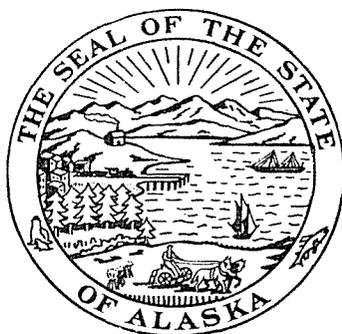


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STATE OF ALASKA

William A. Egan, Governor



ANNUAL REPORT OF PROGRESS, 1969 - 1970

FEDERAL AID IN FISH RESTORATION PROJECT F-9-2

SPORT FISH INVESTIGATIONS OF ALASKA

ALASKA DEPARTMENT OF FISH AND GAME

Wallace H. Noerenberg, Commissioner

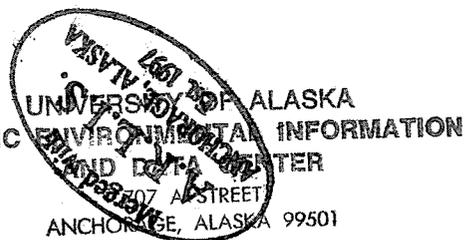
*Alaska* DIVISION OF SPORT FISH

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## INTRODUCTION

This report of progress consists of Job Segment Reports from the State of Alaska, Federal Aid In Fish Restoration, Project F-9-2, "Sport Fish Investigations of Alaska".

The studies reported herein are investigations evaluating the sport fish resources of the state. Recreational and other impacts on the fishery resources necessitates a continuous endeavor of ascertaining facts and knowledge of the fisheries. The 24 jobs reported on are of a continuing nature. The investigations are composed of 11 projects involved with the inventory and cataloging of the sport fish waters of the state, sport fishery creel censuses, and access. Fish species that received special investigational effort include: Dolly Varden, anadromous fish, grayling, sheefish, whitefish, pike, char, and salmon. The information gathered from the combined studies provides necessary background data for a better understanding of management problems and constitutes a basis for necessary future investigations.

The subject matter contained in these reports is incomplete, and the findings and interpretations subject to re-evaluation as work progresses.

## RESEARCH PROJECT SEGMENT

*State:* Alaska

*Project No.:* F-9-2                      *Name:* Sport Fish Investigations of Alaska.

*Job No.:* 9-C-1                      *Title:* Salmonid Rearing and Migration Study - Fire Lake System.

*Period Covered:* July 1, 1969 to June 30, 1970.

## ABSTRACT

The weirs on Upper and Lower Fire lakes were in operation from April 18 to October 25, 1965 with downstream traps operated at both weirs until November.

Three thousand, six hundred seven salmonids of all species were recorded at the weirs. Fish were examined for marks and passed through the weirs in the direction of migration. Fish were sampled at regular intervals for length and weight and scale samples were taken. Population sampling with variable-mesh gill nets throughout the summer recovered an additional 692 salmonids.

The downstream migration of coho salmon, *Oncorhynchus kisutch*, smolts totaled 1,763 at the Upper Fire Lake weir. A normal smolt migration did not occur at Lower Fire Lake and only 44 smolts were recorded through the weir. Peak smolt migration at Upper Fire Lake occurred during the week ending June 4, with the run being dominated by marked age II and marked yearling hatchery smolts.

Smaller numbers of coho parr moved upstream at the Lower Fire Lake weir than in previous years, but the parr were larger in size. A lower percentage of age 0 fish was present than in 1968.

Survival of 1966 brood marked coho from time of release in Upper Fire Lake to migration as age I and age II smolts was 26.1%. Fish of a comparable lot planted into Lower Fire Lake did not migrate as age II smolts, and survival data for the Lower Fire Lake plant did not change from that recorded in 1968 (16.4%).

Two lots of 1967 brood yearling hatchery smolts were marked, and 1,000 smolts were planted into each lake. A migration of 72.5% was recorded from Upper Fire Lake; none of the Lower Fire Lake plant migrated from the lake.

Two lots of 1968 brood coho were marked, and 5,500 and 11,500 were planted into Upper and Lower Fire lakes, respectively.

Gill-net sampling revealed substantial populations of kokanee salmon, *O. nerka*, in both Upper and Lower Fire lakes. Kokanee in Upper Fire Lake appeared to spawn at an earlier age than their Lower Fire Lake counterparts. A nearly equal sex ratio was found at Upper Fire Lake, while females outnumbered males more than three to one at Lower Fire Lake. Four kokanee were recorded at the Upper Fire Lake weir, two in each trap.

Two hundred sixteen rainbow trout, *Salmo gairdneri*, were captured, 199 at the Upper Fire Lake weir

and 17 at the Lower Fire Lake weir. Forty-seven adults were enumerated at the Upper Fire Lake weir; 38 of these were downstream migrants. Net sampling revealed a disproportionate sex ratio for rainbow trout at Upper and Lower Fire lakes similar to that found for kokanee.

Dolly Varden, Salvelinus malma, enumerated at both weirs totaled 148 fish. These fish were primarily juveniles moving upstream at the Lower Fire Lake weir.

A marked king salmon, O. tshawytscha, from the 1966 plant was captured in a gill net in Upper Fire Lake.

A number of Arctic blackfish, Dallia pectoralis, recorded at the Lower Fire Lake weir and in gill-net sets indicate that the species has become well established in Lower Fire Lake.

## RECOMMENDATIONS

1. That the physical and chemical characteristics of both Upper and Lower Fire lakes be examined more completely with emphasis on Lower Fire Lake.
2. That use of thermal branding techniques be explored for inclusion in the study with fin-marking methods presently used.
3. That the food habits of all species present in the system be analyzed to determine levels of interspecific competition, and to establish whether the presence of Arctic blackfish should be considered as a factor affecting the survival of salmonids.
4. That rehabilitation of Upper and Lower Fire lakes be postponed until production requirements permit closing the hatchery.

## OBJECTIVES

1. To investigate the rearing and migratory characteristics of various salmonid stocks in the Fire Lake system.
2. To determine the suitability of various stocks of fish in the Sport Fish Management program.

## TECHNIQUES USED

The study area and the description of the Upper and Lower Fire lakes weirs have been described in previous reports. This report is a continuation of the study reported by Gretz (1963, 1964), Jones and Sexsmith (1965), Jones (1966), and Wallis (1967, 1968, and 1969).

Two groups of marked coho were planted in Upper and Lower Fire lakes during 1969. Fish captured at the weirs were anesthetized with MS-222, examined for marks, and released in the direction of migration. Certain groups of marked fish were given additional marks for later identification. A list of marks used during 1968 and 1969 is included in this report.

Following the migration period, fish populations of Upper and Lower Fire lakes were sampled throughout the summer with two, 125-foot sinker-type gill nets, one monofilament and one nylon. These nets had a six-foot depth and panel mesh varying from 1/2 to 2 inches.

Samples of marked and unmarked fish were taken for measurement of fork length, weight, and for

scale removal. The sampling schedule presented by Wallis and Estabrook (1969) was followed with the following exceptions:

1. At the weirs, unmarked juvenile coho salmon were sampled with the same frequency as marked coho.
2. All coho taken from test nets were measured for length and systematically sampled for weight (every third fish). Scales were removed from every sixth fish. For gill-netted rainbow and kokanee, lengths and weights were recorded for all fish, and a scale sample was removed from every second fish.

Water temperatures were taken daily at both weirs with maximum-minimum thermometers from the first week in May to the third week in June, at which time readings were reduced to three days per week for the remainder of the season.

Lake level readings were taken daily at Lower Fire Lake from May 1 until June 12, when the gauge was buried during road construction. After re-installation on July 16, readings were made every third day. Data provided by the U.S. Geological Survey was used to establish a correlation between lake level and streamflow out of Lower Fire Lake.

## FINDINGS

The Upper Fire Lake (UFL) and Lower Fire Lake (LFL) weirs were placed in operation on April 18. Routine operation of both weirs was discontinued on October 25, but downstream traps were operated at UFL weir until November 10, and from October 30 to November 6 at LFL weir. Ice breakup at Upper and Lower Fire lakes occurred on May 10 and May 6, respectively. Freezeup occurred at LFL on October 24, while UFL did not freeze until November 7.

During the investigational period, 3,607 salmonids of all species were recorded at the weirs. An additional 692 salmonids were taken in gill-net sampling of Upper and Lower Fire lakes.

