season. The abundance of the three-year old age class and females in all age classes increased during the season. For the last three years, three-year olds have not appeared in the samples until June 25-26.

TABLE 22
AGE AND SIZE COMPOSITION OF YUKON RIVER CHUM SALMON
CAPTURED WITH GILL NETS DURING 1967
(Samples obtained from test fishing and commercially operated nets)

AGE/SEX CLASS	8½" Mesh 1/			5½" Mesh 2/			Combined Mesh		
	No.	Percent	Mean L. 3/	No.	Percent	Mean L. 3/	No.	Percent	Mean L. 3/
<u>Three-Year-Olds</u>									
Males	0	.0	0.0	16	2.1	56.9	16	1.2	56.9
Females	2	.3	0.0	34	4.6	55.3	36	2.7	55.1
Both Sexes	2	.3	0.0	50	6.7	55.8	52	3.9	55.7
<u>Four-Year-Olds</u>									
Males	189	30.8	58.8	256	34.3	59.7	445	32.7	59.3
Females	206	33.6	56.1	372	49.9	55.5	578	42.5	55.7
Both Sexes	395	64.4	57.4	628	84.2	57.2	1023	75.2	57.3
<u>Five-Year-Olds</u>									
Males	124	20.2	61.3	36	4.8	61.9	160	11.8	61.4
Females	88	14.4	58.2	31	4.2	58.9	119	8.8	58.4
Both Sexes	212	34.6	60.0	67	9.0	60.5	279	20.6	60.1
<u>Six-Year-Olds</u>									
Males	3	.5	64.0	0	.0	0.0	3	.2	64.0
Females	1	.2	59.0	1	.2	55.0	2	.1	57.0
Both Sexes	4	.7	62.8	1	.2	55.0	5	.3	61.2
<u>Combined Ages</u>									
Males	316	51.5	59.8	308	41.3	59.8	624	45.9	59.8
Females	297	48.5	56.7	433	58.7	55.7	732	54.1	56.1
Both Sexes	613	100.0	58.5	746	100.0	57.4	1359	100.0	57.8

1/ Sample collected 6/6 - 7/8

2/ Sample collected 6/13 - 8/2

3/ Length in centimeters from mid-eye to fork of caudal fin

Table 23. Age and Size Composition of Yukon River Chum Salmon Captured with 8-1/2 and 5-1/2 Inch Mesh Gill Nets Operated During Similar Time Periods (6/22-7/2), 1967.

Age/Sex Class	8-1/2 inch mesh			5-1/2 inch mesh		
	No.	Percent	Mean Length ^{1/}	No.	Percent	Mean Length ^{1/}
<u>Three-Year-Olds</u>						
Males	0	0.0	0.0	0	0.0	0.0
Females	0	0.0	0.0	2	1.4	52.5
<u>Both Sexes</u>	0	0.0	0.0	2	1.4	52.5
<u>Four-Year-Olds</u>						
Males	80	34.8	60.8	31	22.1	50.3
Females	86	37.4	56.7	79	56.5	53.5
<u>Both Sexes</u>	166	72.2	58.7	110	78.6	52.6
<u>Five-Year-Olds</u>						
Males	39	16.9	62.9	13	9.3	61.3
Females	24	10.5	58.0	15	10.7	58.2
<u>Both Sexes</u>	63	27.4	59.8	28	20.0	59.6
<u>Six-Year-Olds</u>						
Males	0	0.0	0.0	0	0.0	0.0
Females	1	0.4	59.0	0	0.0	55.0
<u>Both Sexes</u>	1	0.4	59.0	0	0.0	55.0
<u>Combined Ages</u>						
Males	119	51.7	61.5	44	31.4	59.8
Females	111	48.3	57.0	96	68.6	58.2
<u>Both Sexes</u>	230	100.0	59.3	140	100.0	59.0

^{1/} Length from mid-eye to fork of caudal fin.

Discussion: As shown in Table 24, age compositions of Yukon River chums have varied considerably during the 1961-1967 period. These differences are probably due to unusually good survival and return of certain brood year fish. For example, it is apparent that the 1961 brood year stock experienced very good survival and these fish were unusually abundant during the 1964-1966 seasons. Once run magnitudes can be better determined, age comparisons may be used in making run predictions.

Table 24. Percentage Age Composition of Lower Yukon River Chum Salmon, 1961-1967.

Age	1961 ^{1/}	1962 ^{1/}	1963 ^{1/}	1964 ^{2/}	1965 ^{2/}	1966 ^{3/}	1967 ^{3/}
3	4.1	1.9	6.0	33.2	0.2	7.6	3.9
4	75.3	69.3	83.3	63.0	97.3	71.8	75.2
5	20.6	28.8	10.2	3.7	2.5	20.6	20.6
6	0.0	0.0	.5	0.0	0.0	0.0	.3
No. in Sample	97	915	650	268	486	684	1,359

^{1/} Captured by fishwheel; mostly summer chums.

^{2/} Captured by 5-1/2" and 8-1/2" gill nets; mostly summer chums.

^{3/} Captured by 5-1/2" and 8-1/2" gill nets; summer and fall chums.

NORTON SOUND DISTRICT CHUM SALMON

INTRODUCTION

Sampling of Norton Sound District salmon in 1967 for age, sex, and size composition data was restricted to catch samples collected at Moses Point. A total of 784 chums was sampled from the subsistence set gill net fishery near the mouth of the Kwiniuk River (Moses Point) and also from subsistence and test

beach seine catches taken in the Kwiniuk River. Samples were collected periodically from June 21 to July 13. Due to the similarity of the Moses Point fishery and the Kwiniuk River to other fisheries and streams in Norton Sound, age-sex and size data obtained from this study can generally be applied to the entire Norton Sound district.

Age, Sex, Size Composition: In 1967 four-year old chums (86.1 percent) were the dominant age class followed by 5-year olds (12.2 percent), 3-year olds (1.4 percent), and 6-year olds (0.3 percent). Age and sex composition data by sampling period is presented in Table 25. It is interesting to note the similarity of the age composition pattern for the years 1967 and 1965: 3-year olds, 0.8 percent; 4-year olds, 89.8 percent; 5-year olds, 9.0 percent; and 6-year olds, 0.4 percent. Comparative age and sex composition for the years 1965-1967 is presented in Table 26. In 1967, age classes 3 and 4 increased as the season progressed while 5-year olds decreased in abundance.

