

Informational Leaflet 99

FRAZER LAKE SOCKEYE INVESTIGATIONS, 1966

By:

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March 31, 1967

STATE OF ALASKA

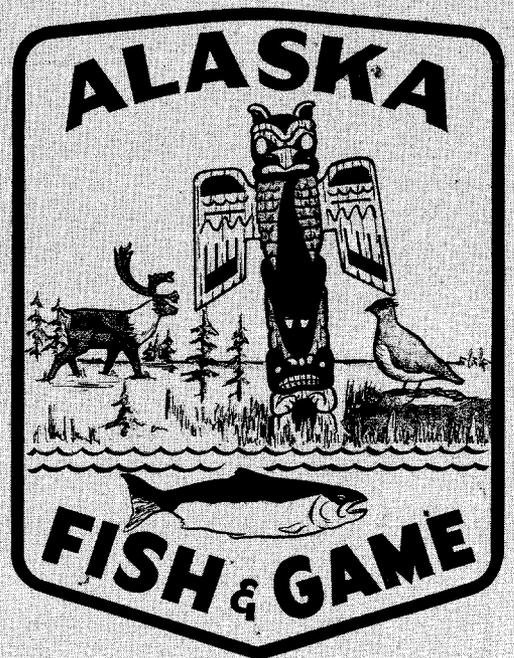
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CORRECTIONS FOR INFORMATIONAL LEAFLET NO. 99

Page 1, paragraph 4, line 2; should read 87,000 fry rather than 8,700 fry.

Page 17, Table 1; should read JUNE-JULY rather than JULY-AUGUST and should read JULY-AUGUST rather than AUGUST-SEPTEMBER.

Page 30, paragraph 3, line 2; should read 57.1 percent rather than 70.5 percent.

Page 38, paragraph 1, line 5; should read - However, on rather than - However, by.

Page 44, paragraph 4, last line; should read survival . - delete "of mortality".

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FRAZER LAKE SOCKEYE INVESTIGATIONS, 1966

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INTRODUCTION

Frazer Lake, second largest lake on Kodiak Island, is located at latitude $51^{\circ} 15'$ north and longitude $154^{\circ} 10'$ west (Figure 1). The lake is approximately eight miles long and one mile wide and the depth varies from 17 meters to over 51 meters. The lake has ten streams suitable for the spawning of sockeye salmon, Oncorhynchus nerka. Four of the ten streams are used extensively (Figure 2). The outlet stream is called Frazer River until it reaches a fork about 3 miles downstream where it enters Dog Salmon Creek which in turn empties into Olga Bay. A 30 foot falls approximately 1/2 mile below the lake outlet blocked salmon passage into the lake until 1962, when fish passage facilities were installed (Figure 3).

In 1951, sockeye salmon eggs were planted in one of the Frazer Lake tributaries in an effort to establish a sockeye salmon run and were continued each year from 1951 until 1956. In 1956, the first progeny, approximately 500 adults, from these plants returned to the base of Frazer falls. A weir was built below the falls to capture the returning spawners, but due to flooding only six were captured and carried over the falls.

In a 10 year period the escapement into the Frazer Lake has increased from six to 11,728 adults (Figure 4).

From 1956 until 1960, no attempt was made to supplement the returning spawners with additional egg plants. In 1961, however, 8,700 fry were transported from the Kitoi Research Station hatchery and planted in Frazer Lake (see Figure 1). Adult spawner transplants were also initiated in 1961 and have continued until the present. The planting of eggs and fry

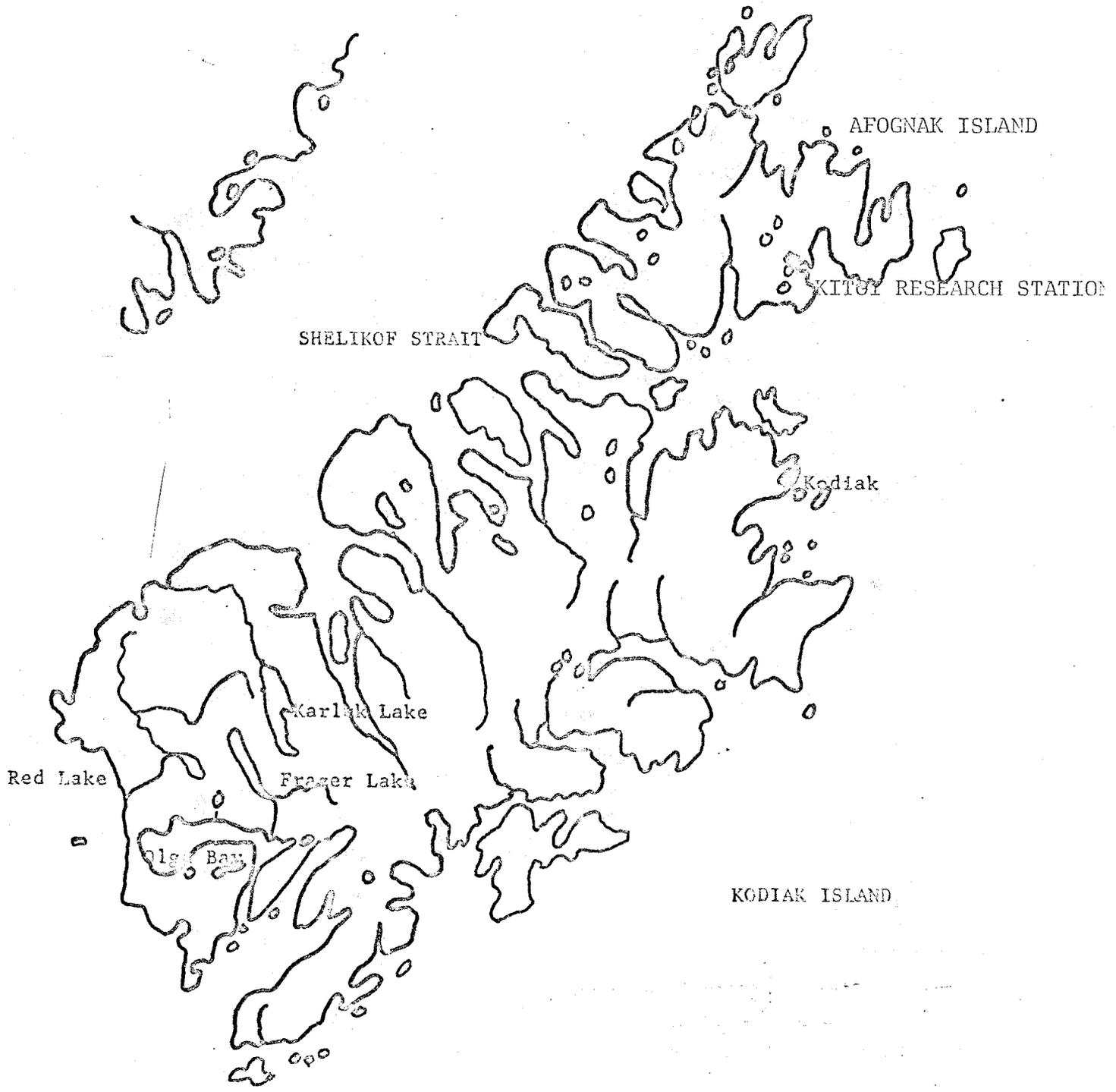
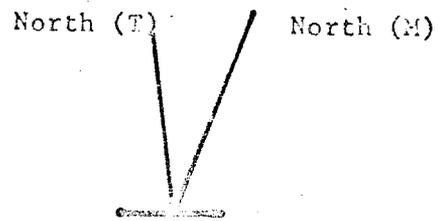


Figure 1. Kodiak Island area showing location of Frazer, Karluk and Red Lakes and the Kitoi Research Station.



Scale: 1 inch=18 miles

FIGURE 2.
MAP showing Frazer Lake
and main spawning streams

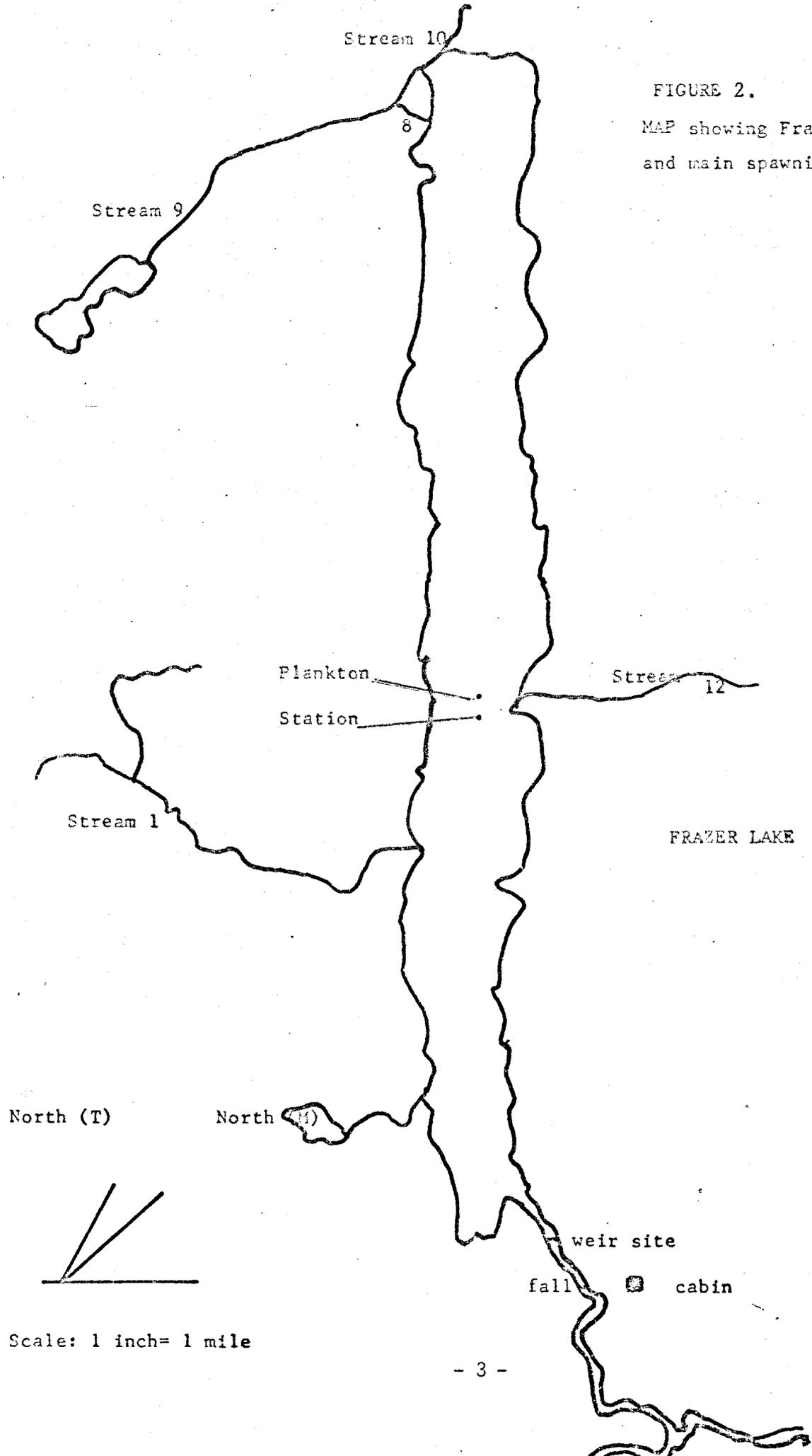
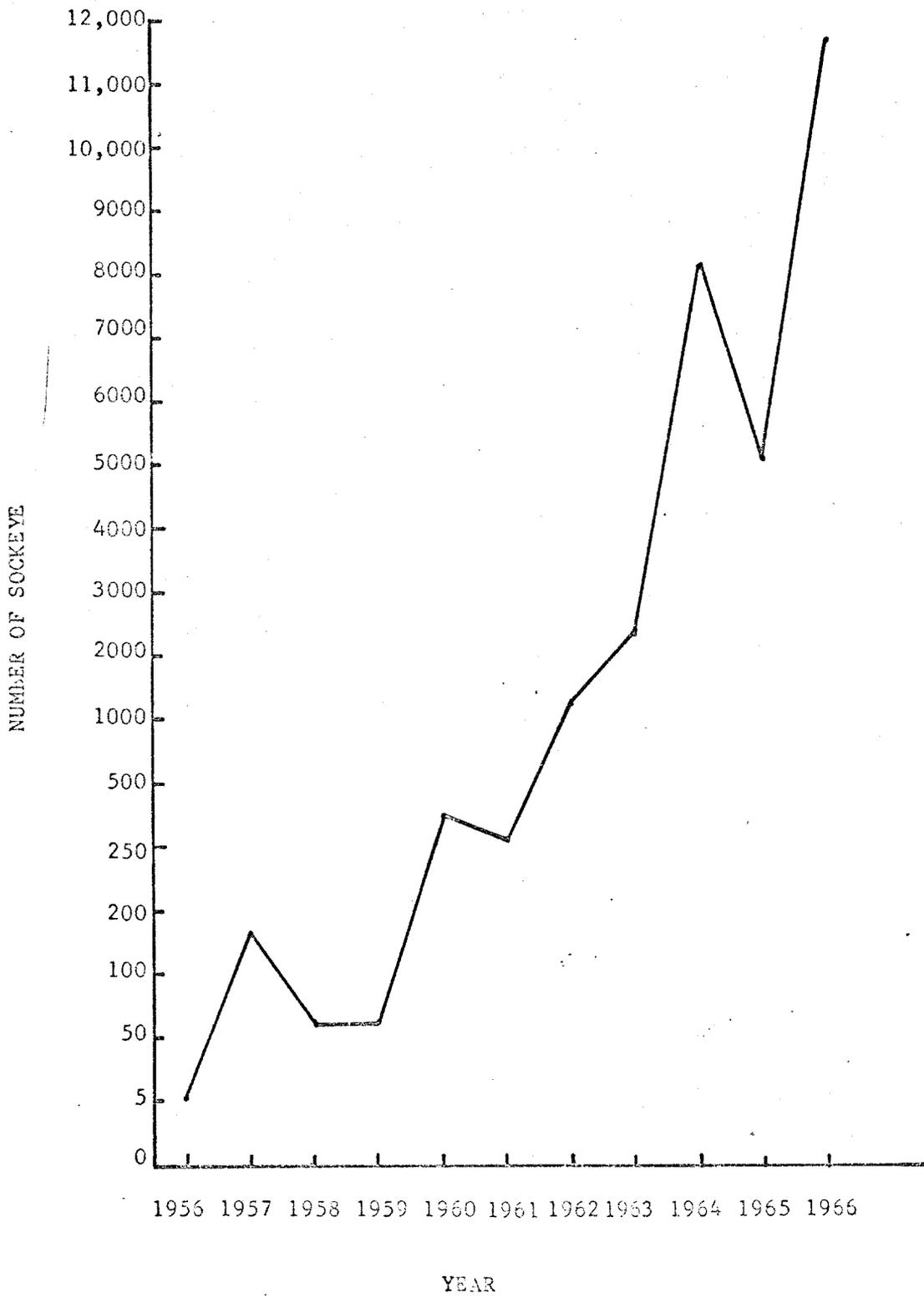