### Coho Salmon

Coho salmon totaling 3,243 fish were enumerated at all traps during 1969 (Table 1). Upon capture, fish were designated as being either parr, smolt, or adult.

#### Smolt Migration:

A downstream coho smolt migration of 1,763 fish was recorded at the UFL weir. There was no major smolt migration from LFL, and only 44 smolts were recorded during the season. A total of 27 smolts were counted through the UFL upstream trap, of which 12 had previously been marked at the downstream trap. Thirty-eight smolts were recorded through the LFL upstream trap, including one age II Ad-LV marked smolt.

Peak downstream movement of smolts at the UFL weir occurred during the week ending June 4 (Figure 1), with 346 smolts recorded on June 1, the peak day of migration. This date is 10-14 days earlier than that recorded during the previous three years. The migration out of UFL commenced on May 28 in streamflows so low that the fish easily became stranded, and on May 29, 54 dead smolts were counted in the upper one-third of the creek above the UFL weir. Although streamflows improved slightly through the week ending June 11, flows above the hatchery outfall (at the UFL weir) were minimal throughout the season.

The reason coho smolts did not migrate out of LFL has not been determined; however, inadequate

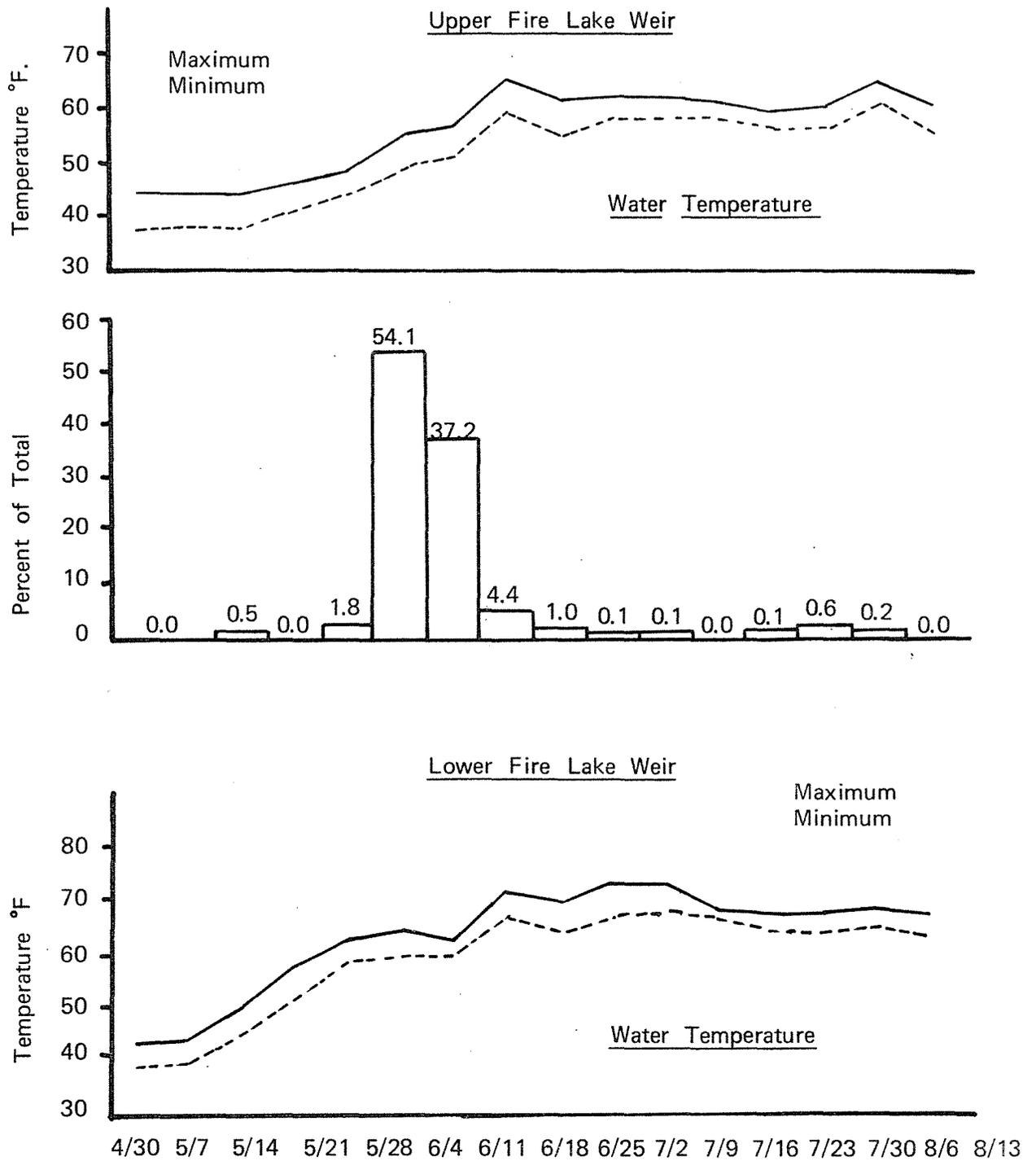


FIGURE 1 TIME OF COHO SMOLT MIGRATION FROM UPPER FIRE LAKE, AND MEAN WATER TEMPERATURES FOR UPPER AND LOWER FIRE LAKES BY WEEKLY PERIOD DURING 1969.

**TABLE 1** Number of Coho Salmon Trapped at the Upper and Lower Fire Lakes Weirs During 1969, by Weekly Periods, and by Parr and Smolt Designations.

Week Ending	Upper Fire Lake Weir				Lower Fire Lake Weir			
	Upstream		Downstream		Upstream		Downstream	
	Parr	Smolt	Parr	Smolt	Parr	Smolt	Parr	Smolt
4/30	0	0	0	0	0	0	1	0
5/7	0	0	0	0	0	0	1	1
5/14	0	0	0	8	0	0	0	1
5/21	0	0	0	0	10	0	0	0
5/28	0	0	0	32	56	5	0	0
6/4	0	2	1	951	31	1	1	0
6/11	3	9	1	654	16	0	0	1
6/18	6	5	0	77	78	4	1	1
6/25	9	1	0	18	32	1	0	0
7/2	0	1	0	2	20	0	1	3
7/9	1	1	0	2	11	0	0	1
7/16	2	2	0	0	22	1	0	0
7/23	1	2	1	1	8	0	0	0
7/30	14	4	0	10	179	5	0	1
8/6	10	0	0	3	307	6	43	6
8/13	3	0	0	0	141	1	17	1
8/20	1	0	1	0	83	0	1	1
8/27	5	0	0	0	35	4	0	5
9/3	2	0	1	0	33	6	16	0
9/10	0	0	0	0	32	1	18	4
9/17	0	0	0	0	18	3	3	0
9/24	0	0	0	0	10	0	5	1
10/1	0	0	1	0	2	0	2	0
10/8	1	0	0	0	5	0	3	0
10/15	0	0	2	0	1	0	21	12
10/22	0	0	2	0	0	0	9	3
10/29	0	0	10	0	0	0	8	2
11/5	0	0	7	0	0	0	1	0
11/12	0	0	4	5	0	0	0	0
Total	58	27	31	1,763	1,130	38	152	44
Dead or killed	0	0	4	74	52	2	3	12
Number Released	58	27	27	1,689	1,078	36	149	32

streamflow may have been a major factor. Streamflows recorded at the LFL outlet during the 1968 and 1969 seasons are compared in Figure 2. The outlet of LFL consists of three adjacent culverts which drain through a low earth-filled dam. The culverts draw water at the surface where the lake is approximately four-feet deep. The lake drain is abrupt, and with little slope or channel formation to aid fish in locating the outlet, the low flows experienced in May and June may have been insufficient to attract migrant fish to the outlet.