During the season, the proportion of males tended to decrease while females increased. For the total season sample, females (60.7 percent) outnumbered males (39.3 percent). The greater proportion of females in 1967 contrast with the more numerous males observed in 1965 and 1966 (see Table 26).

Size composition data of Moses Point chum salmon by sampling period is shown in Appendix Table G. As the season progressed there was a tendency for the average size to decrease. This change in the average size was mainly attributed to the proportion of males present and also to a decrease in the proportion of 5-year olds and a corresponding increase in 3 and 4-year olds. For the entire 1967 season sample the mean length was 58.4 cm. (mid-eye to fork of tail) and the mean weight was 7.3 lbs. Mean lengths and weights of Moses Point chums for previous years are as follows: 1965 (59.1 cm. and 7.1 lbs.) and 1966 (57.3 cm. and 7.8 lbs.).

Fecundity of Chum Salmon: A total of 24 chum salmon ovaries was collected for fecundity counts. The fecundity of Moses Point chums averaged 2,817 eggs per female with a range from 2,093 to 3,482 eggs. In 1965, the fecundity of Moses Point chums averaged 2,931 eggs per female (25 samples). Too few chum salmon ovaries were collected in 1966 to make similar comparisons.

KOTZEBUE DISTRICT CHUM SALMON

Commercial Catch Sampling: In 1967, sampling of the Kotzebue District

Table 25. Age and Sex Composition of Sub-District Z-3 (Moses Point) Chum Salmon, Subsistence Catch Sample, 1967.

Date of Samples	Sex	No.	Percent	Age 3		Age 4		Age 5		Age 6	
				No.	Percent	No.	Percent	No.	Percent	No.	Percent
6/21 - 6/23	Males	81	43.5	0		67	36.0	14	7.5	0	
	Females	105	56.5	0		83	44.6	22	11.8	0	
	Combined Sexes	186	100.0	0		150	80.6	36	19.3	0	
6/27 - 7/1	Males	102	44.0	0		84	36.2	18	7.8	0	
	Females	130	56.0	3	1.3	115	49.6	11	4.7	1	0.4
	Combined Sexes	232	100.0	3	1.3	199	85.8	29	12.5	1	0.4
7/7 - 7/8	Males	31	30.4	0		29	28.4	2	2.0	0	
	Females	71	69.6	2	2.0	60	58.8	8	7.8	1	1.0
	Combined Sexes	102	100.0	2	2.0	89	87.2	10	9.8	1	1.0
7/10 - 7/13	Males	94	35.6	1	0.4	86	32.6	7	2.7	0	
	Females	170	64.4	5	1.9	151	57.2	14	5.3	0	
	Combined Sexes	264	100.0	6	2.3	237	89.8	21	8.0	0	
TOTAL SAMPLE	Males	308	39.3	1	0.1	266	33.9	41	5.2	0	
	Females	476	60.7	10	1.3	409	52.2	55	7.0	2	0.3
	Combined Sexes	784	100.0	11	1.4	675	86.1	96	12.2	2	0.3

Table 26. Age and Sex Composition of Moses Point (Sub-District Z-3-Norton Sound District) of Chum Salmon, 1965-1967.

Year	Number of Samples	Males Percent	Females Percent	Age Composition - Percent			
				3	4	5	6
1965	568	52.3	47.7	0.8	89.8	9.0	0.4
1966	479	54.9	45.1	7.3	65.1	27.6	-
1967	784	39.3	60.7	1.4	86.1	12.2	0.3

chum salmon commercial catch was considerably expanded over previous years. A total of 1,865 chums, representing 6.3 percent of the catch, was sampled periodically during the season from July 22 to August 26. Commercial fishing gear consisted of mainly 6.0 inch mesh (stretched measure). Results of the catch sampling program are discussed below.

Age, Sex, Size Composition of the Commercial Catch: In 1967 the 4-year old age class was dominant (70.9 percent), followed by 5-year olds (20.7 percent), 3-year olds (7.6 percent), and 6-year olds (0.7 percent). Six-year olds were present in the sample for the first time since 1963. During the season there was a tendency for the proportion of 3-year olds to increase while the older age groups decreased in proportion. In Table 27 age and sex composition by sampling period is shown. Comparative age and sex composition data for the Kotzebue commercial catch during the years 1962-1967 is presented in Table 28.

In 1967, as in other years, the proportion of females (62.7 percent) in the commercial catch sample exceeded the proportion of males (37.3 percent). As the season progressed there was a tendency for the proportion of males to decrease while females increased (Table 27). A similar sex ratio pattern was observed in 1965 and 1966.

In Appendix Table H mean lengths (mid-eye to fork of tail) and mean weights of Kotzebue chum salmon by sampling period are presented. The size of the fish by period was generally related to the proportion of males in the sample. Also the size of the fish was related to the timing of the Kobuk and Noatak River chum salmon run through the fishery. The larger fish sampled during the last three periods can be attributed to the greater abundance of the larger Noatak River chums at this time.

Overall, the total 1967 sample chums averaged 61.4 cm. in length and weighed 9.3 lbs. In comparison, the average size for Kotzebue chum salmon for the years 1964 to 1966 are as follows: 1964 (58.6 cm. and 8.3 lbs.), 1965 (59.5 cm. and 9.0 lbs.) and, 1966 (61.4 cm. and 10.1 lbs.).

Noatak and Kobuk River Escapement Sampling: Table 29 compares age, sex and size compositions of 106 Noatak River and 59 Squirrel River (tributary to Kobuk River) chum salmon captured by beach seines on September 10 and August 25 respectively. Compared to the Squirrel River sample, the Noatak River sample was characterized by a greater proportion of males (54.7%), a greater proportion of 4-year olds (68.6%) and 5-year olds (28.4%) and larger sized fish. Squirrel River chums were smaller than Noatak River chums in all age-sex groups. The entire Noatak River sample, ages and sexes combined,

Table 27. Age and Sex Composition of Kotzebue District Chum Salmon, Commercial Catch Sample, 1967.

