AYK REGION
YUKON STATE/FED REPORT #3

ARCTIC YUKON KUSKOKWIM AREA

ANADROMOUS FISH INVESTIGATIONS

ANNUAL TECHNICAL REPORT, 1969

Robert C. Lebida
Fishery Research Biologist

Alaska Department of Fish and Game
Division of Commercial Fisheries
Anchorage, Alaska

ANNUAL TECHNICAL REPORT

ANADROMOUS FISH PROJECT

Project Title: Arctic-Yukon-Kuskokwim Area Anadromous Fish Investigations

Project No: AFC-7-3

Project Period: 1969 Field Season

Prepared by: Robert C. Lebida

Alaska Department of Fish and Game
Cooperator

Subport Building, Juneau, Alaska 99801
Address

This project was financed in part with Anadromous Fish Act (P.L. 89-304) funds through the Bureau of Commercial Fisheries.

PREFACE

The Arctic-Yukon-Kuskokwim area, that portion of Alaska north of Bristol Bay and the Alaska Range, is the largest commercial fishery management unit in the State (Figure 1). This vast region, equal to the combined areas of California, Oregon, Washington and Idaho, encompasses nearly 400,000 square miles.

In 1960, the State of Alaska, Department of Fish and Game, became responsible for the management and research of the fishery resources in the A-Y-K area. Prior to 1960, salmon research programs were practically non-existent in this area although commercial fishing dates back to 1913. The majority of newly allocated funds were used primarily for management of various developing and existing salmon fisheries. As a result, comprehensive salmon research programs, essential for managing the fisheries on a more scientific basis, could not be developed with the limited State monies available. In 1961 and 1962 some Federal funds were utilized in a short term program of Yukon River chum salmon investigations to acquire information for the International North Pacific Fisheries Commission Treaty negotiations.

With the enactment of the Anadromous Fish Act (P.L. 89-304) in 1966, the A-Y-K area has received a total of $157,300 in Federal funds (matched by an equal amount of State monies) during the 1966-1969 fiscal years to expand existing State research programs and to initiate new projects. Present research activities in the A-Y-K area are geared to determine population sizes and escapements, destination, movements and timing of different segments or races and life histories of anadromous fish runs (salmon and sheefish). In addition, the subsistence utilization of anadromous fish populations are investigated.

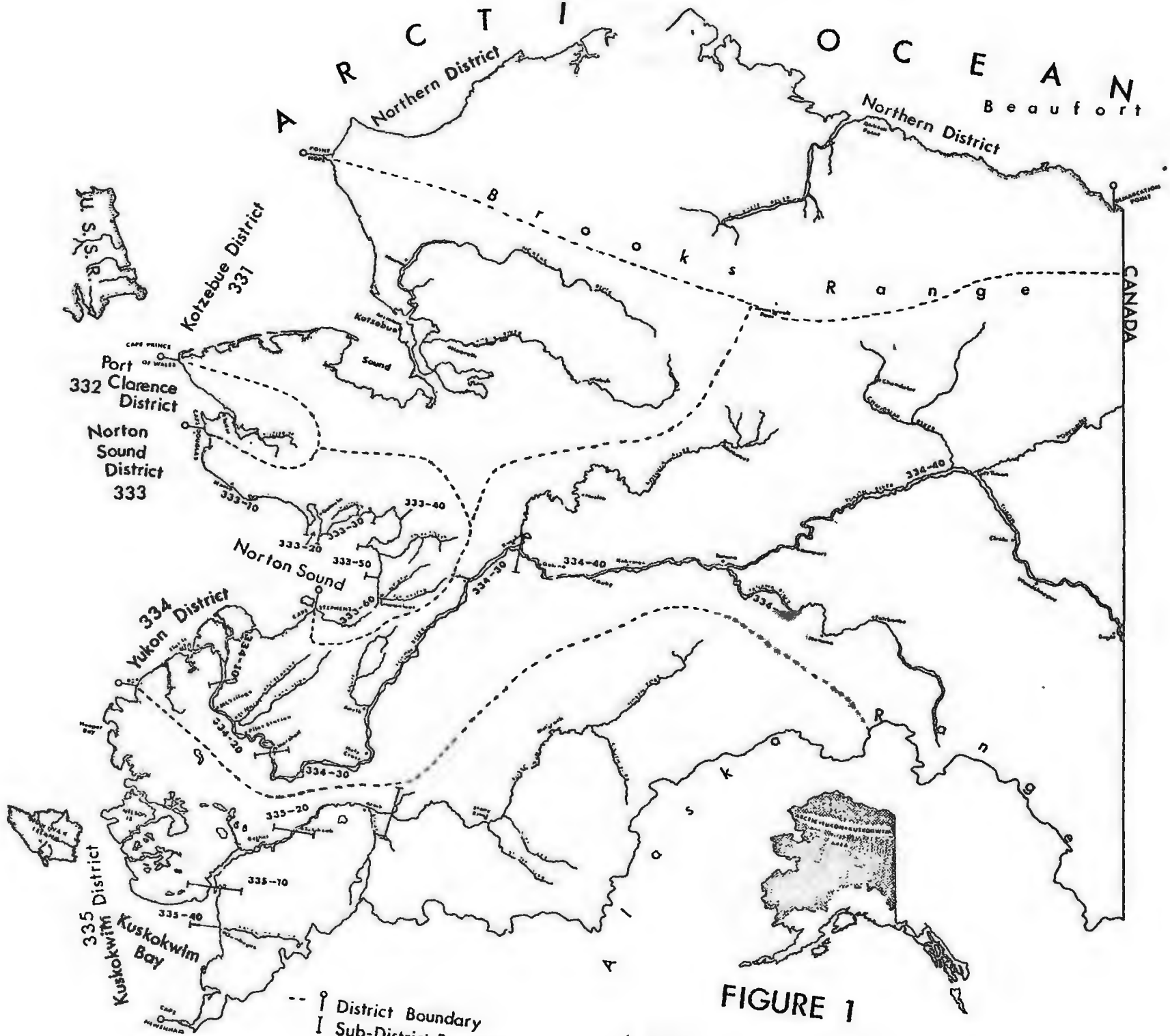


FIGURE 1

A-Y-K AREA MAP

This Annual Technical Report documents the various anadromous fish projects conducted during the 1969 field season and is subject to revision before formal publication of any segment. A total of $47,300 in Federal funds and an equal amount in State matching monies were utilized in fiscal year 1969-1970. Each study is listed below with an estimate of the percentage of the total expenditure:

1. Yukon River Anadromous Fish Investigations (80%)
2. Kwiniuk River Counting Tower Project (10%)
3. Kotzebue Sound Sheefish Investigations (10%)

Beginning in 1970, all project activities will be directly involved with the Yukon River program.

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

LIST OF TABLES

LIST OF TABLES (continued)

LIST OF FIGURES

LIST OF APPENDICES

YUKON RIVER ANADROMOUS FISH INVESTIGATIONS, 1969

INTRODUCTION

The Yukon River studies were initiated in 1961 to obtain information regarding life histories, population sizes and escapements, destination, movements and timing of anadromous fish run segments or races along with obtaining estimates of their utilization by the subsistence fishery.

Early phases of the program were designed to evaluate chum and king salmon runs. Initial tag and recovery efforts conducted at the mouth of the river provided much of the basic information but accurate population estimates were lacking. Location of the study area within an intensive commercial fishery and the influence of coastal storms, which often seriously affected fishing effort, were deemed responsible for the lack of sufficient population data. The tag and recovery project was, therefore, reestablished above the commercial fishery at Ohogamiut (mile 185) in 1968. A test fishing site was maintained at the river mouth to determine run timing and abundance indices of king and chum salmon entering the fishery.

Exploratory work during the 1968 season indicated that some method of capturing salmon other than with gill nets would be desirable. Previous gill net operations required far too much effort for the number of fish captured. The mortality rate of gill netted fish was greater than half the catch with delayed mortality of tagged fish impossible to determine. Resulting efforts were applied toward the construction and operation of a fishwheel in conjunction with a tag-recovery and catch sampling program based at Ohogamiut during the 1969 field season. Salmon spawning escapement surveys and comprehensive subsistence fishery surveys were also conducted throughout the district. Limited sheefish investigations were continued in the Yukon River.

OBJECTIVES

1. Determine population sizes and escapements of anadromous fish passing through the Ohogamiut area.
2. Determine migration routes of anadromous fish in the study area.
3. Determine migration rates and timing of anadromous fish passing through the lower Yukon area, specifically between the mouth and the tagging site and various upriver recovery sites.
4. Determine life histories of anadromous fish in the Yukon River.
5. Determine subsistence utilization of anadromous fish populations.

   Secondary objectives:

   a. Construct and evaluate the effectiveness of a fishwheel as a piece of sampling gear.

   b. Evaluate short term tag-recovery values of the Floy FD-67 anchor tags on king and summer chum salmon.

METHODS AND MATERIALS

Set gill nets of 5-1/2 and 8-1/2 inch stretch mesh nylon webbing with standard floats and weighted with a lead line were used to capture salmon and sheefish. Each net was approximately 25 fathoms long by 3-1/2 fathoms deep.

A fishwheel constructed of native spruce logs andcut lumber, was fished on an experimental basis. Three baskets, each 12 feet long and 11 feet wide with a 6 foot deep scoop, were covered with heavy guage 2 inch square mesh wire netting which was later replaced by 2 inch square mesh nylon seine webbing. Panels of surplus canvas, 11 feet by 3 feet, were attached to the bottom outside

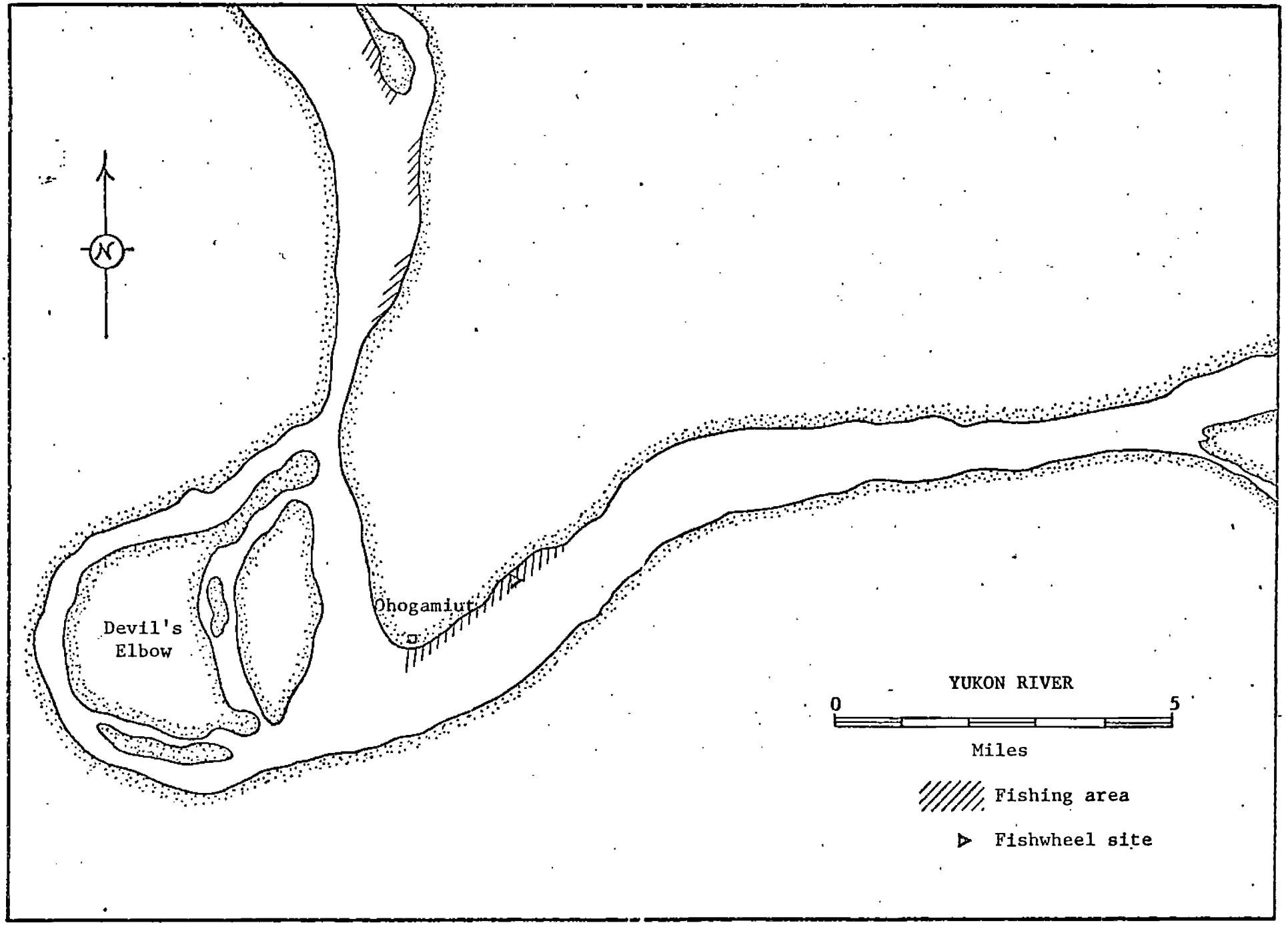
edge of each basket as a means of increasing water resistance to speed up rotation of the wheel. Adjustable axle supports allowed fishing depth to be increased or decreased. The fishwheel was anchored to shore with a single 1/2 inch diameter wire rope. Two boom logs held the fishwheel offshore in the current. A lead was installed from the mid-section of the fishwheel platform to shore. The lead extended from the river bottom to just above the surface of the water.

The Yukon River tagging operations began May 30. All fishing was conducted in an area within three miles upstream and ten miles downstream of Ohogamiut (Figure 2). Set gill nets were usually fished for 24 hour periods at several locations restricted to the presence of eddies. All nets were checked approximately every 2 hours to decrease fish mortality. Not more than three nets were fished at any one period of time. Test fishing gill nets were fished near the north shore of the south mouth channel in the vicinity of Flat Island (Figure 1). The gear was operated continuously from June 4 to July 7.

Fishwheel construction began June 5. The apparatus was placed in operation June 21, approximately one mile upstream of Ohogamiut. Rotation speed of the wheel equaled three revolutions per minute. Basket depth was adjusted to fish approximately one foot above the river bottom. Captured fish were deposited into a live box where they were held until tagged and released.