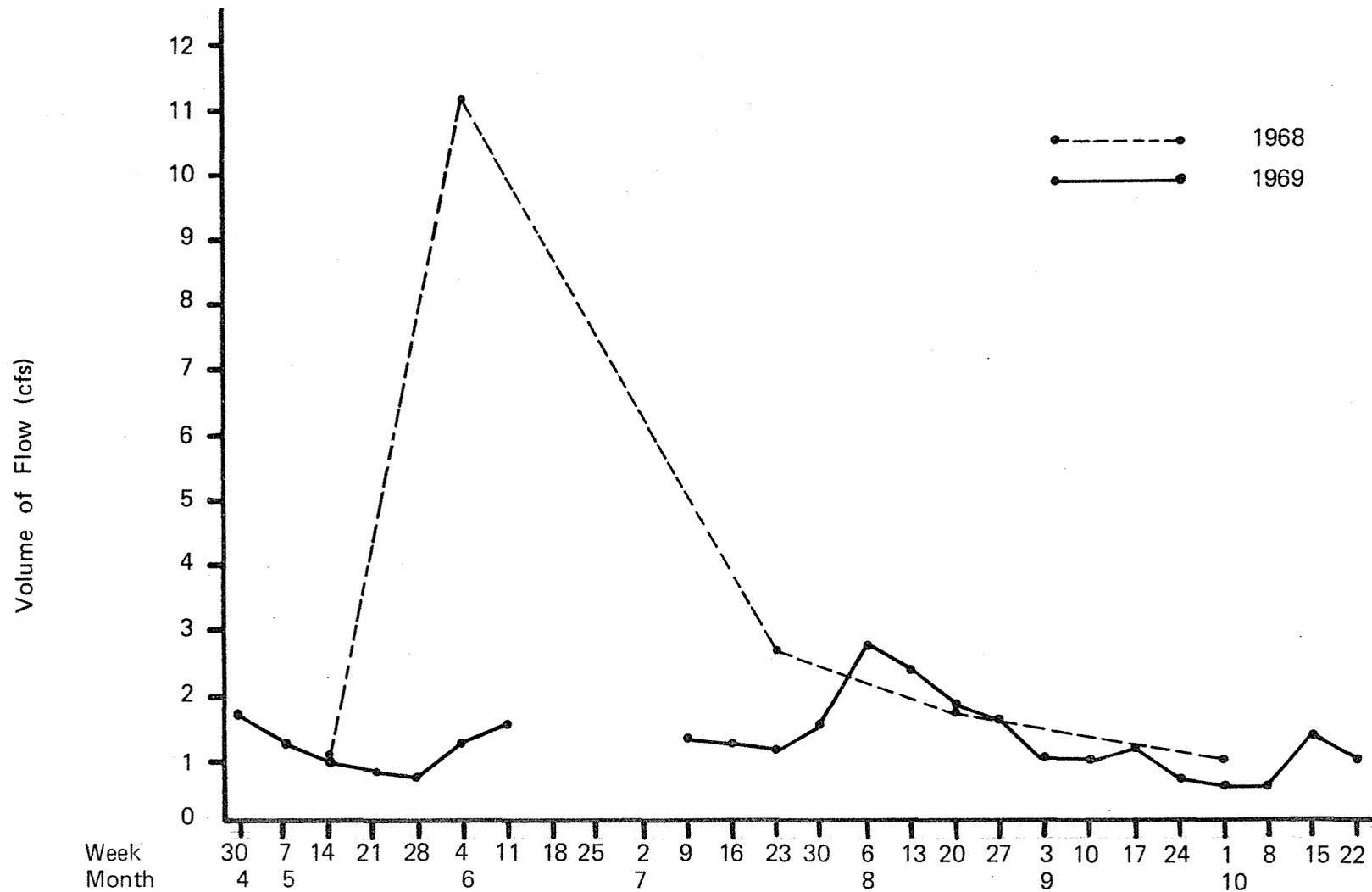


FIGURE 2 STREAMFLOW MEASURED AT THE OUTLET OF LOWER FIRE LAKE, 1968-69. DATA FROM DIRECT MEASUREMENTS OF 1968 FLOW PROVIDED BY US GEOLOGICAL SURVEY. FLOW DATA FROM 1969 DERIVED FROM STREAMFLOW-LAKE LEVEL CORRELATION.

The trash screen installed in 1964 (Jones and Sexsmith, 1965) may also have acted as a barrier. Since this screen did not prevent logs and debris from entering the culverts, the screen was removed at the end of the summer.

A rapid rise in water temperatures was noted in the two weeks immediately preceding the smolt migration. Mean weekly maximum and minimum temperatures for the LFL weir included in Figure 1 provide a record of temperature variation of the lake surface during smolt migration. Due to low streamflow, temperatures recorded at the UFL weir prior to the week ending June 11 were largely a reflection of the hatchery water supply from the 17-foot depth in UFL, and not of temperatures of the lake surface and stream above the weir. At the end of the season, use of the hatchery outfall at the UFL weir was permanently discontinued. Future temperatures at the UFL weir will reflect environmental conditions.

The size composition of smolts sampled at the UFL weir is presented in Figure 3. The mean length of smolts from UFL is larger than in previous years because the migration was dominated by age II and yearling hatchery fish. The length of marked age II smolts from UFL has increased in each of the last two years, with recorded mean lengths of 146 mm in 1967, 150 mm in 1968, and 154 mm in 1969. Yearling hatchery smolts were larger than age II migrants with a mean length of 160 mm. One RP marked age III smolt (206 mm fork length) was recorded at the UFL weir, and an unmarked age III smolt (225 mm) was verified by scale analysis. Scale analysis of unmarked fish indicated that nearly 60% were age I (Table 2).

**TABLE 2** Age Composition of Unmarked Coho Determined by Analysis of Scales Collected at Upper Fire Lake Downstream and Lower Fire Lake Upstream Traps During 1969.

<u>Source &amp; Sample Size</u>	<u>Age</u>	<u>No.</u>	<u>Fork Length (mm)</u>		<u>% of Total</u>
			<u>Range</u>	<u>Mean</u>	
UFL Downstream - 22 Smolt	I	13	108 - 140	121	59.1
	II	9	133 - 172	156	40.9
LFL Upstream - 45 Parr	0	11	67 - 88	80	24.4
	I	34	80 - 111	94	75.6

The small number of smolts recorded out of LFL moved almost entirely after the end of the normal migration period, with 50% recorded after August 3. The mean length of unmarked emigrants from LFL was 123 mm (N = 19).

#### Parr Movements:

Small numbers of parr were recorded at the UFL weir (Table 1). Ten of the 31 parr recorded downstream were from the August 31, Ad marked fingerling plant. The peak of the upstream movement occurred during the week ending July 30. No marked parr were recorded in the upstream trap.

Few parr moved out of LFL during June and July. The peak downstream movement occurred the first week of August when the first substantial streamflow of the season was recorded. A total of 152 parr were captured in the LFL downstream trap, and 72 were marked fish from the August plant. Five marked fish returned to the lake through the upstream trap.

The upstream movement of parr at LFL was the least recorded since 1963. The length composition of parr sampled from the upstream migration was separated into four periods (Figure 4).