Date of Samples	Sex	No.	Percent	Age 3		Age 4		Age 5		Age 6	
				No.	Percent	No.	Percent	No.	Percent	No.	Percent
7/22 - 7/26	Males	73	45.9	2	1.3	47	29.6	22	13.8	2	1.3
	Females	86	54.1	2	1.3	54	34.0	28	17.6	2	1.3
	Combined Sexes	159	100.0	4	2.6	101	63.6	50	31.4	4	2.6
7/28 - 8/2	Males	130	37.8	8	2.3	93	27.0	29	8.4	0	
	Females	214	62.2	4	1.2	135	39.2	70	20.3	5	1.5
	Combined Sexes	344	100.0	12	3.5	228	66.2	99	28.7	5	1.5
8/4 - 8/9	Males	125	39.2	14	4.4	93	29.2	18	5.6	0	
	Females	194	60.8	7	2.2	148	46.4	39	12.2	0	
	Combined Sexes	319	100.0	21	6.6	241	75.6	57	17.8	0	
8/11 - 8/17	Males	189	34.9	24	4.4	129	23.8	35	6.5	1	0.2
	Females	353	65.1	15	2.8	267	49.3	71	13.1	0	
	Combined Sexes	542	100.0	39	7.2	396	73.1	106	19.6	1	0.2
8/20 - 8/26	Males	178	35.5	26	5.2	120	24.0	31	6.2	1	0.2
	Females	323	64.5	39	7.8	238	47.5	44	8.8	2	0.4
	Combined Sexes	501	100.0	65	13.0	358	71.5	75	15.0	3	0.6
TOTAL SAMPLE	Males	695	37.3	74	4.0	482	25.8	135	7.2	4	0.2
	Females	1,170	62.7	67	3.6	842	45.1	252	13.5	9	0.5
	Combined Sexes	1,865	100.0	141	7.6	1,324	70.9	387	20.7	13	0.7

Table 28. Age and Sex Composition of Commercial Caught Cham Salmon
Kotzebue District, 1962-1967.

Year	Number of Samples	Males Percent	Females Percent	Age - Percent			
				3	4	5	6
1962	69	26.1	73.9	8.7	62.3	27.5	1.5
1963	255	35.0	65.0	32.6	47.4	18.8	1.2
1964	463	43.6	56.4	55.7	42.5	1.8	-
1965	480	42.1	57.9	2.7	92.3	5.0	-
1966	430	40.2	59.8	8.6	65.8	25.6	-
1967	1,865	37.3	62.7	7.6	70.9	20.7	0.7

Table 29. Age, Sex, and Size Composition of Beach Seine Caught Noatak and Kobuk River Chum Salmon, 1967.

	MALES					FEMALES					COMBINED SEXES				
	Age Class	No.	Percent	Mean ^{1/} Length (cm.)	Mean Weight (lbs.)	Age Class	No.	Percent	Mean Length (cm.)	Mean Weight (lbs.)	Age Class	No.	Percent	Mean Length (cm.)	Mean Weight (lbs.)
N O A T A K	3	0				3	3	2.8	57.8	6.8	3	3	2.8	57.8	6.8
	4	42	39.6	66.3	12.0	4	31	29.2	62.2	8.6	4	73	68.8	64.5	10.0
	5	<u>16</u>	<u>15.1</u>	<u>68.9</u>	<u>14.0</u>	5	<u>14</u>	<u>13.3</u>	<u>65.4</u>	<u>10.0</u>	5	<u>30</u>	<u>28.4</u>	<u>67.2</u>	<u>12.7</u>
	R. TOTAL	58	54.7	67.0	12.6	TOTAL	48	45.3	62.8	8.9	TOTAL	106	100.0	65.1	10.0
K O B U K	2	1	1.7	40.5	2.8	2	0				2	1	1.7	40.5	2.8
	3	14	23.7	52.7	6.9	3	22	37.3	52.1	5.5	3	36	61.0	52.3	6.0
	4	9	15.3	61.0	11.0	4	10	16.9	57.7	8.2	4	19	32.2	59.2	9.0
	5	<u>1</u>	<u>1.7</u>	<u>62.5</u>	<u>12.8</u>	5	<u>2</u>	<u>3.4</u>	<u>57.0</u>	<u>8.4</u>	5	<u>3</u>	<u>5.1</u>	<u>58.8</u>	<u>9.0</u>
R. TOTAL	25	42.4	55.6	8.4	TOTAL	34	57.6	54.0	6.5	TOTAL	59	100.0	54.7	7.0	

^{1/} Mid-eye to fork of tail.

averaged 65.1 centimeters in length and 10.9 pounds in weight compared to 54.7 centimeters and 7.3 pounds for the Squirrel River sample. Carcass sampling and gill net catch samples from additional tributaries of the Kobuk River also consisted of smaller sized fish but a lesser percentage of 3-year olds (Table 30).

A tag and recovery program, conducted during 1966-67, has shown that the peak of the Kobuk River chum salmon run passes through Kotzebue Sound earlier in the season when compared to the Noatak River run. Differences in sizes, noted above, are probably related to differences in the amount of ocean growth made during the current season of these two runs. Larger, more representative samples of Noatak and Kobuk River chum salmon are required before it can be accurately determined if differences in age, sex and size compositions represent racial characteristics.

It is interesting to note the occurrence of a 2-year old chum salmon in the Kobuk River (Squirrel R.) sample (Table 29). The specimen was a mature male (40.5 cm. length; 2.8 lbs. weight). Two-year old chums are extremely rare and also the chance for capture is very unlikely by use of conventional gill nets (5-1/2 inch to 6 inch mesh). A cursory search of some of the literature also indicated that 2-year old chums are seldom found elsewhere. Two-year old chum salmon have been previously reported from Honshu, Hokkaido, and British Columbia.

SUMMARY

Kuskokwim River

1. Age composition of 610 king salmon sampled from commercial catches was 73.4 percent 6_2 fish followed by the 7_2 (15.9%), 5_2 (10.2%) and 4_2 (.5%) age classes.
2. Samples from Department test fishing and tagging gill nets indicated that 5-1/2 inch mesh nets captured a preponderance of the 4_2 and 5_2 age groups compared to the 8-1/2 and 9-1/2 inch mesh samples which exhibited similar age and sex compositions as that of the commercial catch sample.
3. Age compositions of commercial catches during the 1964-1967 period indicate very good survival and production of the 1960 brood year of Kuskokwim River king salmon.

Table 30. Age, Sex and Size Composition of Kobuk River Chum Salmon, 1967 (Gill Net Catch and Carcass Samples).