Figure 3. Frazer Lake fish pass facilities completed in 1962.

FIGURE 4. FRAZER LAKE ESCAPEMENTS, 1956 - 1966



was started again in 1965 (Figures 5 and 6).

In 1964, extensive spawning ground surveys were made on all inlet streams. The numbers of salmon were enumerated, composition of gravel and areas where spawning occurred were recorded. The major stream (No. 10) of the ten potential spawning streams is approximately 10 miles in length (Figure 2). The lake shores were also surveyed and types of shoreline noted on a topographical map of Frazer Lake (ADF&G Informational Leaflet #72).

The establishment of a research program in 1965 to investigate the introduced sockeye was initiated by the building of a smolt weir at Frazer Lake (Figure 7). In conjunction with the smolt work, adult returns and lake sampling procedures were initiated. Facilities for adult sampling were constructed at the fish pass. The weir and adult sampling facilities were removed in the fall of 1965 and re-installed in the spring of 1966.

The 1965 smolt and adult sampling procedures, data and results are presented in the Department of Fish and Game Informational Leaflets, No's. 77 and 78. The following report will use some of the 1965 data, but will largely deal with data collected in 1966.

The fields of investigation discussed will include juvenile sockeye studies, adult studies and spawning ground studies.

PURPOSE

The main objective of the 1966 studies was the continuation of the sampling procedures initiated in 1965, with minor modifications, that would provide information concerning: (1) the basic productivity of Frazer Lake, (2) juvenile and adult sockeye survival, and (3) the effects of sockeye introduction on a large lake system previously devoid of salmon.

SAMPLING FACILITIES

Prior to 1965, facilities for smolt sampling were non-existent except for the occasional use of gill and fyke nets. In 1965, upon completion of a temporary smolt weir, the first planned smolt program was activated. The

FIGURE 5. ADULT TRANSPLANTS FROM RED LAKE TO FRAZER LAKE, 1961 - 1966.

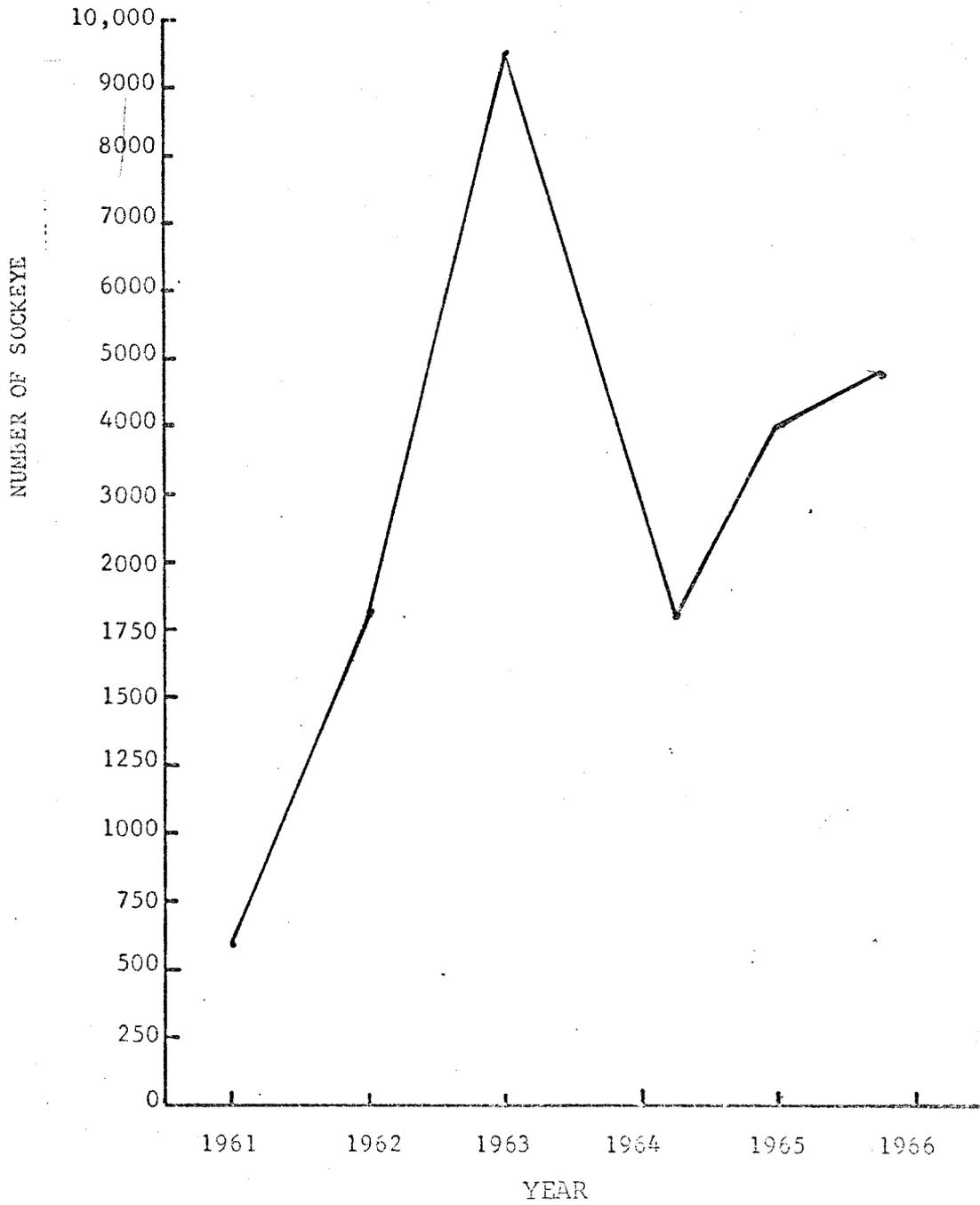
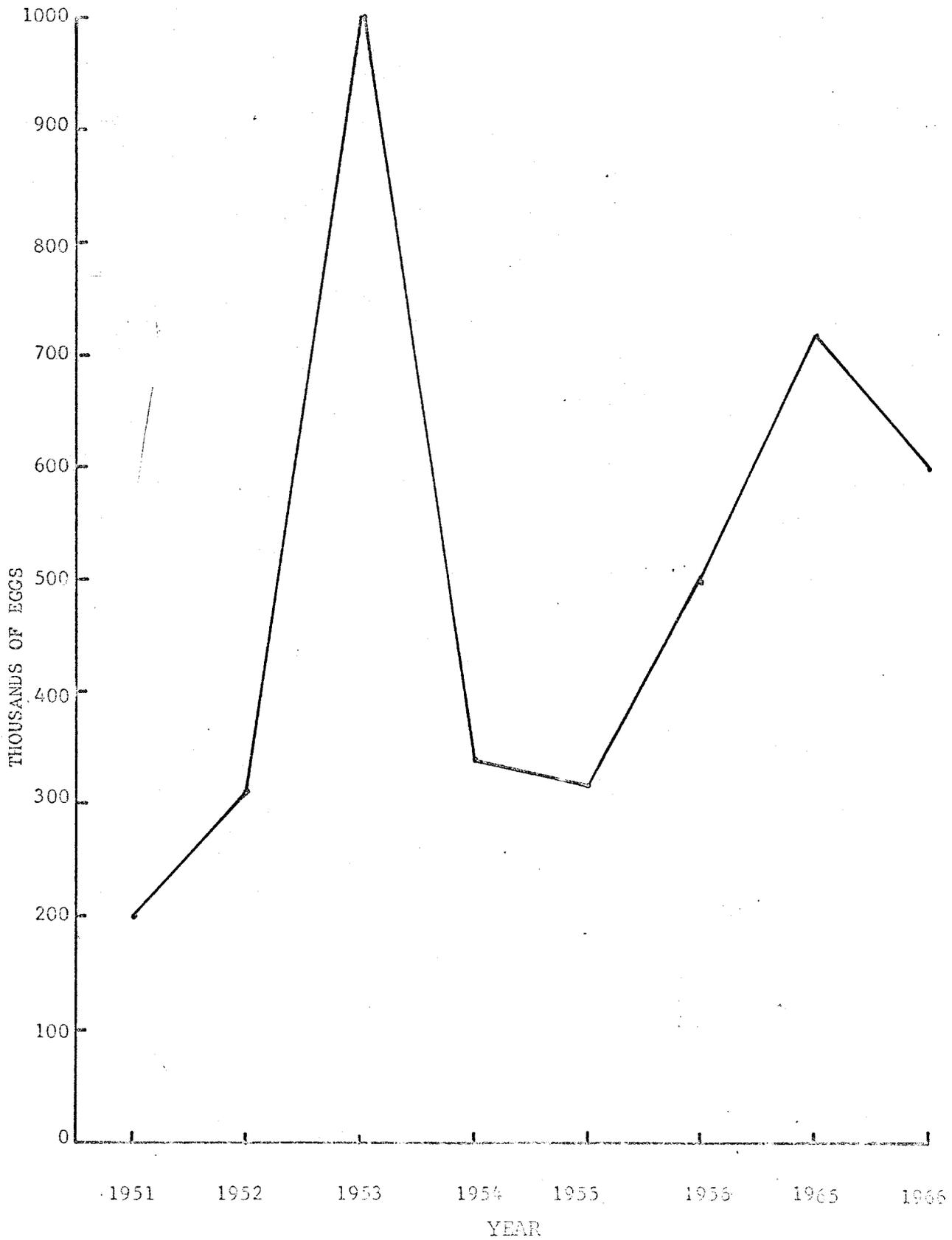