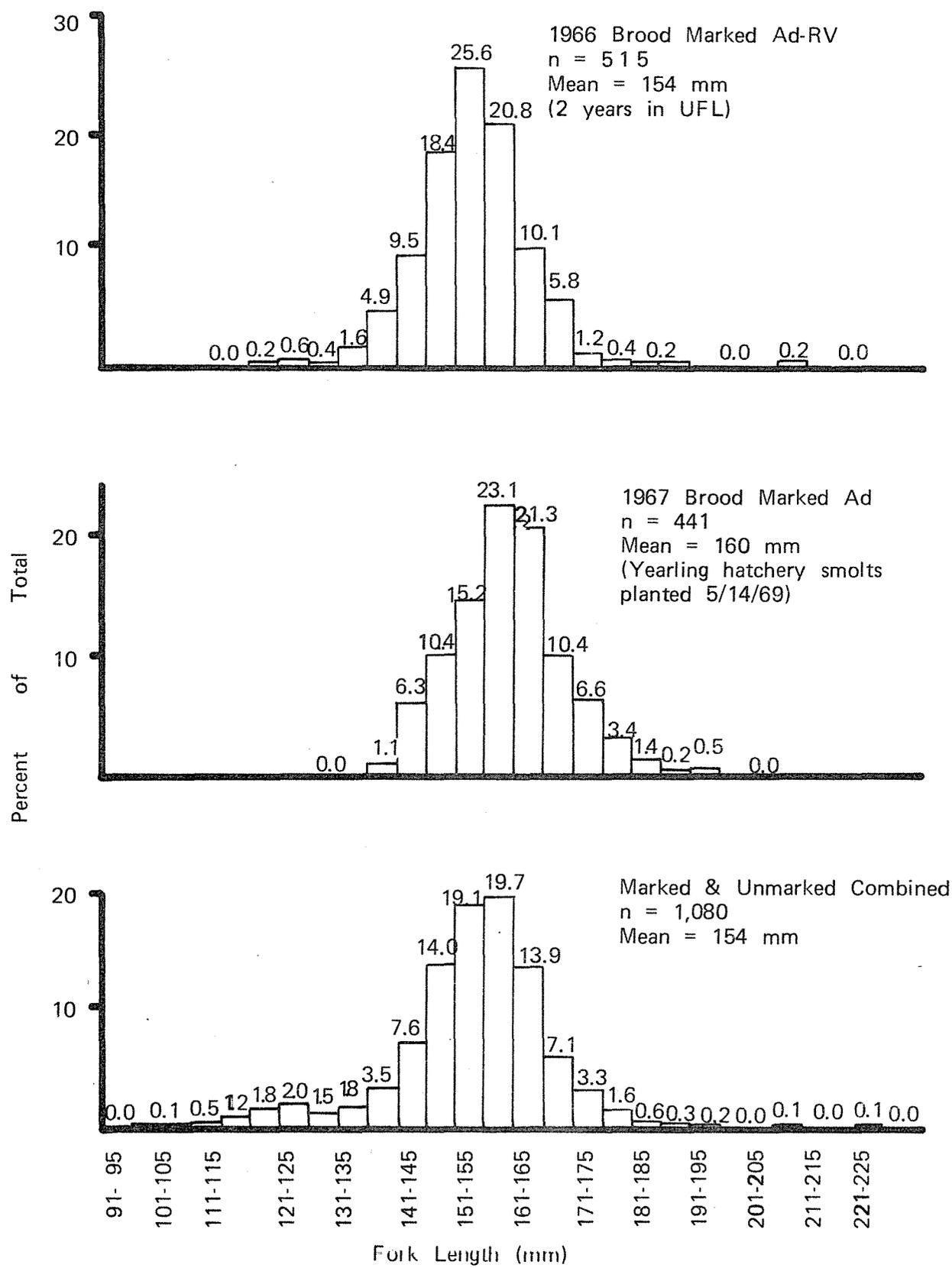


FIGURE 3 SIZE COMPOSITION OF COHO SMOLTS FROM UPPER FIRE LAKE, 1969.

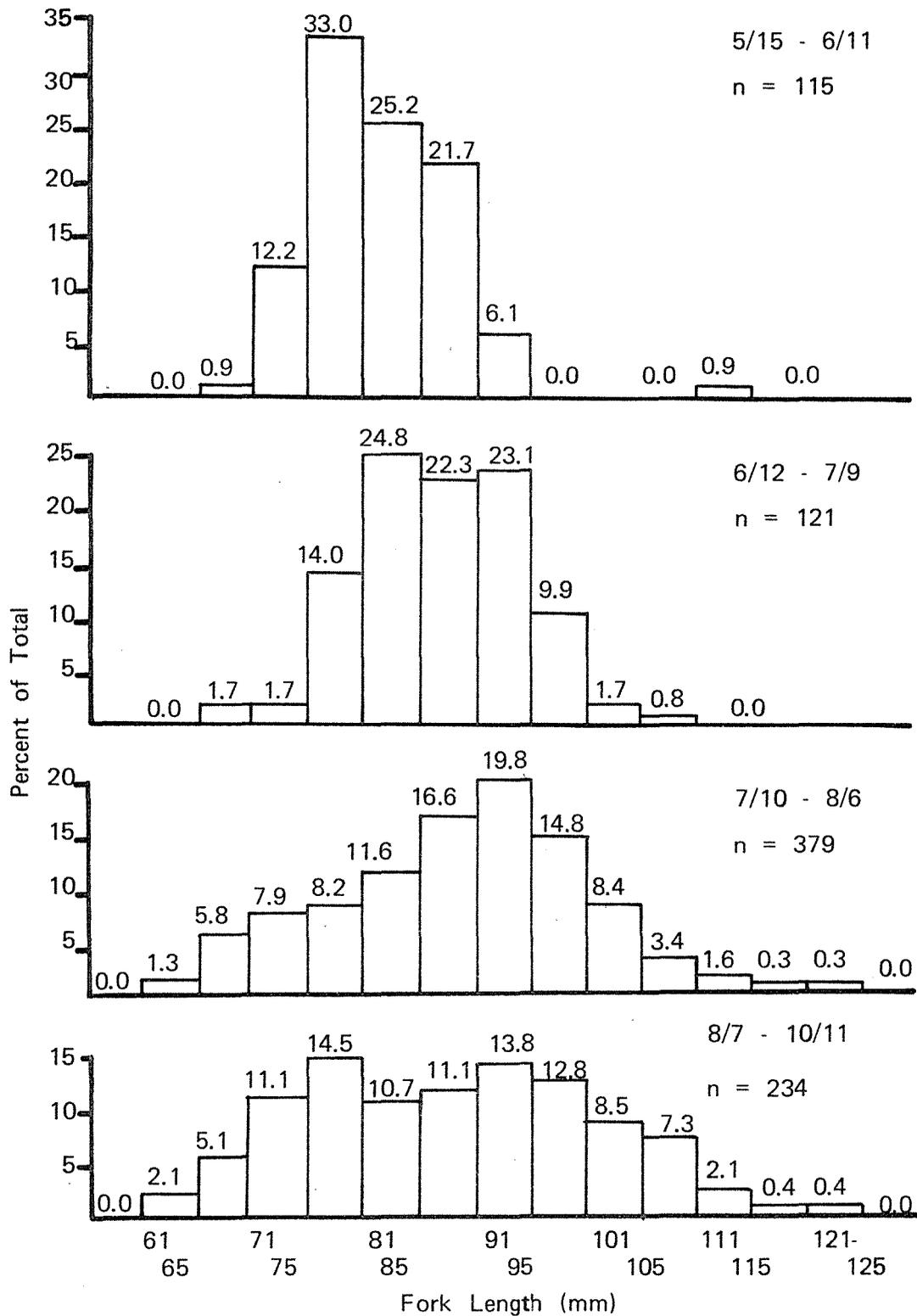


FIGURE 4 SIZE COMPOSITION OF COHO PARR AT LOWER FIRE LAKE UPSTREAM TRAP, BY FOUR PERIODS DURING 1969.

Age composition of parr recorded at the LFL weir upstream trap during 1969 was determined by scale analysis (Table 2). While the 1968 and 1969 upstream movements were similar, the following differences were noted:

1. The mean length of 1969 parr (88 mm) was 6.5 mm greater than the 1968 parr.
2. Age 0 parr arrived at the weir approximately two weeks later in 1969 than in 1968.
3. A smaller percentage of age 0 parr appears to have been involved in the total upstream movement in 1969.

The smaller number of parr which moved upstream, and low percentage of age 0 parr may have been a result of low streamflows during part of the 1969 season. Poor success of the 1968 spawn may also be a contributing factor.

#### Marked Coho:

Groups of fin-marked fish recovered at the Upper and Lower Fire lakes weirs during 1969 were confined largely to smolts and parr from the two plants made during the season, and to age II smolts migrating from UFL (Table 3). As indicated by footnote, a number of marks of uncertain origin or history were recorded. A summary of fin marks used in the Fire Lake system from 1967 to 1969 is presented in Table 4. Marks used prior to 1967 were tabulated by Wallis (1968). Planting and recovery data for groups of 1965, 1966, 1967, and 1968 brood coho marked and planted in Upper and Lower Fire lakes is presented in Table 5. Because of the unusual nature of the 1969 smolt migration, data collected from LFL must be considered incomplete until the end of the 1970 season.

Few age III coho have been recorded from UFL in the past. One age III, RP marked smolt from the 1965 brood Swanson River stock was recovered. The fish was very thin, weighing 66 grams and measuring 206 mm fork length.

None of the Ad-LV marked fish of the 1966 Big Creek, Oregon, stock actively migrated out of LFL as age II; one dead smolt was found in the trap in late July. Ad-RV marked fish from the 1966 Big Creek, Oregon, stock released into UFL produced the highest return of age II smolts of any group planted in UFL to date (15.2% of the total plant). One smolt from this group released below the UFL weir migrated out of LFL (0.1%).

