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STATE OF ALASKA
Keith H. Miller, Governor

ANNUAL REPORT OF PROGRESS, 1968 - 1969

FEDERAL AID IN FISH RESTORATION PROJECT F-9-1

SPORT FISH INVESTIGATIONS OF ALASKA

ALASKA DEPARTMENT OF FISH AND GAME
Wallace H. Noerenberg, Acting Commissioner

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INTRODUCTION

This report of progress involves the findings and work accomplished under the State of Alaska, Federal Aid in Fish Restoration, Project F-9-1, "Sport Fish Investigations of Alaska".

The work conducted during this reporting period constitutes effort on nine separate studies which are crucial in evaluating the sport fishing resources of the State. Recreational demands have necessitated broadening our knowledge of the fishery. All 20 jobs were of continuing nature enabling the Department to keep abreast of present and future impacts on certain fish species. Specifically, the work included work on inventory and cataloging of the sport fish and sport fish waters of the State, sport fishery creel census and access. Special emphasis was given to Dolly Varden, silver salmon, anadromous fish, grayling, salmon, sheefish, pike, and char. The information gathered has provided supporting documentation for better fish management and a basis for necessary future investigations.

The subject matter contained in these reports may be inconclusive. The findings and interpretation are subject to re-evaluation as the work progresses.

RESEARCH PROJECT SEGMENT

STATE: ALASKA Name: Sport Fish Investigations of Alaska.

Project No: F-9-1 Title: Inventory and Cataloging of Kenai Peninsula, Cook Inlet and Prince William Sound Drainages and Fish Stocks.

Job No: 7-A

Period Covered: July 1, 1968 to June 30, 1969.

ABSTRACT

A creel census on the Russian River during a flies-only season revealed an estimated 12,730 red salmon, Oncorhynchus nerka, were harvested by 17,300 man-days of effort. The seasonal rate of success was 0.13 red salmon per hour. A regulation prohibiting the retention of snagged fish reduced the catch by 37.9 percent. The estimated escapements for the early and late runs of red salmon were 9,506 and 41,912 fish, respectively. The early run sport harvest was predominately age 2.3 (78.4 percent) fish, whereas the late catch was primarily age 2.2 (83.3 percent) red salmon.

A total of 1,216 Arctic grayling, Thymallus arcticus, from Crescent Lake was introduced into Juneau Lake in a continuing attempt to establish a self-sustaining population. The transplanted fish were predominately age I+ and had a mean fork length of 179.6 mm.

Population sampling was conducted on five landlocked lakes containing transplanted red salmon. The mean lengths for age III+ red salmon ranged from 180.7 to 256.2 mm. Information concerning sexual maturity and food habits is discussed.

Growth and relative survival rates were compared for rainbow trout, Salmo gairdneri, in three rehabilitated lakes. Average lengths for age II+ rainbow trout ranged from 373.2 to 537.6 mm.

Cataloging and inventory activities were performed on 39 Kenai Peninsula lakes. Sixteen of these lakes contained game fish with rainbow trout the most common species. Surface acreage, maximum depth and gillnet catch data are presented. Detailed volumetric surveys were completed on six lakes which have good potential for management.

The results of the second year's study on the seasonal depth distribution of Arctic char, Salvelinus alpinus, are presented. Vertical gillnet sampling at East Finger Lake revealed most Arctic char occupied midwater or bottom depths during the summer and rose to the surface layers in the fall. Eighty-nine percent of the catch was captured in water colder than 55°F. Length data from 465 char indicated that males (314.4 mm) averaged slightly longer than females (296.8 mm). The male-to-female sex ratio was 0.7 to 1. Number of eggs per mature female ranged from 413, for a 305 mm fish, to 870, for one 354 mm in length.

RECOMMENDATIONS

Retain present objectives of the study with emphasis directed toward the following:

1. Continue the Russian River creel census to determine the effects of an anti-snagging regulation on red salmon.

2. Evaluate past Arctic grayling transplants and investigate additional waters for establishment of the species.

3. Continue evaluation of currently stocked lakes and stocking policies.

OBJECTIVES

1. To assess the environmental characteristics of the existing and potential recreational fishery waters of the job area; to obtain estimates of existing and/or potential use and sport fish harvest; and to determine spatial distribution of game fishes in selected waters.

2. To investigate, evaluate and develop plans for the enhancement of anadromous fish stocks.

3. To evaluate application of fishery restoration measures and availability of sport fish egg sources.

4. To assist as required in the investigation of public access status to the area's fishing waters and to make specific recommendations for segregation of public fishing access sites.

5. To evaluate multiple water-use development projects (public and private) and their effects on the area's streams and lakes for the proper protection of sport fish resources.

6. To provide recommendations for the management of sport fish resources in these waters and direct the course of future studies.

TECHNIQUES USED

The Russian River creel census was a modification of the method described by Neuhold and Lu (1957). Sampling procedures were identical to those outlined by Engel (1964), except that fishermen counts were increased to include four of the five weekdays.

Arctic grayling were collected with a 50-foot beach seine at the outlet of Crescent Lake. Fish were placed in holding pens in the lake prior to being transported by aircraft in 22-gallon plastic containers. Bottled oxygen was utilized during each transplant. Shipments were made at densities as high as two pounds of fish per gallon of water. Water temperatures were maintained at approximately 58°F.

Standard lake survey methods were used to collect physical and chemical data. Monofilament and multifilament gill nets (125 x 6-foot) having five mesh sizes ranging from 3/4- to 2-inch bar measure were used to determine the fish species present and relative abundance. All fish were measured from the tip of the snout to the fork of the tail. A portable P-100 Ross depth finder was used for general cataloging activities. Detailed volumetric surveys were accomplished with aerial photographs, sounding line and/or recording fathometer.

Depth distribution was determined for Arctic char by suspending monofilament gill nets from the surface to the lake bottom. Each net was wound around a sealed section of 4-inch aluminum pipe eight feet in length. Aluminum axles were welded on each end of the sealed pipe to aid in setting and rewinding. The aluminum pipe served as a roller-float from which the nets were unwound until the lower end reached the lake bottom. Mesh sizes were: 1/2-, 3/4-, 1-, 1 1/4-, and 1 3/4-inch bar measure. Two vertical gill net series, each consisting of five nets with the above mesh sizes, were utilized for the study. A detailed description of the nets and their method of operation have been presented by Engel (1967).

FINDINGS

Russian River Creel Census

The development of the Russian River red salmon fishery has been presented in Alaska Department of Fish and Game, Federal Aid in Fish Restoration, Annual Progress Reports by Lawler (1962 and 63) and Engel (1964, 65, 66 and 67). Notable changes in the fishery within recent years are as follows: (1) Prior to 1965, virtually the entire recreational red salmon harvest was taken by snagging; (2) A single hook restriction in 1965 and a fly-only regulation in 1966 were initial attempts to eliminate snagging; (3) In 1967 the fly-only requirement was supplemented with a foul-hook regulation which required that any fish hooked elsewhere than in the head, mouth or gill be immediately released. Past regulatory requirements for the Russian River have been discussed in detail by Engel (1967).

In accordance with the anti-snagging philosophy, both the fly-only and foul-hook restrictions were maintained during the 1968 red salmon migration. To evaluate these regulations, the creel census initiated in 1962 was continued during this report segment. The census extended from June 10 through August 15 and sampled nearly the entire fishing effort on red salmon. Projected fishermen counts estimate 17,300 man-days of effort or 94,900 fishing hours. Based on interviews with 11,526 fishermen who had caught 8,211 salmon, the harvest was estimated to be 12,730 red salmon. The mean rate of success was 0.13 salmon per hour. Table 1 summarizes fishing effort, harvest and rate of success since 1962.

TABLE 1 - Red Salmon Sport Harvest, Effort and Rate of Success on the Russian River, 1962 to 68.