FIGURE 6. EGG PLANTS, FRAZER LAKE, 1951 - 1966



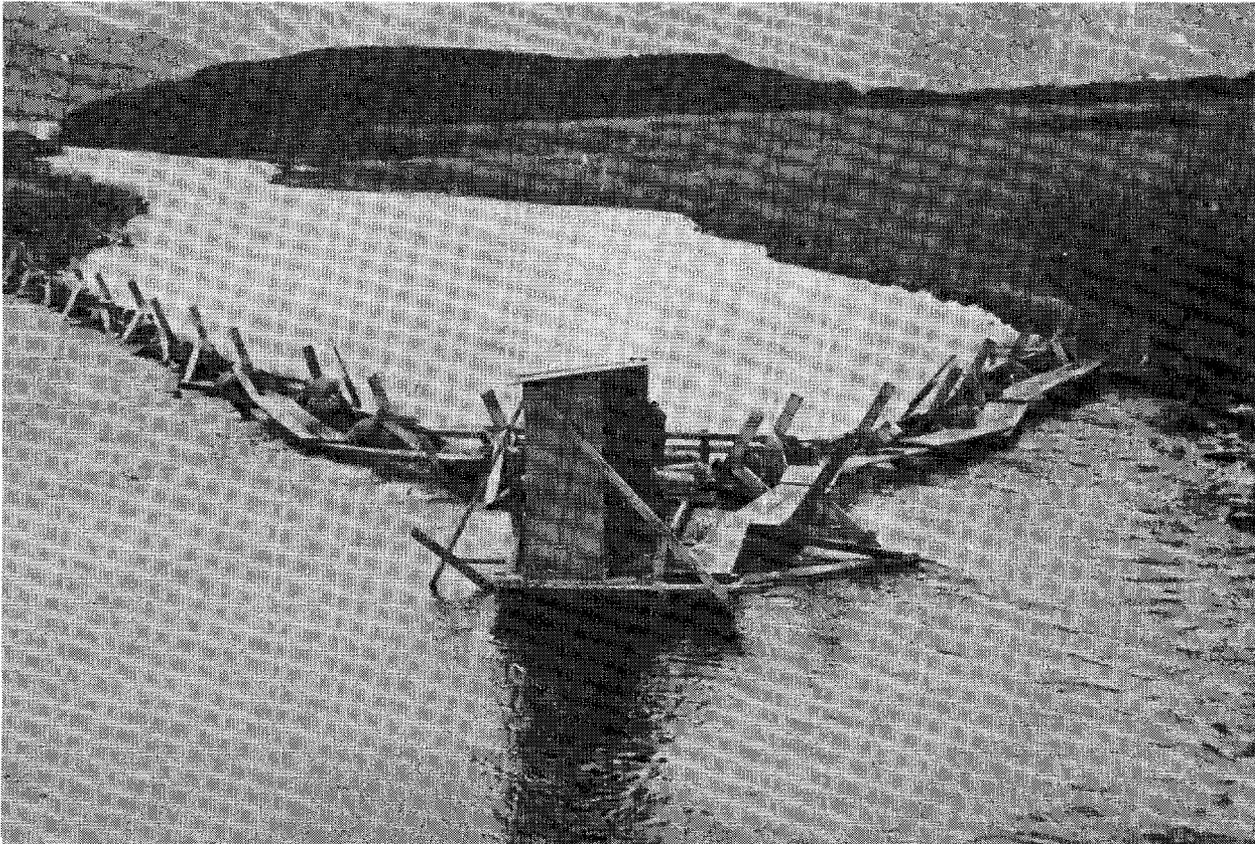


Figure 7. Smolt weir, Frazer Lake, 1966

weir has been in operation two seasons. Some modifications were made in 1966 which decreased the mortality encountered in 1965. The modifications included: (1) enlargement of the smolt box, (2) placing plywood over the screens nearest the box entrance which decreased water flow through the screens allowing smolts easier access into the box, and (3) placing sand bags at the bottom of screen panels to prevent washouts. The weir was in operation from May 21 until August 20, 1966. At the time of weir removal from the stream approximately 200 smolts per day were still migrating.

Adult sampling was conducted at the fish passage facility. The fish pass facility is ideally suited with only slight modifications necessary for studying upstream migration and for allowing controlled access of species into the lake. The enumeration of every adult required the construction of a sampling box placed just outside the last resting pool. The box was so constructed that adults entering the box could be detained and sampled if needed; if not, they were free to swim through the box and counted as they exited. The use of the sampling trap could also exclude undesirable species from the lake.

Adult sampling facilities were completed the 1st of June and the fish pass was opened at this date. The sampling box was removed the 20th of August and the pass closed to upstream migrants.

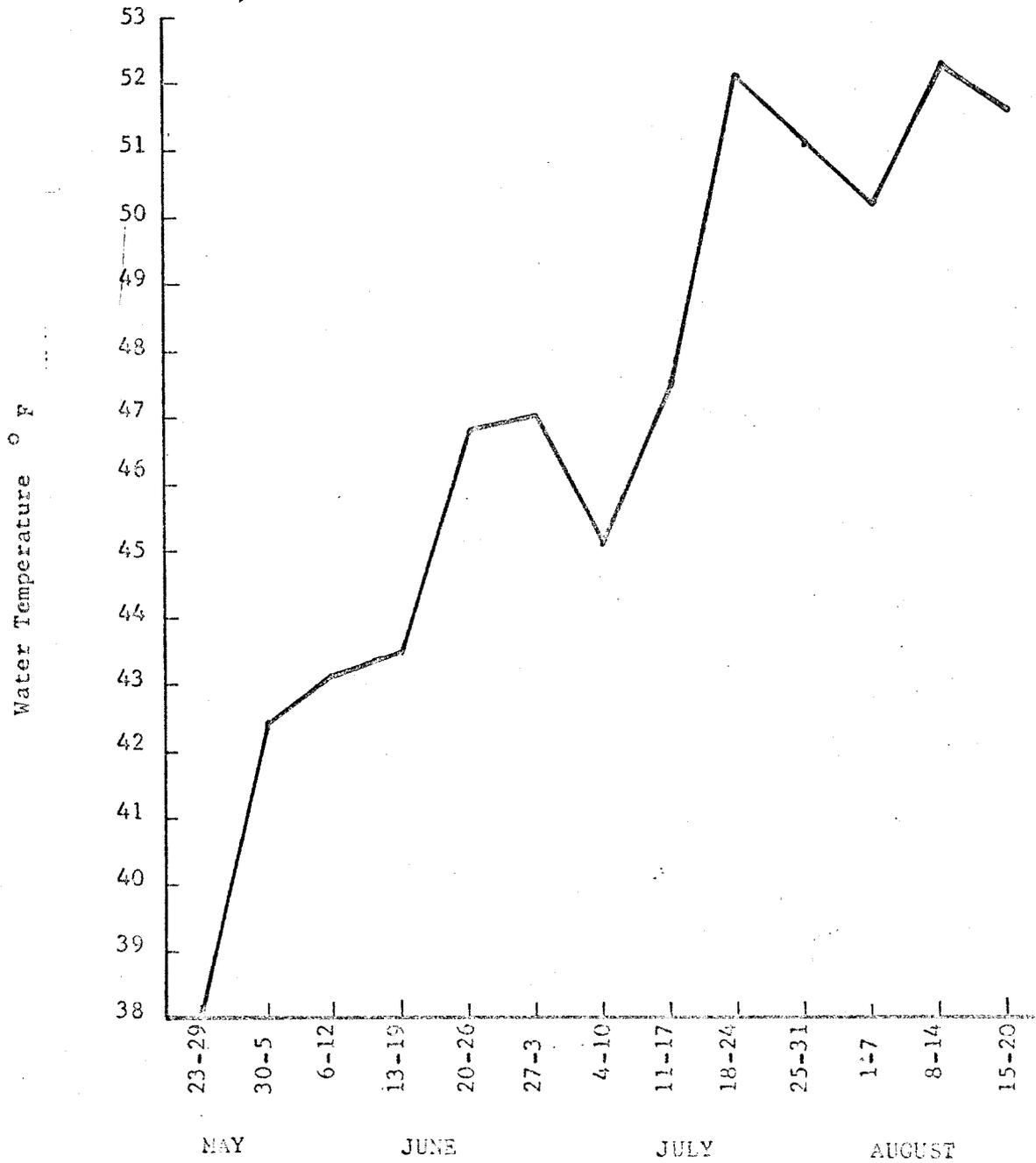
SMOLT INVESTIGATIONS

Sampling Procedure

The smolt weir was opened on May 21, and sampling continued until August 20, 1966. The weir was checked twice daily at 9:00 a.m. and 4:00 p.m. During the peak migration period it was necessary to make night counts. If extremely large numbers of smolt were observed at the 4:00 p.m. check, then a night count would be made usually starting at 10:00 p.m. and lasting until 1 or 2 a.m.

During the 9:00 a.m. check, the stream water temperature was recorded and all species of migrating fish enumerated (Figure 8). Three days a week lengths and scales were randomly taken from the sampled smolts. The scale sampling was an increase from the weekly sample obtained in 1965. The smolts were anesthetized in MS 222 (tricaine

Figure 8.
AVERAGE WEEKLY WATER TEMPERATURES
TAKEN AT SMOLT WEIR DAILY ABOUT 9:00 a.m.



1966

methanesulfonate) for a period of 1 to 5 minutes. When the smolts were completely relaxed they were placed on a wet sheet of 10 mm to the centimeter graph paper and the fork length was marked on the graph paper by pricking the paper at the fork of the tail with a probe (Meehan, 1966).

Scales were taken from the left side of the smolt immediately above the lateral line between the dorsal and adipose fins. A scalpel was used to remove the scales. The scales were then placed on microscope slides and the date, fork length and, if weighed, weight recorded on each slide. After each smolt was measured, it was placed in a holding box until fully recovered, usually 30 to 60 minutes. The sampled smolts were then released as a group in the late afternoon.

The 1966 sampling procedure consisted of the following separate operations:

1. All migrating fish were counted every day and all mortality was recorded.
2. During each 7 day sampling period 150 random scales and lengths were taken. For convenience 80 scales were taken on Sunday, 35 scales on Tuesday, and Friday respectively.
3. Weights were taken each sampling period from 5 fish in each 5 mm size group for condition factor. This was an increase from the weekly sample obtained in 1965.

Sampling ended August 20, 1966, after thirteen continuous sampling periods in which 157,291 smolts, 1,926 random scales, 1,951 lengths, and 713 weights were recorded. Actually 1,951 scales were taken, but 25 scales were regenerated or unreadable.

Timing of Smolt Migration

Seaward migration of smolts started the last week in May, reaching a peak the third week in June when approximately 1/3 of the total run migrated (Figure 9). The 1966 smolt migration followed the usual pattern of rapid increase until a peak was reached and then a gradual decline until sampling ended. The 1966 migration was of shorter duration than 1965, lasting 13 weeks compared to 16 weeks (Figure 10). A possible reason for the marked peak period this year, over last year's extended migration, was

FIGURE 9. TIMING OF SMOLT MIGRATION, FRAZER LAKE, 1966.