Salmon tagging was intiated with Floy FD-67 international orange anchor tags and modified tagging gun. Yellow and white spaghetti tags of flexible 1/16 inch diameter plastic tubing in 13 inch lengths affixed to stainless steel needle applicators were also used on salmon and sheefish. Each tag was inscribed with a number and the legend - REWARD ADFG ANCHORAGE.

Figure 2 . · Map of the Yuk ver, Ohogamiut, Alaska.



All fish were tagged just below and at the posterior end of the dorsal fin. Floy tags were self-anchoring when inserted with the tagging gun. Spaghetti tags were inserted with a tagging needle through both sides of the fish the skin and flesh posterior ~~to dorsal fin.~~ After insertion, the needle was removed and the two free ends of the tag were tied tightly with an overhand knot. Adipose fins of all tagged salmon were excised as a check against tag loss.

For each tagged fish, the following information was recorded: date, tagging site, gear, tag number, species and length. Sampling data were obtained from commercial, subsistence and Department test fishing and tagging site catches. Scale samples were removed from the area of the first or second scale row, above the lateral line, located on a diagonal line down from the insertion of the dorsal fin to the origin of the anal fin.

All fish scales were interpreted for age and data tabulated. Tag recovery data were analyzed by hand calculator. Remaining results are pending receipt of Department computer analysis.

For purposes of this report, a 4_2 salmon returning to spawn in 1969 would be the progeny of the 1965 run that migrated from freshwater to the ocean in the spring of 1967.

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 analysis.

Department biologist and a subsistence survey crew collected tag recoveries from fishermen within Alaska. In the Yukon Terrotiry, Canadian Department of Fisheries and Royal Canadian Mounted Police personnel collected tag recoveries. Additional tags were returned by individuals through the mail.

A reward of $1.00 was offered for each tag returned with the appropriate recovery information of date and recovery location.

Estimate of salmon escapements were determined by aerial surveys utilizing Cessna 180 or Piper PA-18 type aircraft.

Much of the subsistence fishery data ~~was~~ were obtained 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.

Two-man crews, traveling by boat, surveyed the majority of the Yukon River fisheries, 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 drainage.

RESULTS

Several problems were encountered which resulted in comparatively small numbers of salmon being captured and tagged. Fluctuating low water conditions (10-15 feet below normal), fishwheel construction and difficulty in locating suitable fishing sites hampered operations. Since the determination of a reliable population estimate of king salmon passing through the Ohogamiut area did not appear feasible this year, emphasis was placed on obtaining additional information on migration rates, timing and distribution of run segments or races of king and summer chum salmon.

King Salmon

Table 1 summarizes the king salmon tag-recovery data. Of 537 kings captured at the tagging site, 293 (54.6%) were tagged and released. Gill nets accounted for the largest catch (437) and mortality (53.5%), while the fishwheel accounted for 100 kings and a 10.0 percent mortality. The overall recovery rate of tagged fish was 26.3 percent. Nearly all recoveries were taken in 8-1/2 inch mesh gill nets of upriver fishermen. The daily numbers of king salmon captured, tagged and recovered by tagging date are presented in Appendix A. Tag-recovery data for recoveries (6) made by tagging site nets within 24 hours of the date of tagging are not included.

Distribution of recoveries by area

The number and percentage distribution of king salmon tag recoveries by recovery area are summarized in Table 2. The greatest percentage (93.5%) of recoveries occurred in the Alaskan portion of the main Yukon River, particularly in the Russian Mission to Holy Cross area where a large amount of fishing effort is located in relative close proximity to the tagging site. Remaining recoveries were made in the Yukon Territory. The furthest recovery occurred in the Pelly River at Pelly Crossing, Yukon Territory, a distance of 1,580 miles upstream from the mouth of the Yukon. Tag and recovery data are presented in Appendix B.

Recovery rates by tagging period

King salmon upriver recovery rates by tagging period are summarized in Table 3. The largest percentage of recoveries (47.8%) occurred during June 1-15, the period of maximum gill net commercial fishing effort. Reduced effort and a change to a fishwheel chum salmon fishery during the subsequent two periods accounted for only 20.6 and 14.8 percent recoveries respectively. Data indicates a substantial harvest of the early portion of the king salmon run.

Table 1. King salmon tag-recovery summary, Ohogamiut, Yukon River, 1969.

Gear	Effort (days)	Number captured	Percent captured	Mortality		Tagged			Recovered		
				Number	Percent	Number	Percent	Percent total	Number	Percent	Percent total
Fishwheel	21	100	18.6	10	10.0	90	90.0	30.7	10	11.1	13.0
Gill net	42	437	81.4	234	53.5	203	46.5	69.3	67	33.0	87.0
Total	42[1/]	537	100.0	244	45.4	293	54.6	100.0	77	26.3	100.0

1/ Maximum number of days gear operated.

Table 2. Distribution and migration rates of tagged king salmon, Yukon River, 1969.

Area of recovery	Miles from tagging site	Recoveries No.	Recoveries %	Tagging dates (range)	Recovery dates (range)	Mean days out	Mean miles per day
Below Ohogamiut	-	9	11.7	6/4-30	6/16-7/6	7.1	-
Russian Mission	28	4	5.2	6/3-27	6/7-7/5	3.5	8.0
Paimiut	66	6	7.8	6/3-24	6/6-27	4.3	15.3
Above Paimiut	76	10	12.9	6/1-24	6/11-7/2	10.2	7.4
Mouth, Innoko River	89	2	2.6	6/3-27	6/6-7/1	3.0	29.7
Holy Cross	98	13	16.9	6/2-25	6/6-7/26	9.9	9.9
Grayling	151	1	1.3	6/24	7/2	8.0	18.9
Kaltag	268	1	1.3	6/17	6/28	11.0	24.4
Nulato	299	2	2.6	6/11-12	6/28-7/2	18.5	16.2
Koyukuk	317	1	1.3	6/26	7/20	24.0	13.2
Mouth, Koyukuk R.	323	3	3.9	6/23-7/3	7/6-26	14.3	22.6
Kokrines	423	3	3.9	6/23-7/4	7/15-20	16.7	25.3
Tanana	510	3	3.9	6/13-25	7/8-25	13.7	37.2
Above Tanana	540	4	5.2	6/3-23	6/26-7/5	19.8	27.2
Rampart	578	4	5.2	6/15-29	7/1-15	15.8	36.6
Nenana (Tanana R.)	675	4	5.2	6/22-27	7/13-23	25.8	26.2
Mouth of Chena R. (Tanana R.)	727	1	1.3	6/24	7/20	26.0	28.0
Fort Yukon	817	1	1.3	6/27	7/20	23.0	35.5
Old Crow (Porcupine R.), Y.T.	1,074	1	1.3	6/15	7/13	28.0	38.4
Carmacks, Y.T.	1,366	2	2.6	6/18-27	7/28-8/17	45.5	30.0
Pelly Crossing (Pelly R.) Y.T.	1,395	2	2.6	6/12-28	7/26-8/17	42.0	33.2

Table 3. King salmon recovery rates by tagging period, Yukon River, 1969.

Tagging period	Tagged		Recovered		
	Number	Percent	Number	Percent	Percent total
6/1-15	67	22.9	32	47.8	41.6
6/16-30	199	67.9	41	20.6	53.2
7/1-12	27	9.2	4	14.8	5.2
Total	293	100.0	77	26.3	100.0

Migration rates

Migration rates of Yukon River king salmon recovered at various locations are summarized in Table 2. The maximum rate recorded was 38.4 miles per day while the average rate was 24.2 miles per day. In general, migration rates increased as the distance traveled upstream increased. These migration rates should not be considered as the actual rate of travel due to the following inherent tag and recovery limitations: (1) tagged fish were usually in an initially weakened or disoriented condition as a result of handling and tagging, (2) comparatively few fish were tagged and recovered and (3) reported recovery dates may be inaccurate. Based on peak catches in the Flat Island and Ohogamiut areas, the migration rate of untagged fish was approximately 46 miles per day (Figure 3).

General run timing

The daily catches of king salmon are listed in Appendix A. The first king salmon was captured June 1. One notable peak of abundance occurred during June 23-24 in the Ohogamiut area. Smaller run peaks occurred approximately four days apart between both the Flat Island and Chogamiut fishing sites.

King salmon catches made at Ohogamiut and Flat Island are compared in Figure 3. Differences in the magnitude of the catches between the two sites reflect the influence of the intensive downriver commercial fishery on the salmon migrations.

During the first two and one-half weeks of the season, the majority of the king salmon run entered the river by the south mouth. As indicated by commercial and Flat Island catches, the peak in the south mouth run occurred between June 7-11 (Table 4).

Fig King salmon daily catches at Flat Islan Ohogamiut, Yukon River, 1969.

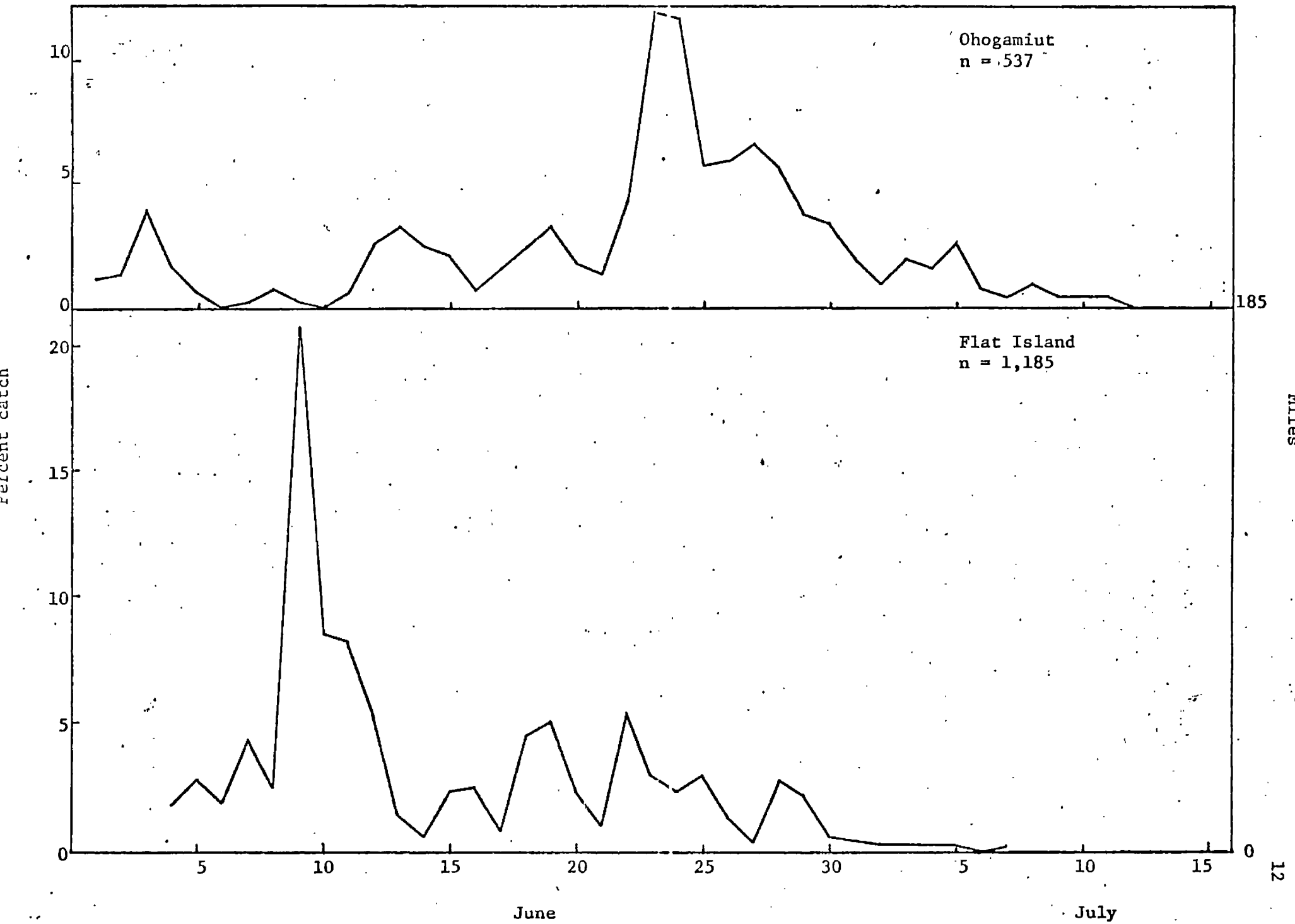


Table 4. Percent by date of king salmon commercial catch (Statistical area 334-12) and Flat Island test fishing catches, Yukon River, 1969[1/]

Date	Percent catch	
	Commercial (n=21,894)	Test fishing[2/] (n=528)
6/ 4	9	1
6/ 7	9	13
6/11	36	37
6/14	22	6
6/18	4	9
6/20	10	9
6/24	9	14
6/28	1	12

1/ Test fishing date from a single 25 fathom gill net of 8-1/2 inch mesh.

2/ Does not include 41 kings taken after the close of the commercial fishing season (6/28).

Since intensive fishing effort and excellent fishing conditions prevailed in the south mouth area, an excessive commercial harvest was made and escapement of this run segment was judged very poor. This is indicated by the relatively poor catches made at the Ohogamiut site prior to June 22. Because of the poor escapement, fishing time was reduced from 3-1/2 to 2 days during the week of June 19-25 in subdistrict 334-10 and June 22-28 in subdistrict 334-20.

Catch data indicated that after June 19, a majority of the king salmon run began utilizing the Kwiguk mouth, middle mouth and north mouth entry routes. There is less fishing effort in these areas compared to the south mouth and since this run of fish was coincidental with reduced fishing time, escapement through the lower 150 miles of river was considered good. This segment of the run produced the peak catches made at the Ohogamiut site during June 23-24.

Population estimate considerations

A reliable population estimate was not feasible due to fishwheel construction and exploratory fishing which limited the number of king salmon tagged and the resulting lack of sufficient data. However, a population estimate of king salmon passing through the tagging area was calculated utilizing a simple Peterson formula based on upriver subsistence and commercial fishing recoveries (Appendix C). Results indicated an escapement estimate of 52,599 and total run estimate of 160,564 king salmon.