Year	Sport Harvest	Effort (man-days)	Catch Per Hour	Census Period
1962	4,700	6,595	0.22	6/15 - 8/12
1963	5,060	7,880	0.19	6/08 - 8/15
1964	6,855	4,940*	0.31	6/20 - 8/16
1965	10,700	8,320	0.25	6/15 - 8/15
1966	21,820	17,890	0.21	6/15 - 8/15
1967	12,140	16,470	0.13	6/10 - 8/15
1968	12,730	17,300	0.13	6/10 - 8/15

*Damage to the Seward Highway by the March 27 earthquake resulted in reduced effort.

The foul-hook restriction reduced intentional snagging as well as the total harvest of red salmon. An estimated 7,760 salmon (37.9 percent of total landed) were reported released because of the anti-snagging regulation. This was comparable to 1967 when 40.5 percent of the catch was released. Although fishing ethics were perceptibly improved by the foul-hook regulation, some anglers continued to intentionally snag salmon. Frustrated anglers fishing unsuccessfully among large numbers of salmon commonly reverted to snagging simply because of the greater opportunity to play and land a fish. Field observations suggest that approximately 50 percent of the released salmon were intentionally snagged, whereas the remaining fish were inadvertently foul-hooked by anglers employing conventional fishing techniques.

Differences between weekday and weekend fishing pressures and success rates were consistent with past information collected at the Russian River. Thirty-nine weekday and 38 weekend and holiday counts averaged 58.7 and 101.5 anglers, respectively. Anglers fished an average of 5.3 hours on weekdays and 5.8 hours on weekend days. Weekday fishermen averaged 0.16 salmon per hour while weekend anglers caught 0.10 fish per hour. A comparison of catch statistics for recent years shows a substantial reduction in the mean rate of success and a gradual increase in the length of the average fishing day (Table 2). The reduced rate of success appears related to regulation changes rather than a decrease in red salmon populations.

TABLE 2 - Differences Between Weedkay and Weekend Day Fishing Pressures and Rates of Success at the Russian River, 1964 to 68.

	Seasonal Average					
	Fisherman Counts		Catch Per Hour		Hours Fished	
Year	Weekdays	Weekend Days	Weekdays	Weekend Days	Weekdays	Weekend Days
1964	12.1	26.7	0.46	0.25	3.3	4.8
1965	19.6	64.3	0 32	0.22	4.3	5.4
1966	56.2	112.7	0.30	0.17	4.8	5.5
1967	56.8	87.9	0.17	0.09	5.3	5.6
1968	58.7	101.5	0.16	0.10	5.3	5.8

During the census period, an estimated 800 Dolly Varden, Salvelinus malma, 450 rainbow trout, 55 pink salmon, Oncorhynchus gorbuscha, 40 silver salmon, O. kisutch, 6 round whitefish, Prosopium cylindraceum, and 3 Arctic grayling were taken incidental to red salmon. Approximately 35 king salmon, O. tshawytscha, were reported landed and released.

A counting tower at the outlet of Lower Russian Lake, operated by the Commercial Fisheries Division, provides an assessment of the escapement after the red salmon run has been harvested by the Cook Inlet commercial and Russian River sport fisheries. Since 1960, escapements past the tower have ranged from 22,804 to 56,960 with a mean of 44,107 red salmon. The 1968 escapement of 51,418 was substantially above the previous eight-year average. Foot surveys on the Russian River downstream from the tower site revealed an additional 6,200 spawning red salmon.

Besides red salmon, 1,648 silver salmon, 120 pink salmon and 56 king salmon were estimated to have passed the counting tower. A minimum of 63 additional king salmon were observed spawning downstream from the tower.

The bimodal nature of the red salmon migration was similar to past escapement patterns. The early run arrived at the stream about June 8 and had passed through the sport fishery by early July. The second run arrived about July 20 and was nearly complete by August 15.

The importance of the early run, which received approximately 70 percent of the seasonal effort and contributed about 65 percent of the harvest, was again evident. The estimated early-run sport catch of 8,255 salmon (46.5 percent of the run) resulted in a below-average escapement of 9,506 red salmon. A summary of early run sport harvests and escapements for recent years is presented in Table 3.

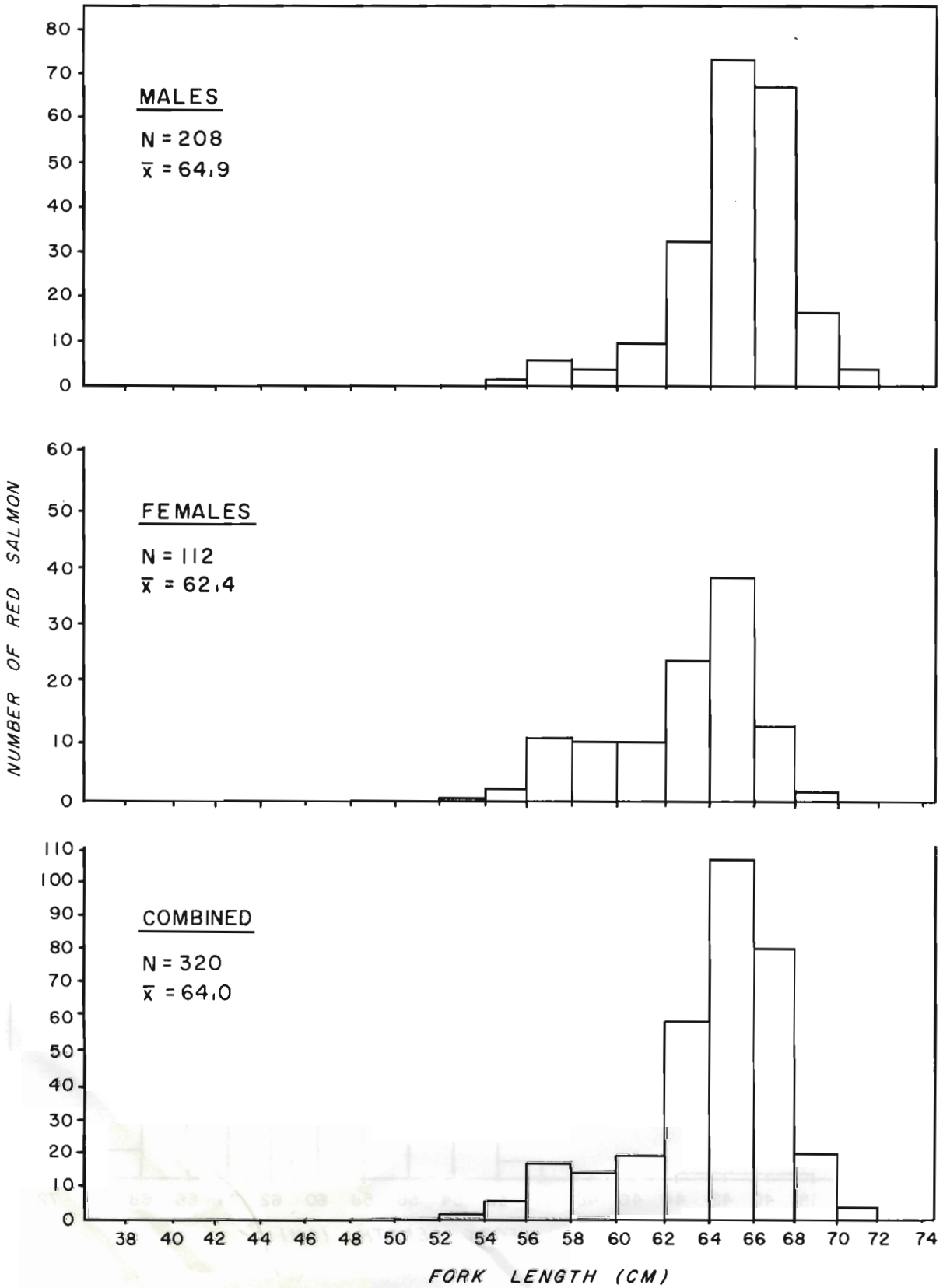

FIGURE 1. LENGTH FREQUENCIES OF EARLY RUN RED SALMON TAKEN FROM THE RUSSIAN RIVER, 1968.