Two lots of yearling hatchery smolts of 1967 brood Eagle Creek, Oregon, origin were marked and planted in Upper and Lower Fire lakes on May 14 (Table 5). None of the Ad-LM marked smolts migrated out of LFL. At UFL, the migration of 725 Ad marked fish (72.5% of the total plant) represents a good return of smolts planted 15 days prior to the onset of migration. However, only two smolts from this group (0.2%) were recovered at the LFL weir.

Two lots of 1968 brood coho of Bear Lake origin were released in the Fire Lake system in 1969. On August 21, 5,500 fingerlings were Ad marked and released in UFL. From August 22-24, 11,500 fingerlings were Ad-LV marked and planted in LFL. Both lots were released at a size of 208 fish per pound. Ten parr from the UFL plant arrived at the UFL weir in 1969, nearly all after the middle of October. A total of 72 Ad-LV marked parr from the LFL release were recaptured at the LFL weir where they received an additional mark (LM); seven subsequently returned to the lake through the upstream trap.

#### Length-Weight Data for Juvenile Coho:

Wallis (1967) provided data to establish length-weight relationships for coho measured at the Upper and

TABLE 3 Number of Marked Coho Salmon Captured in the Upper and Lower Fire Lakes Downstream Traps by Weekly Period During 1969.

Week Ending	Mark At capture: Added:	Upper Fire Lake Weir*			Lower Fire Lake Weir			
		AdRV LM	Ad RM**	Ad RM***	AdLV RM****	AdRM --	AdRVLM --	AdLV LM****
5/14		2	0	--	0	0	0	--
5/21		0	0	--	0	0	0	--
5/28		5	2	--	0	0	0	--
6/4		476	394	--	0	0	0	--
6/11		308	279	--	0	1	0	--
6/18		26	39	--	0	0	1	--
6/25		8	3	--	0	0	0	--
7/2		1	0	--	0	0	0	--
7/9		1	0	--	0	0	0	--
7/16		0	0	--	0	0	0	--
7/23		0	1	--	0	0	0	--
7/30		6	2	--	1	0	0	--
8/6		2	1	--	0	0	0	--
8/13		0	0	--	0	0	0	--
8/20		0	0	--	0	0	0	--
8/27		0	0	0	0	0	0	0
9/3		0	0	1	0	0	0	16
9/10		0	0	0	0	1	0	13
9/17		0	0	0	0	0	0	2
9/24		0	0	0	0	0	0	4
10/1		0	0	0	0	0	0	1
10/8		0	0	0	0	0	0	1
10/15		0	0	1	0	0	0	19
10/22		0	0	2	0	0	0	8
10/29		0	0	2	0	0	0	8
11/5		0	0	3	0	0	0	0
11/12		1	4	1	0	0	0	0
Total		836	725	10	1	2	1	72
Dead or killed		39	25	1	1	1	0	2
Number released		797	700	9	0	1	1	70

\*Other marks recorded: 3 Ad-LV, 24 Ad-RV-RM, 25 Ad-RV-LM, 5 Ad-BV, 6 Ad-RM, 1 RV, & 1 RP.

\*\*Ad-RM: From May, 1969 smolt plant marked Ad upon release in UFL. Ad-RM marked fish recorded at LFL were from this group only.

\*\*\*Ad-RM: From August, 1969 fingerling plant, marked Ad upon release in UFL.

\*\*\*\*Ad-LV-RM: From August, 1967 fingerling plant, marked Ad-LV upon release in LFL. Ad-LV-LM: From August, 1969 fingerling plant, marked Ad-LV upon release in LVL.

**TABLE 4** Summary of Fin Marks Used on Coho Salmon in the Fire Lake System, 1967-1969.

<u>Brood</u>	<u>Year</u>	<u>Fin Mark*</u>	<u>Remarks</u>
1966	1967	Ad-RV	5,500 fingerling @ 153/lb planted in UFL, 8/31/67.
	1967-68	Ad-RV-RM	160 parr (1967) and 388 age I smolts (1968) with RM removed at UFL weir.
	1969	Ad-RV-LM	797 age II smolts with LM removed at UFL weir.
1966	1967	Ad-LV	11,500 fingerling @ 156/lb planted in LFL, 8/30/67.
	1967-68	Ad-LV-LM	385 parr (1967) and 1,456 age I smolts (1968) with LM removed at LFL weir.
1967	1969	Ad	1,000 yearling hatchery smolts @ 12/lb planted in UFL, 5/14/69.
	1969	Ad-RM	700 smolts with RM removed at UFL weir.
1967	1969	Ad-LM	1,000 yearling hatchery smolts @ 12/lb planted in LFL, 5/14/69.
1968	1969	Ad	5,500 fingerling @ 208/lb planted in UFL, 8/21/69.
	1969	Ad-RM	9 parr with RM removed at UFL weir.
1968	1969	Ad-LV	11,500 fingerling @ 208/lb planted in LFL, 8/22-24/69.
	1969	Ad-LV-LM	70 parr with LM removed at LFL weir.

\*Abbreviations used to identify marked fish:

Ad - adipose	RP - right pectoral	D - dorsal
LP - left pectoral	RV - right ventral	RM - right maxillary
LV - left ventral	BV - both ventrals	LV - left ventral
		LM - left maxillary

Marks are listed in the following order, regardless of the order in which fish received them:

Adipose - Ventral (Pectoral) - Maxillary

TABLE 5 Planting and Recovery Data for 1965, 1966, 1967, and 1968 Brood Coho Salmon Planted in Upper and Lower Fire Lakes.

Brood	Planting Data					Recovery Data*					Total	
	Lake	No.	Date	Avg. Size		Weir	Age				No.	%
							0	I	II	III		
1965	UFL	2,000	8/66	233/lb	RP	UFL	2	367	90	1	460	23.0
						LFL**	0	15	45	0	60	3.0
						Total	2	382	135	1	520	26.0
1965	LFL	2,000	8/66	234/lb	LP	LFL	25	483	88	0	596	29.8
1966	UFL	5,500	8/67	153/lb	AdRV	UFL	160	389	836	-	1,385	25.2
						LFL**	0	48	0	-	48	0.9
						Total	160	437	836	-	1,433	26.1
1966	LFL	11,500	8/67	156/lb	AdLV	LFL	385	1,505	1	-	1,891	16.4
1967	UFL	1,000	5/69	12/lb	Ad	UFL	--	725	--	-	725	72.5
1967	LFL	1,000	5/69	12/lb	AdLM	LFL	--	0	--	-	0	0.0
1968	UFL	5,500	8/69	208/lb	Ad	UFL	10	--	--	-	10	0.2
1968	LFL	11,500	8/69	208/lb	AdLV	LFL	72	--	--	-	72	0.6

\*Numbers to the first weir of recapture; gill-net catches not included.

\*\*Fish recorded at the LFL weir which escaped capture at the UFL weir are added to the total for the UFL weir.

TABLE 6 Length-Weight Relationship of Coho Salmon Trapped at Upper Fire Lake Downstream and Lower Fire Lake Upstream Traps, 1969.

Fork Length (mm)	Upper Fire Lake						Lower Fire Lake		
	No. in Sample	Weight in Grams		No. in Sample	Weight in Grams		No. in Sample	Weight in Grams	
		Range	Mean		Range	Mean		Range	Mean
61- 65							--	---	---
66- 70							3	3.6- 4.0	3.8
71- 75							4	3.6- 5.9	4.6
76- 80							13	4.6- 6.2	5.2
81- 85							16	5.5- 7.3	6.3
86- 90							14	6.4- 9.1	7.8
91- 95							11	7.7-12.7	10.1
96-100							5	9.1-12.7	11.5
101-105							3	10.4-13.7	12.5
106-110							5	13.3-20.1	19.6
111-115		Age II Smolt					1	---	13.8
116-120		Marked Ad-RV			Yearling Hatchery		1	---	20.8
121-125					Smolt Marked Ad		1	---	22.4
126-130	--	---	---				--	---	---
131-135	1	---	28.8	--	---	---		<u>Unmarked Parr</u>	
136-140	2	24.4-28.2	26.3	1	---	28.4			
141-145	2	28.7-29.1	28.9	2	29.3-32.5	30.9			
146-150	14	29.8-35.5	32.8	1	---	34.3			
151-155	10	31.3-40.7	36.3	5	33.4-36.4	33.3			
156-160	11	30.7-49.4	39.0	10	34.5-42.8	39.3			
161-165	8	42.4-49.2	45.0	12	38.7-46.7	42.4			
166-170	3	43.3-57.8	49.6	3	38.9-52.6	45.3			
171-175	2	46.4-50.0	48.2	5	44.5-51.7	47.9			
176-180	--	---	---	2	50.8-56.4	53.6			
181-185	--	---	---	1	---	59.7			
186-190	1	---	67.8	--	---	---			
Total	54			42			77		

178

Lower Fire lakes weirs in 1966. The tabulations for UFL were from age I fish. Length-weight data from age II Ad-RV marked fish from UFL, and Ad marked yearling hatchery smolts are presented in Table 6. Length-weight data for emigrant parr at LFL are included.