Age, sex and size composition

A total of 322 king salmon was sampled for age, sex or size information from June 1 through July 12. Of these, 100 were captured by a fishwheel and the remaining 222 by gill nets.

Fishwheel. Age 4_2 kings comprised 68.0 percent of the fishwheel catch while age 5_2 fish (15.0%) were second in abundance. The 7_2 age group was absent from the catch. Sex differentiation by external means was not feasible with the sampled fish which were tagged and released. The mean length (mid-eye to fork of tail) of the total fish sampled was 588 mm. Age and size data for fishwheel caught kings are presented in Table 5.

Gillnet. The age, sex and size composition of 222 king salmon captured in 8-1/2 inch mesh gill nets is presented in Table 6. The 6_2 age group represented 41.0 percent of the sample, followed by the 4_2 (36.0%), 5_2 (12.1%) 7_2 (10.4%) and 3_2 (0.5%) age groups. The sample contained 67.6 percent males and 32.4 percent females. Age 3_2 females were not encountered, but females were more abundant than males in the 6_2 and 7_2 age groups. Males were dominant in the 4_2 and 5_2 age groups. Females had greater mean lengths then males for all age categories, except for the 4_2 age group; a possible result of sample size. A conversion table for mid-eye - snout to fork length for male and female king salmon captured at river mile 185 was calculated using linear regression methods (Table 7.).

Chum salmon

Table 8 summarizes the summer chum salmon tag-recovery data. Of 2,677 chums captured at the tagging site, 1,508 (56.4%) were tagged and released. A single fishwheel accounted for 2,229 (83.3%) chums. Gill nets of 8-1/2 inch mesh were essentially ineffective as chum salmon gear and caused considerable mortality (74.8%) on captured fish. The overall tag recovery rate was 6.9 percent. The low rate is atributed to a decline in effort and subsistence fishing.

Table 5. Age and size composition of king salmon taken with fishwheel at Ohogamiut, Yukon River, 1969.

	Age group				
	3_2	4_2	5_2	6_2	Total
Combined sexes					
Number	8	68	15	9	100
Percent	8.0	68.0	15.0	9.0	100.0
Mean length (mm)1/	380	563	656	850	588

1/ Mid-eye to fork of tail.

Table 6. Age, sex and size composition of untagged king salmon taken with gill nets[1/] at Ohogamiut, Yukon River, 1969.

	Age group					
	3_2	4_2	5_2	6_2	7_2	Total
Males						
Number	1	78	24	37	10	150
Percent	0.5	35.1	10.8	16.7	4.5	67.6
Mean length (mm)[2/]	359	575	663	869	1,019	690
Females						
Number	0	2	3	54	13	72
Percent	-	0.9	1.3	24.3	5.9	32.4
Mean length (mm)	-	568	781	893	997	898
Combined sexes						
Number	1	80	27	91	23	222
Percent	0.5	36.0	12.1	41.0	10.4	100.0
Mean length (mm)	359	575	676	883	1,006	757

1/ 8-1/2 inch mesh.
2/ Mid-eye to fork of tail.

Table 7. King salmon fork length conversion table; mid-eye to snout, Yukon River, mile 185.

Mid-eye to fork length			Mid-eye to fork length		
Male (n=72)	Female (n=45)	Snout to fork length	Male (n=72)	Female (n=45)	Snout to fork length
33.3	-	36.0	75.1	76.0	81.0
34.2	-	37.0	76.0	76.8	82.0
35.2	-	38.0	76.9	77.7	83.0
36.1	-	39.0	77.7	78.6	84.0
37.0	-	40.0	78.6	79.5	85.0
39.0	-	41.0	79.4	80.4	86.0
38.9	-	42.0	80.3	81.3	87.0
39.8	-	43.0	81.2	82.2	88.0
40.7	-	44.0	82.0	83.1	89.0
41.6	-	45.0	82.9	84.0	90.0
42.5	-	46.0	83.7	84.9	91.0
43.5	-	47.0	84.6	85.8	92.0
44.4	-	48.0	85.5	86.6	93.0
45.3	-	49.0	86.3	87.5	94.0
46.2	-	50.0	87.2	88.4	95.0
47.1	-	51.0	88.0	89.3	96.0
48.1	-	52.0	88.9	90.2	97.0
49.0	-	53.0	89.8	91.1	98.0
49.9	-	54.0	90.6	92.0	99.0
50.8	-	55.0	91.5	92.9	100.0
51.7	-	56.0	92.3	93.8	101.0
52.7	-	57.0	93.2	94.6	102.0
53.6	-	58.0	94.1	95.5	103.0
54.5	-	59.0	94.9	96.4	104.0
55.4	-	60.0	95.8	97.3	105.0
56.3	-	61.0	96.6	98.2	106.0
57.3	-	62.0	97.5	99.1	107.0
58.3	-	63.0	98.4	100.0	108.0
59.1	-	64.0	99.2	100.9	109.0
60.0	-	65.0	100.1	101.8	110.0
60.9	-	66.0	100.9	102.7	111.0
61.9	-	67.0	101.8	103.6	112.0
62.8	-	68.0	102.7	104.4	113.0
63.7	-	69.0	103.5	105.3	114.0
64.6	-	70.0	104.4	106.2	115.0
65.5	-	71.0	105.2	107.1	116.0
66.5	-	72.0	106.1	108.0	117.0
67.4	-	73.0	107.0	108.9	118.0
68.3	-	74.0	107.8	109.8	119.0
69.2	-	75.0	108.7	110.7	120.0
70.1	-	76.0	109.5	111.6	121.0
71.1	-	77.0	110.4	112.4	122.0
72.0	-	78.0	111.3	113.3	123.0
72.9	-	79.0	112.1	114.2	124.0
73.8	-	80.0	113.0	115.1	125.0

Table 8. Chum salmon tag-recovery summary, Ohogamiut, Yukon River, 1969.

Gear	Effort (days)	Number captured	Percent captured	Number released	Mortality		Tagged			Recovered		
					Number	Percent	Number	Percent	Percent total	Number	Percent	Percent total
Fishwheel	21	2,229	83.3	320	475	21.3	1,434	64.3	95.1	101	7.0	97.1
Gill net	42	448	16.7	39	335	74.8	74	16.5	4.9	3	4.0	2.9
Total	42[1/]	2,677	100.0	359	810	30.2	1,508	56.4	100.0	104	6.9	100.0

1/ Maximum number of days gear operated.

The daily number of chum salmon captured, tagged and recovered by tagging date are presented in Appendix D. Tag-recovery data for recoveries (3) made by tagging site nets within 24 hours of the date of tagging are not included.

Distribution of recoveries by area

The number and percentage distribution of chum salmon tag recoveries by recovery area are presented in Table 9. All recoveries were made within the Alaska portion of the main Yukon River. The greatest percentage (67.1%) of recoveries occurred in the Mountain Village to Russian Mission area. Recoveries below the tagging site (50.8%) were probably due to disorientation, a result of retaining fish within a live box for an extended period of time prior to tagging. Immediate tagging and release of fish soon after capture should minimize this problem. The furthest recovery was made in the Koyukuk River at Huslia, a distance of 711 miles upstream from the mouth of the Yukon. Tag and recovery data are presented in Appendix E.

Migration rates

Migration rates of Yukon River chum salmon recovered at various locations are presented in Table 9. Average rates ranged from 0.8 to 33.1 miles per day. Wide fluctuations occurred due to the inherent tag and recovery limitations. No distinguishable migration rate patterns were recognized.

Based on peak catches in the Flat Island and Ohogamiut areas, the migration rate of untagged fish was approximately 22.0 miles per day with the majority of fish entering the river through the south mouth (Figure 4).

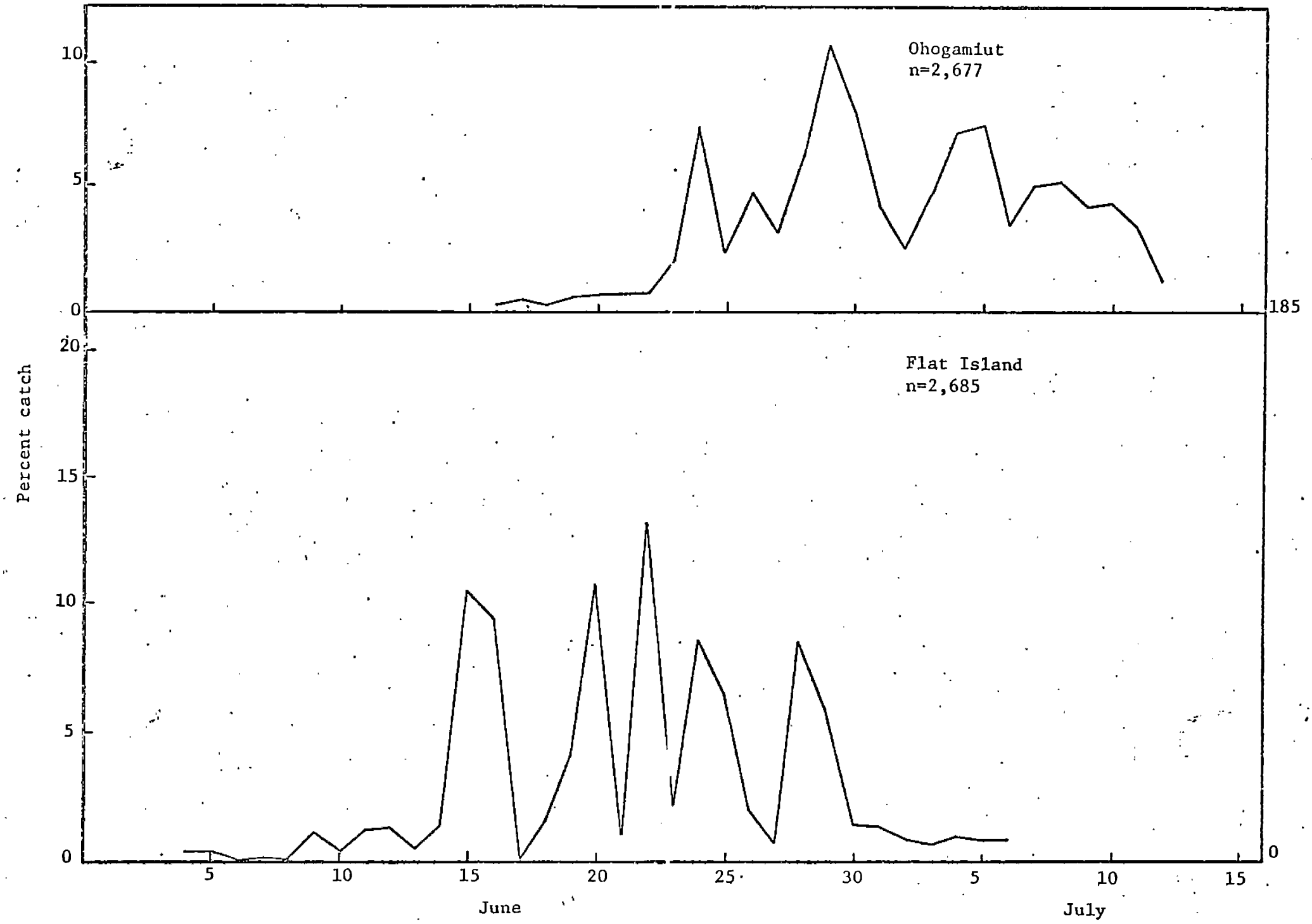
General run timing

The daily catches of chum salmon are listed in Appendix D. The first chum salmon was captured June 12. The peak catch occurred June 29 (Figure 4).

Table 9. Distribution and migration rates of tagged chum salmon, Yukon River, 1969.

Area of recovery	Miles from tagging site	Recoveries No.	Recoveries %	Tagging dates (range)	Recovery dates (range)	Mean days out	Mean miles per day
Aproka Pass	150	2	1.9	6/27-30	7/4-7	7.0	-
Fish Village	133	1	1.0	6/24	6/30	6.0	-
Mountain Village	98	4	3.8	6/23-7/6	6/25-7/24	7.8	-
Mouth, Andreafsky River	81	9	8.6	6/24-7/8	6/28-7/12	5.8	-
Pilot Station	63	15	14.4	6/29-7/8	7/6-19	8.2	-
Marshall	24	18	17.3	6/24-7/10	7/4-23	7.6	-
Ingrihak	15	4	3.8	7/4-12	7/6-30	18.0	-
Ohogamiut (mile 185)	0	7	6.7	6/24-7/8	6/26-7/10	4.8	-
Russian Mission	28	13	12.5	6/24-7/11	7/2-30	6.9	4.1
Paimiut	66	1	1.0	7/10	7/12	2.0	33.0
Above Paimiut	76	1	1.0	7/5	7/10	5.0	15.2
Mouth, Innoko River	89	4	3.8	6/24-7/3	7/5-9	8.8	10.1
Holy Cross	94	6	5.8	6/24-7/1	7/2-8	7.6	12.4
Anvik	132	4	3.8	6/19-7/4	6/23-20	10.5	12.6
Shageluk (Innoko R.)	143	1	1.0	6/27	7/12	15.0	9.5
Grayling	151	6	5.8	6/24-7/3	7/2-10	8.7	17.4
Kaltag	265	1	1.0	6/18	6/26	8.0	33.1
Nulato	299	4	3.8	7/2-11	7/15-30	16.0	18.7
Koyukuk	317	1	1.0	7/10	7/20	10.0	31.7
Tanana	510	1	1.0	6/25	7/12	17.0	30.0
Huslia (Koyukuk R.)	526	1	1.0	6/23	8/15	53.0	9.9

Figure 4. Chum salmon daily catches at F. . .sland and Ohogamiut, Yukon River, 1969.



Smaller catch peaks were attributed to entry magnitude of chums into the river mouth as evidenced by the Flat Island catches.

Population estimate considerations

As a result of the small number of recoveries (104), a population estimate of chum salmon was not considered feasible.

Age, sex and size composition

The age, sex and size structure of 789 summer chum salmon captured in a fishwheel and 8-1/2 inch mesh gill nets is presented in Table 10. Fishwheel and gill net catches were combined because of the relative uniformity in fish size, total catches and age groups represented. Age 4_1 (84.0%) chums were most abundant for both sexes followed by age 5_1 (11.0%) and age 3_1 (5.0%) fish. Males exhibited greater mean lengths than females for all age groups. A conversion table for mid-eye - snout to fork length for male and female summer chum salmon captured at river mile 185 was calculated using linear regression methods (Table 11.).