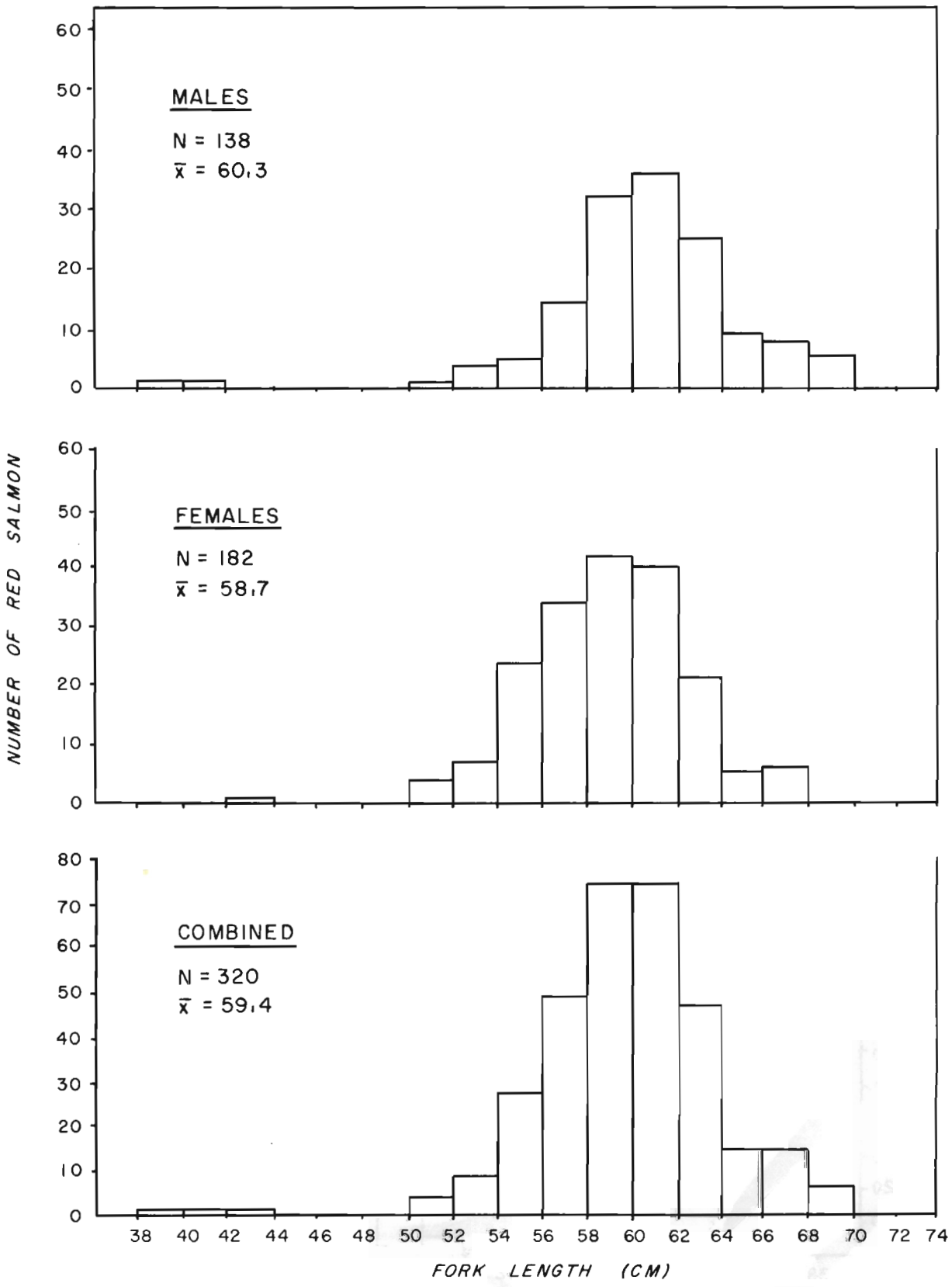

FIGURE 2. LENGTH FREQUENCIES OF LATE RUN RED SALMON TAKEN FROM THE RUSSIAN RIVER, 1968.

TABLE 3 - Russian River Red Salmon Catch Distribution and Tower Counts for Past Years.

Year	Total Escapement	Early Run* Escapement	Est. Early Run Catch	Total Early Run	Percent of Early Run Caught
1960	37,680	7,807	---	---	---
1961	22,804	6,712	---	---	---
1962	48,214	28,980	3,408	32,388	10.5
1963	56,960	13,136	3,670	16,806	21.8
1964	52,052	12,260	4,970	17,230	28.8
1965	37,152	18,440	7,758	26,198	29.6
1966	43,880	14,280	16,365	30,645	53.4
1967	54,112	11,768	8,496	20,265	41.9
1968	51,418	9,506	8,255	17,761	46.5

*July 15 was used as the termination date for the early run.

Catches from the two Russian River runs were randomly sampled for age, length and sex compositions. The length-frequency distribution of 320 red salmon from the early run is shown in Figure 1. The modal length of the combined sexes fell between 64 and 66 cm. Mean fork lengths for males and females were 64.9 and 62.4 cm, respectively. The male-to-female sex ratio was 1.9:1. Figure 2 illustrates the length-frequency distribution of 320 red salmon from the late run. Fish from this sample had a mode between 58 and 62 cm. Mean lengths for males (60.3 cm) and females (58.7 cm) were considerably shorter than those recorded from the early run. The male-to-female sex ratio of 0.8:1 also differed sharply.

The age composition of the two runs provides an explanation for the disparity in length frequencies. Scale analysis, by the Commercial Fisheries Division, revealed that six-year old fish comprised 78.4 percent of the early run sample, whereas 83.3 percent of the late run consisted of five-year old salmon. Both runs were dominated by fish that had migrated to sea after two winters in fresh water. A summary of age classes by sex is shown in Table 4.

TABLE 4 - Percent of Various Age Classes of Adult Red Salmon Sampled at the Russian River, 1968.

Age Class	Male	Female	Combined	Sample Size
Early Red Salmon Run:				
1.2	2.2	10.7	5.0	14
1.3	10.3	12.9	11.2	31
2.2	3.3	9.7	5.4	15
2.3	84.2	66.7	78.4	218
Late Red Salmon Run:				
1.2	4.7	5.5	5.2	13
1.3	1.0	2.0	1.6	4
2.2	85.8	78.8	81.7	206
2.3	3.8	7.5	5.9	15
3.2	4.7	6.2	5.6	14

Grayling Transplants

Arctic grayling were introduced into Juneau Lake in 1964 and again in

1966. Gill net sampling during the summer of 1968 suggested that the initial plants, consisting of 413 adult grayling, failed to develop a self-sustaining population. In view of Juneau Lake's high recreational potential and the apparent favorable ecological conditions that exist within the drainage, a third grayling transplant was attempted during 1968.

Sub-adult grayling were seined at the outlet of Crescent Lake from July 30 thru August 1. Retention and transfer of the fish resulted in the observed death of three grayling. The water temperatures at the outlets of the Crescent and Juneau Lakes were 58° and 59°F, respectively. The maximum time in transit between donor and recipient lakes was 32 minutes.

A total of 1,216 grayling were released, in apparent good condition, at the outlet of Juneau Lake. Fork lengths from 55 transplanted fish ranged from 130 to 286 mm with a mean of 179.6 mm. Scale analysis of these fish suggested that the transplant was composed of 98 percent age I+ and 2 percent age II+ grayling.