	MALES					FEMALES					COMBINED SEXES				
	Age Class	No.	Percent	Mean ^{1/} Length (cm.)	Mean Weight (lbs.)	Age Class	No.	Percent	Mean Length (cm.)	Mean Weight (lbs.)	Age Class	No.	Percent	Mean Length (cm.)	Mean Weight (lbs.)
GILL NET	3	12	31.6	54.9	7.4	3	3	7.9	54.9	6.9	3	15	39.5	54.9	7.3
	4	8	21.1	59.6	9.4	4	14	36.8	60.3	8.9	4	22	57.9	60.0	9.1
	5	0				5	1	2.6	56.0	6.3	5	1	2.6	56.0	6.3
	TOTAL	20	52.7	56.8	8.2	TOTAL	18	47.3	59.1	8.4	TOTAL	38	100.0	57.9	8.3
CARCASS SAMPLES	3	8	14.5	55.4	<u>2/</u>	3	4	7.3	53.4		3	12	21.8	54.8	
	4	9	16.4	60.6		4	22	40.0	56.4		4	31	56.4	57.6	
	5	6	10.9	64.1		5	6	10.9	58.9		5	12	21.8	61.5	
	TOTAL	23	41.8	59.7		TOTAL	32	58.2	56.5		TOTAL	55	100.0	57.9	

^{1/} Mideye to fork of tail

^{2/} Weights not taken for carcass samples.

Yukon River

1. Age composition of 991 king salmon, which are believed to be representative of lower Yukon commercial catches, was similar to that of the Kuskokwim River.
2. Males (all age classes) and the 5₂ age class declined in abundance as the season progressed.

Lower River

1. Andreafsky-Anvik River king salmon carcass samples contained fewer females and fewer salmon of the 6₂ and 7₂ age groups when compared to the upriver Teslin River sample.
2. A total of 1,359 chum salmon was sampled from commercial catches and tagging - test fishing catches. The four-year old age group was most abundant (75.2%) followed by five-year olds (20.6%), three-year olds (3.9%) and six-year olds (0.3%).
3. The abundance of five-year olds and males in all age groups declined during the season.
4. The 8-1/2 inch mesh gill nets "selected out" five-year old chum salmon and 5-1/2 inch mesh gill nets "selected out" three and four-year old females.
5. Age composition of Yukon River chum salmon have varied considerably during the 1961-1967 period. Chum salmon of the 1961 brood year were very abundant in the 1964-1966 samples.

Norton Sound

1. A total of 784 chum salmon were periodically sampled from subsistence and test net catches at Moses Point in 1967.
2. Age composition of the 1967 catch sample is as follows: 4-year olds (86.1 percent), 5-year olds (12.2 percent), 3-year olds (1.4 percent), and 6-year olds (0.3 percent).
3. As the season progressed the proportion of 3 and 4-year olds increased while 5-year olds decreased.

4. The proportion of females sampled was 60.7 percent. The proportion of males decreased as the season progressed while females increased.
5. In 1967 Moses Point chums averaged 58.4 cm. in length and weighed 7.3 lbs.
6. The fecundity of 24 samples of Moses Point chum salmon averaged 2,817 eggs per female with a range of 2,093 to 3,482 eggs.

Kotzebue

1. A total of 1,865 chum salmon were sampled periodically from the Kotzebue commercial catch in 1967.
2. Four-year old chum salmon (70.9 percent) were the most abundant age class followed by 5-year olds (20.7 percent), 3-year olds (7.6 percent), and 6-year olds (0.7 percent).
3. As noted in previous years the proportion of females (62.7 percent) in the commercial catch exceeded the proportion of males (37.3 percent).
4. In 1967 the size of chum salmon in the commercial catch averaged 61.4 cm. in length and weighed 9.3 lbs.
5. A sample of approximately 450 fish was shown to provide reliable seasonal estimates of sex composition and of the proportion of the more abundant age classes.
6. Significant differences in age, sex and size composition between Noatak and Kobuk River chums was indicated by comparing escapement samples from both systems.
7. An extremely rare two-year old chum salmon was found in the Kobuk River escapement sample.

KOTZEBUE SOUND SHEEFISH STUDY

INTRODUCTION

Kotzebue Sound sheefish spend a portion of their life history in the saline waters of Kotzebue Sound and in the brackish waters of Hotham Inlet and Selawik Lake. Like salmon, known spawning runs occur in the Kobuk and Selawik Rivers during June through September with spawning taking place hundreds of miles upstream from the ocean.

In the Kotzebue Sound region of northwestern Alaska (Figure 6), sheefish are taken mainly for subsistence by village residents. A limited number of sheefish are also harvested for commercial utilization for local markets. Expansion of the commercial fishery depends on development of outside markets and establishment of suitable processing facilities.

Basic life history studies of sheefish populations and accurate records of subsistence and commercial catches are essential for proper management of the fishery. In order to develop sound management practices, biological investigations of sheefish were expanded in 1967 with emphasis on the following objectives:

1. Record the subsistence and commercial harvest data.
2. Obtain age-sex-size composition and fecundity information.
3. Obtain estimates of spawning populations and observe spawning behavior.
4. Determine movements of populations and seasonal abundance on a year-round basis.