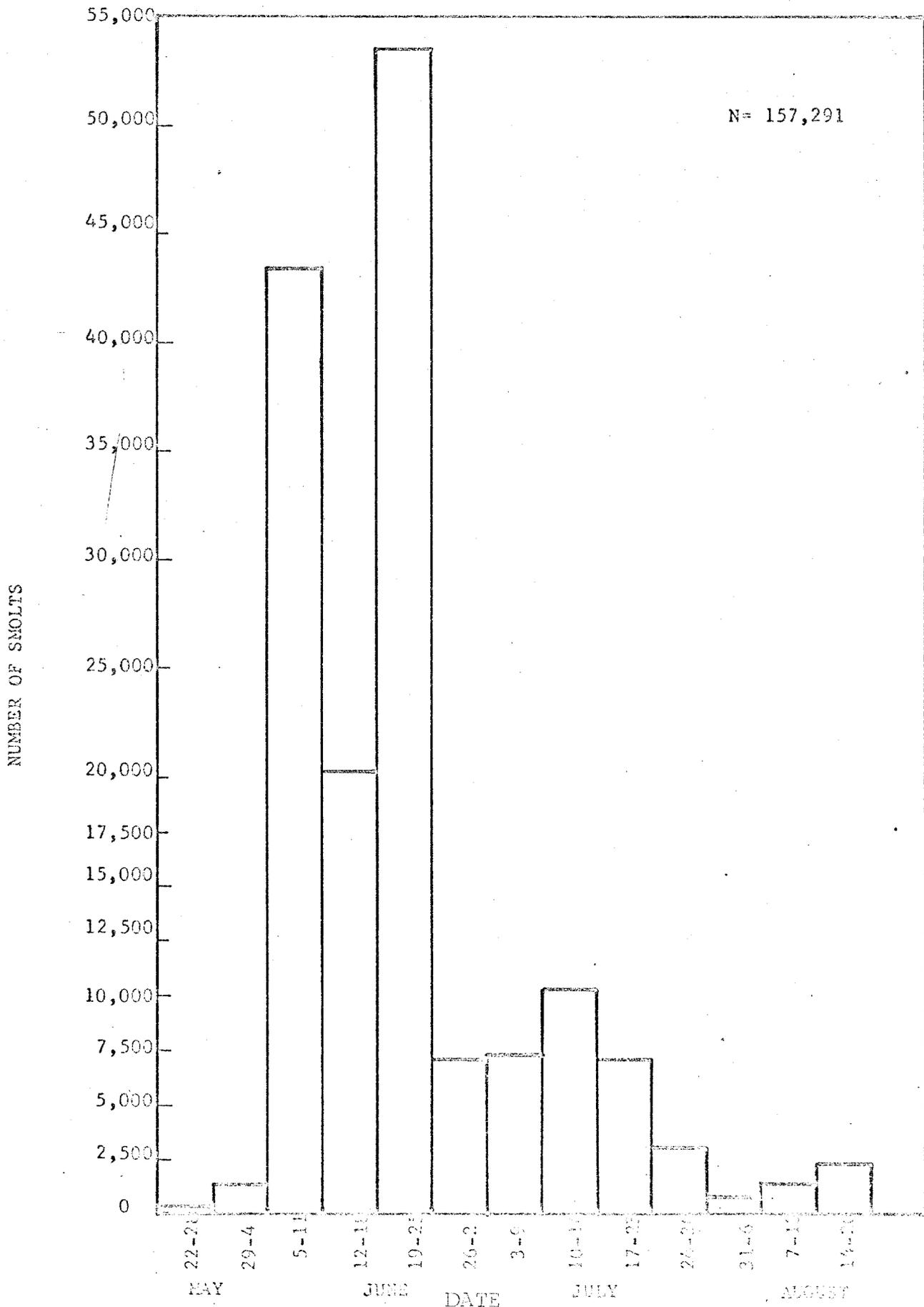
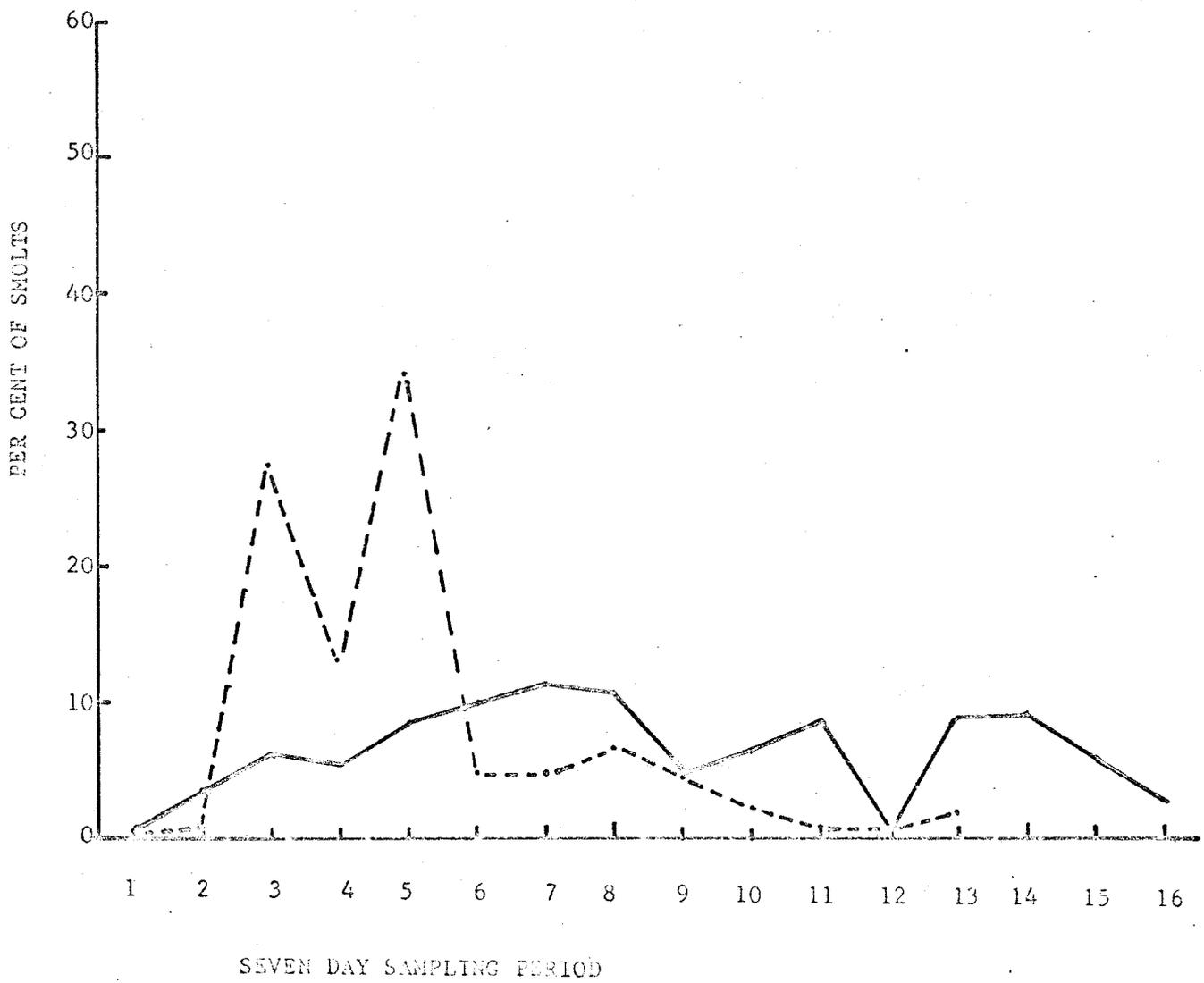


FIGURE 10. SMOLT TIMING MIGRATION, FRAZER LAKE, 1965 and 1966.



1965 ———
1966 - - - -

in the increased numbers of smolt migrating in 1966. The number of smolts (157,291) enumerated in 1966 showed an increase over the 26,945 smolts counted in 1965.

Length-Frequency Distribution of Smolts

The lengths of migrating smolts varied from 120 mm to 214 mm with only two exceptions under 120 mm and one over 214 mm (Figure 11). The two fish under 120 mm were fish with respective lengths of 107 mm and 79 mm; the smolt over 214 mm was a 4-annuli smolt of 253 mm. The dominant size group was 180-184 mm, an increase of 20 mm from last year. The mean size group was 170-174 mm, an increase of 10 mm from last year.

Lengths were taken in conjunction with the random scale samples during the thirteen week sampling period.

Age Class Composition of Smolts and Timing by Age

Each sampling period, 150 random scale samples were collected for later age analysis. Age composition for each sampling period was determined and the individual age classes were projected to the total enumeration for that sampling period (Table 1). Using this method, age composition for all migrating smolts was calculated. By depending on only random scales for age composition, the problem of relating age to length in the overlap areas was eliminated this year (Table 2).

Three age classes were again represented this year. The dominant age class was again the age II fish*. Age composition of the total migration was 18.3 percent I, 66.3 percent II, and 15.4 percent III fish.

The 2-annuli smolt dominated the entire migration leaving the lake in greater numbers at the start of migration and continuing throughout the migration (Figure 12). One-check (annuli) smolts and 3-check smolts varied in dominance throughout the season, however, more 1-checks left the system than 3-checks, the exact opposite from 1965 (Figure 13).

* Roman numeral corresponds to the number of annuli or winters in fresh water.

Figure 11. Frequency-Distribution of Random Sample of 1,951 Fork Lengths
 Frazer Lake, 1966

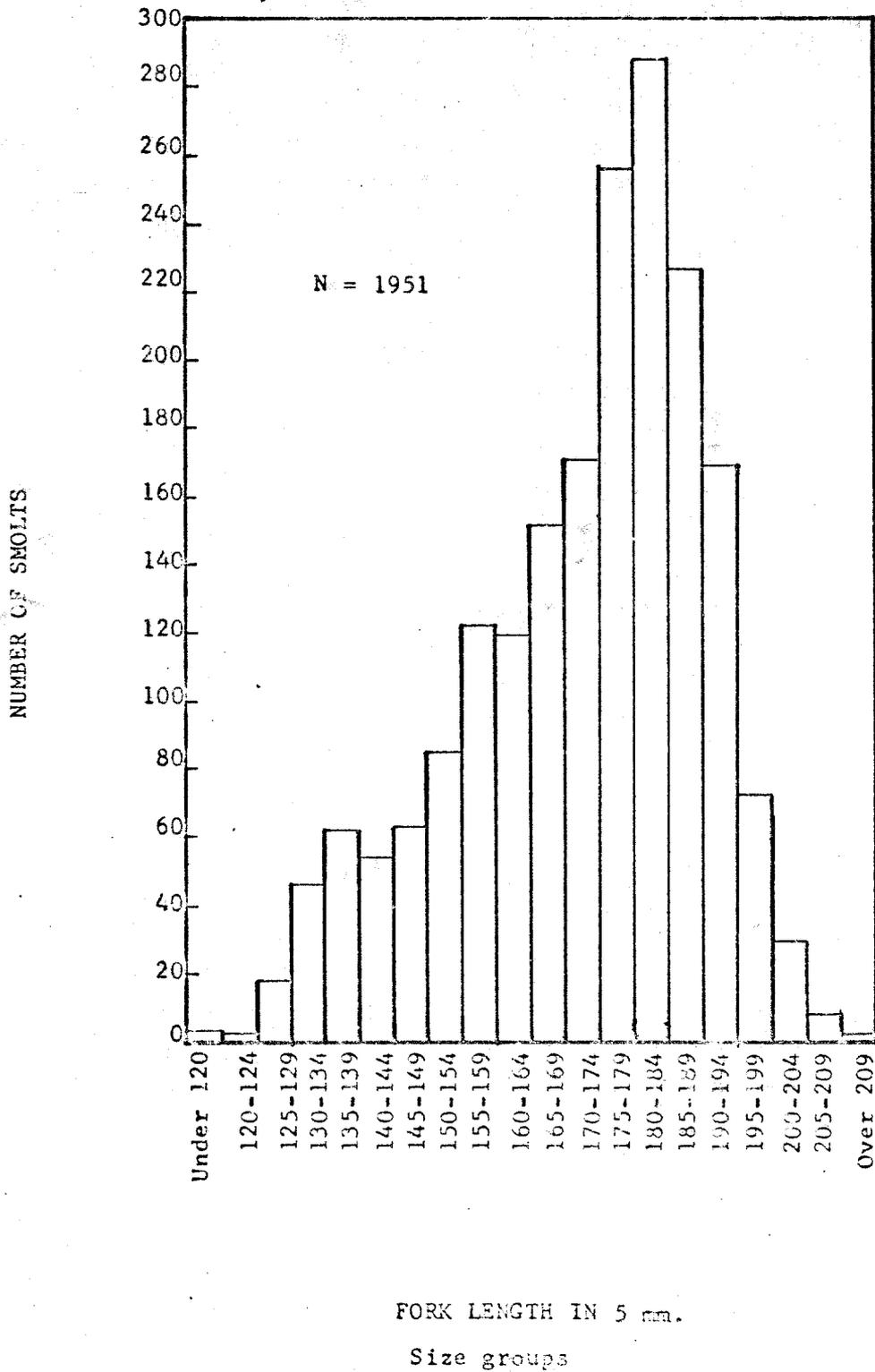


Table 1. Age composition and weekly enumeration of random weekly scale samples.