Red Salmon Transplants

Experimental red salmon transplants were evaluated by gill net sampling in five lakes to determine relative survival and growth rates. Smolts from Bear Lake near Seward were utilized for all introductions. The 1965 and 1966 transplants were predominately age I smolts that had mean fork lengths of 116.4 and 80.6 mm, respectively (Logan, 1966). The 1967 transplant was composed of 90.7 percent age II and 9.3 percent age I smolts that had a combined mean length of 99.1 mm (Logan, 1967). Table 5 shows numbers of fish and lakes where introductions were made.

TABLE 5 - Number of Red Salmon Smolts Stocked in Kenai Peninsula Lakes, 1965 to 67.

Lake	Date Stocked	Fish Per Surface Acre	Total Fish Stocked
Sunken Island	June, 1966	224	31,350
	June, 1967	94	13,140
Portage	June, 1966	644	18,670
	June, 1967	378	10,950
Upper Jean	June, 1965	25	1,150
	June, 1966	754	34,670
	June, 1967	196	9,020
Rock	June, 1966	1,038	8,300
	June, 1967	1,279	10,230
Bottinentin	June, 1967	137	38,220

With the exception of Bottinentin Lake, the physical and chemical features of the study lakes have been described by Engel (1967). Upper Jean, Portage and Sunken Island Lakes have generally similar characteristics; each exceeds 40 feet in depth and all are thermally stratified during the summer. Rock Lake is a small, shallow lake that exhibits a homoiothermus condition during the summer.

Bottinentin Lake, with a surface area of 280 acres and a maximum depth of 10 feet, is located at an elevation of approximately 275 feet. The water of the lake is stained with humic materials, and aquatic vegetation is extensive. The pH is 6.6, and the M.O. alkalinity is approximately 65 ppm.

Because the lakes have diverse physical, chemical and biological characteristics, the red salmon populations display considerable variation in

growth. For comparative purposes the various annual transplants were aged and identified during subsequent years solely on the basis of length. This procedure may be subject to some error, however, because in a few instances length overlap was evident between salmon of different introduction dates. Table 6 depicts the length, weight and relative survival of the fish planted in 1966, during the fall of 1967 (age II) and 1968 (age III).

TABLE 6 - Growth Comparisons for 1966 Red Salmon Transplants in Five Kenai Peninsula Lakes.

Lake	Year Sampled	Number of Fish	Size Range (mm)	Mean Length (mm)	Mean Weight (mm)	Catch Per Hour
Rock	1967	67	218 - 291	256.2	0.51	1.37
	1968	32	238 - 380	312.3	0.93	1.39
Upper Jean	1967	26	164 - 285	223.9	0.32	0.27
	1968	14	193 - 293	243.9	0.42	0.21
Sunken I.	1967	107	151 - 278	190.1	0.17	1.34
	1968	38	204 - 283	232.8	0.31	0.58
Portage	1967	13	153 - 211	180.7	0.14	0.20
	1968	41	181 - 321	207.3	0.22	0.81
Bottinentin	1968	11	135 - 216	159.5	0.11	0.14

The size attained by the red salmon in Upper Jean, Sunken Island, Portage, and Botteninten Lakes suggest relatively unproductive waters or unfavorable ecological conditions for red salmon. Rock Lake, with the heaviest stocking density, produced the largest fish.

Sexual maturity appeared related to size rather than age. Mature fish comprised 21 percent and 50 percent, respectively, of the gill-net catches from Rock Lake during 1967 and 1968. All mature fish in 1967 were males, whereas females made up 12 percent of the spawning population in 1968. Less than 10 percent of the fish from the four lakes producing slow growth were spawners.

Stomach analysis of red salmon from Sunken Island and Portage Lakes revealed cladocerans and copepods as the principal food groups. Freshwater shrimp, Gammarus, was the only food item recorded from the Rock Lake salmon. Threespine sticklebacks, Gasterosteus aculeatus, constituted the bulk of the diet of the fish from Upper Jean Lake, and aquatic insects and sticklebacks were the dominant food consumed by the salmon from Bottinentin Lake.

Lake Stocking Evaluations

Sport and Arc Lakes, rehabilitated in July, 1965, were stocked with rainbow trout at a rate of 400 fingerlings per surface acre in July, 1966. Scout Lake, rehabilitated in June, 1966, was stocked during August, 1966 with 285 rainbow fingerlings per surface acre. Rotenone was used to remove threespine sticklebacks from each lake. Physical and chemical characteristics of the lakes have been described by Engel (1967).

Gill net sampling during October, 1967, indicated that the trout in Sport, Arc and Scout Lakes averaged 286.4, 288.6 and 300.9 mm, respectively. The 1967 catch rates (fish per net hour) were inversely related to the mean size of the fish. Subsequent sampling in October, 1968, showed that the trout in Sport and Arc Lakes averaged 373.2 and 373.7 mm, respectively, while those in Scout Lake had a mean length of 537.6 mm. Gill-net catches ranged from a low of 0.04 fish per hour in Scout Lake to 0.47 fish per hour in Sport Lake. The average size and relative abundance of the planted trout are compared in Table 7.

TABLE 7 - Gill Net Summary for Three Rehabilitated Kenai Peninsula Lakes Containing Rainbow Trout.

Lake	Year	Length Range (mm)	Mean Length (mm)	Weight (lbs)	Catch Per Hour*
Sport	1967	240 - 318	286.4	0.64	0.40
	1968	340 - 397	373.2	1.55	0.47
Arc	1967	269 - 312	288.6	0.67	0.27
	1968	335 - 387	373.7	1.61	0.17
Scout	1967	260 - 331	300.9	0.83	0.15
	1968	490 - 575	537.6	4.82	0.04

*Catch per net hour - 125 x 6-foot variable mesh gill nets.

During 1967 and 1968 both Sport and Arc Lakes supported moderate fishing pressure and produced fair to good catches of rainbow trout. Scout Lake's failure to produce acceptable numbers of trout apparently resulted from an incomplete stickleback kill. Shoreline observations suggest complete eradication in Sport and Arc Lakes, whereas sticklebacks have increased to pre-rehabilitation numbers in Scout Lake.

Lake Surveys

Basic surveys were performed on 39 lakes during this report period. Most of the waters were located north of the city of Kenai in an area experiencing rapid population and industrial growth. Surveys were directed toward compiling information for use in developing management plans to resolve problems associated with the petrochemical industry. Public access to potential recreational fishing waters is also an acute problem in the area. Table 8 shows the location, surface acreage and maximum observed depth of the surveyed waters.

TABLE 8 - Location, Surface Acreage and Maximum Depth of Lakes Surveyed on the Kenai Peninsula During 1968.

Lake	Surface Acres*	Maximum Observed Depth (ft.)	Location
Bottleneck	36	54	T2N., R12W., Sec. 4-9
Headquarter	130	3	T4N., R10W., Sec. 5-6-8
Embro	38	55	T8N., R11W., Sec. 35
Beck	180	28	T8N., R11W., Sec. 36
Katrina	63	44	T8N., R11W., Sec. 26
Charisma	51	32	T7N., R11W., Sec. 1-2
Duck	75	5	T7N., R11W., Sec. 21
Foreland	60	43	T7N., R12W., Sec. 3-4
Dolomite	23	30	T7N., R11W., Sec. 1-12
Shimmeron	130	95	T8N., R11W., Sec. 35-36
Dogbone	25	13	T7N., R11W., Sec. 18
Swan**	90	72	T6N., R 3W., Sec. 7-8-17
Trout	195	119	T5N., R 4W., Sec. 1-2
Juneau	140	45	T6N., R 3W., Sec. 30-31
Parsons	100	15	T7N., R11W., Sec. 17-18
Boomerang	10	18	T2N., R12W., Sec. 3
Eighteen	38	23	T2N., R12W., Sec. 3-10
Upper Slikok	51	8	T4N., R10W., Sec. 7
Soup	20	11	T6N., R 9W., Sec. 16-21
Calf	20	17	T6N., R 9W., Sec. 22
Berg	70	20	T2N., R11W., Sec. 22
Savka	19	23	T6N., R 9W., Sec. 23

TABLE 8 (Cont.) - Location, Surface Acreage and Maximum Depth of Lakes Surveyed on the Kenai Peninsula During 1968.