Coho From Gill-Net Samples:

Following the smolt migration period, both lakes were sampled periodically with variable mesh gill nets. Nets were fished a total of 315 hours at LFL and 290 hours at UFL. The results of individual sets are presented in Tables 7 and 8. Coho represented nearly 75% of the total catch at LFL (Table 9). Data in

TABLE 7 Summary of Gill-Net Catches in Lower Fire Lake, 1969.

Sample Date	Species*	No. Caught	Fork Length (mm)		Catch/Net Hr.	% of Total
			Range	Mean		
6/19	SS	172	95-235	137	2.29	82.3
	RT	16	96-415	245	0.21	7.7
	KK	15	184-231	214	0.20	7.2
	DV	1	Unmeasured	--	0.01	0.5
	BF	4	111-208	164	0.05	1.9
	Cot	1	--	105	0.01	0.5
7/10	SS	88	88-390	144	1.83	87.1
	RT	6	194-546	323	0.12	5.9
	KK	6	207-245	223	0.12	5.9
	BF	1	--	169	0.02	1.0
8/6	SS	65	100-203	166	1.35	74.7
	RT	19	183-427	280	0.40	21.8
	KK	3	225-235	231	0.06	3.4
8/27	SS	35	106-218	182	0.73	68.6
	RT	8	218-430	309	0.16	15.7
	KK	6	211-233	222	0.12	11.8
	BF	2	190-227	208	0.04	3.9
9/10	SS	37	104-229	182	0.77	68.5
	RT	8	178-363	259	0.16	14.8
	KK	6	215-238	226	0.12	11.1
	BF	3	224-237	229	0.06	5.6
10/8	SS	58	105-261	177	1.21	54.2
	RT	1	--	385	0.02	0.9
	KK	17	204-230	223	0.35	15.9
	DV	2	219-249	234	0.04	1.9
	BF	29	156-234	188	0.60	27.1

\* SS - Silver (coho) salmon  
 RT - Rainbow trout  
 KK - Kokanee

DV - Dolly Varden  
 BF - Arctic blackfish  
 Cot - Cottids

TABLE 8 Summary of Gill-Net Catches in Upper Fire Lake, 1969.

Sample Date			Fork Length (mm)		Catch/ Net Hr.	% of Total
			Range	Mean		
6/19	RT	8	149-438	216	0.16	50.0
	KK	6	222-253	241	0.12	37.5
	DV	2	196-380	286	0.04	12.5
7/11	SS	6	158-175	167	0.12	20.0
	RT	13	104-260	178	0.27	43.3
	KK	8	208-242	227	0.17	26.7
	DV	3	219-282	247	0.06	10.0
8/7	SS	1	---	180	0.02	9.1
	RT	6	194-333	247	0.12	54.5
	KK	4	165-286	246	0.08	36.4
8/28	SS	1	---	215	0.02	2.9
	RT	16	169-322	214	0.33	47.1
	KK	17	222-294	262	0.35	50.0
9/11	SS	1	---	213	0.02	6.2
	RT	7	208-415	274	0.15	43.8
	KK	8	246-270	260	0.17	50.0
10/9	SS	6	95-158	114	0.12	37.5
	KS	1	---	381	0.02	6.2
	RT	5	261-338	295	0.10	31.2
	KK	4	107-238	174	0.08	25.0

TABLE 9 Species Composition of the Gill-Net Surveys of Upper and Lower Fire Lakes, 1969.

	SS		RT	KK	DV		Cot	Catch/Net Hr.
Upper Fire Lake								
Number	15	1	55	47	5	---	--	--
% of total	12.2	0.8	44.7	38.2	4.4	---	--	0.42
Lower Fire Lake								
Number	455	--	58	53	3	39	1	
% of total	47.7	--	9.6	8.7	0.5	6.4	0.2	1.93

TABLE 10 Ratio of Marked to Unmarked Coho Salmon and Summary of Marks Recovered from Lower Fire Lake Gill Nets, 1969.

Date	Net-Set Totals		Originating in UFL					Originating in LFL			
	Marked	Unmarked	Ratio	AdRVRM	AdRVLM	AdRV	AdRM	AdLM	AdLV	AdLVLM	Ad*
6/19	33	139	0.24:1	2	1	2	3	14	10	-	1
7/10	15	72	0.21:1	-	2	-	1	8	4	-	-
8/6	21	44	0.48:1	2	1	-	2	7	8	1	-
8/27	7	28	0.25:1	-	-	-	-	4	2	-	1
9/10	7	30	0.23:1	-	-	1	-	3	2	-	1
10/8	11	47	0.23:1	-	-	-	1	9	-	-	1
Season total	94	360	0.26:1	4	4	3	7	45	26	1	4

\*Determined by scale analysis to belong to yearling hatchery smolt group (Ad-RM & Ad-LM), lake of origin unknown.

Table 7 indicates that percentage of coho in the catch declined during the season. The ratio of marked to unmarked fish was relatively stable throughout the sampling period (Table 10). The decline is reflected by marked and unmarked fish alike. Smolts originating in UFL represented 19.1% of the season total of marked fish caught in LFL, but only two of these fish were taken after August 6. The failure of UFL migrants to appear in the gill nets is consistent with observations made in 1967 and 1968, i.e., only small percentages of smolts released below the UFL weir were recovered at the LFL weir. The fact that yearling hatchery smolts from UFL (Ad-RM) failed to appear in numbers commensurate with their counterparts at LFL (Ad-LM) further supports the hypothesis advanced by Wallis and Estabrook (1969) that a high mortality occurs among smolts passed through the UFL weir. The reason for this is not known; however, excessive mortality may result from handling and fin-marking at the weir. Mechanical injury received in negotiating the stream may also play a part in high mortality rates.

Dominance of the LFL coho population by age II fish was confirmed by scale analysis (Table 11). These findings are consistent with observations made in 1968 when age II coho were observed dominating the smolt migration.

**TABLE 11** Age Composition of Unmarked Coho Salmon Determined by Analysis of Scales Collected During the 1969 Lower Fire Lake Gill-Net Survey.

<u>Sample Size</u>	<u>Age</u>	<u>No.</u>	<u>Fork Length (mm)</u>		<u>% of Total</u>
			<u>Range</u>	<u>Mean</u>	
6 Parr	I	6	98-131	108	100.0
60 Smolt	I	21	104-182	133	35.0
	II	37	142-261	190	61.7
	III	2	226-256	241	3.3

The size composition of coho taken from LFL gill nets was separated into two periods as indicated in Figure 5. A differential growth rate was observed among unmarked age II coho in the second half of the sampling period. The more rapid growth of some fish in the sample is not known, but examination of 35 stomachs indicated a change in feeding habits may be responsible.

Out of those fish caught in UFL gill nets, 4 of the 15 coho were 1966 brood Ad-RV marked fish (Table 8), indicating that some "landlocking" occurred. Six yearling hatchery smolts marked Ad were captured; some of these fish may migrate at age II. The remaining five coho taken in the October 9 set were Ad marked parr from the August plant. They ranged from 95-102 mm fork length with a mean of 99 mm.

#### Kokanee

Four adult kokanee salmon were recorded at the UFL weir. Two females, 234 and 230 mm, were captured in the upstream trap on August 2 and August 21, respectively. Neither fish had begun to show spawning color. Two spent males measuring 286 and 278 mm were recorded in the downstream trap on October 10.