Date	Sample Size	Number Smolt Age *			Weekly Enumeration	Number Smolt Age Weekly Enumeration		
		I	II	III		I	II	III
MAY								
22-28	149	4	131	14	257	7	226	24
MAY-JUNE								
29-4	150	3	133	14	1,288	26	1,142	120
5-11	150	4	124	22	43,151	1,122	35,686	6,343
12-18	149	17	112	20	20,200	2,323	15,170	2,707
19-25	149	48	76	25	53,290	17,159	27,178	8,953
JULY-AUGUST								
26-2	147	57	73	17	7,011	2,720	3,478	813
3-9	150	30	98	22	7,273	1,455	4,749	1,069
10-16	149	23	93	33	10,294	1,585	6,434	2,275
17-23	149	30	97	22	6,929	1,393	4,511	1,025
24-30	147	28	96	23	3,085	586	2,015	484
AUGUST-SEPTEMBER								
31-6	145	29	101	15	790	158	551	81
7-13	148	12	128	8	1,433	116	1,240	77
14-20	144	7	121	16	2,290	115	1,923	252
Total	1,926	292	1,383	251	157,291	28,765	104,303	24,223

Percent age composition relative to total run.

$$\frac{28,765}{157,291} = 18.3\% \quad \text{I}$$

$$\frac{104,303}{157,291} = 66.3\% \quad \text{II}$$

$$\frac{24,223}{157,291} = 15.4\% \quad \text{III}$$

$$100.0\%$$

*Roman numeral corresponds to number of annuli or winters in freshwater.

Table 2. Age composition and length-frequency comparison of random scale samples

Size Group Fork Length mm	Sample Size	Number of Smolts of Age		
		I	II	III
Less than 120	1	1		
120-124	2	2		
125-129	16	16		
130-134	46	46		
135-139	63	63		
140-144	51	49	2	
145-149	64	53	11	
150-154	83	39	44	
155-159	121	21	100	
160-164	118	2	116	
165-169	147	0	147	
170-174	170		168	2
175-179	256		255	1
180-184	287		277	10
185-189	222		181	41
190-194	168		78	90
195-199	73		4	69
200-204	29			29
205-209	7			7
210-214	2			2
TOTAL	1,926	292	1,383	251

FIGURE 12.

TIMING OF MIGRATION BY WEEK AS INDICATED BY NUMBER OF
SMOLT IN EACH AGE CLASS IN THE SAMPLES, FRAZER LAKE, 1966

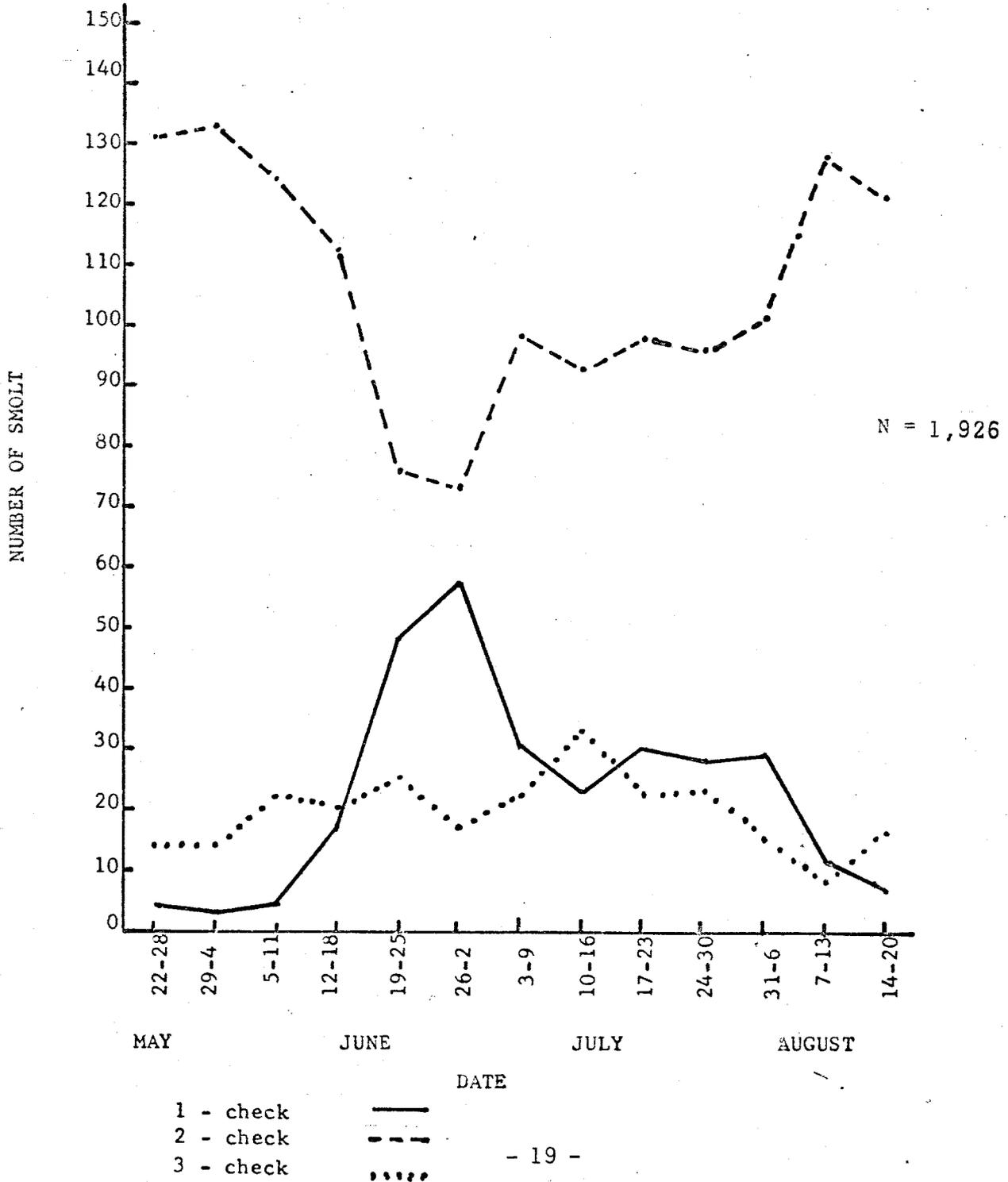
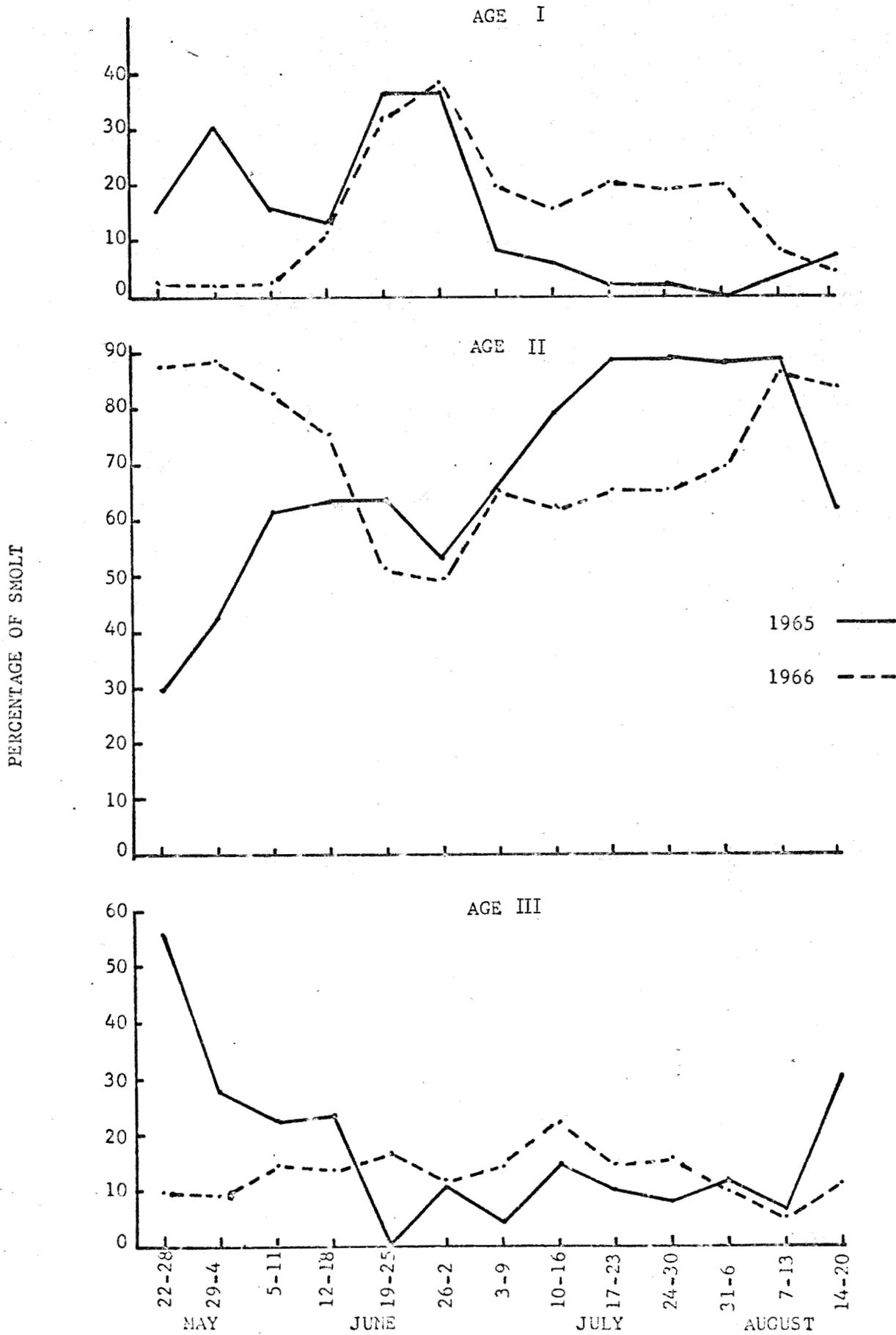


FIGURE 13. TIMING OF MIGRATION BY WEEK AS INDICATED BY PERCENTAGE OF SMOLT IN EACH AGE CLASS OF THE SAMPLE, FRAZER LAKE, 1965, 1966



The shifting of age composition between the 1- and 3-check smolts tended to substantiate the theory advanced last year that the greater number of smolts inhabiting the lake, the fewer 3-check smolts in the migration due to the less abundance of food and living space available. In comparing the 1965 age composition with the 1966 age composition, it can be seen that in 1966 the 2-check fish have decreased from 74.2 percent to 66.3 percent, the 1-check have increased from 6.4 percent to 18.3 percent, and the 3-check have decreased from 19.4 percent to 15.4 percent of the run.

The three age classes of the 1966 smolt migration are the progeny of the 1962, 1963 and 1964 adult spawning runs respectively. In 1962 the adult escapement into Frazer Lake was 1,290, with an additional 1,800 transplanted adults from Red Lake for a total of 3,090 spawners. In 1963 the adult escapement was 2,357 and 9,500 transplanted adult spawners for a total of 11,857. In 1964, the escapement was 8,166 and 1,800 adults were transplanted for a total of 9,966 fish. After the 1967 smolt migration is analyzed the complete freshwater age class composition for the 1963 brood year will yield survival and age composition of smolt produced.

Condition Factor

Each sampling period five smolts in each 5 mm size group were weighed to obtain the condition factor. Table 3 illustrates some mean weights per size group weighed in the 1966 field season.

Using the formula $\frac{W \times 10^n}{L^3}$ the condition factor for each smolt was calculated, and the mean condition factor was determined for each age class. One-check smolt showed a general increase with some fluctuations during the season. Two-check smolt followed somewhat the same pattern. Three-check smolt showed high condition factors at the start of the season but a general decreasing trend was noted during the season (Table 4).

Predation and Mortality on Smolts

From June 1 until August 15, the smolts were under the constant predation of a breeding colony of Mew Gulls (Larus canus) (approximately 500 in number). These gulls nest on the two islands near the lake outlet. The greatest predation activity occurred at the smolt weir and at the base of the falls. Gulls were observed diving on and catching smolts on many different occasions. Efforts were made to discourage these predators, but

Table 3. Mean weights in each size group.

5 mm Size Groups Fork Length	Sample Size	Mean Weight Grams
Less than 120	1	17.2
120-124	2	16.5
125-129	15	19.5
130-134	24	20.8
135-139	27	24.2
140-144	36	26.5
145-149	37	30.5
150-154	36	32.8
155-159	42	36.2
160-164	45	39.5
165-169	57	43.5
170-174	65	47.2
175-179	61	51.1
180-184	56	55.4
185-189	57	59.3
190-194	63	62.2
195-199	52	68.0
200-204	27	71.3
205-209	8	77.7
210-214	2	83.6
Greater	0	----
Total	713	

Table 4. Average condition factor.