Lake	Surface Acres*	Maximum Observed Depth (ft.)	Location
Cow	138	40	T6N., R 9W., Sec. 15-16-21
Eevook	12	7	T6N., R 9W., Sec. 22
Yellowjacket	38	21	T6N., R 9W., Sec. 14-23
Tear-Drop	26	79	T8N., R11W., Sec. 23-26
Douglas	90	25	T7N., R11W., Sec. 28
Jeep	25	15	T8N., R11W., Sec. 15-22
Martin	35	15	T2N., R12W., Sec. 15
Boundary	36	20	T2N., R11W., Sec. 17-20
Moreland	16	17	T7N., R12W., Sec. 12
Millco	20	26	T7N., R11W., Sec. 7
Medico	43	14	T7N., R11W., Sec. 7 R12W., Sec. 12
Airplane	110	50	T8N., R11W., Sec. 14-23
Emerald	24	37	T7N., R12W., Sec. 12
Hump	18	26	T8N., R11W., Sec. 23
Nikishka	58	66	T7N., R11W., Sec. 3
Gasterosteous	6	16	T2N., R12W., Sec. 4
Devils Club	19	20	T7N., R12W., Sec. 3

*Acreages were determined by map grids from U.S.G.S. maps, (1:63,360).

**Lake not gill netted.

Gill net sampling revealed game fish in 16 lakes, with rainbow trout the most common species (Table 9). Longnose suckers, Catostomus catostomus; silver salmon; lake trout, S. namaycush; Dolly Varden; and round whitefish were also encountered during the surveys. Threespine sticklebacks were abundant in many of the waters.

TABLE 9 - Gill Net Results for Lakes Surveyed on the Kenai Peninsula During 1968.

Lake	Species*	Number of Fish	Fork Length (mm)	Mean Length (mm)	Catch Per Hour**
Bottleneck	RB	16	165 - 323	213	0.35
Headquarter	DV	1	185	185	0.02
	SS	2	163 - 218	191	0.05
Embro	RB	61	147 - 354	251	1.35
	SS	1	346	346	0.02
	SK	1	448	448	0.02
Beck	RB	76	152 - 417	280	1.51
	SK	2	320 - 483	402	0.04
Katrina	RB	40	108 - 305	209	1.26
	SK	1	296	296	0.03
Charisma	RB	28	146 - 443	263	0.58
	SS	1	106	106	0.02
	SK	2	415 - 428	422	0.04
Duck	RS	1	550	550	0.05
	RB	17	230 - 444	344	0.80
	SK	53	156 - 346	276	2.51
Foreland	RB	1	530	530	0.02
Dolomite	RB	2	253 - 267	260	0.03
Shimmeron	RB	52	107 - 457	230	1.13
	SS	4	106 - 222	183	0.09
	SK	7	358 - 455	416	0.15
Dogbone	SS	21	208 - 390	255	0.34
	DV	2	478 - 530	504	0.03

TABLE 9 (Cont.) - Gill Net Results for Lakes Surveyed on the Kenai Peninsula During 1968.

Lake	Species*	Number of Fish	Fork Length (mm)	Mean Length (mm)	Catch Per Hour**
Trout	LT	2	261 - 385	323	0.58
	WF	208	208 - 370	300	4.63
Juneau	LT	5	375 - 610	504	0.14
	RB	2	268 - 550	409	0.06
	WF	36	185 - 344	268	0.97
Parsons	RB	40	160 - 409	335	0.88
	SK	20	120 - 400	283	0.66
Boomerang	RB	9	109 - 338	210	0.51
Eighteen	RB	3	240 - 435	368	0.06
Upper Slikok	No fish taken				
Soup	No fish taken				
Calf	No fish taken				
Berg	No fish taken				
Cow	No fish taken				
Savka	No fish taken				
Eevook	No fish taken				
Yellowjacket	No fish taken				
Tear-Drop	No fish taken				
Douglas	No fish taken				
Jeep	No fish taken				
Martin	No fish taken				
Boundary	No fish taken				
Moreland	No fish taken				
Millco	No fish taken				
Medico	No fish taken				
Airplane	No fish taken				
Emerald	No fish taken				
Hump	No fish taken				
Nikishka	No fish taken				
Gasterosteous	No fish taken				
Devils Club	No fish taken				

*Key: RB - rainbow trout SK - longnose sucker WF - whitefish
DV - Dolly Varden RS - red salmon
SS - silver salmon LT - lake trout

**Catch per net hour - 125 x 6-foot variable mesh gill nets.

Volumetric Surveys

Complete volumetric surveys were performed on six lakes which have good potential for management. Morphometric data for these lakes is presented in Table 10. Jerome Lake was rehabilitated with rotenone and subsequently stocked with rainbow trout.

TABLE 10 - Morphometric Data for Six Kenai Peninsula Lakes.

Lake	Surface Acres	Volume Acre (ft)	Maximum Depth (ft)	Mean Depth (ft)	Location
Beluga	160	512	10	3.2	T6S., R13W.
Cabin	53	580	20	11.0	T7N., R12W.
Hidden	1,687	111,964	148	66.4	T5N., R 5W.
Jerome	16	138	15	8.5	T5N., R 2W.
Upper Summit	258	10,729	70	41.6	T6N., R 1W.
Lower Summit	59	308	12	5.2	T7N., R 1W.

Arctic Char Studies in East Finger Lake

Knowledge about the life history of Arctic char is essential to its management in the lakes of the Kenai Peninsula. Creel census studies have shown that Arctic char are relatively unimportant to the summer sport fishery, whereas the species contributes substantially to the harvest during the winter, spring and fall. Factors that influence seasonal variation in depth distribution were studied at East Finger Lake during 1967 and 1968.

East Finger Lake has a surface area of 70 acres and a maximum depth of 47 feet. The lake has no permanent inlets, but drains by an intermittent outlet stream to Middle Finger Lake. During the summer of 1967, dissolved oxygen remained above 5 ppm at all depths. The average pH ranged from 6.9 at the surface to 6.6 at the bottom. The mean level of methyl orange alkalinity, which varied only slightly with depth, was 68 ppm. Water analyses were not continued in 1968 because the fluctuation in concentrations were not believed to be of a magnitude to influence depth distribution.

Collection of data related to the vertical movement of char was accomplished from July 1 to October 25, 1967, and from May 22 to October 20, 1968. The study remained active each year until the first formation of ice. Fish were collected at two permanent, vertical gill net stations that were in the same locations both years of the study. Station 1, located at the north end of the lake, was 45 feet deep; and Station 2, at the south end of the lake, was 44 feet deep.

Comparison of water temperatures for the period July through October, 1967 and 1968, revealed warmer mean temperatures in 1968. Temperatures recorded in 1967 at the surface, 21 feet and the bottom averaged 56.5°, 49.0°and 41.6°F, respectively. Mean temperatures at the same depths in 1968 were 58.1°, 51.0°and 43.1°F, respectively. Temperature profiles were nearly identical at both stations throughout the investigation. Isotherms at Station 1 during 1967 and 1968 are shown in Figure 3.

In 1967 and 1968, a total of 241 and 194 Arctic char, respectively, were captured in the vertical gill nets. Sixty-three percent of the char were taken at Station 1 during 1967, whereas the catch was evenly divided between the two stations in 1968. Since capture depths were fairly consistent at both locations, the samples were combined for analysis.