The age structure of summer chum salmon sampled by weekly time period of migration is summarized in Table 12. Migration patterns for both sexes of each age group were similar. The June 29 to July 5 period experienced the peak run of all age groups. Age 4_1 and 5_1 fish appeared in catches during June 8-14 period, while age 3_1 chums appeared during the June 22-28 period. Migration timing of males advanced that of females. Of 390 males sampled, 23.0 percent were captured prior to the run peak of June 29 as compared to 18.4 percent of the 399 females captured during the same period.

Table 10. Age, sex and size composition of summer chum salmon taken with fishwheel and gill nets[1/] at Ohogamiut, Yukon River, 1969.

	Age group 3_1	4_1	5_1	Total
Males				
Number	18	327	45	390
Percent	2.3	41.4	5.7	49.4
Mean length (mm)[2/]	502	580	624	581
Females				
Number	21	336	42	399
Percent	2.7	42.6	5.3	50.6
Mean length (mm)	494	548	585	549
Combined sexes				
Number	39	663	87	789
Percent	5.0	84.0	11.0	100.0
Mean length (mm)	498	564	605	565

1/ 8-1/2 inch mesh.
2/ Mid-eye to fork of tail.

Table 11. Chum salmon fork length conversion table; mid-eye to snout, Yukon River, mile 185.

Mid-eye to fork length		
Male (n=315)	Female (n=367)	Snout to fork length
39.0	39.5	41.0
39.8	40.4	42.0
40.6	41.2	43.0
41.5	42.1	44.0
42.3	42.9	45.0
43.2	43.8	46.0
44.0	44.7	47.0
44.8	45.5	48.0
45.7	46.4	49.0
46.5	47.3	50.0
47.4	48.1	51.0
48.2	49.0	52.0
49.0	49.9	53.0
49.9	50.7	54.0
50.7	51.6	55.0
51.5	52.5	56.0
52.4	53.3	57.0
53.2	54.2	58.0
54.1	55.1	59.0
54.9	55.9	60.0
55.7	56.8	61.0
56.6	57.7	62.0
57.4	58.5	63.0
58.2	53.4	64.0
59.1	60.2	65.0
59.9	61.1	66.0
60.8	62.0	67.0
61.6	62.9	68.0
62.4	63.7	69.0
63.3	64.6	70.0
64.1	65.4	71.0
64.9	66.3	72.0
65.8	67.2	73.0
66.6	68.0	74.0
67.4	68.9	75.0
68.3	69.8	76.0
69.1	70.6	77.0
70.0	71.5	78.0
70.8	72.4	79.0
71.6	73.2	80.0

Table 12. Age composition of summer chum salmon sampled by weekly time period of migration with a fishwheel and gill nets[1/] at Ohogamiut, Yukon River, 1969.

Date	Number of fish by age group 3_1	4_1	5_1	Total	Percent total
			Males		
6/1-7	0	0	0	0	0.0
6/8-14	0	1	0	1	0.1
6/15-21	0	24	2	26	3.3
6/22-28	2	132	21	155	19.6
6/29-7/5	9	131	17	157	19.9
7/6-7/12	7	39	5	51	6.5
Total	18	327	45	390	49.4
			Females		
6/1-7	0	0	0	0	0.0
6/8-14	0	0	0	0	0.0
6/15-21	0	17	2	19	2.4
6/22-28	2	110	14	126	16.0
6/29-7/5	14	167	17	198	25.1
7/6-7/12	5	42	9	56	7.1
Total	21	336	42	399	50.6
			Combined sexes		
6/1-7	0	0	0	0	0.0
6/8-14	0	1	0	1	0.1
6/15-21	0	41	4	45	5.7
6/22-28	4	242	35	281	35.6
6/29-7/5	23	298	34	355	45.0
7/6-7/12	12	81	14	107	13.6
Total	39	663	87	789	100.0

1/ 8-1/2 inch mesh.

FD-67 Anchor Tag Evaluation

Table 13 summarizes the FD-67 tagging data. In all, 67 king salmon and 6 chum salmon were tagged with 33 (49.2%) and 1 (16.7%) respectively recovered. Accidental breakage of the tagging gun prevented application of additional tags. No tag losses were reported. Since this information is voluntary, tag loss evaluation is difficult. Three tags were recovered over 1,000 miles from the tagging site. The furthest tag recovery occurred at Pelly Crossing (Pelly River), Yukon Territory, a distance of 1,395 miles. The maximum period of time a tag was attached to a live salmon was 44 days.

Based on the limited data available, FD-67 anchor tags appear suitable for in river short term tag-recovery studies. Evaluation of this equipment will continue in 1970.

Sheefish

During 1969, five sheefish were captured at Ohogamiut during the period of June 1-July 12. Maximum effort was directed toward the salmon project. Of the sheefish captured, 4 were tagged and released. No recoveries were recorded for the 1969 or previous years tagging efforts.

A summary of the 1967-1969 tagging results is presented in Table 14. It is expected that additional recoveries from the sheefish tagging projects will be made in future years. In 1970, sheefish will again be tagged and released incidental to the salmon projects. As additional recoveries are reported in the future, important information on the movements and distribution of sheefish in the Yukon River drainage will be obtained.

Table 13. Tag-recovery summary of Floy FD-67 anchor tags, Yukon River, 1969.

Species	Number tagged	Number recovered	Percent recovered	Miles traveled (range)	Days out (range)
King salmon	67	33	49.2	28-1,395	3-44
Chum salmon	6	1	16.7	132	4
Total	73	34	46.6	28-1,395	3-44

Table 14. Sheefish tag-recovery summary, Yukon River, 1967-1969.

Tagged		Recovered			Cumulative	Percent
Year	Number	Year	Number	Percent	percent	remaining
1967	10	1967	0	0.0	0.0	100.0
		1968	1	10.0	10.0	90.0
		1969	0	0.0	10.0	90.0
1968	154	1968	10	6.5	16.5	83.5
		1969	0	0.0	16.5	83.5
1969	4	1969	0	0.0	16.5	83.5
Total	168		11	6.5	6.5	93.5

Subsistence Surveys

The 1969 subsistence catches recorded for the Yukon district are presented in Table 15. A minimum of 14,921 king salmon and 208,827 salmon of other species were taken. Catches were below average. The recorded subsistence catches represent minimum figures for salmon consumed prior to the surveys and ~~others~~ catches made after the completion of surveys are not always recorded.

Subsistence catches of Yukon River chum salmon have declined markedly during recent season. Although adverse fishing conditions and the immediate employment situation have had some effect, the decline is largely the result of a lack of dependence on subsistence fishing. As shown in Table 16, there has been a decline in fishermen, sled dogs and the number of fishwheels for the Yukon River.

Aerial Survey Estimates of Salmon Escapements

Approximately 30 hours were spent conducting aerial surveys of salmon spawning streams in the Yukon district during 1969. Selected streams of the Yukon, Koyukuk and Teslin River systems were surveyed. Results are summarized in Table 17.

DISCUSSION AND FUTURE PLANS

Although population estimates were unattainable in 1969, the tag and recovery project demonstrated the feasibility of capturing king and chum salmon with fishwheels in suitable condition for tagging. Disregarding any unknown delayed mortality, data revealed a significant reduction in catch mortality

Table 15. Subsistence salmon catches, Yukon district, 1969.[1/]

Year	Kings	Other salmon[2/]
1961	23,719	407,814
1962	19,910	358,441
1963	32,656	421,625
1964	22,817	485,630
1965	19,723	458,379
1966	14,017	214,236
1967	19,661	288,595
1968	14,832	189,607
1969[3/]	14,921	208,827

1/ Includes Yukon Territory (Canada) catches.
2/ Mostly chum salmon.
3/ Data is preliminary.

Table 16. Decline in subsistence fishing effort, Yukon River, 1961-1969.

Selected year	Number of fishing families surveyed	Number of dogs owned	Number of fishwheels operated
1961	624	4,806	169
1963	597	4,155	156
1965	541	3,974	127
1967	471	2,752	87
1968	476	2,719	71
1969	458	2,442	63

Table 17. Aerial survey estimates of salmon escapements, Yukon district, 1969.[1/]

Stream	Date	Aerial survey rating	Kings	Chums
Andreafsky River				
West Fork	7/21	Poor-Fair	231	159,500[2/]
East Fork	7/21	Poor-Fair	274	119,000[3/]
Total			505	278,500
Anvik River	7/23	Poor	296	- [4/]
Salcha River	8/1	Poor	461	425
Nisutlin River	8/15	Fair	205	-
Big Salmon River	8/15	Fair	286	-
Northern Lake outlet[5/]	8/15		5	
Little Salmon River	8/17	Fair	120	-

1/ If more than one survey of a stream was flown, only the high count is presented.
2/ Includes an estimated 14,500 carcasses.
3/ Includes an estimated 11,000 carcasses.
4/ Impossible to count.
5/ Foot survey of upper 1/2 mile.

induced by fishwheels as compared to gill nets, however, fishwheel catch figures were considered extremely low for king salmon. An outside lead that will shunt fish toward the fishwheel is believed a satisfactory method of increasing the total catch.

The test fishing catch data presented in this report were affected by environmental conditions, varying fishing methods and other factors which are not necessarily related to salmon abundance. Even with these limitations, the test fishing data is thought to be the best representation of run timing and magnitude into the river. Commercial catches are not adequate for this analysis because of gaps in the data caused by periodic closed fishing periods.

One serious limitation of the study is that the Flat Island catch data cannot be used as an abundance index for the entire Yukon River run. Salmon enter the Yukon River by several mouths, and the proportion of the run entering each mouth varies considerably from year to year. For example, there were 25,826 and 27,202 king salmon taken commercially in the south and middle mouths respectively during 1967 (Geiger et. al. 1967). With similar fishing effort, there were only 6,600 kings taken in the middle mouth during 1968 compared to 27,898 kings taken in the south mouth (Geiger et. al. 1968). In 1969, south and middle mouth catches totaled 21,894 and 12,875 kings respectively (Regnart et. al. 1969). Another rest fishing site should probably be established above the confluences of the major mouths or channels (near Fish Village) in order to establish abundance indices for the entire run.

Although the sex and size characteristics of commercial salmon catches are readily attainable, little information is known regarding these characteristics for the total run or for the spawning escapement. The effect of an

intensive commercial fishery on the quality, as well as the quantity of the spawning escapement should be of great concern to the fishery management biologist.

Age composition of salmon runs can be expected to vary from year to year because of differences in the survival and return of various brood year stocks. Sex ratios of any particular run, especially for king salmon, may vary from 1:1 depending on the relative abundance of the various age classes. For example, an unusually large return of age 4_2 and 5_2 king salmon could produce an overall sex ratio in favor of males.

Yukon River king salmon runs consist of fish ranging from 3 to 7 (possibly 8) years of age. Because of gear selectivity for different sized fish, the various age and sex classes are not captured in proportion to their real abundance. It has been shown that 8-1/2 inch mesh (approximate) gill nets, which are operated in the commercial fishery, are selective on age 6_2 and 7_2 females (Geiger, et. al. 1968). Fishwheel test catches indicate a selectivity of the younger age classes. Because of the intensive and selective nature of the fishery, the resultant king salmon spawning escapements ~~and selective nature of the fishery, the resultant king salmon spawning escapements~~ are suspected to be normally composed of a majority of males with relatively high percentage of the 3_2, 4_2 and 5_2 age groups.

The optimum sex ratio for spawning king salmon is not known, but a surplus of age 3_2 to 5_2 males in the spawning escapement contributes little to run productivity. A 1:1 sex ratio, or even a majority of females on the spawning grounds would be best for maximum production. Preliminary data obtained during the past several years indicates that differences of one or two inches in gill

net mesh size can considerably alter the age, sex and size composition of the catch. The use of gill nets of a smaller mesh size would reduce the harvest of the more productive females in the older age groups and increase the harvest of the younger age groups which are predominantly males. The catch would then spread out to include some harvest of all of the available age groups.

Other considerations involving the use of smaller mesh gill nets to harvest king salmon would be the effect on the marketability of the catch, increased incidental catch of chum and sockeye salmon and the possible drop-out problem associated with the larger sized king salmon.

The 1969 study also shows the occurrence of seasonal changes in age, sex and size compositions of the 1969 king and summer chum salmon runs. If these trends exhibit similar and distinct patterns from year to year, then it may be possible to alter the characteristics of the catch by altering the fishing season.

The subsistence fishery rivals the commercial fishery as 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.

Increased welfare payments and more employment opportunities have resulted in a general decline in fishing effort throughout the A-Y-K area. Snow vehicles are beginning to replace sled dogs and this is expected to speed up the decline of the subsistence fishery in the future as less dog food is needed.

The documentation of catches and associated fishery data (amount of gear, number of fishermen, etc.) by subsistence surveys may indicate relative run magnitudes, escapements and trends in the dependence on subsistence fishing. The

surveys are also insurance against a large number of unreported tag recoveries by subsistence fishermen.

Aerial surveys are the most commonly used salmon escapement enumeration methods since a relatively large number of streams can be observed in a short period. However, inherent weather and water conditions limit accuracy. It should also be emphasized that aerial survey determination of spawning salmon is considered an estimate or index of escapement and not the actual or total number of spawners in a stream. If aerial survey procedures are standardized and enviromental conditions do not vary much, then estimates (indices) of salmon escapements made at the same stage of the run can be compared from year to year. The high count or estimate of escapement usually made at the peak of spawning is considered as the best index of the total escapement. Annual escapement indices of major streams, plus accurate commercial and subsistence catch data, are of extreme importance to the management biologist in evaluating run magnitudes of various stocks. These techniques are being applied annually in the Yukon District.

During the 1970 field season, three improved fishwheels with deeper baskets, floating pillow block bearings and outside leads will be operated in the Ohogamiut area. All salmon will be tagged and then released. A recovery site will be established 40-50 miles upriver of Ohogamiut. If good fishing sites are available, large numbers of salmon in suitable condition for tagging can be obtained and should contribute sufficient data for a reliable population estimate.