Date	Average Condition Factor (K) and Sample Size (N) for Smolts of Age								
	K	I	N	K	II	N	K	III	N
22-28	.871		4	.924		31	.921		9
MAY									
29-4	.837		3	.906		37	.927		8
5-11	.875		4	.924		29	.894		9
12-18	.927		16	.916		33	.898		8
JUNE									
19-25	.918		22	.929		28	.881		11
26-2	.938		23	.908		32	.862		11
3-9	.919		17	.885		34	.876		9
10-16	.952		15	.870		29	.841		14
JULY									
17-23	.920		17	.917		38	.884		11
24-30	.890		11	.924		33	.860		15
31-6	.945		13	.964		28	.915		11
AUGUST									
7-13	.958		6	.935		33	.893		7
14-20	.937		5	.906		27	.887		15
For Entire Season									
	.914		156	.916		412	.887		138

proved to have little effect. It is believed that these gulls are the primary predator of migrating smolts.

Another predator that was observed taking smolt was the Red-breasted Merganser (Mergus serrator). The mergansers were better adapted to smolt catching than the gulls and would have been the number one predator except for their limited numbers. The mergansers fished not only the river, but also the lake while the gulls seemed to confine their fishing to the river.

The only other predator of any consequence that was observed was the land otter. The otter paid several visits to the smolt box, doing his own kind of sampling. In 1965, smolt mortality was almost 10 percent of the run, but through weir modifications mortality was reduced to less than 1 percent in 1966 with a much larger migration (Table 5). It is believed that smolt mortality at the weir is something that has to be expected in normal weir operation and can never be completely eliminated.

SUMMARY

1. The smolt weir was opened on May 21, 1966, and sampling and enumeration continued until August 20, 1966.
2. Sampling procedures were modified from last year in that more scale and weight samples were taken.
3. Many of the smolt enumerations were made at night between the hours of 10 and 2 in order to decrease weir mortality.
4. Stream water temperatures taken during the 13-week sampling period in 1966 indicated a minimum weekly water temperature of 38.1° F. and a maximum weekly water temperature of 52.1° F.
5. The sockeye smolt migration reached a peak the third week of June when approximately 1/3 of the total run migrated seaward.
6. The average fork length of sockeye smolts was 170-174 mm, an increase of 10 mm from 1965.
7. The migration contained three age classes with 2-check smolt comprising

Table 5. Total number and mortality of various species of fish trapped by downstream smolt weir, Frazer Lake, 1966.

Species	Total Number Trapped	Mortality	
		Number	Percent
Sockeye salmon (<u>O. nerka</u>)	157,291	1,554	0.9
Dolly Varden char (<u>S. malma</u>)	324	53	16.3
Rainbow trout (<u>Salmo gairdneri</u>)	15	0	0
Threespine stickleback (<u>Gasterosteus aculeatus</u>)	371	343	92.4
Cottid (<u>C. aleuticus</u>)	14,423	12,542	86.9

66.3 percent of the run. This is a decrease from 1965 when 74.2 percent of the run were 2-check smolts.

8. A total migration of 157,291 smolts were enumerated. This was an increase over the 26,945 smolts counted in 1965.
9. Smolt mortality at the weir was less than 1 percent this year compared to 10 percent in 1965.

ADULT INVESTIGATIONS

Sampling Procedure

All adults were captured as they exited from the fish pass facilities by means of a trap placed adjacent to the exit into which adults voluntarily entered (Figure 14). Once in the trap, fish were netted and placed in an anesthetizing box containing MS 222 (tricaine methanesulfonate) to facilitate handling.

The sampling period consisted of seven separate days. During this time 200 adult fish were sampled to determine fork length and sex (visual determination), and a scale was taken from each of the 200 fish for age analysis. Weights were taken from five males and five females in each 20 mm size group. The fish that were not sampled were counted and allowed to continue their upstream migration.

Fish Enumeration

In 1966 the first adult passed through the fish pass on June 11 and the last fish on August 23. Figure 15 shows the numbers and timing of the migration. The run exhibited one distinct peak which occurred the second week in July when approximately 3,800 of the 11,728 fish enumerated were counted through the fish pass.

Sockeye were the dominant species counted through the fish pass, but some chum salmon (O. keta) were also counted (Table 6). The river below the falls contained many Dolly Varden (Salvelinus malma); but this species was denied entry into Frazer Lake being classed as undesirable.

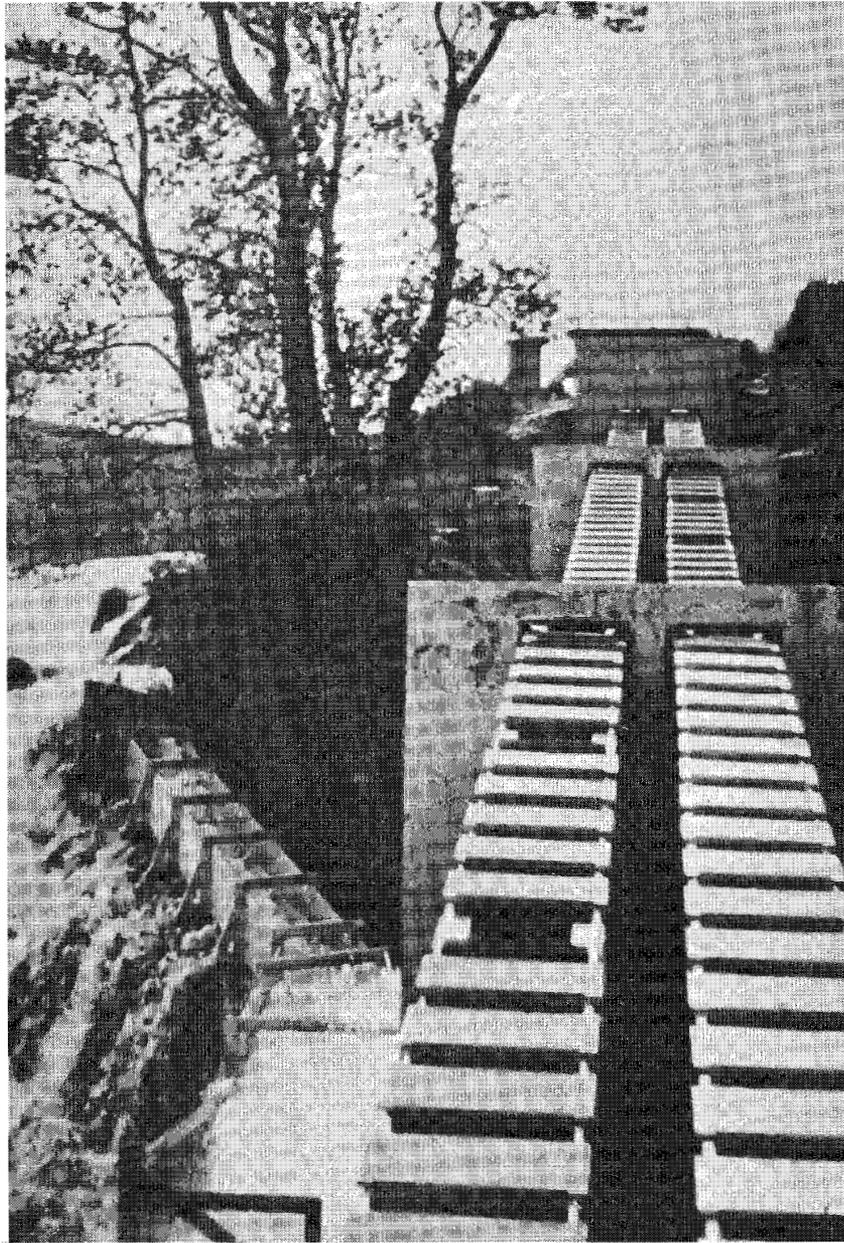


Figure 14. Fish pass facilities, Frazer Lake, 1966.

FIGURE 15. MIGRATION AND TIMING OF UPSTREAM MIGRANTS, FRAZER LAKE, 1966

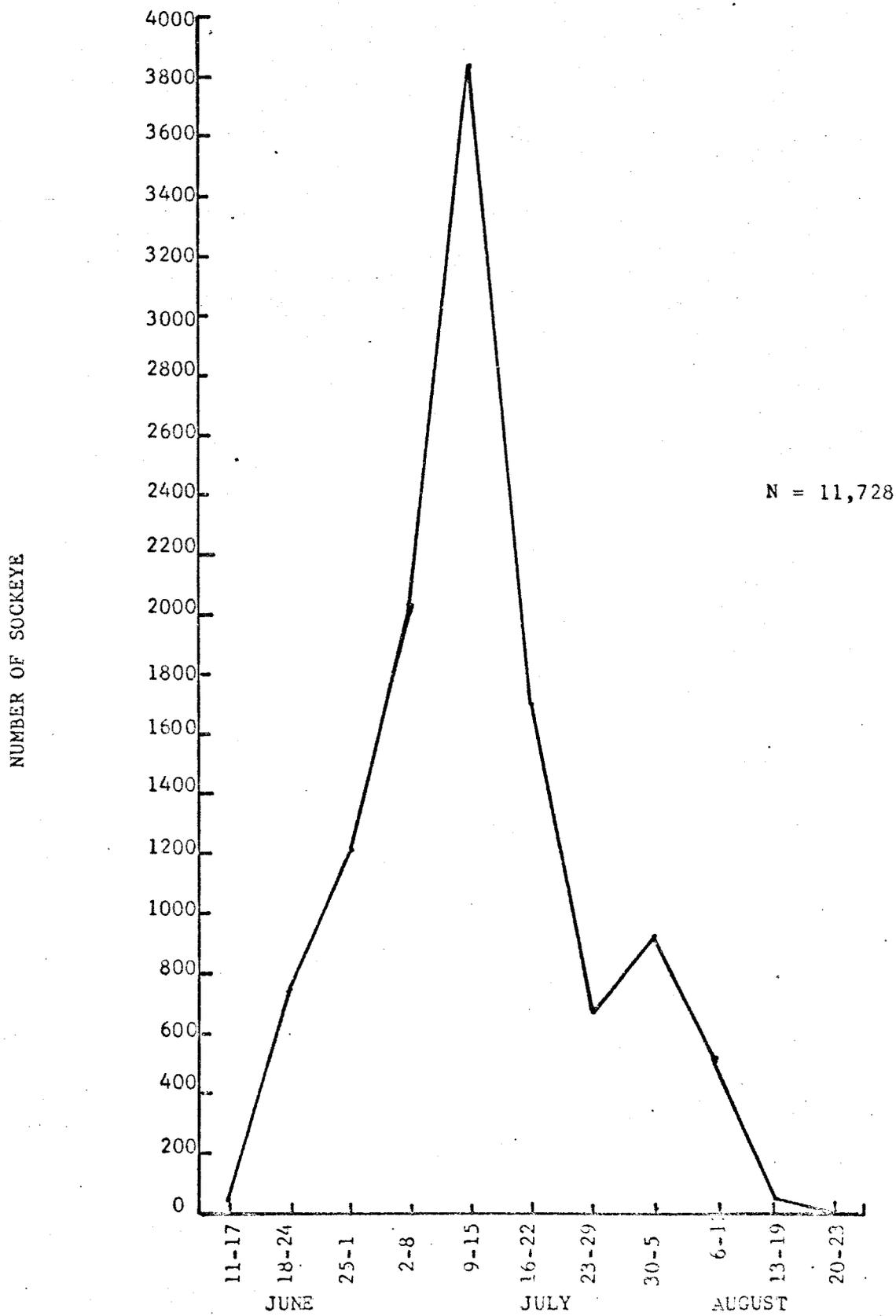


Table 6. Species enumeration at the fish pass, Frazer Lake, 1965 and 1966.

<u>Species</u>	<u>1966</u>	
	<u>Number</u>	<u>Mortality at Ladder</u>
<u>Oncorhynchus nerka</u>	11,728	44
<u>Oncorhynchus keta</u>	253	0
<u>Salmo gairdneri</u>	1	0
	<u>1965</u>	
<u>Oncorhynchus nerka</u>	5,074	54
<u>Oncorhynchus keta</u>	10	0
<u>Oncorhynchus gorbuscha</u>	1,688	0
<u>Salmo gairdneri</u>	1	0

The 1966 escapement of 11,728 sockeye was the largest in Frazer Lake history. It is an increase of 6,654 fish over the 1965 escapement of 5,074 (see Figure 4).

Age and Size Distribution of Adult Spawners

Scale analysis of 1,577 scales revealed that the 1966 sockeye escapement consisted of eleven separate age groups (Table 7, Figure 16).