The majority of the Arctic char occupied mid-water or bottom depths during the summer months and then rose to the surface layers in the fall (Figures 4 and 5). The average capture depths in 1967 during July, August, September, and October were 32.4, 24.9, 19.6, and 17.3 feet, respectively. Mean capture depths during the same months in 1968 were 20.1, 22.8, 24.9, and 9.8 feet, respectively. Since only nine char were gill netted during May and June, 1968, depth-distribution patterns could not accurately be determined for this seasonal period. However, 77 percent of the spring sample (May and June) was captured within 20 feet of the surface.

Eighty-nine percent of the char were taken in water colder than 55°F during both years of the investigation. During the summers (July to August) of 1967 and 1968, 70 and 50 percent of the char, respectively, were captured in water that ranged from 41° to 50°F. The reduced catch in the cooler water in 1968 may have resulted from the greater depth of the isotherms.

Of the environmental factors measured, only water temperature appeared to influence the seasonal depth distribution of Arctic char. The fall movement of char from the depths to the surface water layers closely coincided with the occurrence of 50°F surface temperatures. The vertical distribution of zooplankton and the effect of light intensity on char behavior, however, were not measured during the study.

Despite less fishing effort, the fall gill-net catches (September to October) were considerably greater than mid-summer catches (July to October).

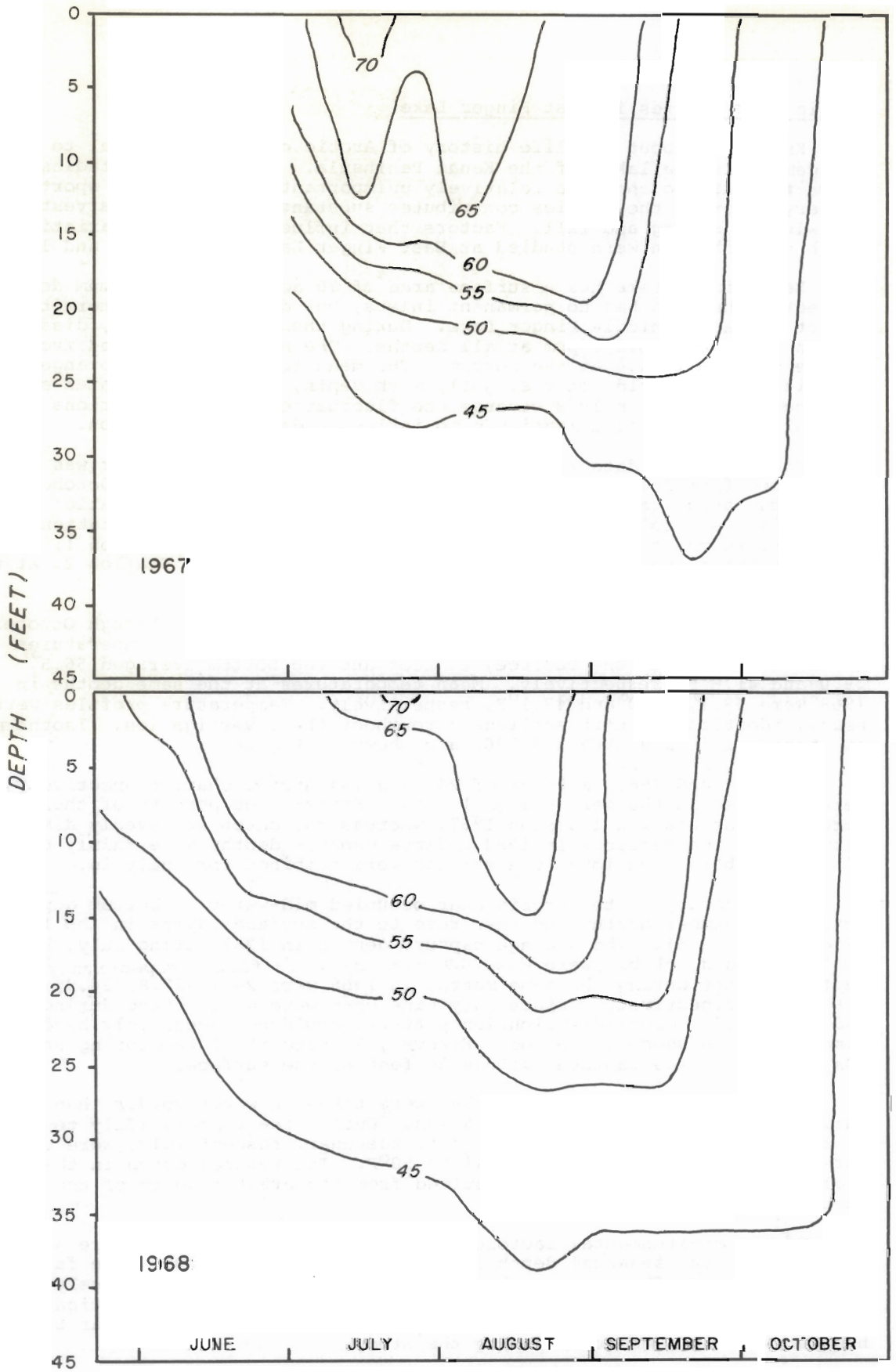

FIGURE 3. TEMPERATURE ISOTHERMS (F) OF STATION I AT EAST FINGER LAKE, 1967 - 1968.