It is recommended that age, sex and size studies be continued for all species of salmon with more emphasis placed on assessing age, sex and size characteristics of spawning populations. Future research effort should include a

comprehensive gill net selectivity experiment which should be continued for several years to include runs of varying magnitudes and age characteristics.

SUMMARY

King Salmon

1. Of 537 king salmon captured, 293 (54.6%) were tagged and released.
2. Gill nets accounted for 437 (81.4%) kings while 100 (18.6%) were captured with a fishwheel. Gill net and fishwheel mortality was 53.5 and 10.0 percent respectively.
3. The overall recovery rate was 26.3 percent. Nearly all recoveries were made by commercial and subsistence fishermen.
4. Over 93 percent of all recoveries occurred in the Russian Mission-Holy Cross area. The furthest recovery occurred 1,580 miles upstream in the Pelly River, Yukon Territory.
5. Data indicates a substantial harvest of the early portion of the run.
6. The maximum migration rate recorded for tagged fish was 38.4 miles per day while the average rate was 24.2 miles per day. In general, migration rates increased as the distance traveled upstream increased.
7. The first king salmon was captured June 1. One notable peak of abundance occurred during June 23-24 in the Ohogamiut area.
8. Although a relatively small number of king salmon were tagged, a population estimate was calculated based on a simple Peterson formula. Results indicated an escapement estimate of 52,599 and total run estimate of 160,564 king salmon.

9. Age composition of 100 Yukon River king salmon sampled from fishwheel catches was 68.0 percent 4_2 fish followed by the 5_2 (15.0%), 6_2 (9.0%) and 3_2 (8.0%) age groups.

10. Age composition of 222 king salmon sampled from 8-1/2 inch mesh gill net catches was 41.0 percent 6_2 fish followed by the 4_2 (36.0%), 5_2 (12.1%), 7_2 (1.04%) and 3_2 (0.5%) age groups.

11. Males were dominant in the 4_2 and 5_2 age groups, and overall, composed 67.6 percent of the sample. A majority of the 6_2 and 7_2 age groups were females.

12. The age and sex composition of the sample showed little change as the season progressed.

13. Limited information indicates that the intensive and selective nature of commercial fisheries using 8-1/2 inch mesh gill nets results in spawning escapements of king salmon having an excess of males with relatively high percentages of 3_2, 4_2 and 5_2 age groups.

14. The use of gill nets of smaller mesh sizes would probably reduce the harvest of themore productive females and increase the harvest of the younger age groups which are predominantly males.

Chum Salmon

1. Of 2,677 chum salmon captured, 1,508 (56.4%) were tagged and released.

2. Gill nets accounted for 448 (16.7%) chums while 2,229 (83.3%) were captured with a fishwheel. Gill net and fishwheel mortality was 74.8 and 21.3 percent respectively.

3. The overall recovery rate was 6.9 percent. Nearly all recoveries were made by subsistence fishermen.

4. The greatest percentage (67.1) of recoveries occurred in the Mountain Village-Russian Mission area. Over 50 percent of the recoveries occurred below the tagging site. The furthest recovery was made 711 miles upstream in the Koyukuk River.

5. Migration rates varied considerably, ranging from 0.8 to 33.1 miles per day.

6. The first chum salmon was captured June 12. The peak catch occurred June 29.

7. Of 789 summer chum salmon captured in a fishwheel and 8-1/2 inch mesh gill nets, age 4_1 (84.0%) chums were most abundant for both sexes followed by the 5_1 (11.0%) and 3_1 (5.0%) age groups.

8. The sex ratio was approximately equal.

9. The age and sex composition changed slightly as the season progressed. Age 3_1 fish appeared in catches nearly two weeks later than the 4_1 or 5_1 age groups. Migration timing of males advanced that of females.

Tag Evaluation

1. Based on limited data, Floy FD-67 anchor tags appeared suitable for in river short ~~and long~~ term tag-recovery studies.

Sheefish

1. Five sheefish were tagged and released at the Ohogamiut area. No recoveries were recorded.

2. Of 168 sheefish tagged and released during a three year period, only 11 (6.5%) have been recovered.

Subsistence Surveys

1. A minimum total subsistence catch of 14,921 kings and 208,827 other species, mostly chums, was recorded in the Yukon area.
2. Yukon River chum salmon catches for 1966-1969 have declined markedly as a result of a decline in the dependence on subsistence fishing.

Aerial Surveys

1. Selected streams of the Yukon, Koyukuk and Teslin River systems were surveyed.

KWINIUK RIVER COUNTING TOWER PROJECT, 1969

INTRODUCTION

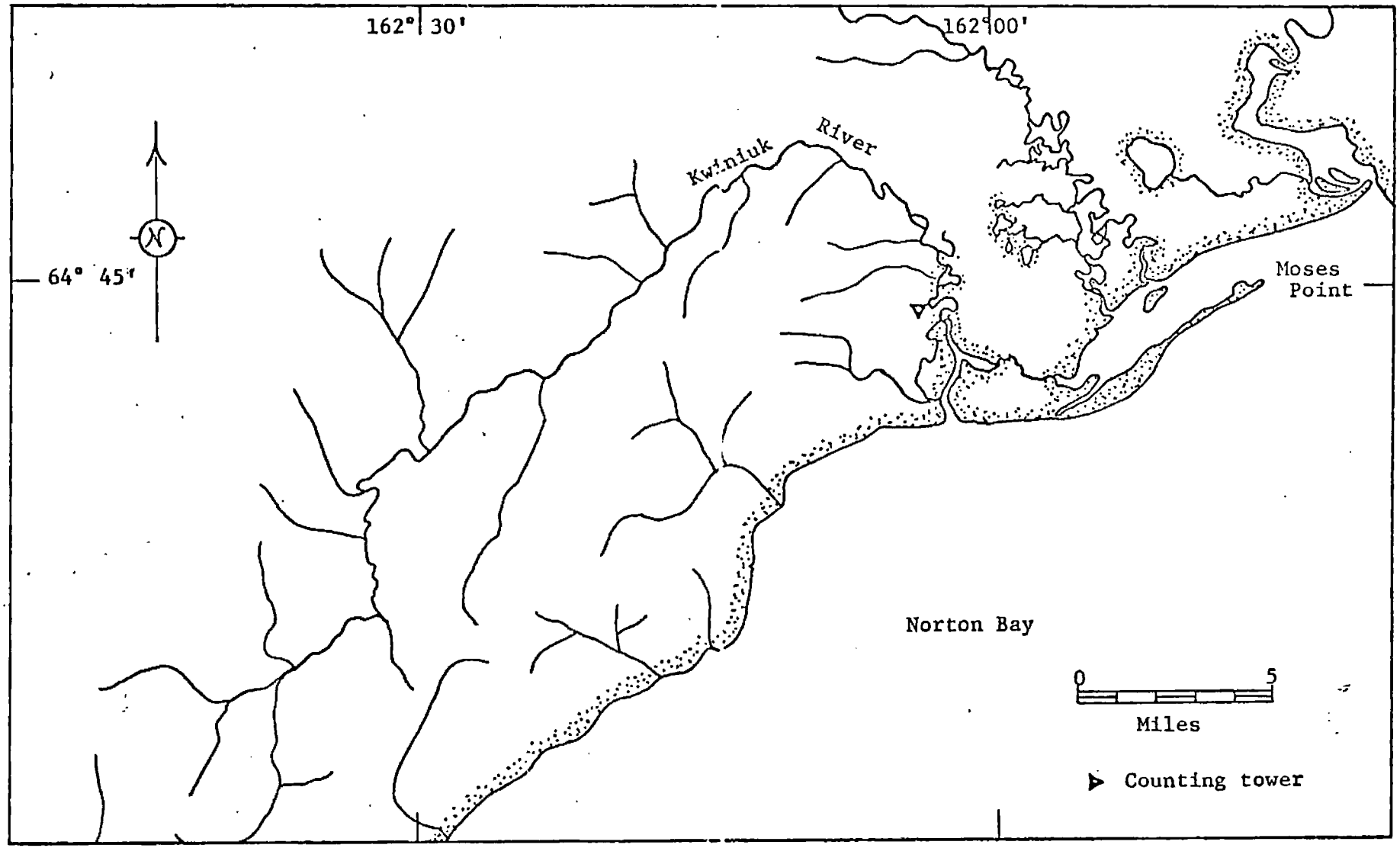
Since 1965, a counting tower project has been located on the Kwiniuk River, 110 miles east of Nome (Figure 5). The Kwiniuk River, similar to other major rivers in Norton Sound receives moderate runs of chum and pink salmon which are harvested by subsistence and commercial fisheries. To effectively manage the Norton Sound fisheries, it is important that frequent estimates of escapements during the season be obtained either by aerial survey methods or tower counts.

OBJECTIVES

The 1969 Kwiniuk River counting tower project objectives were to:

1. Obtain daily and seasonal timing and magnitude of salmon escapements.
2. Evaluate the accuracy of 10 minute salmon escapement counts as compared to hourly counts.
3. Evaluate aerial survey estimates as compared to counting tower enumeration of salmon escapements.
4. Observe behavior of salmon migrating past the counting tower.
5. Evaluate the feasibility of counting migrating salmon with the aidof artificial lighting.
6. Periodically sample the Moses Point commercial salmon fishery for age, sex and size information.

Figure 5 . Map of the Kwiniuk River, Alaska



METHODS AND MATERIALS

A portable 20 foot aluminum counting tower was erected over a 30 foot high bank on the same location used since 1965 approximately five miles above the river mouth. A 25 fathom beach seine was used to block a secondary channel formed by a mid-river sand bar at the tower site.

A power line, with two 400 watt incandescent light bulbs, housed in 18 inch diameter reflectors, was strung across the main channel to provide illumination during dark or cloudy nights. A 1250 watt gasoline generator produced electric current for the lights.

A three man crew began 24 hour counting operations on June 26, and terminated operations on July 26. Each crew member counted salmon for two-four hour shifts daily. Hourly counts were broken down into 10 minute totals and hourly totals. If counts were missing for a time interval, escapements were determined by averaging the counts preceding and following that period. Salmon moving downstream were subtracted from the total count.

Aerial surveys were conducted from a chartered Cessna 180 aircraft. Inclement weather and logistic problems precluded more than one survey.

The commercial and subsistence fishery catches were periodically sampled for age, sex and size information at the river mouth.

RESULTS

Estimation of escapements from tower counts.

In 1969, a total of 19,749 chum 57,497 pink and 12 king salmon was counted past the tower. Daily and total escapements for 1969 are presented in Appendix F. The main peak of the chum run occurred during the period July 3-9, while the

peak of the pink run passed the tower during the period June 15-19 (Figure 6). All of the king salmon passed the tower before July 15.

The chum salmon escapement was the second lowest recorded since 1965 (Table 18). Of particular interest was the excellent escapement of 56,683 pink salmon; a 16-fold increase over the 1967 brood year escapement of only 3,508 fish. This was the second consecutive year of high pink salmon abundance recorded in the system.

Estimate of total seasonal escapement by 10 minute counts

The migration pattern of chum and pink salmon past the tower in 1969 as estimated by 10 minute counts appeared to be comparable to hourly timing. Relative errors of the total season's expanded 10 minute counts versus actual hour counts were calculated to be +2.9 percent for chums and -12.2 percent for pinks. Previous years data indicates a wider range and magnitude of relative error (Table 19).

Reliability of this method is questionable since it is dependent on daily migration timing. It becomes apparent that continous 24 hour counts per day are essential to obtain reliable estimates of both the daily and total seasonal escapements.

Aerial survey estimates compared to tower counts

An aerial survey of the entire Kwiniuk River was conducted July 9, 1969. A total of 18,524 salmon was enumerated and included 8,567 chums, 4,990 pinks, 2 kings and 4,965 unidentified small salmon. The cumulative tower count, up to and including July 8, was 10,568 chum, 8,683 pink and 12 king salmon. Comparative species ratios of identified chum and pink salmon for both tower counts and aerial survey estimates were 1.7:1 and 1.2:1 respectively. The aerial survey

Figure 6. Daily migration patterns of chum and pink salmon, Kwiniuk River, 1969.

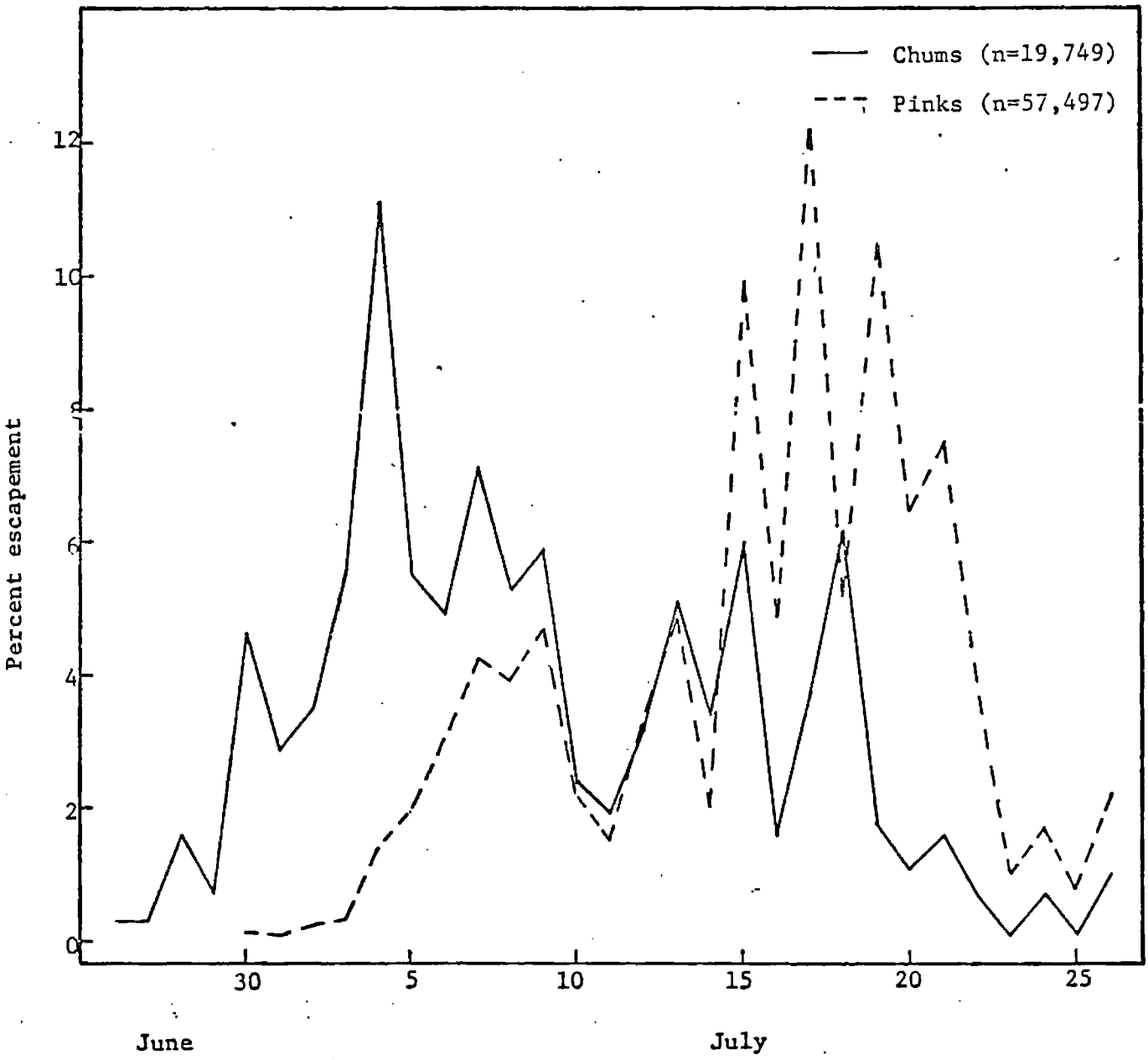


Table 18. Chum and pink salmon escapements[1/], Kwiniuk River, 1965-1969.