The 1966 dominant age of 2.2* was the same as in 1965. Approximately 70.5 percent of the 1966 adults had spent two years in fresh water and two years in salt water. Precocious males (jacks) accounted for 2.3 percent of the total escapement.

The sex ratio was a normal 51.6 percent males to 48.4 percent females.

The dominant size group in the 1966 Frazer Lake escapement was 540-559 mm (fork length) for females, and 560-579 mm for males (Figure 17). These 1966 dominant size groups were the same as the 1965 dominant size groups.

Condition Factor

Condition factors for both males and females were relatively high, the mean for both males and females was 1.14 (Table 8). The condition factor for males decreased during the season, as did that of the females. Both sexes, however, exhibited fluctuations.

The fish that were sampled or tagged at the fish pass were examined for cuts, scars, and bruises that could be attributed to injuries received while jumping at the falls. Wounds that were probably received while jumping

*A number preceding the period represents the number of freshwater annuli. A number after the period represents the number of saltwater annuli. Thus, a 2.2 fish is in its 5th year having 2 winters in freshwater and 2 winters in saltwater.

Table 7. Age composition and length^{1/} of male and female sockeye salmon escapement, Frazer Lake, 1966^{2/}.

	AGE GROUP *											Total or Average
	1.1	1.2	1.3	1.4	2.1	2.2	2.3	2.4	3.1	3.2	3.3	
	<u>Combined Sexes</u>											
Number of fish	71	1,845	841	25	146	6,702	1,405	13	48	599	33	11,728
Percent of escapement	0.6	15.7	7.2	0.2	1.3	57.1	12.0	0.1	0.4	5.1	0.3	100.0
	<u>Males</u>											
Number of fish	9	111	66	4	18	436	121	2	6	37	4	814
Mean length	411.3	555.6	595.5	636.0	435.1	565.6	616.2	675.5	476.6	587.9	646.7	563.8 ^{3/}
Percent of escapement	0.6	7.0	4.2	0.3	1.1	27.6	7.7	0.1	0.4	2.3	0.3	51.6
	<u>Females</u>											
Number of fish	1	117	43	1	1	465	84	-	1	47	3	763
Mean length	449.0	536.0	586.5	621.0	506.0	549.5	598.6	-	528.0	567.5	597.0	553.9 ^{3/}
Percent of escapement	0.1	7.4	2.7	0.1	0.1	29.4	5.3	-	0.1	3.0	0.2	48.4

continued -

Table 7 (continued)

	AGE GROUP *											Total or Average
	1.1	1.2	1.3	1.4	2.1	2.2	2.3	2.4	3.1	3.2	3.3	
	<u>Differences</u>											
Mean differences	37.7	19.6	9.0	15.0	70.9	16.1	17.6	-	51.4	20.4	49.7	30.7 ^{3/}
Percent females smaller than males	-	3.5	1.5	2.3	-	2.8	2.8	-	-	3.4	7.6	3.4 ^{3/}
Percent males smaller than females	8.3	-	-	-	14.0	-	-	-	9.7	-	-	10.6 ^{3/}

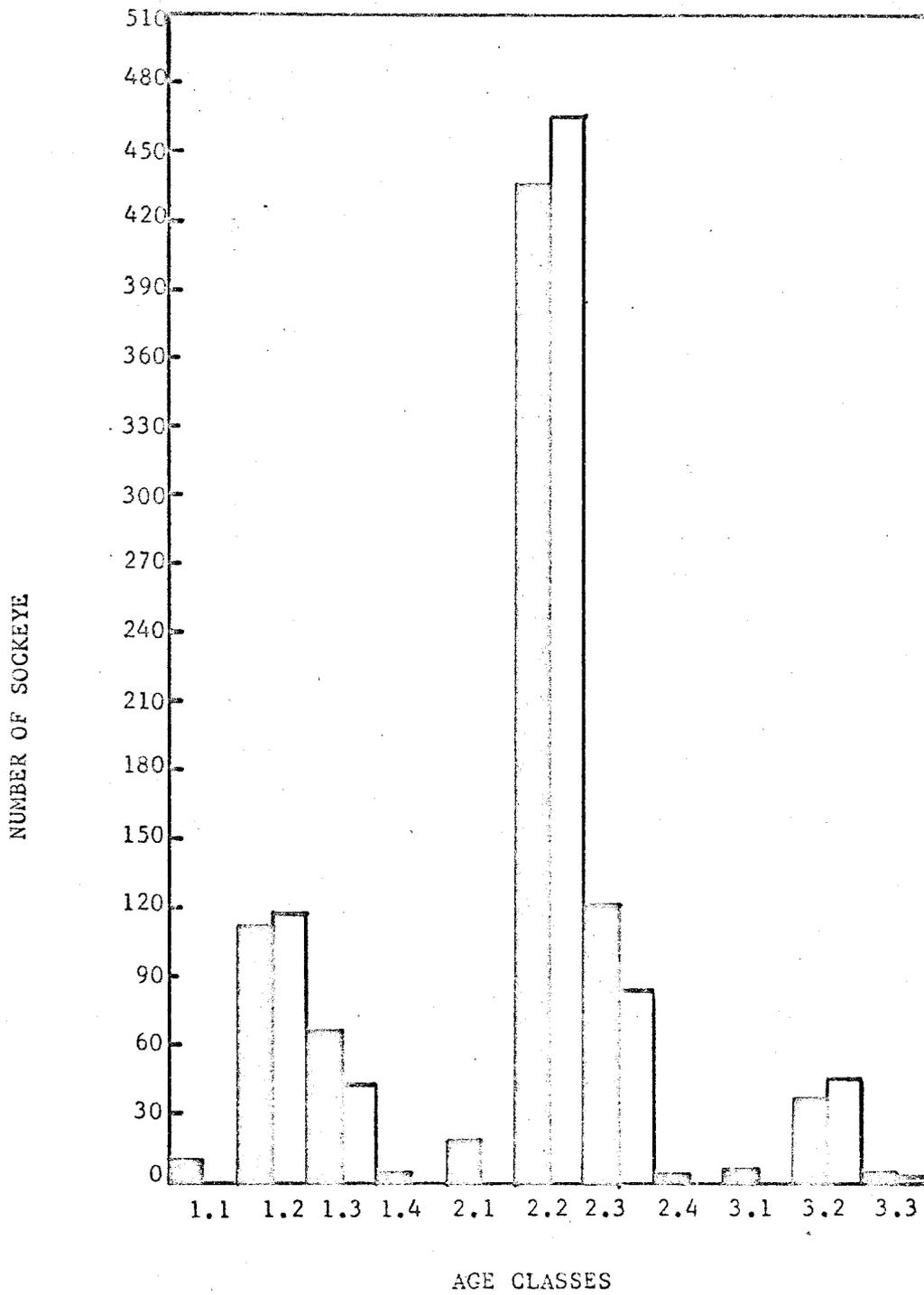
^{1/} Fork length in millimeters

^{2/} Based on analysis of scales taken from 1,577 fish throughout migration.

^{3/} Not weighted by sample size of individual age groups.

* A number preceding the period represents the number of freshwater annuli. A number after the period represents the number of saltwater annuli. Thus, a 2.2 fish is in its 5th year having 2 winters in freshwater and 2 winters in saltwater.

FIGURE 16. AGE DISTRIBUTION OF ADULT MALE AND FEMALE SOCKEYE SALMON,
FRAZER LAKE, 1966



MALE (N = 814)
FEMALE (N = 763)

FIGURE 17. LENGTH - FREQUENCY DISTRIBUTION OF SOCKEYE SALMON
 ESCAPEMENT, FRAZER LAKE, 1966

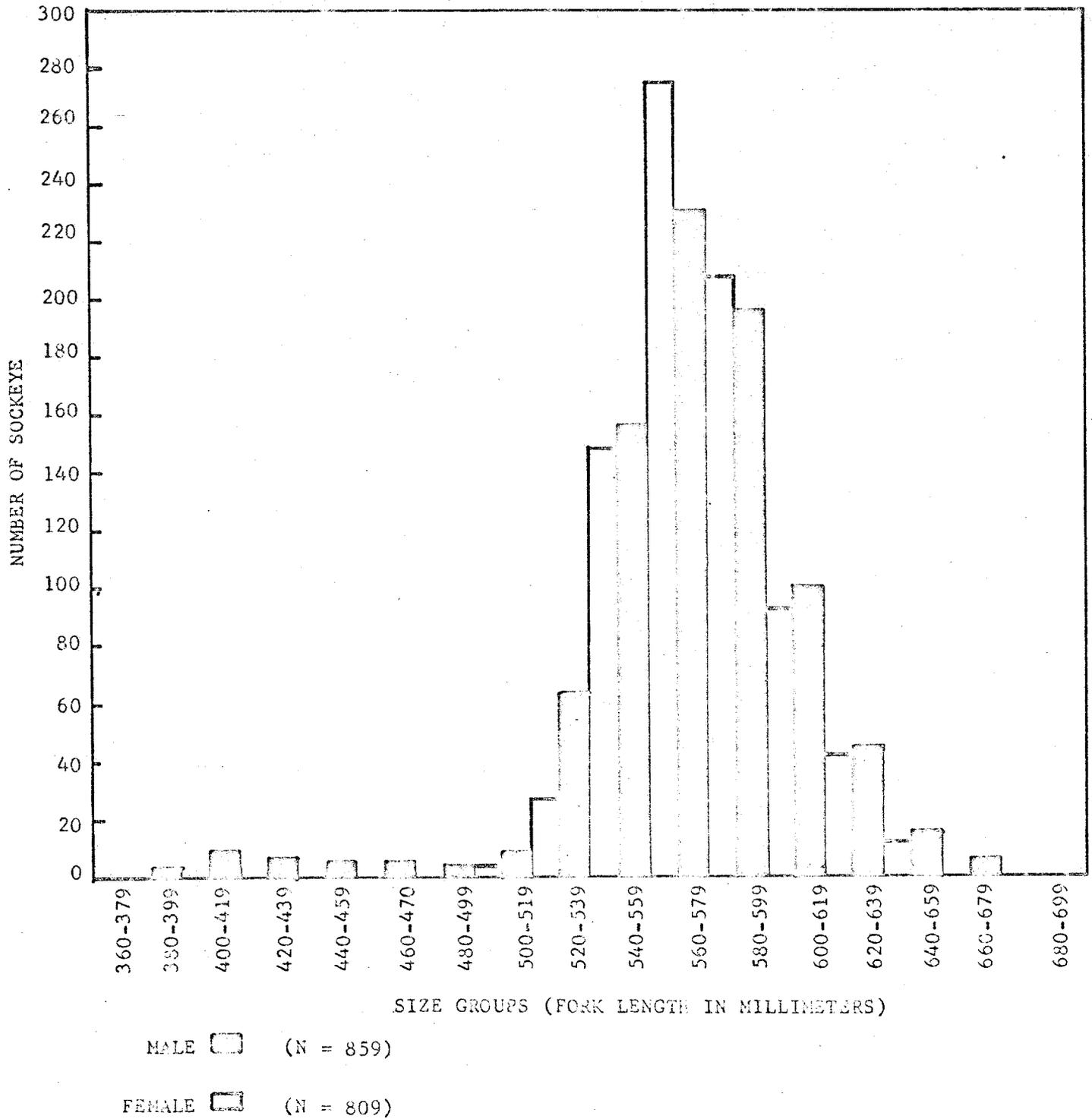


Table 8. Average weekly condition factors (K) for male and female sockeye salmon, Frazer Lake, 1966.

Average Condition Factor (K) and Sample Size (N)					
Date	Males		Females		
	K	N	K	N	N
June 11-17	1.17	24	1.13		16
18-24	1.19	45	1.18		35
July 25- 1	1.23	42	1.18		33
2- 8	1.19	31	1.18		26
9-15	1.14	35	1.13		28
16-22	1.14	34	1.15		27
23-29	1.09	37	1.14		25
Aug. 30- 5	1.07	35	1.11		27
6-12	1.08	38	1.12		35
Seasonal	1.14	321	1.14		252

at the falls numbered 416 out of 6,339 fish examined or only 6.5 percent of the run. This is a relatively low percentage considering the many jumps observed at the falls.

Sockeye apparently preferred moving up the ladder on bright sunny afternoons as was the case in 1965.