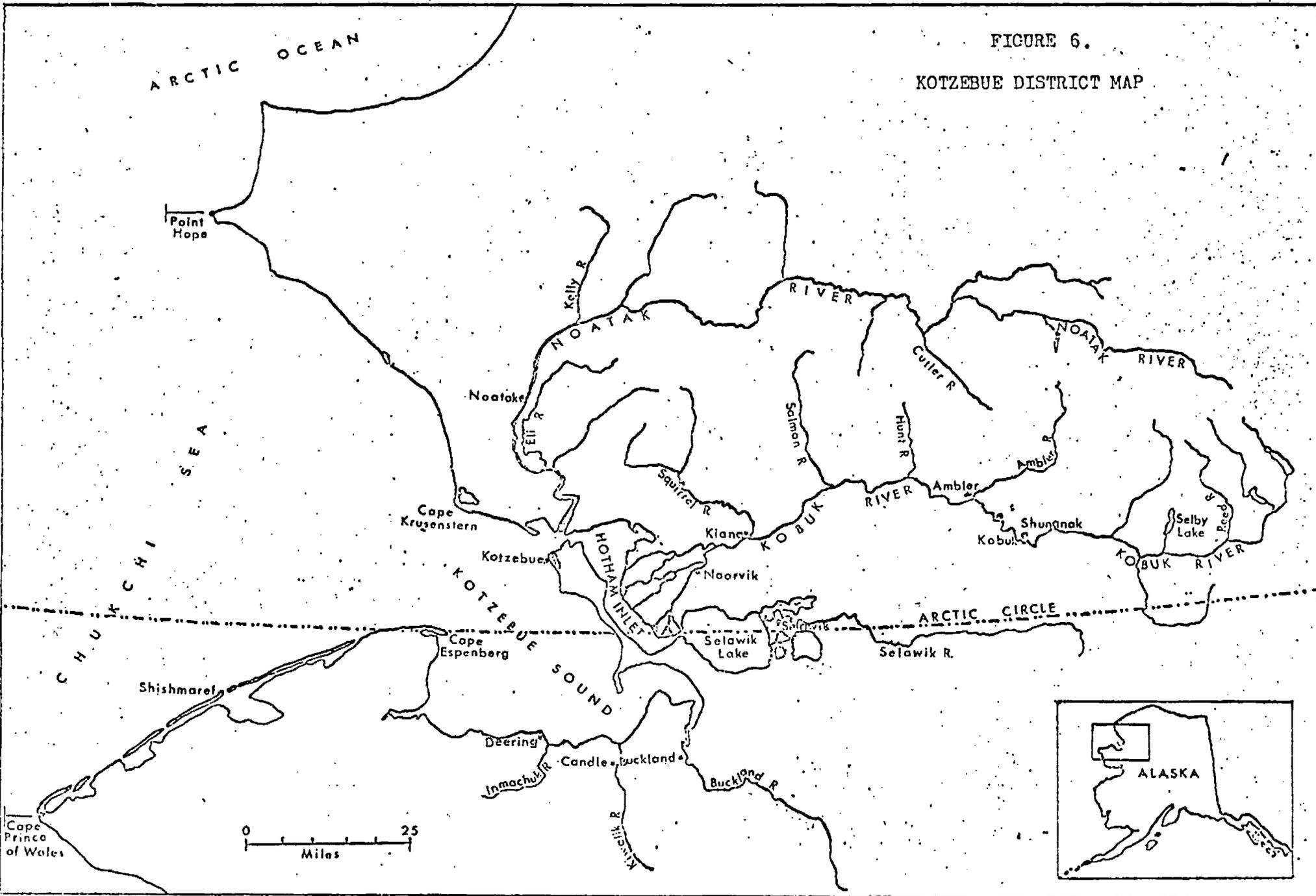
Detailed information regarding age-sex-size of sheefish is being analyzed and will be presented in later reports.

METHODS AND MATERIALS

The methods and materials used in the sheefish studies were as follows:

FIGURE 6.

KOTZEBUE DISTRICT MAP



1. Subsistence catch data was obtained primarily by personal interviews of fishing families in the following villages: Kotzebue, Selawik, Noorvik, Kiana, Ambler, Shungnak, and Kobuk. Catch questionnaire forms were distributed to those fishermen not contacted. Records of commercial catches were obtained from fish tickets and personal interviews.
2. Age-sex-size composition data was collected by sampling the commercial, subsistence and test catches taken in Kotzebue Sound, Hotham Inlet, and Kobuk River. Lengths were measured from the tip of the snout to the fork of the tail in centimeters. Weight was recorded in pounds. Sex was determined by examination of gonads or external observations of sexually mature fish on the spawning grounds. Sex could not be determined for frozen sheefish caught in the winter or spring. Scale smears were taken above the lateral line between the dorsal and adipose fin. Fecundity information was collected from test catches taken near the spawning grounds on the upper Kobuk River. Estimates of the fecundity of five female fish were calculated by weight of a sample count of 1,000 eggs compared to the weight of both ovaries of each fish.
3. Aerial surveys of known spawning grounds were conducted. Observations of spawning behavior were conducted during late September on the upper Kobuk River. Daily water temperatures and climatological data was recorded. Known spawning areas were marked and depth of river and the type of streambed gravel was noted.
4. Movements and seasonal abundance of sheefish populations were studied by a tag-recovery program. Sheefish were captured with set gill nets and rod and reel for tagging in the upper Kobuk River. Yellow spaghetti tags were used and a one-dollar reward was offered for each tag recovery.

Assistance in planning and conducting some of the field studies was given by Ken Alt of the Division of Sport Fish.

RESULTS

Subsistence and Commercial Catches: In Table 31 catch data for the

Table 31. Subsistence and Commercial Sheefish Catches, Kotzebue District, 1966-1967

SUBSISTENCE CATCH

<u>Village</u>	<u>Fishermen Interviewed</u>	<u>Number of Sheefish</u>
Noorvik	28	3,792
Kiana	19	925
Ambler	11	194
Shungnak	11	166
Kobuk	<u>7</u>	<u>99</u>
SUBTOTAL	76	5,166 (June, 1967 - October, 1967)
Kotzebue	30	10,060 (October, 1966 - May, 1967)
Selawik	<u>29</u>	<u>7,164</u> (March, 1967 - November, 1967)
TOTAL DISTRICT CATCH	135	22,390

COMMERCIAL CATCH

Kotzebue	10	992 (October, 1966 - May, 1967)
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Kobuk River villages, Kotzebue and Selawik are presented. An extensive subsistence survey of the villages was conducted for the first time in 1967. Recorded catches are believed to represent approximately 90 percent of the actual harvest. The total subsistence catch was 22,390 sheefish taken from the fall of 1966 to the fall of 1967.

It is interesting to note that five types of fishing gear are used to catch sheefish depending on location of fishermen and time of year. Kotzebue fishermen take large numbers of sheefish during the late fall and winter with gill nets set under the ice in Kotzebue Sound and Hotham Inlet. During the spring, the Kotzebue fishermen mostly jig with lures through the ice. Selawik residents also use this method in the spring. After break-up of the river ice in early June, the Selawik fishermen used rod and reel to catch large numbers of sheefish in the Tuklomarak and Selawik Rivers. Kobuk River fishermen primarily used gill nets during the summer to capture migrating sheefish bound for upriver spawning areas. In late September, villagers from Shungnak and Kobuk used beach seines to catch sheefish off the spawning grounds. Gill nets are again used by Kobuk River fishermen to take the post-spawning sheefish migrating downstream.