Species	1965	1966	1967	1968	1969
Chum	26,634	32,786	24,444	18,813	19,687
Pink	8,301	10,629	3,508	126,764	56,683

1/ Tower count minus upriver subsistence catch.

Table 19. Estimate of total chum and pink salmon seasonal escapements by 10 minute counts, Kwiniuk River, 1966-1969.

Species	Total 24 hour counts	Total expanded 10 minute counts	Percent relative error
		1966	
Chum	27,261	29,692	+8.9
Pink	10,138	10,770	+6.2
		1967	
Chum	26,520	26,100	-1.6
Pink	3,397	2,982	-12.2
		1968	
Chum	18,976	13,470	
Pink	129,052	104,880	-29.0
			-18.7
		1969	
Chum	19,749	20,310	+2.8
Pink	57,497	50,508	-12.2

estimate was 96.2 percent of the accumulated tower count. The survey was conducted by an experienced observer and pilot. Results are presented in Table 20.

Observations of salmon behavior

In 1969, water levels in the Kwiniuk River were, for the most part, unusually low and clear. Salmon moving past the tower were easily observed, and similar to previous years, migrated primarily during the mid-afternoon to early morning hours (Figure 7). The artificial light suspended across the river, nor the vibrations from the generator seemed to affect fish movement past the tower. Artificial lighting greatly enhanced counting during periods of subdued natural light.

Age, sex and size composition of salmon

A total of 1,190 chum and 139 pink salmon samples was collected from the Moses Point commercial fishery for age, sex and size information. All fish scales were interpreted for age and data tabulated. Results are pending receipt of Department computer analysis.

DISCUSSION AND FUTURE PLANS

During the past five years, 1965-1969, this project has been of immense value in providing day-to-day information on the timing and trends in the size of the chum and pink salmon runs. The data has been especially useful toward management of the Norton Sound fisheries since the Kwiniuk River is considered to be typical of the salmon spawning streams located in Norton Sound.

Table 20. Estimate of salmon escapements by counting tower and aerial survey methods, Kwiniuk River, 1969.

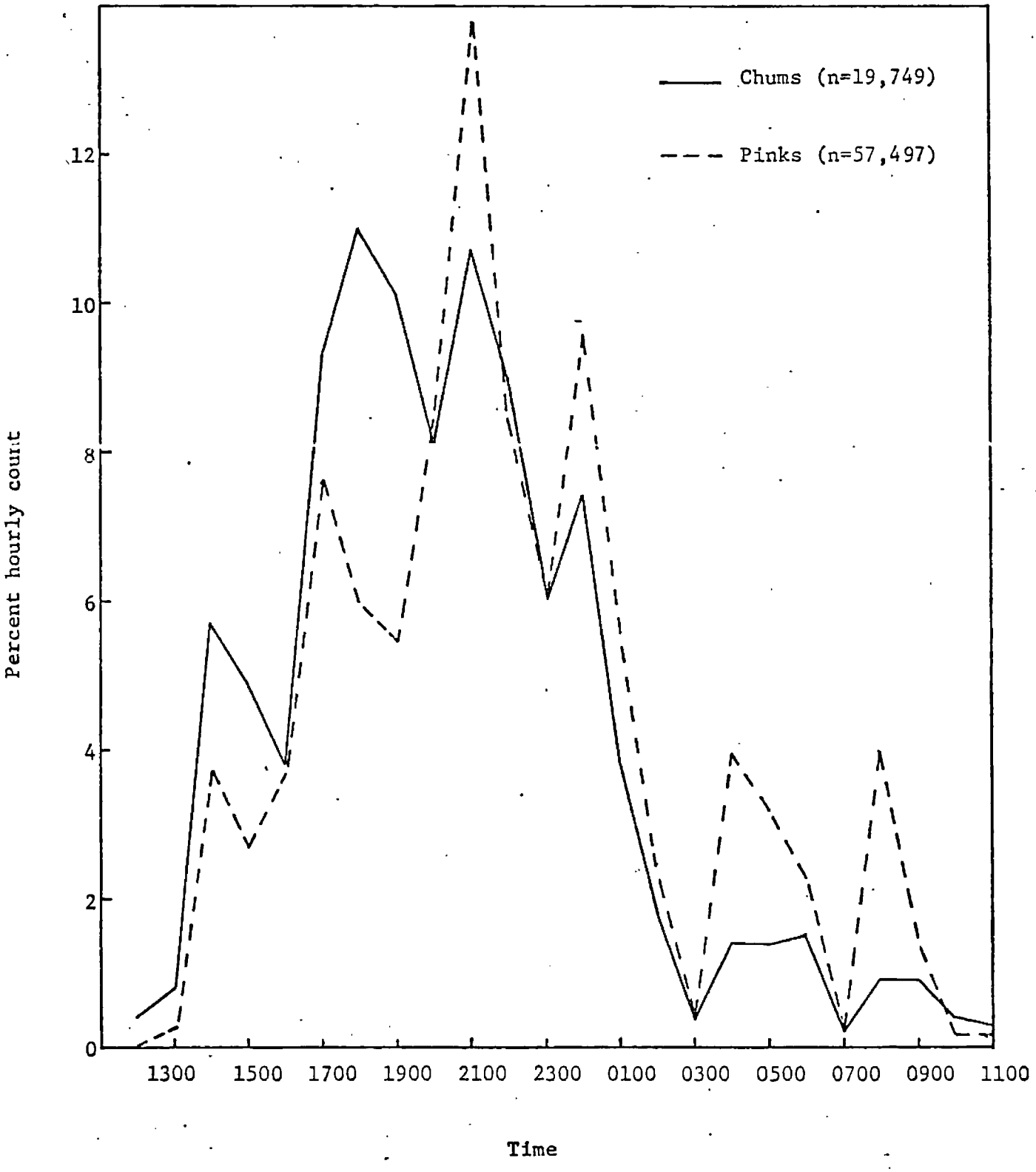
Species	Tower count[1/] Number	Tower count[1/] Percent sub total	Tower count[1/] Percent total	Aerial survey estimate[2/] Number	Aerial survey estimate[2/] Percent sub total	Aerial survey estimate[2/] Percent total
Chums	10,568	54.9	54.9	8,567	63.2	46.2
Pinks	8,683	45.1	45.1	4,990	36.8	26.0
Kings	12	<0.1	<0.1	2	<0.1	<0.1
Sub total	19,263	100.0		13,559	100.0	
Unidentified[3/]	--		--	4,965		26.8
Total	19,263		100.0	18,524		100.0

1/ Cumulative enumeration up to and including 7/8/69.

2/ Conducted 7/9/69.

3/ Includes both small chum and pink salmon.

Figure 7. Hourly migration patterns of chum and pink salmon, Kwiniuk River, 1969.



With the Kwiniuk River tower project becoming more and more useful toward management of the salmon fisheries, it is planned to utilize only management funds for this project in 1970, and to channel previously allocated Federal research monies to Yukon River programs. The required project completion report will be presented at a later date upon final analysis of the 1965-1969 data.

SUMMARY

1. For the fifth consecutive year, a counting tower project on the Kwiniuk River, a typical Norton Sound stream, was operated primarily for the purpose of obtaining the daily and seasonal timing and magnitude of the salmon runs which can be generally applied toward management of the Norton Sound fisheries.
2. A total of 19,749 chum, 57,497 pink and 12 king salmon was counted past the tower in 1969. The peak of the chum run occurred on July 3-9 while the pink run peaked during the period of July 15-19.
3. Ten minute tower counts per hour did not provide an acceptable estimate of total season escapement of chum and pink salmon in 1969 when compared to the total hourly counts.
4. An aerial survey estimate was 96.2 percent of the accumulated tower count escapement for a selected time period.
5. In 1969, water levels of the Kwiniuk River were generally low and clear, allowing for excellent observing conditions. Similar to previous years, salmon passing the tower traveled mainly during the mid-afternoon to early morning hours.
6. Two 400 watt incandescent light bulbs, operated by a portable generator, enhanced counting during dark or cloudy nights.

KOTZEBUE SOUND SHEEFISH INVESTIGATIONS, 1969

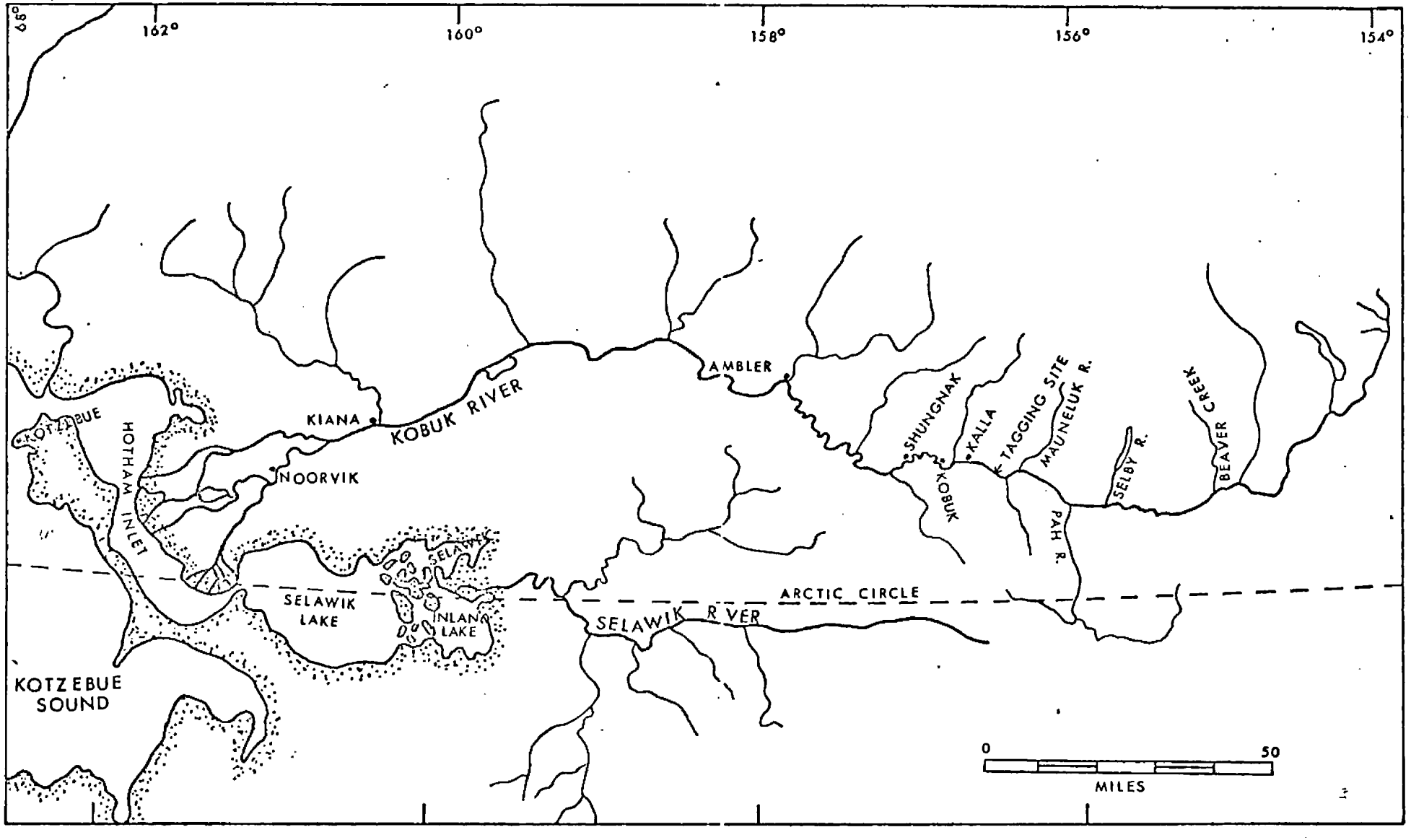
INTRODUCTION

Sheefish or innconu (Stenodus leucichthys), a member of the whitefish family Coregonidae, are distinguished by a large mouth, extended lower jaw and large scales. Much larger than whitefish, they often weigh as much as 50 to 60 pounds. Sheefish are distributed in parts of Arctic North America and Siberia. In Alaska, sheefish are found primarily in the Kuskokwim, Yukon, Selawik and Kobuk River drainages. Sheefish are considered anadromous in Alaska waters, although resident populations are believed to occur in the upper Yukon River system.

In the Kotzebue Sound area (Figure 8), sheefish are primarily found in the Kobuk and Selawik Rivers. After breakup of the river ice in late May or early June, sheefish ascend the Kobuk and Selawik Rivers and spawn in the upper reaches during late September. Following spawning, sheefish move downstream into the brackish to saline waters of Hotham Inlet, Selawik Lake and Kotzebue Sound.