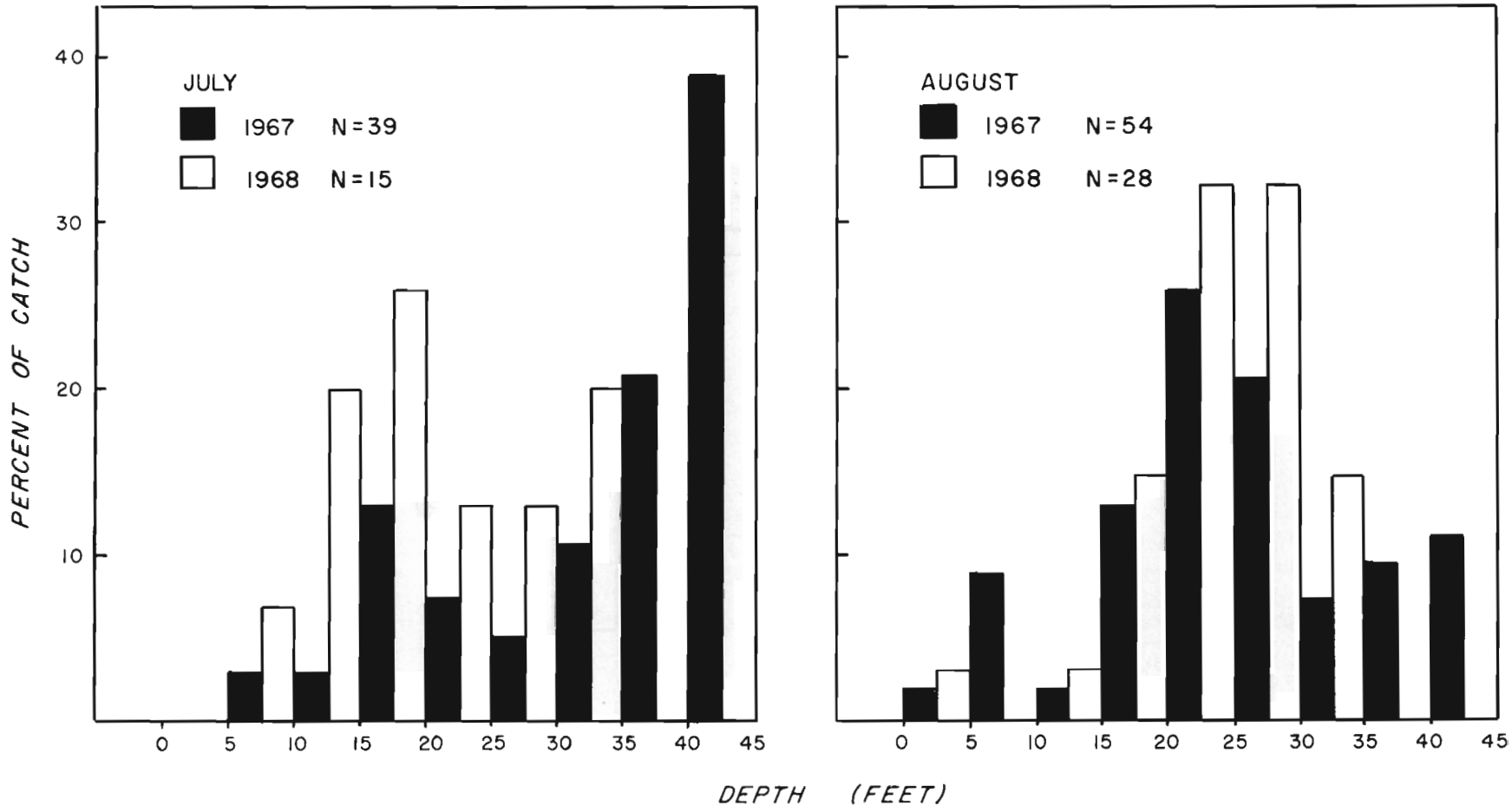

FIGURE 4. THE PERCENT OF ARCTIC CHAR CAPTURED AT EAST FINGER LAKE DURING JULY AND AUGUST, 1967 AND 1968.

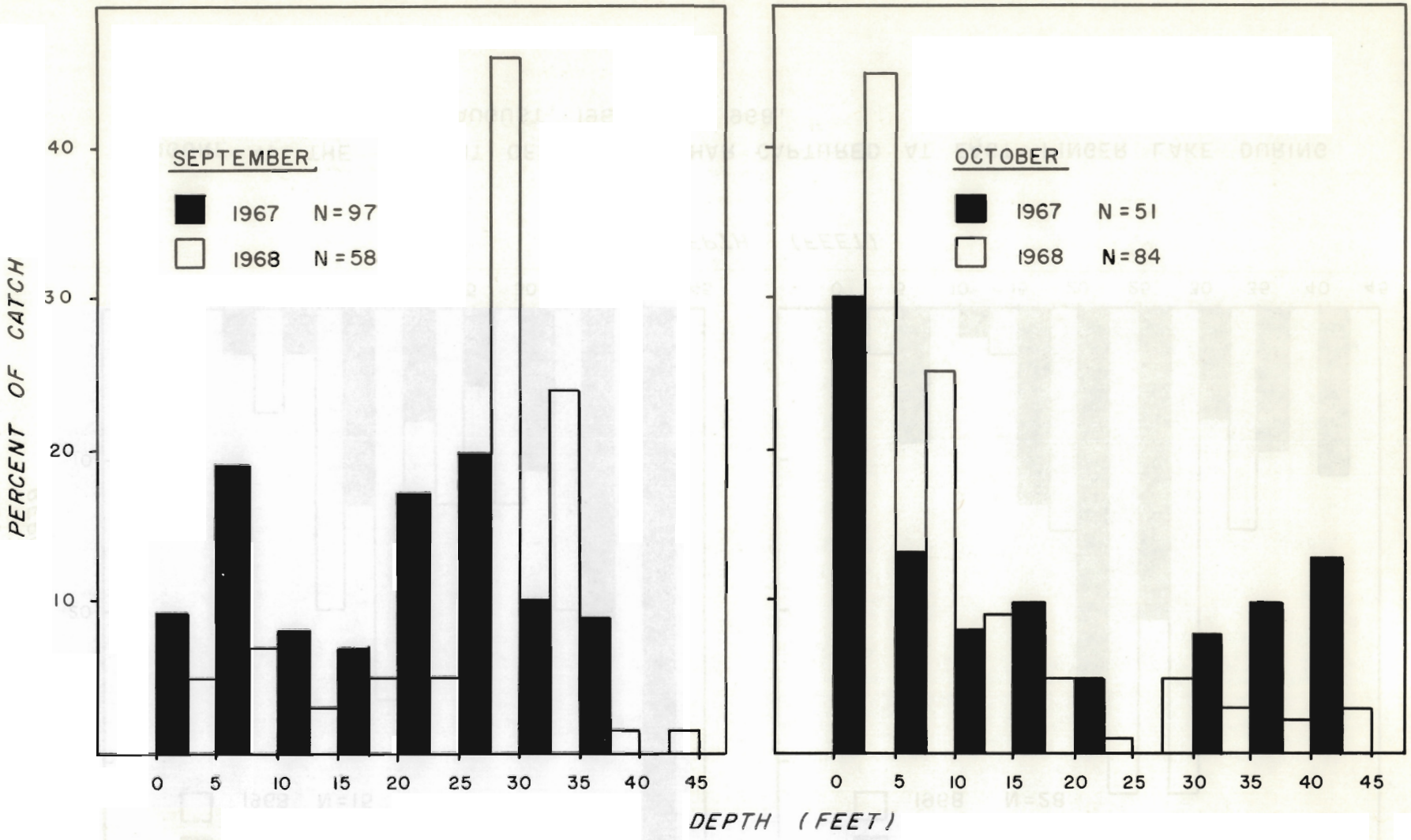

FIGURE 5. THE PERCENT OF ARCTIC CHAR CAPTURED AT EAST FINGER LAKE DURING SEPTEMBER AND OCTOBER, 1967 AND 1968.