The commercial catch for the period October, 1966 to May, 1967 totaled 992 sheefish taken by ten Kotzebue fishermen (Table 32). Most of the catch was marketed in local stores of Kotzebue and Nome. The average weight of sheefish taken in commercial fishery was 6 pounds.

Table 32. Age-Sex-Size Composition and Fecundity Information: During the period August, 1966 to September, 1967 the following numbers of sheefish were sampled:

Date	Area	Gear	No. of Samples
8/66	Hotham Inlet	Commercial-set gill net	95
9/66	Kobuk River	Test gill net, rod & reel	
		Subsistence-beach seine	154
12/66	Hotham Inlet	Commercial-set gill net	84
5/67	Hotham Inlet	Subsistence-jigging	84
8/67	Kotzebue Sound	Test-gill net	8
9/67	Kobuk River	Test-gill net, rod & reel	
		Subsistence-beach seine	201

Size and sex composition data by gear has been tabulated for the

September, 1967 Kobuk River sample and is summarized in Table 33. Hook and line is selective toward the more active male sheefish while gill nets and beach seine capture more females. Due to differences in gear selectivity, it is difficult to determine the actual sex ratio of the spawning population. It is interesting to note that for the combined gear, the overall sex ratio of the September, 1967 sample is nearly 1:1 (103 males: 98 females).

Age, sex, and size composition for the above sample (gear combined) is presented in Table 34. All sheefish sampled were taken near the spawning grounds and presumed to be sexually mature. The age classes of male sheefish ranged from 7 to 14 years. Age 8 males were the most abundant. The age of females ranged from 9 to 20 years. The dominant age class of the female was age 14.

Fecundity of five female sheefish, ranging in size from 18.5 to 34.3 lbs., varied from 167,204 to 315,670 eggs per fish.

Estimate of Spawning Population Size: Aerial survey methods appear promising for obtaining an index of the spawning population size. Under good survey conditions (clear water, fair skies, and negligible wind) a minimum of 1,025 schooling sheefish were observed over a distance of 40 river miles on the upper Kobuk River on September 20, 1967. In 1966 a school of 1,200 sheefish were observed in a single large school 26 miles above the village of Kobuk during an aerial survey of salmon spawning areas on September 5. During September of 1968, extensive aerial surveys of the upper Kobuk and Selawik Rivers will be conducted if favorable counting conditions exist.

Seasonal Distribution and Movements: During the past two years, valuable information on the movements of sheefish have been obtained from the release of tagged fish. In Table 35 tag and recovery data is presented for the years 1966 and 1967. One of the primary objectives of the tagging program was to determine movements of the Selawik and Kobuk River populations during the winter and spring. Prior to the tagging programs it was thought that the Selawik River population was found exclusively in Selawik Lake and the Kobuk River population resided in Hotham Inlet during the winter and spring. Recoveries of two tagged Kobuk River sheefish in Selawik Lake during late spring of 1967 indicated that the two populations intermingled in the Hotham Inlet and Selawik Lake areas.

Another objective of the tagging program was to determine the spawning frequency of sheefish. A 1967 recovery of a spent male sheefish that was tagged on the Kobuk River spawning grounds in 1966 in the same area indicated that

Table 33. Mean Fork Lengths, Mean Weight, and Sex Composition of Sheefish Taken by Hook and Line, Gill Net, and Beach Seine, Upper Kobuk River, 1967.

Sex	HOOK AND LINE				GILL NET				BEACH SEINE				COMBINED GEAR			
	No.	Percent	F.L. ^{1/}	Wt. ^{2/}	No.	Percent	F.L.	Wt.	No.	Percent	F.L.	Wt.	No.	Percent	F.L.	Wt.
Male	51	71.8	77.6	10.4	37	46.3	77.5	10.9	15	30.6	76.9	10.2	103	51.3	77.5	10.4
Female	21	29.2	93.8	21.7	43	53.7	99.9	25.2	34	69.4	98.2	21.8	98	48.7	98.0	23.3
Combined Sexes	72	100.0	82.3	13.7	80	100.0	89.5	18.6	49	100.0	91.9	18.2	201	100.0	87.5	16.4

^{1/} Fork length in centimeters.

^{2/} Weight in pounds.

TABLE 34

AGE, SEX, AND SIZE COMPOSITION OF SPAWNING SHEEFISH, UPPER KOBUK RIVER, 1967

Age Class	MALES				FEMALES				COMBINED SEXES			
	Number	Percent	Fork Length 1)	Weight 2)	Number	Percent	Fork Length	Weight	Number	Percent	Fork Length	Weight
7+	10	4.9	66.5	6.3					10	4.9	66.5	6.3
8+	22	10.8	69.3	6.7					22	10.8	69.3	6.7
9+	18	8.9	72.9	8.7	1	0.5	89.0	12.0	19	9.4	73.8	8.8
10+	12	5.9	79.8	11.2					12	5.9	79.8	11.2
11+	16	7.9	83.7	13.2	5	2.5	87.2	15.1	21	10.4	84.5	13.6
12+	14	6.9	85.8	13.3	7	3.4	90.9	19.3	21	10.4	87.5	15.1
13+	8	3.9	86.8	15.4	19	9.4	93.2	20.9	27	13.3	91.3	17.7
14+	4	2.0	89.5	17.4	29	14.3	94.8	21.8	33	16.3	94.2	21.3
15+					15	7.4	96.8	21.7	15	7.4	96.8	21.7
16+					8	3.9	101.3	29.4	8	3.9	101.3	29.4
17+					8	3.9	100.7	30.1	8	3.9	100.7	30.1
18+					4	2.0	107.6	37.1	4	2.0	107.6	37.1
19+					2	1.0	113.3	35.4	2	1.0	113.3	35.4
20+					1	0.5	104.0	46.0	1	0.5	104.0	46.0

1) Centimeters

2) Pounds

TABLE 35. DAILY NUMBER OF SHEEFISH TAGGED ON UPPER KOBUK R
AND NUMBER AND DATE OF RECOVERIES BY AREA

1966 TAGGING									
Tagging Date	Number Tagged	1966 Recoveries			1967 Recoveries			Total Recoveries	Number Tags
		Spawning Area	Noorvik	Kiana	Spawning Area	Noorvik	Selawik Lake		
9-13									
9-14									2
9-15									
9-16									
9-17	4					1(6-15)	1(5-5)	2	1
9-18	5								1
9-19	2					1(6-16)		1	
9-20									1
9-21	9					2(6-15,17)		2	1
9-22	9	2(9-26,27)	1(12-15)	1(10-4)	1(9-30)			5	
9-23	2								
9-24	5								
9-25	1						1(5-14)	1	
9-26	1								
9-27									
9-28	2								
9-29									
TOTALS	49	2	1	1	1	4	2	11	116

1/ Recovery dates in parenthesis.

sheefish are presumably capable of spawning annually once sexual maturity is reached. In addition, four sheefish (all males), tagged in 1966 on the spawning grounds, were captured in mid-June, 1967, near Noorvik about 38 miles above the mouth of the Kobuk River. However, it is not known if these fish were returning to the upper spawning grounds.