Residents of the Kotzebue Sound area utilize sheefish for subsistence purposes. Subsistence fishermen along the Kobuk River take moderate numbers of sheefish with gill nets during the upstream spawning and downstream post-spawning migrations. Some residents of the upper Kobuk River harvest sheefish near the spawning grounds with beach seines. In the Selawik-Inland Lake and Kotzebue areas, fishermen take sheefish with gill nets and by jigging with lures through the ice.

Figure 8. Map of the Kobuk and Selawik Rivers.



A limited commercial fishery exists near the village of Kotzebue. About 10 to 20 fishermen, using set gill nets and jigging with lures through the ice, take sheefish in small quantities primarily for the local markets in northwestern Alaska. A few sheefish are shipped to stores in Anchorage and Fairbanks. To date, lack of adequate processing and cold storage facilities, along with a very limited market has restricted expansion of the commercial fishery.

A slowly developing interest in taking sheefish by sport fishing is occurring. Sheefish are often difficult to land once hooked, especially the larger fish. The best sport fishing areas are located near Selawik Village after breakup in the spring and in the upper Kobuk River during the fall.

The Kobuk and Selawik drainage sheefish tagging program has been a cooperative venture between the Division of Commercial Fisheries and the Division of Sport Fisheries. This report deals only with data collected by the Division of Commercial Fisheries during 1969. Detailed presentation of tagging data is omitted because of incomplete results available to date. Numerous tags are still at large and many recoveries will not be collected until the 1970 subsistence surveys. A comprehensive completion report compiled with the assistance of the Division of Sport Fisheries is planned for 1971.

OBJECTIVES

The project objective throughout the study period was to provide sound management practices regarding the commercial and subsistence utilization of sheefish.

Secondary means of achieving the objective were to:

1. Determine distribution and movements of Kotzebue Sound sheefish populations.
2. Determine if consecutive annual spawning occurs.
3. Obtain estimates of spawning populations and observe spawning behavior.
4. Obtain age, sex, size and fecundity data.
5. Obtain accurate records of the subsistence and commercial harvest data.

METHODS AND MATERIALS

Equipment

Set gill nets of 5 to 6-1/2 inch stretched mesh nylon or cotton webbing with standard floats weighted with a lead line were used to capture sheefish for tagging. Nets varied in size from 15 to 25 fathoms long by 1-1/2 to 2 fathoms deep.

Hook and line was used to supplement gill net catches. Gear consisted of conventional spinning tackle utilizing metal lures.

Tagging was accomplished with yellow spaghetti tags of flexible 1/16 inch diameter plastic tubing in 13-inch lengths affixed to stainless steel needle applicators. Each tag was inscribed with a number and the legend - REWARD ADF&G ANCHORAGE. Fish were not immobilized for tagging.

Fixed wing, single engine aircraft of the Piper PA-18 type were chartered for aerial surveys.

Procedures

Fishing operations were conducted on the Kobuk River spawning grounds, 24-30 river miles above the village of Kobuk during September 3-13. Gill nets

were fished continuously throughout the study period. Hook and line was used during the mid-afternoon to evening hours.

All uninjured fish were tagged and released. Spaghetti tags were inserted with a tagging needle through the skin and flesh, posterior to the dorsal fin. After insertion, the needle was removed and the two free ends of the tag were tied tightly with an over-hand knot.

Notices informing native fishermen of the tag-recovery program were posted in each village. A reward of $1.00 was offered for each tag returned along with scale samples plus date and location of the tag recovery. Department biologists collected tag recoveries from native fishermen. Additional tags were returned by individuals through the mail.

Aerial surveys of the Kobuk River spawning grounds were conducted from single engine aircraft on August 25 and September 10, 1969.

Spawning ground observations were limited to recording daily air and water temperatures. Known spawning areas were marked and the depth of river and type of stream bed gravel were noted.

Age, sex and size composition data were collected by sampling the commercial, subsistence and Department tagging site catches taken in Kotzebue Sound, Hotham Inlet, Selawik area and the Kobuk River. Lengths were measured from the tip of the snout to the fork of the tail in centimeters. Weights were recorded in pounds. Sex was determined by examination of the gonads when possible, or by external examination of the sexually mature fish on the spawning grounds. Fullness and over extension of female abdominal walls, large reddish appearing vents plus

overall body size were used as identifying criteria. Scales were taken in the area above the lateral line, between the dorsal and adipose fin and then placed in envelopes to be later mounted on glass microscope slides for age determination.

Fecundity information was collected from tagging site catches taken near the spawning grounds. Fecundity estimates were calculated by comparing the weight of a subsample of 1,000 eggs to the total weight of both ovaries of each fish sampled.

Subsistence catch data were obtained by personal interviews of fishing families in the following villages: Noorvik, Kiana, Ambler, Shungnak, Kobuk, Selawik and Kotzebue. Catch questionnaire forms were distributed to those fishermen not contacted. Records of commercial catches were obtained from fish tickets and personal interviews with fishermen and processors.

RESULTS

Distribution, movements and consecutive annual spawning

Table 2/ summarizes the Kobuk River tag recovery data. Of 473 sheefish captured at the tagging site, 278 (58.8%) were tagged and released. Gill nets accounted for 349 (73.8%) of the fish, while the remaining 124 (26.2%) were taken with hook and line. The gill net mortality rate was 55.9 percent. No mortality was observed with fish caught on hook and line. As of March 1, 1970, the overall recovery rate was 43.5 percent for fish tagged during 1969. Spawning ground tagging efforts during 1967 and 1968 contributed an additional 26 (7 and 19 respectively) recoveries, an indication of consecutive annual

Table 21. Sheefish tag-recovery summary, Kobuk River, 1969.[1/]

Gear	Number captured	Percent	Mortality		Tagged			Recovered[2/]		
			Number	Percent	Number	Percent	Percent total	Number	Percent	Percent total
Hook & line	124	26.2	0	0	124	100.0	44.6	52	41.9	43.0
Gill net	349	73.8	195	55.9	154	44.1	53.4	69	44.8	57.0
Total	473	100.0	195	41.2	278	58.8	100.0	121	43.5	100.0

1/ 9/3-13.

2/ As of 3/1/70.

spawning (Table 22). Nearly all recoveries were taken in gill nets and beach seines of downriver subsistence fishermen during the 1969 post-spawning migration.

Estimate of spawning population size

Two aerial surveys were conducted 17 days apart by different observers on the upper Kobuk River. Weather conditions were ideal with bright sunshine, no wind and clear water. A total of 5,930 and 3,654 sheefish were enumerated between the village of Kobuk and the mouth of the Beaver Creek on August 25 and September 10, 1969, respectively. No fish were observed above the Beaver Creek. Table 23 summarizes the survey data.

Estimate variability of the two surveys is not attributed to spawning and downstream migration, but to observer experience. The September 10, survey was conducted by an inexperienced observer and is considered an underestimate.

~~TABLE . Aerial survey estimates of the sheefish spawning~~ population in the upper Kobuk River, 1969

Area	Number of fish by date 8/25	9/10	
Kobuk-Kalla		35	
Kalla-Mauneluk R.	5,405	1,830	2,101
Mauneluk R.-Pah R.		236	
Pah R.-Selby R.	121	339	
Selby R.-Beaver Cr.	404	1,214	
Total	5,930	3,654	

Spawning observations

Limited sheefish spawning observations were conducted in 1969 due to a lack of spawning activity during project operations. Water temperatures ranged between 45-52° F. from September 3-14. Two males and

Table 22. Sheefish tag-recovery data, Kobuk River, 1966-1969.

Tagged		Recovered			Cumulative	Percent
Year	Number	Year	Number	Percent	percent	remaining
1966	40	1966	4	10.0	10.0	90.0
		1967	7	17.5	27.5	72.5
		1968	4	10.0	37.5	62.5
		1969	0	0	37.5	62.5
1967	116	1967	19	16.4	16.4	83.6
		1968	20	17.2	33.6	66.4
		1969	7	6.0	39.6	60.4
1968	334	1968	93	27.8	27.8	72.2
		1969	19	5.7	33.5	66.5
1969	278	1969	121	43.5	43.5	56.5
Total	768		294	38.3	38.3	61.7

Table 23. Aerial survey estimates of the sheefish spawning population in the upper Kobuk River, 1969.

Area	Number of fish by date 8/25	9/10	
Kobuk-Kalla)		35)	
Kalla-Mauneluk R.)	5,405	1,830)	2,101
Mauneluk R.-Pah R.)		236)	
Pah R.-Selby R.	121	339	
Selby R.-Beaver Cr.	404	1,214	
Total	5,930	3,654	

three females were sampled in near spawning condition, September 11. Milt and roe was extruded with application of a slight amount of pressure on the abdomen. No other mature fish were sampled in this condition.

Age, sex and size composition

During 1969, the upper Kobuk River sheefish spawning population was sampled for age, sex and size composition data. These samples have not been analyzed to date. Results will be published in the project completion report.

Fecundity

Five sheefish were selectively sampled for fecundity data. A direct relationship was exhibited in size of fish and number of eggs produced. Fecundity varied from 106,500 to 390,667 eggs per fish. Ages of sampled fish ranged from 13+ to 18+ years. The mean ovary weight of each fish accounted for 20.2 percent of the total body weight. The average number of eggs per pound of body weight was 9,202 eggs, with 103 eggs per gram of ovary weight. Fecundity data are summarized in Appendix G. A linear regression analysis of fecundity data compiled during the life of the project will be documented in the completion report.

Subsistence and commercial catches

The 1968-1969 Kotzebue district subsistence and commercial sheefish catches for the Kobuk River villages, Selawik and Kotzebue are presented in Table 24. Recorded catches are believed to represent

Table 24. Subsistence and commercial sheefish catches, Kotzebue district, 1969.

Village	1968 - 1969 Fishermen interviewed	Number of sheefish	
Subsistence			
Noorvik	20	1,324	
Kiana	22	409	
Ambler	20	554	
Shungnak	17	530	
Kobuk	11	553	
Subtotal	90	3,370	(10/68-12/69)
Selawik	35	4,140	(3-11/69)
Kotzebue	19	4,362	(10/68-12/69)
Total	144	11,872	
Commercial			
Kotzebue	-	2,206	(10/68-12/69)

approximately 90 percent of the actual harvest. Based on the catch of 2,206 (14,338 pounds), commercially caught sheefish averaged 6.5 pounds. Results of age composition data were not available for this report. Documentation of sport fish catches is lacking.

DISCUSSION AND FUTURE PLANS

During the past four years (1966-1969), valuable information on the seasonal distribution and movements, spawning behavior, improved recording of subsistence and commercial catch data, fecundity relationship and age, sex and size composition of the spawning populations of sheefish have been obtained. Analysis of data and presentation in a project completion report will document final results. Based on this information, proper management of the sheefish resource may be initiated. Management funds will now be utilized for the project with previously allocated research monies channeled to Yukon River programs.

Future recommendations are to tag sheefish on the upper Selawik River spawning grounds in late September to determine if the Kobuk and Selawik River sheefish runs are two distinct populations. An investigation of the sheefish early life history would also be of merit in supplying information on eggs, larvae and juvenile stages.

SUMMARY

1. A total of 278 sheefish was tagged in the vicinity of the Kobuk River spawning grounds during 1969. To date, 121 (43.5%) have been recaptured.

2. Recovery of spent or mature fish tagged on the Kobuk River spawning grounds in previous years indicates that sheefish are capable of spawning annually.
3. Aerial surveys indicate the Kobuk River to be a major sheefish spawning system.
4. Fecundity estimates of 5 female sheefish ranged from 106,500 to 390,667 eggs per fish. Ovary weight accounted for 20.2 percent of the total body weight and the mean number of eggs per pound of body weight was 9,202.
5. Subsistence and commercial catches during the 1968-1969 season accounted for 11,872 and 2,206 sheefish respectively.
6. Recommendations are for tagging Selawik River spawning populations and investigating the sheefish early life history.

LITERATURE CITED

Geiger, M., R. Regnart and R. Baxter. 1967. Arctic-Yukon-Kuskokwim area anadromous fish investigations. Annual Technical Report, Anadromous Fish Project (AFC-7-1). Alaska Dept. of Fish and Game, 94 p.

_____, _____, _____ and C. Yanagawa. 1968. Arctic-Yukon-Kuskokwim area anadromous fish investigations. Annual Technical Report, Anadromous Fish Project (AFC-7-2). Alaska Dept. of Fish and Game, 113 p.

Regnart, R., R. Baxter, and M. Geiger. 1966. Arctic-Yukon-Kuskokwim area 1966 annual report. Section II; Special Studies. Alaska Dept. of Fish and Game, 125 p.

_____, _____ and C. Yanagawa. 1969. Arctic-Yukon-Kuskokwim area 1969 annual report (in press). Alaska Dept. of Fish and Game.

APPENDIX A

Number of king salmon captured, tagged and recovered by date and gear, Yukon River, 1969.

Date	Number tagged			Number untagged			Total catch	Recoveries
	Fishwheel	Gill net	Total	Fishwheel	Gill net	Total		
6/1	-	3	3	-	3	3	6	1
6/2	-	5	5	-	2	2	7	2
6/3	-	15	15	-	6	6	21	7
6/4	-	3	3	-	6	6	9	1
6/5	-	1	1	-	2	2	3	1
6/6	-	0	0	-	0	0	0	-
6/7	-	1	1	-	0	0	1	-
6/8	-	1	1	-	3	3	4	1
6/9	-	0	0	-	1	1	1	-
6/10	-	0	0	-	0	0	0	-
6/11	-	2	2	-	1	1	3	1
6/12	-	10	10	-	4	4	14	4
6/13	-	14	14	-	3	3	17	8
6/14	-	7	7	-	6	6	13	3
6/15	-	5	5	-	6	6	11	3
6/16	-	1	1	-	2	2	3	-
6/17	-	1	1	-	7	7	8	1
6/18	-	8	8	-	5	5	13	2
6/19	-	10	10	-	7	7	17	0
6/20	-	3	3	-	6	6	9	1
6/21	-	3	3	-	4	4	7	0
6/22	1	9	10	0	13	13	23	3
6/23	4	33	37	0	26	26	63	15
6/24	4	27	31	0	31	31	62	6
6/25	8	8	16	0	14	14	30	3
6/26	16	4	20	0	11	11	31	2
6/27	30	2	32	0	3	3	35	5
6/28	7	4	11	7	7	14	25	1
6/29	4	4	8	1	11	12	20	1
6/30	3	5	8	0	10	10	18	1
7/1	0	2	2	1	7	8	10	-
7/2	2	0	2	0	3	3	5	0
7/3	0	4	4	0	6	6	10	3
7/4	3	2	5	0	3	3	8	1
7/5	5	3	8	0	6	6	14	-
7/6	0	0	0	1	3	4	4	-
7/7	0	1	1	0	0	0	1	-
7/8	1	0	1	0	4	4	5	-
7/9	0	2	2	0	0	0	2	-
7/10	1	0	1	0	1	1	2	-
7/11	1	0	1	0	1	1	2	-
7/12	0	-	0	0	-	0	0	-
Totals	90	203	293	10	234	244	537	77

APPENDIX B

King salmon tag-recovery data, Yukon River, 1969.