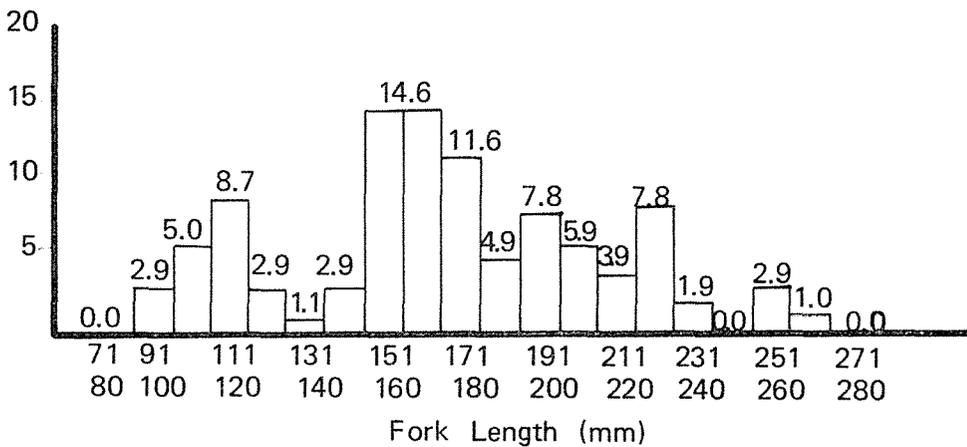
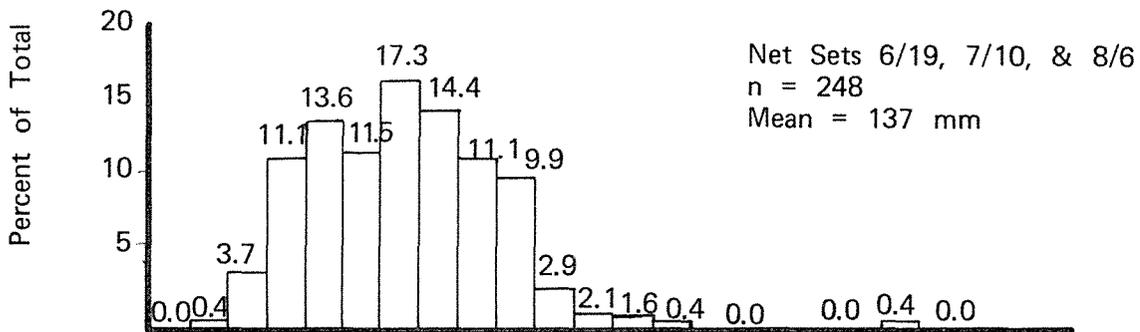
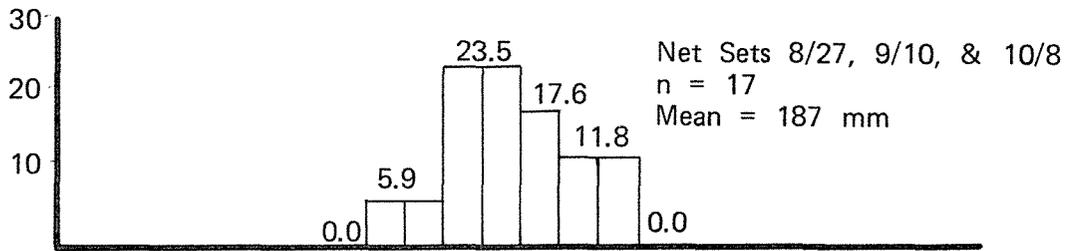
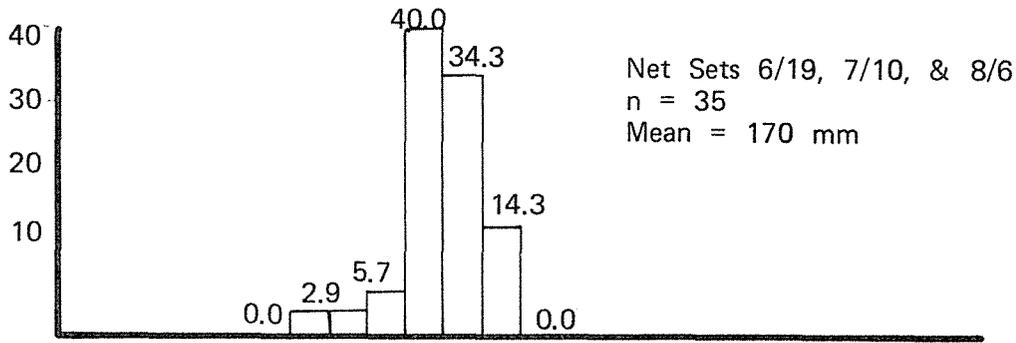


FIGURE 5 SIZE COMPOSITION OF NON-MIGRANT COHO FROM THE LOWER FIRE LAKE GILL-NET TEST FISHING SERIES BY TWO TIME PERIODS DURING 1969.

The population surveys of Upper and Lower Fire lakes disclosed the presence of populations of kokanee in both lakes. Of 53 kokanee taken at LFL, 8 Ad marked fish from 48 smolts marked at the UFL weir in 1967 were recovered. Scale analysis indicated the LFL population sample is dominated age age III fish. Examination of 22 scales disclosed 2 age II, 19 age III (including 1 marked Ad), and 1 age IV kokanee. Although some sexual development was noted, only one ripe fish, a 232 mm male from the September 10 set, was taken. Kokanee from the net sample ranged in length from 184 to 245 mm with an average fork length of 221 mm. Examination disclosed 12 males and 40 females with 1 juvenile (184 mm) not examined (Table 12).

The UFL population sample of 47 kokanee was also dominated by age III fish. Examination of 23 scales disclosed 1 age I, 4 age II, 16 age III, and 2 age IV kokanee. Advanced sexual development was noted among males taken as early as August 7; five of eight males and three of six females were ripe or nearly so and in full spawning color on August 28. All males and females (eight fish) were dimorphic and ripe on September 11. Apparently, most UFL kokanee spawn at age III. In the first week of October, carcasses were noted at both the inlet and outlet of the lake. Kokanee from the net sample ranged in length from 107 to 294 mm with a mean length of 244 mm. The age I juvenile was one of two taken in the October 9 set with five coho from the 1969 fall release. In contrast to that observed for LFL, the sex ratio for UFL kokanee was found to be very nearly 1:1 (Table 12).

**TABLE 12** Comparison of Sex Ratios of Kokanee Salmon and Rainbow Trout Taken in Gill Nets in Upper and Lower Fire Lakes, 1969.

<u>Lake</u>	<u>Kokanee</u>			<u>Rainbow</u>		
	<u>Male</u>	<u>Female</u>	<u>Ratio</u>	<u>Male</u>	<u>Female</u>	<u>Ratio</u>
Upper Fire Lake	23	21	1.09:1	19	19	1.00:1
Lower Fire Lake	12	40	0.30:1	15	38	0.39:1

### Rainbow Trout

A total of 216 rainbow trout were captured at Upper and Lower Fire lakes weirs in 1969 (Table 13). The same conditions which suppressed coho salmon movements at LFL influenced the movements of rainbow trout as well, and were apparently more restrictive to rainbow than to other salmonids. Only 17 juveniles and no adult rainbow trout were recorded at the LFL weir.

In spite of low streamflows, numbers of rainbow trout recorded at the UFL weir were greater than those recorded in 1967 and 1968. Three males and six females were recorded through the upstream trap (range, 191 - 306 mm; mean, 238 mm). Sixteen males and 22 females were recorded through the downstream trap (range, 188 - 324 mm, mean, 254 mm). Peak numbers of juveniles were recorded the first week of August at the upstream trap and in the downstream trap in the last week of October.

An Ad-LV marked female, estimated to weigh 2.3 kg was taken by an angler near the outlet of LFL on May 4. Since the mark was administered at the LFL weir upstream trap in 1963 (Gretz, 1964), the fish was at least six years old.

The rainbow trout sample from gill-net catches (58 fish from LFL and 55 from UFL) disclosed a disproportionate sex ratio similar to that obtained for kokanee (Table 12). A 1:1 ratio was found for UFL fish but females outnumbered males by nearly three to one at LFL. A small number of adult rainbow trout

exhibiting advanced stages of sexual development were taken in the September and October net sets. One female at LFL and two females at UFL had full egg skeins on October 8 and 9. One male at UFL was ripe on October 9. The presence of maturing fish in the fall is not surprising, since a source of many rainbow trout in the system is from hatchery escapees, and recent hatchery broods have all been from fall-spawned stocks. LFL fish ranged in length from 96 to 546 mm with a mean length of 278 mm. The length of fish from UFL ranged from 104 to 438 mm with a mean length of 224 mm.