Verification of the scale method for age determination of sheefish was another objective of the tagging program. Scale smears were collected from each tagged fish prior to release and fishermen were asked to take a scale sample from each tagged fish caught. To date, no scale samples of tagged sheefish, taken after mid-June when annulus formation is believed to be completed, have been obtained. It is anticipated that scale samples will be collected from fishermen as more fish are tagged and as fishermen become better acquainted with the tagging program.

Spawning Observations: In 1966 and 1967, spawning observations were conducted during late September on the upper Kobuk River, between 24 and 30 miles above the village of Kobuk. Peak spawning in 1967 occurred during the period September 27-29, similar to 1966 spawning. The most active spawning occurs during the late afternoon and evening hours. Spawning occurred in water depths of 4 to 8 feet over gravel in moderately swift current of the main river. Water temperatures during spawning ranged from 40-43° Fahrenheit. Mortality of sheefish eggs, which sink to the stream bottom upon being discharged at the surface by the female, appeared to be substantial due to predation by grayling and whitefish. Several grayling and whitefish captured after completion of sheefish spawning contained large numbers of sheefish eggs in their stomachs.

DISCUSSION

In the Kotzebue Sound area sheefish are intensively fished in Hotham Inlet, Selawik Lake, and to a lesser extent in Kotzebue Sound, during the period late October to late May. The movements and distribution of the Kobuk and Selawik River populations in these waters during the winter and spring months are unknown. One of the main goals of the current sheefish investigation is to determine the movements of the sheefish populations throughout the year by means of a tag and recovery program. This information is needed for proper management of the fishery. Expansion of the tagging program is planned for 1968 and will include the tagging of Selawik River sheefish during June.

Another important aim of the present study is to obtain an estimate of

spawning populations either by aerial survey or tag and recovery methods. A tag and recovery study may provide an estimate of the size of the spawning population, however, a reliable estimate would depend on fishermen accurately reporting their catches and turning in tag recoveries. At present, aerial survey counts appear to be the best approach toward obtaining an index or estimate of the spawning population. Studies of the Kobuk River indicate that sheefish utilize a relatively small spawning area and spawn during a short time span in late September when the river is low and clear.

SUMMARY

1. Subsistence fishermen from Kotzebue, Selawik, and the Kobuk River villages harvested 22,390 sheefish during the 1966-67 season.
2. During the period October, 1966 to May, 1967 a total of 992 sheefish, averaging six pounds each, were taken in the commercial fishery.
3. Fecundity estimates of five sheefish ranged from 167,204 to 315,670 eggs per female fish.
4. Aerial surveys of Kobuk River spawning grounds indicate a minimum count of 1,025 sheefish in 1967 and 1,200 in 1966.
5. Recovery of two tagged Kobuk River sheefish in Selawik Lake indicates that intermixing does occur between the Kobuk River and Selawik River populations during the winter and spring months.
6. A 1967 recovery of a spent male sheefish, tagged on the spawning grounds in 1966, on the upper Kobuk River demonstrates that sheefish are capable of spawning annually upon reaching sexual maturity.
7. Peak spawning activity in 1966 and 1967 occurred during the period September 27-29. Water temperatures during peak spawning in 1967 ranged from 40-43° Fahrenheit. Mortality of spawned sheefish eggs was apparently high due to predation by grayling and whitefish.

APPENDIX

APPENDIX TABLE A
 AGE-LENGTH COMPOSITION OF KUSKOKWIM
 RIVER COMMERCIAL KING SALMON CATCHES
 SAMPLED DURING JUNE 1-23, 1967 1/

Age Class	Length in centimeters <u>2/</u>				Combined Sexes Mean length	Number in Sample	
	Males		Females			Male	Female
	Mean length	Range	Mean length	Range			
4 ₁₋₂	66.4	61.5- 69.2	-	-	66.4	3	0
5 ₂	74.1	53.3- 84.5	77.8	68.5- 83.5	75.0	47	15
6 ₂	89.8	67.8-105.2	88.8	75.8-101.3	89.2	200	248
7 ₂	97.2	70.1-109.1	91.0	70.4-103.0	93.5	39	58
Totals or Mean	88.0	53.3-109.1	88.7	68.5-103.0	88.4	289	321

1/ Majority of King Salmon captured with 8-1/2" stretched mesh-drift gill nets

2/ Mid-eye to fork of caudal fin

APPENDIX TABLE B
 AGE-WEIGHT COMPOSITION OF KUSKOKWIM
 RIVER COMMERCIAL KING SALMON CATCHES
 SAMPLED DURING JUNE 1-23, 1967 1/

Age Class	Weight in Pounds				Combined Sexes	Number in Sample	
	Males		Females			Mean weight	Male
	Mean weight	Range	Mean weight	Range			
4 ₁₋₂	11.1	9.2-12.4	-	-	11.1	3	0
5 ₂	15.8	4.8-21.5	18.1	12.4-23.5	16.8	47	15
6 ₂	28.8	11.6-47.6	26.9	15.8-40.8	27.7	200	248
7 ₂	36.1	13.6-54.0	29.5	15.6-42.4	32.2	39	58
Totals or Mean	27.5	4.8-54.0	27.0	12.4-42.4	27.2	289	321

1/ Majority of king salmon captured with 8-1/2" stretched mesh-drift gill nets

APPENDIX TABLE C
 LENGTH FREQUENCIES OF KUSKOKWIM RIVER
 KING SALMON CAPTURED BY DEPARTMENT TAGGING
 AND TEST FISHING NETS OF VARYING MESH SIZE, 1967