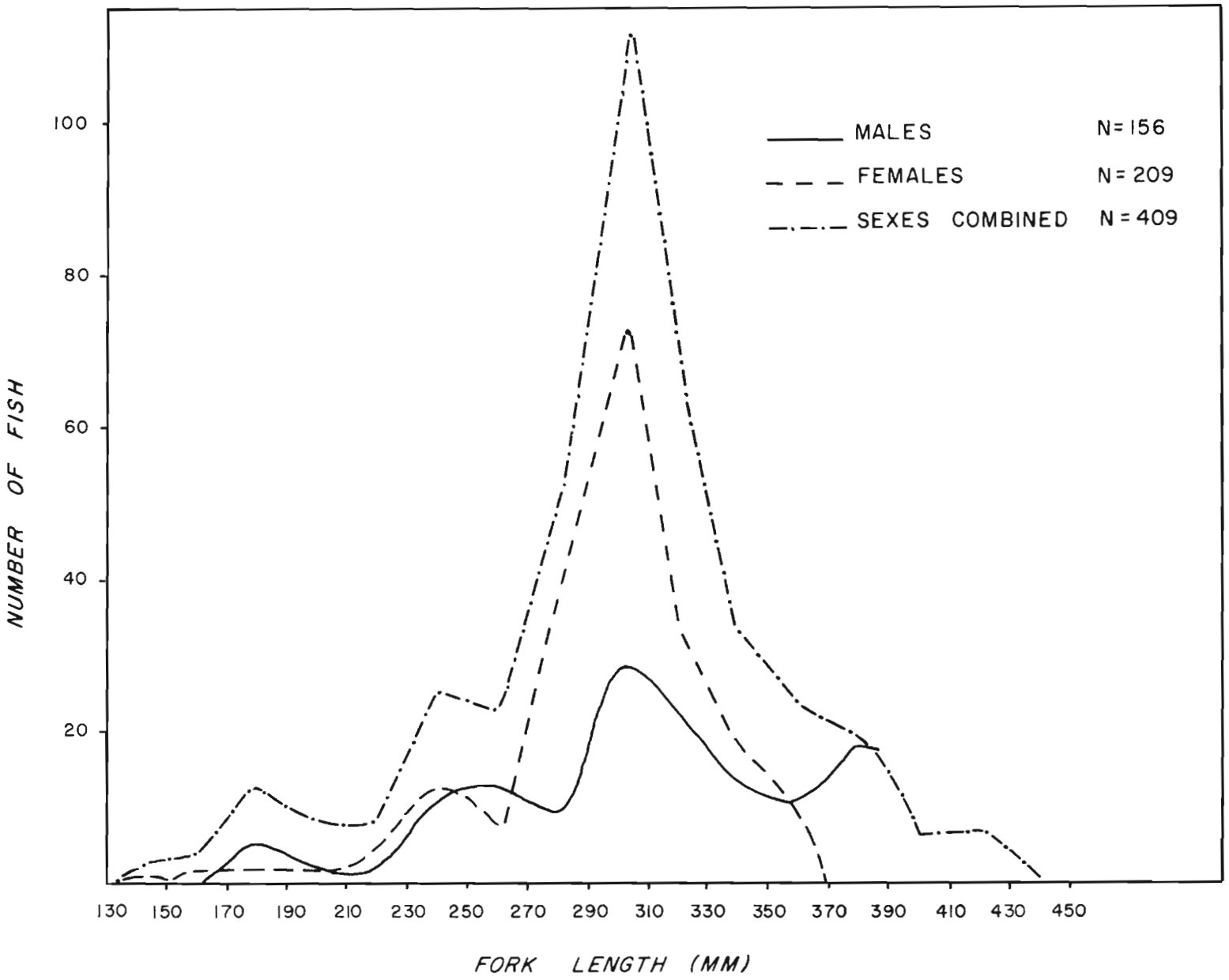

FIGURE 6. LENGTH DISTRIBUTION OF MALE AND FEMALE ARCTIC CHAR COLLECTED FROM EAST FINGER LAKE, 1967 - 1968.

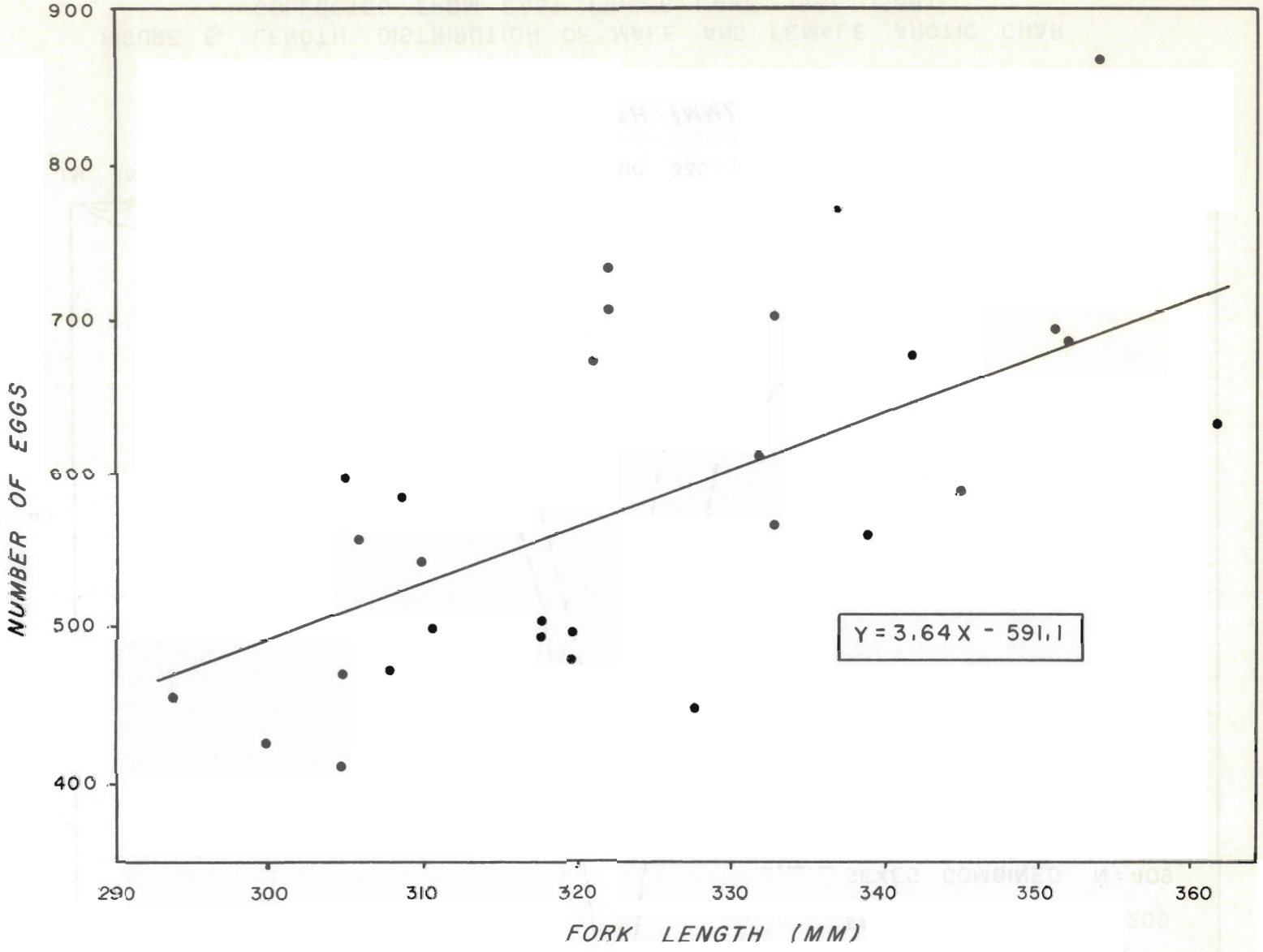

FIGURE 7. RELATION BETWEEN LENGTH AND FECUNDITY OF ARCTIC CHAR FROM EAST FINGER LAKE, 1967-1968.

The numbers of char collected during the fall of 1967 and 1968 were 148 and 142, respectively; whereas the mid-summer catches during the same years totaled 93 and 43. Differences in seasonal catch rates may have resulted from any of the following: (1) increased char activity during the fall and hence greater vulnerability to gill net capture, (2) greater periods of darkness during the fall which increased gill net efficiency, and (3) the unit of effective gear would theoretically increase in the fall if warm surface temperature restrict char to the depths during the summer.

Thirty-four longnose suckers varying from 154 to 227 mm in length were gill netted during the study. Suckers were captured at the bottom to within 7 feet of the surface. The average depth of capture was 27.2 feet. Only 12 percent of the suckers were captured within 5 feet of the bottom.

Length data from 465 Arctic char revealed that males (314.4 mm) averaged slightly longer than females (296.8 mm). Mean weights for male and female char were 0.82 and 0.65 pounds, respectively. Length-frequency distributions by sex are shown in Figure 6. The ratio of males to females was 0.7:1.

The spawning period for Arctic char was not definitely defined because spent or partially spent fish were not collected during either year of the investigation. However, the presence of gravid and ripe fish in October gill net catches indicated that spawning occurred soon after the study terminated, probably during the period of ice cover.

Fork lengths for gravid females ranged from 294 to 362 mm with a mean of 322.8 mm. Mature males averaged 375.7 mm and ranged from 340 to 415 mm in length. The ratio of sexually mature males to females was 0.2:1. Approximately 35 percent of the char over 300 mm showed sexual development.

Fecundity was determined by actual counts of mature eggs in the ovaries of 29 females. The number of eggs ranged from 413 for a 305 mm specimen to 870 for a 354 mm female. There was an increase in the number of eggs produced with increasing length. This relationship is expressed by the linear regression of egg count (Y) on fork length (X) (Figure 7). The equation for estimating number of eggs is: $\hat{Y} = 3.64X - 591.1$.

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