**TABLE 13** Number of Rainbow Trout and Dolly Varden Char Captured at Upper and Lower Fire Lakes Weirs by Weekly Periods During 1969.

Week Ending	Upper Fire Lake Weir				Lower Fire Lake Weir			
	Upstream		Downstream		Upstream		Downstream	
	RT	DV	RT	DV	RT	DV	RT	DV
4/30	0	0	0	0	0	0	0	3
5/7	0	0	0	0	0	0	0	0
5/14	0	0	3	0	0	0	0	1
5/21	0	0	3	0	2	5	0	0
5/28	0	0	4	0	2	11	0	0
6/4	5	0	14	0	2	6	0	0
6/11	2	2	3	0	2	7	0	0
6/18	4	3	3	0	2	13	0	1
6/25	2	7	4	0	0	3	0	0
7/2	0	0	0	1	0	0	0	1
7/9	4	0	3	0	0	0	0	0
7/16	4	2	2	0	0	0	0	0
7/23	4	1	0	0	0	0	0	0
7/30	10	0	2	1	0	13	0	6
8/6	17	4	5	3	0	5	0	7
8/13	1	1	1	1	0	11	0	1
8/20	7	1	8	0	0	4	1	0
8/27	2	2	1	0	1	1	0	0
9/3	9	1	1	0	0	0	0	0
9/10	3	2	1	1	0	2	0	0
9/17	2	1	1	0	0	1	0	0
9/24	10	0	0	1	0	0	1	0
10/1	0	0	0	1	0	0	0	0
10/8	4	1	1	0	0	1	0	0
10/15	0	1	0	2	0	2	2	0
10/22	0	0	0	1	1	0	0	0
10/29	0	0	13	1	0	0	1	0
11/5	0	0	19	1	0	0	0	0
11/12	0	0	17	0	0	0	0	0
Total	90	29	109	14	12	85	5	20
Dead or killed	0	0	35	3	0	0	1	1
Number released	90	29	74	11	12	85	4	19

In an effort to determine the importance of rainbow trout predation on fingerling coho, a total of 65 stomachs from fish caught in both lakes was examined with emphasis on fish taken after the August coho fingerling releases. One case of salmonid predation was noted; the stomach of a 546 mm male weighing 2.3 kg from LFL contained one coho smolt (185 mm fork length) and numerous parts of other salmonids.

#### Dolly Varden Char

A total of 148 Dolly Varden were captured in all traps during 1969 (Table 13). A small downstream movement was recorded at the LFL weir during the last week of July and the first week of August. Three males and five females, recorded during this time, ranged from 186 to 274 mm fork length with a mean of 234 mm. Eighty-five juvenile Dolly Varden moved upstream during June and August. The length of these fish ranged from 84 to 148 mm with a mean of 114 mm.

Six male and four female Dolly Varden were recorded in the UFL upstream trap after August 1 (range 191 to 286 mm; mean 235 mm). Six males and three females were recorded in the downstream trap. Recognition of several fish with distinctive scars indicated that some upstream migrants returned downstream.

A total of eight Dolly Varden were taken in gill nets, and only three of these were from LFL. Past migration data indicates Dolly Varden are more abundant in the lakes than gill-net sampling indicates. Apparently, because of their size and habits, the species is not vulnerable to gill-net sampling in the Fire Lake system.

#### Miscellaneous Species

One king salmon was recovered from an UFL test net on October 9. The fish, bearing a dorsal mark from the 1966 UFL plant, measured 381 mm and weighed 795 grams. A local angler reported catching a marked king salmon of similar size.

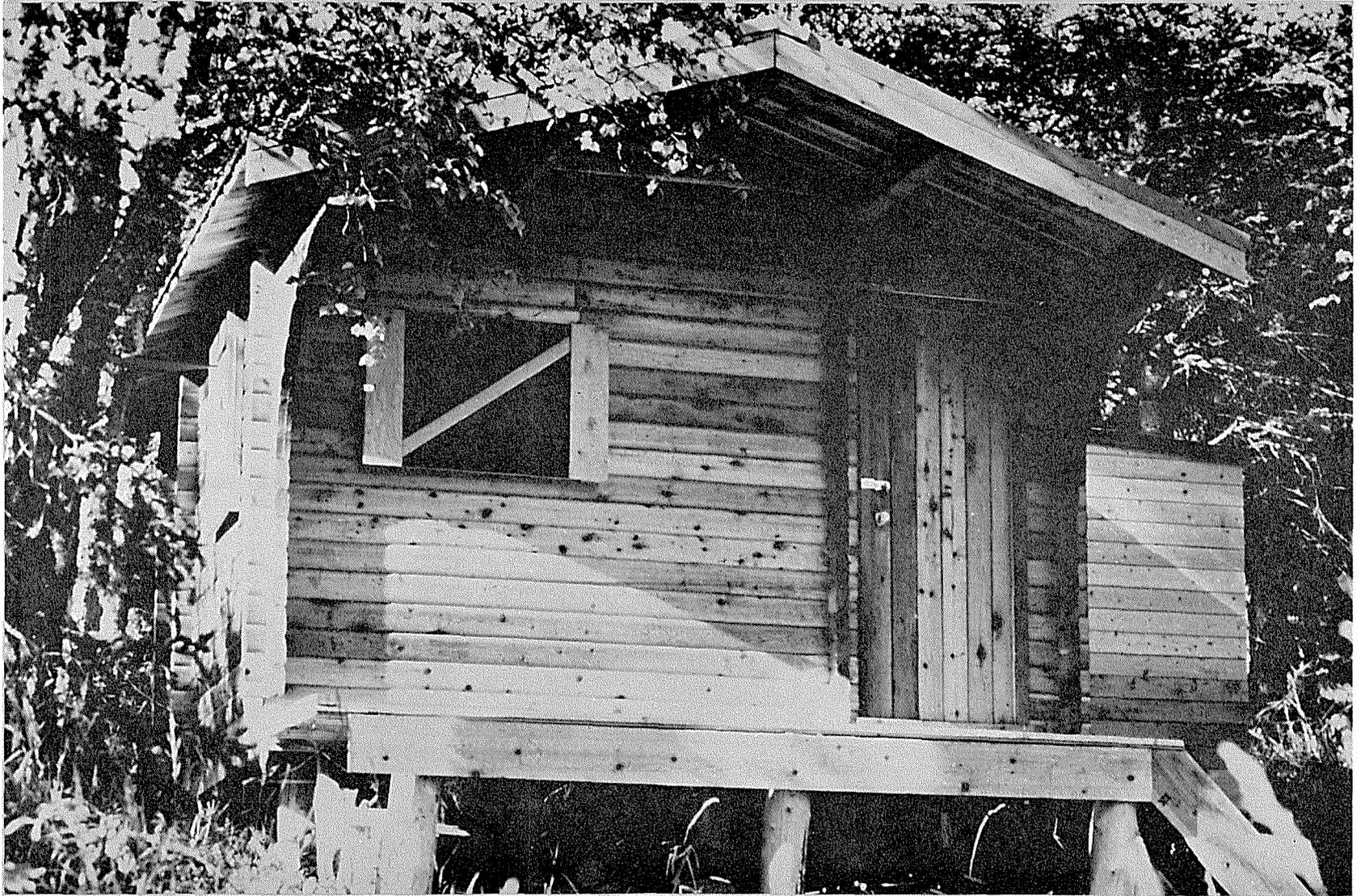
A total of 266 Arctic blackfish were recorded at the LFL weir downstream trap during 1969. More than half were recorded between mid-April and mid-May. An additional 39 adults were taken in gill nets in LFL. During the past two seasons, the blackfish population appears to have increased dramatically. The impact large numbers of this species may have on the salmonid population of LFL is not known.

Slimy sculpin, Cottus cognatus, are abundant in some areas of the creek between Upper and Lower Fire lakes. One adult sculpin, 105 mm in length, was taken in a gill net in LFL on June 19.

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THE RUSSIAN RIVER FIELD RESEARCH STATION, LOCATED ON LOWER RUSSIAN RIVER, KENAI PENINSULA, IS USED BY FISHERY BIOLOGISTS AND AIDS IN COLLECTING INFORMATION ON RED SALMON IN THE SYSTEM.