Tagging date	Tag number	Recovery area (mi.)	Recovery date	Miles traveled	Days out
6/1	444	261	7/2	76	31
6/2	443	261	6/11	76	9
	23350	283	6/9	98	7
6/3	446	274	6/6	89	3
	448	725	6/29	540	26
	449	283	6/6	98	3
	606	213	6/7	28	4
	607	251	6/6	66	3
	611	725	6/26	540	23
	613	283	6/7	98	4
6/4	601	82	6/16	-103[4]	-
6/5	617	261	6/14	76	9
6/8	620	283	6/26	98	18
6/11	442	487	7/2	299	21
6/12	603	251	6/19	66	7
	618	475	6/28	290	16
	622	725	6/30	540	18
	625	1,580[1]	7/26	1,395	44
6/13	628	695	7/25	510	12
	630	251	6/16	66	3
	632	141	6/19	-44	-
	633	10	6/28	-175	-
	634	283	7/14	98	31
	636	251	6/20	66	7
	637	261	6/24	76	11
	23358	261	6/24	76	11
6/14	641	261	6/20	76	6
	643	261	6/27	76	13
	644	261	6/22	76	8
6/15	645	103	6/28	-82	-
	648	1,259[2]	7/13	1,074	28
	651	763	7/1	578	16
6/17	657	453	6/28	268	11
6/18	660	1,551	7/28	1,366	40
	662	261	6/21	76	3
6/20	23379	279	6/26	94	6
6/22	23393	860[3]	7/13	675	21
	23403	269	6/25	84	3
	23404	279	6/26	94	4

(Continued)

APPENDIX B (continued)

Tagging date	Tag number	Recovery area (mi.)	Recovery date	Miles traveled	Days out
6/23	23407	213	6/24	28	1
	23412	141	6/27	-44	-
	23421	763	7/6	578	13
	23425	283	6/26	98	3
	23435	512	7/6	327	13
	23438	720	7/5	535	12
	23439	775	7/11	590	18
	23441	170	6/24	-15	-
	23444*	606	7/20	421	27
	23452	289	6/25	104	2
	23454	279	6/26	94	3
	23463	251	6/27	66	4
	23464	180	6/26	-5	-
	23466	279	7/6	94	13
	23467	695	7/8	510	15
6/24	24031	213	6/25	28	1
	24035	251	6/26	66	2
	24039	860[3/]	7/23	675	29
	24050*	912[3/]	7/20	727	26
	24072	261	6/25	76	1
	24075	336	7/2	151	8
6/25	24176*	283	6/29	98	4
	24177*	283	7/26	98	31
	24201	695	7/9	510	14
6/26	24234*	860[3/]	7/23	675	27
	24331*	496	7/20	311	24
6/27	24371*	103	7/1	-82	-
	24419*	860[3/]	7/23	675	26
	24432	213	7/5	28	8
	24442*	1,551	8/17	1,366	51
	24452*	1,002	7/20	817	23
6/28	24462	1,580	8/7	1,395	40
6/29	24478	763	7/15	578	16
6/30	22184	170	7/6	-15	-
7/3	22412	512	7/26	327	23
	22416	512	7/10	327	7
	22433	606	7/15	421	12
7/4	21375	606	7/15	421	11

* Fishwheel
1/ Pelly River, Y.T.
2/ Porcupine River
3/ Tanana River
4/ Negative values indicate miles below tagging site.

APPENDIX C

King salmon population estimate data and calculations, Yukon River, 1969.

Subdistrict	Commercial catch	Subsistence catch	Total
334-10	70,858	3,154	74,012
334-20	14,799	2,225	17,024
334-30	3,577	3,845	7,422
334-40	985	4,723	5,708
Yukon Territory	1,640	974	2,614
TOTAL	91,859	14,921	106,780

Test fishing catches

Flat Island = 1,185

Aerial survey escapement estimates[1/]

Andreafsky River = 505[2/]

Estimated number of kings passed tagging area

Number tagged = 293
Subdistrict 334-30, 334-40 and Yukon Territory subsistence and commercial catches = 15,744
Number of recoveries[3/] = 68
Population estimate = $\frac{(293)\ (15,744)}{68}$ = 67,838

Estimates of escapement above tagging area

Population estimate	67,838
Upriver catches	-15,744
Estimated escapement	52,094

Total estimate of Yukon River king salmon run

Subdistrict 334-10 and 334-20 subsistence and commercial catch	91,036
Test fish catch	1,185
Aerial survey escapement estimate	505
Population estimate	67,838
TOTAL ESTIMATE OF KING SALMON RUN	160,564

1/ Chulinak River located downstream from the tagging site was not surveyed.
2/ This is considered a minimum count due to unfavorable survey conditions.
3/ Does not include 9 tag recoveries made below the tagging site.

APPENDIX D

Number of chum salmon captured, tagged and recovered by data and gear, Yukon River, 1969.

Date	Number tagged			Number untagged			Total catch	Recoveries
	Fishwheel	Gill net	Total	Fishwheel	Gill net	Total		
6/1	-	0	0	-	0	0	0	-
6/2	-	0	0	-	0	0	0	-
6/3	-	0	0	-	0	0	0	-
6/4	-	0	0	-	0	0	0	-
6/5	-	0	0	-	0	0	0	-
6/6	-	0	0	-	0	0	0	-
6/7	-	0	0	-	0	0	0	-
6/8	-	0	0	-	0	0	0	-
6/9	-	0	0	-	0	0	0	-
6/10	-	0	0	-	0	0	0	-
6/11	-	0	0	-	0	0	0	-
6/12	-	0	0	-	1	1	1	0
6/13	-	0	0	-	0	0	0	0
6/14	-	0	0	-	1	1	1	0
6/15	-	1	1	-	0	0	1	0
6/16	-	2	2	-	2	2	4	0
6/17	-	2	2	-	8	8	10	0
6/18	-	0	0	-	5	5	5	0
6/19	-	5	5	-	7	7	12	2
6/20	-	4	4	-	12	12	16	0
6/21	-	3	3	-	14	14	17	0
6/22	6	0	6	1	11	12	18	0
6/23	30	8	38	0	15	15	53	2
6/24	88	23	111	10	75	85	196	10
6/25	32	0	32	21	11	32	64	6
6/26	105	0	105	7	14	21	126	4
6/27	72	2	74	10	0	10	84	6
6/28	1	0	1	142	24	166	167	0
6/29	154	1	155	109	16	125	280	9
6/30	126	0	126	74	15	89	215	9
7/1	73	4	77	22	12	34	111	5
7/2	48	2	50	11	5	16	66	2
7/3	89	0	89	28	7	35	124	8
7/4	107	0	107	67	17	84	191	10
7/5	125	3	128	51	19	70	198	5
7/6	56	2	58	22	13	35	93	8
7/7	84	4	88	31	16	47	135	5
7/8	88	3	91	31	14	45	136	6
7/9	23	1	24	80	8	88	112	0
7/10	61	1	62	32	20	52	114	4
7/11	41	3	44	35	12	47	91	2
7/12	25	-	25	11	-	11	36	1
Totals	1,434	74	1,508	795	374	1,169	2,677	104

APPENDIX E

Chum salmon tag-recovery data, Yukon River, 1969.

Tagging date	Tag number	Recovery area (mi.)	Recovery date	Miles traveled	Days out
6/19	667	317	6/23	132	4
	23368	453	6/26	268	7
6/23	23443	87	6/25	-98[3]	2
	23449[1]	711	8/15	526	53
6/24	23486	103	6/28	-82	4
	24051	336	7/10	151	16
	24074	279	7/2	94	8
	24105	185	7/6	0	12
	24109	161	7/7	-24	13
	24117	279	?	94	?
	24121	269	7/8	84	14
	24135	52	6/30	-133	6
	24140	104	7/5	-81	11
	24154	213	7/14	28	0
6/25	24166	181	6/26	-4	1
	24171	185	6/26	0	1
	24172	104	7/6	-81	11
	24178	87	7/5	-98	10
	24189	695	7/12	510	17
	24200	213	7/5	28	10
6/26	24213	269	7/5	84	9
	24224	283	7/8	98	12
	24257	317	7/3	132	7
	24298	279	7/3	94	7
6/27	24353	35	7/4	-150	7
	24363[2]	328	7/12	143	15
	24373	87	6/28	-98	1
	24394	336	7/2	151	5
	24434	283	7/7	98	10
	24458	104	7/?	-81	?
6/29	21953	336	7/9	151	10
	21967	103	7/?	-82	?
	21993	161	6/29	-24	0
	22022	161	7/5	-24	6
	22025	161	7/19	-24	20
	22041	317	7/20	132	21
	22043	185	7/1	0	2
	22060	161	6/29	-24	0
	24484	122	7/13	-63	14
6/30	22116	161	7/6	-24	6
	22124	122	7/6	-63	6
	22137	213	7/2	28	2
	22141	161	7/23	-24	23
	22143	269	7/6	84	6
	22155	35	7/7	-150	7
	22196	213	7/2	28	2

(Continued)

APPENDIX E (continued)

Tagging date	Tag number	Recovery area (mi.)	Recovery date	Miles traveled	Days out
6/30	22226	336	7/10	151	10
	22231	122	7/?	-63	?
7/1	22260	161	7/4	-24	3
	22264	122	7/15	-63	14
	22281	161	7/5	-24	4
	22296	283	7/2	98	1
	22302	336	7/10	151	9
7/2	22345	486	7/?	301	?
	22363	213	7/7	28	5
7/3	22385	161	7/15	-24	12
	22394	161	7/4	-24	1
	22396	269	7/9	84	6
	22410	161	7/5	-24	2
	22417	213	7/6	28	3
	22434	336	7/5	151	2
	22455	472	7/19	287	16
	22470	161	7/10	-24	7
7/4	21303	213	7/4	28	0
	21325	122	?	-63	?
	21330	170	7/?	-15	?
	21336	108	7/?	-82	?
	21344	489	7/20	304	16
	21346	185	7/5	185	1
	21370	122	7/15	-63	11
	21382	104	7/7	-81	3
	22491	213	7/7	28	3
	22499	317	7/14	132	10
7/5	11917	122	7/14	-63	9
	11931	261	7/10	76	5
	11949	161	7/11	-24	6
	11957	104	7/7	-81	2
	11958	123	7/10	-62	5
7/6	14764	170	?	-15	?
	14771	161	7/8	-24	2
	14780	123	7/?	-62	?
	14784	185	7/10	0	4
	14797	87	7/24	-98	18
	20104	161	7/11	-24	5
	20109	122	7/15	-63	9
	20135	122	7/11	-24	5
7/7	20302	161	7/15	-63	8
	20320	213	7/30	28	23
	20327	122	7/9	-63	2
	20332	213	7/12	28	5
	20398	122	7/11	-63	4

APPENDIX E (continued)

Tagging date	Tag number	Recovery area (mi.)	Recovery date	Miles traveled	Days out
7/8	00832	185	7/10	0	2
	00851	104	7/12	-81	4
	00855	122	7/19	-63	11
	00875	122	7/?	-63	?
	00912	213	7/10	28	2
	00920	170	7/?	-15	?
7/10	01000	161	7/10	-24	0
	02517	496	7/20	311	10
	02531	213	7/19	28	9
	02532	251	7/12	66	2
7/11	02567	213	7/14	28	3
	02597	487	7/?	302	?
7/12	02631	170	7/30	-15	18

1/ Koyukuk River.
2/ Innoko River.
3/ Negative values indicate miles below tagging site.

APPENDIX F

Daily chum and pink salmon escapements, Kwiniuk River, 1969.

Date	Chums	Pinks	Kings
6/26	57	17	1
27	56	2	0
28	314	22	2
29	144	11	1
30	904	65	2
7/ 1	582	14	0
2	687	101	0
3	1,117	146	0
4	2,195	787	5
5	1,081	1,094	0
6	970	1,715	1
7	1,407	2,441	0
8	1,054	2,268	0
9	1,159	2,723	0
10	470	1,278	0
11	380	855	0
12	623	1,908	0
13	998	2,803	0
14	681	1,129	0
15	1,178	5,677	0
16	307	2,794	0
17	753	7,013	0
18	1,228	2,977	0
19	362	6,057	0
20	211	3,729	0
21	315	4,317	0
22	140	2,234	0
23	17	595	0
23	135	969	0
25	29	476	0
26	195	1,280	0
Total	19,749	57,497	12
Catch above tower	-62	-814	-
Escapement	19,687	56,683	12

APPENDIX G

Sheefish fecundity data, Kobuk River, 1969.

Age	Fork length (cm)	Body weight (lbs.)	Body weight (g)	Estimated number of eggs	Ovary weight (g)	Percent body weight	Weight of 1,000 eggs (g)	No. of eggs per pound of body weight	No. of eggs per gram of ovary weight
13+	86	14.5	6,577	106,500	1,065	16.2	10	7,345	100
16+	94	19.5	8,845	170,400	1,704	19.3	10	8,738	100
16+	103	24.0	10,886	222,727	2,450	22.5	11	9,280	91
18+	111	30.5	13,834	289,222	2,603	18.8	9	9,483	111
18+	115	35.0	15,876	390,667	3,516	22.1	9	11,162	111
					$\bar{X}$	20.2	10	9,202	103