Fork length in cm.	Mesh Size			Fork length in cm.	Mesh Size		
	5-1/2"	8-1/2"	9-1/2"		5-1/2"	8-1/2"	9-1/2"
35	1			87	7	5	4
36	1			88	4	4	11
--				89	4	7	3
--				90	8	13	13
48	1			91	1	8	5
49	1			92	2	5	1
50	8			93	8	9	6
51	4			94	3	10	11
52	6		1	95	4	5	8
53	6		1	96	2	8	7
54	7			97	6	9	7
55	11	1		98	6	2	11
56	3	1		99	2	5	8
57	9	1		100	7	8	12
58	6			101	1	2	6
59	4			102		3	5
60	12		1	103		2	5
61	2			104		5	3
62	2			105	1	2	1
63	5			106	2	3	2
64	2		1	107		1	1
65	1		1	108		1	1
66	1			109		1	1
67	1			110			1
68				111			1
69				112			
70	5	4		113		1	
71	4			Totals	210	156	170
72	1						
73	2		3				
74	7	1					
75	5						
76	1	1	1				
77	4	1	2				
78	2						
79	2						
80	7	6	4				
81	2	1	5				
82	2	3	2				
83		3	4				
84		4	1				
85	2	7	3				
86	3	3	6				

APPENDIX TABLE D
 AGE COMPOSITIONS OF KUSKOKWIM
 RIVER RED, COHO AND CHUM SALMON
 CAPTURED WITH 5-1/2" MESH TEST AND COMMERCIAL
 GILL NETS, 1967

Species	Age	Male		Female		Sexes Combined	
		No.	%	No.	%	No.	%
Red Salmon	4 ₂	0	0.0	2	4.4	2	4.4
	5 ₂	11	24.5	15	33.4	26	57.9
	5 ₃	2	4.4	5	11.1	7	15.5
	6 ₂	1	2.2	0	0.0	1	2.2
	6 ₃	<u>5</u>	<u>11.1</u>	<u>4</u>	<u>8.9</u>	<u>9</u>	<u>20.0</u>
Totals	19	42.2	26	57.8	45	100.0	
Coho Salmon	3 ₂	9	4.0	3	1.3	12	5.3
	4 ₃	<u>117</u>	<u>51.8</u>	<u>97</u>	<u>42.9</u>	<u>214</u>	<u>94.7</u>
	Totals	126	55.8	100	44.2	226	100.0
Chum Salmon	3 ₁	2	2.6	0	0.0	2	2.6
	4 ₁	25	32.9	41	54.0	66	86.9
	5 ₁	<u>5</u>	<u>6.6</u>	<u>3</u>	<u>3.9</u>	<u>8</u>	<u>10.5</u>
	Totals	32	42.1	44	57.9	76	100.0

APPENDIX TABLE E
 AGE COMPOSITIONS OF KANEKTOK RIVER
 RED, COHO AND CHUM SALMON
 COMMERCIAL CATCHES, 1967 ^{1/}

Species	Age	Males		Females		Sexes Combined	
		No.	%	No.	%	No.	%
Red Salmon	4 ₂	0	0.0	2	10.0	2	10.0
	5 ₂	9	45.0	9	45.0	18	90.0
	Totals	9	45.0	11	55.0	20	100.0
Coho Salmon	3 ₂	1	5.6	0	0.0	1	5.6
	4 ₃	4	22.2	13	72.2	17	94.4
	Totals	5	27.8	13	72.2	18	100.0
Chum Salmon	3 ₁	6	2.8	6	2.8	12	5.6
	4 ₁	48	22.8	150	71.1	198	93.9
	5 ₁	0	0.0	1	0.5	1	0.5
	Totals	54	25.6	157	74.4	211	100.0

^{1/} Exact mesh size of gill nets not known but probably about 5-1/2 inch mesh.

APPENDIX TABLE F
 AGE-LENGTH COMPOSITION OF YUKON KING
 SALMON CAPTURED WITH 8-1/2" STRETCHED
 MESH GILL NETS DURING JUNE 2 - July 8, 1967

MEAN ORBIT LENGTHS IN CENTIMETERS

Age Class	Males		Females		Combined Sexes	
	Number	Mean length	Number	Mean length	Number	Mean length
4 ₂	7	54.6	1	60.0	8	55.3
5 ₂	72	73.9	28	74.5	100	74.1
6 ₂	332	86.4	389	85.1	721	85.7
6 ₃	3	74.0	0	0	3	74.0
7 ₂	65	94.6	64	89.2	129	91.9
7 ₃	4	84.0	19	84.3	23	84.2
8 ₃	1	90.0	1	85.0	2	87.5
Combined ages	484	58.9	502	61.2	986	85.0

ERRORES

*Note + correct
 error in Mean
 Lengths*

*check against
 original*

APPENDIX TABLE G
 MEAN LENGTHS AND MEAN WEIGHTS OF SUB-DISTRICT Z-3
 (MOSES POINT) CHUM SALMON, SUBSISTENCE CATCH SAMPLE, 1967

Date of Samples	Number	Percent Males	Mean <u>1/</u> Length (Cm.)	Mean Weight (Lbs.)
6/21 - 6/23	186	(43.5)	59.4	7.5
6/27 - 7/1	232	(44.0)	58.8	7.3
7/7 - 7/8	102	(30.4)	58.1	6.8
7/10 - 7/13	264	(35.6)	57.5	7.1
Total Sample	784	(39.3)	58.4	7.3

1/ Mideye to fork of tail.

APPENDIX TABLE H
 MEAN LENGTHS AND MEAN WEIGHTS OF KOTZEBUE DISTRICT CHUM SALMON,
 COMMERCIAL CATCH SAMPLE, 1967

Date of Samples	Number	Percent Males	Mean <u>1/</u> Length (Cm.)	Mean Weight (Lbs.)
7/22 - 7/26	159	(45.9)	61.3	9.3
7/28 - 8/ 2	344	(37.8)	60.9	8.7
8/ 4 - 8/ 9	319	(39.2)	61.8	9.5
8/11 - 8/17	542	(34.9)	61.6	9.7
8/20 - 8/26	501	(35.5)	61.1	9.0
Total Sample	1,865	(37.3)	61.4	9.3

1/ Mid-eye to fork of tail.