Frazer Lake Water Temperatures

Lake water temperatures were taken at four representative stations on the lake with the temperatures recorded to a depth of 46 meters. The temperatures that appear on Figure 18 are averages from the four sampling stations. The first series of temperatures were taken May 28 and at that time only a two degree difference existed from the surface to a depth of 46 meters. As was seen in the 1965 water temperatures, no definite thermocline existed in Frazer Lake during the period May 28 to August 22. On August 12, a 10-degree temperature difference was noted from the surface to a depth of 46 meters, but this was a gradual decrease not to be confused with the sharp decrease found when a thermocline is encountered.

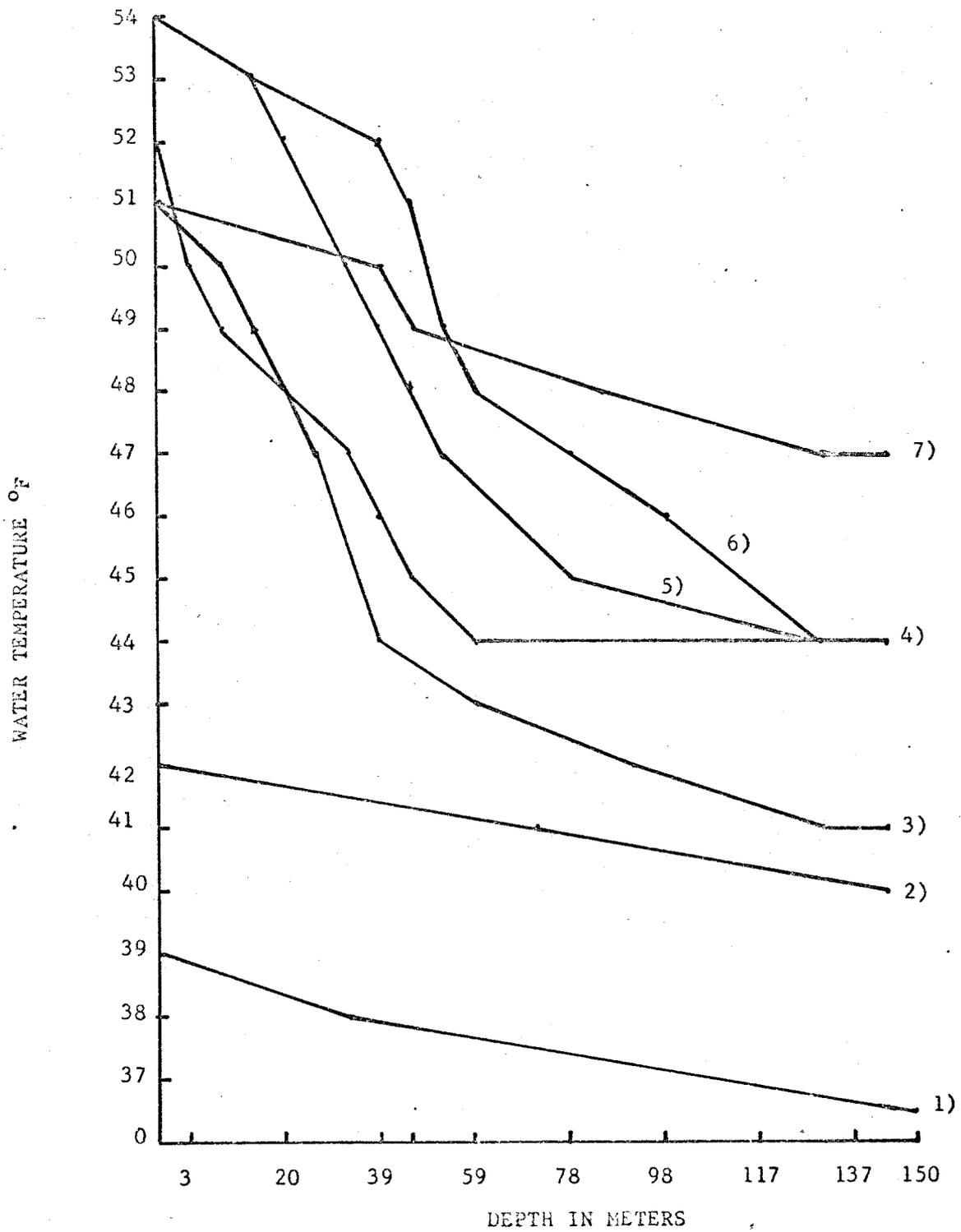
Vertical plankton hauls were made every two weeks. The plankton analysis has not been completed, but the results will appear in a forthcoming informational leaflet.

Tagging Program

Before the 1966 field season, operational plans were formulated for separating the introduced Red Lake spawners (which were air transported from Red Lake) and the Frazer Lake fish on the spawning grounds. It was first decided to tag all introduced Red Lake fish, but it was felt this might considerably slow the fish transportation process and reduce the number of fish that could be planted. The other alternative was to tag all Frazer Lake fish as they ascended the fish pass which could be easily accomplished providing the run was small.

Starting on June 11, all Frazer fish ascending the fish pass were tagged and visually sexed. Petersen disc tags were used in different color combinations based on time periods to separate the fish. All fish that were tagged were anesthetized in MS 222 to facilitate ease of handling and prevent unnecessary injury to the fish during tagging. A tagging cradle was

FIGURE 18. MEAN WATER TEMPERATURES, FRAZER LAKE, 1966



1) May 28
 2) June 14
 3) June 29
 4) July 14

5) July 28
 6) Aug. 12
 7) Aug. 22

used and the complete tagging process required two men.

Every fish was tagged until July 12, when this became physically impossible for the two man crew because of an increase in the numbers of fish ascending the fish pass. To delay the fish too long might have had a harmful effect on their timing, causing the fish to return to the base of the falls and refuse to ascend the fish pass again. However, by July 12, 554 fish were tagged before the total tagging operation ceased. At this time it was estimated that there were approximately 10,000 additional fish waiting to ascend the fish pass.

The original tagging program was designed to separate Red Lake and Frazer Lake fish on the spawning grounds but was defeated by not tagging all Frazer Lake fish. However, some information was obtained regarding distribution and timing of spawners. Because of the numerous tags in the stream, visual counts were easily made.

After necessarily discontinuing the plan to tag all Frazer Lake fish, a sample of 200 sockeye were tagged each week starting July 16 for spawning ground identification.

There were 16,455 adult spawners in Frazer Lake in 1966; 6,339 of these fish were tagged with various color combinations (Table 9).

From tag observations and recoveries, the majority of fish tagged in June, July and August spawned in streams 1 and 10 (Figure 2). The tagging program indicated that there was an indiscriminate mixing of all color combinations in streams 1 and 10 (Table 10). There was little if any relation between entry time into the lake and the spawning area chosen.

Stream Surveys

Surveys were made of all streams considered capable of maintaining spawning sockeye and two stream surveys were made of the four major spawning streams, each two weeks apart (Table 11). On the first and second survey all fish were counted, but due to the lack of time and the preponderance of tagged fish, tags were recovered only on the second survey.

Stream 10, as in 1965, was the most utilized spawning stream, containing 2,603 observed sockeye. Stream 1 was the second most utilized

Table 9. Tag observations and recoveries in all spawning areas.

Date	Tag Color	Number Tagged	Number Recovered	Percent Recovered	Number Observed	Percent Observed
June 11 - 26	Yellow-Yellow	1,102	104	9.4	367	33.3
June 26 - 30	Red - White	848	92	10.8	236	35.9
July 1 - 12	Red - Red	3,575	384	10.7	1,340	37.4
July 16 - August 11	Red - Yellow	814	52	6.4	83	10.2
TOTAL or PERCENT		6,339	632	9.9	2,026	31.9

Table 10. Percentage of sockeye found in each spawning area based on a ratio untagged and tagged fish observations or recoveries.

<u>Location</u>	<u>Percent untagged</u>		<u>Percent tags observed</u>				<u>Percent tags recovered</u>			
	<u>Live</u>	<u>Dead</u>	<u>YY</u>	<u>RW</u>	<u>RR</u>	<u>RY</u>	<u>YY</u>	<u>RW</u>	<u>RR</u>	<u>RY</u>
Stream 16	0.2	0.3								
Stream 1	17.7	22.6	48.2	47.9	31.9	6.0	43.3	33.7	27.6	5.7
Stream 7	-	0.3	0.5	-	-	-	-	-	-	-
Stream 12	8.0	0.7	6.0	8.5	3.4	7.2	2.9	6.5	2.9	-
Beach near 12	1.8	-	2.7	3.4	1.7	2.4	-	-	-	-
Stream 9	0.3	0.3	-	-	0.1	1.2	-	-	-	-
Stream 10	63.0	67.5	42.6	40.2	62.9	83.2	50.0	58.8	64.8	67.3
Beach Area	9.0	-	-	-	-	-	1.9	1.0	1.6	9.6
Smolt Weir	-	8.3	-	-	-	-	1.9	-	2.6	5.8
Fish Pass	-	-	-	-	-	-	-	-	-	5.8
Olga Bay	-	-	-	-	-	-	-	-	0.5	5.8
<hr/>										
TOTAL PERCENT	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 11. Stream and beach surveys, Frazer Lake, 1966

Date	Location	Temp. °(F)	LIVE SOCKEYE				DEAD SOCKEYE				Total			
			Untagged	Tags Observed			Untagged	Tags Recovered						
				YY	RW	RR		RY	Natural Bear Kill	YY		RW	RR	RY
July 25	Stream 16	54°	4	-	-	-	-	1	-	-	-	-	-	5
July 26	Stream 15	52°	-	-	-	-	-	-	-	-	-	-	-	0
July 27	Stream 14	47°	-	-	-	-	-	-	-	-	-	-	-	0
July 27	Stream 13	47°	-	-	-	-	-	-	-	-	-	-	-	0
July 27	Stream 1	47°	308	177	113	427	5	3	86	6	4	6	0	1,135
July 28	Stream 7	47°	-	2	-	-	-	1	-	-	-	-	-	3
July 28	Stream 11	48°	-	-	-	-	-	-	-	-	-	-	-	0
July 29	Stream 12	48°	138	22	20	45	6	2	1	1	2	1	-	238
July 29	Beach near 12	48°	32	10	8	23	2	-	-	-	-	-	-	75
August 1	Stream 9	47°	5	-	-	2	1	-	1	-	-	-	-	9
August 3	Stream 10	47°	1,099	156	95	843	69	12	254	13	22	35	5	2,603
August 10	Stream 1	-	-	-	-	-	-	-	-	39	27	100	3	169
August 14	Stream 12	-	-	-	-	-	-	-	-	2	4	10	-	16
August 15	Stream 9	55°	-	-	-	-	-	-	-	-	-	-	-	0
August 15	Lake Beach Area	-	158	-	-	-	-	-	-	2	1	6	5	172
August 17	Stream 10	-	-	-	-	-	-	-	-	39	32	214	30	315
June 25-														
August 16	Smolt weir	-	-	-	-	-	-	33	-	2	-	10	3	48
July 27-														
August 2	Olga Bay	-	-	-	-	-	-	-	-	-	-	2	3	5
August 8-														
August 9	Fish Pass	-	-	-	-	-	-	-	-	-	-	-	3	3
TOTAL			1,744	367	236	1,340	83	52	342	104	92	384	52	4,796
PERCENT TOTAL			36.4	7.7	5.0	28.0	1.7	1.0	7.1	2.1	2.0	8.0	1.0	100.0

stream having 1,135 observed sockeye followed by stream 12 and stream 9. In 1965, the four major streams that contained the largest number of fish were 10, 1, 9, and 12, in that order.

A survey made on August 15 from a skiff yielded 172 observed sockeye beach spawning in the lake, an increase over last year when no sockeye were observed spawning on the beaches.

Five tags were caught in the Moser-Olga Bay set net fishery and returned to the Department. From the remarks on the tag recovery forms filled out by the fishermen, these fish were spawned or badly injured. These fish were tagged at the fish pass and due to their weakened condition very likely drifted over the falls and were lost downstream to Moser-Olga Bay. A few fish were observed spawning below the falls and in front of the smolt weir. It was believed last year that only Red Lake fish had spawned in front of the smolt weir, but this year numerous tags were observed in front of the weir indicating a preference of some Frazer Lake fish to spawn in and near the lake outlet.

Predation

Bear predation was heaviest on streams 1 and 10. The number of bear kills observed on stream 1 was 86 untagged and 49 tagged. On stream 10, 254 untagged and 250 tagged bear kills were observed and recovered. On stream 10, eight tags were recovered in one dropping of bear feces with lesser numbers recovered in other droppings. A total of 19 tags were recovered in bear feces on stream 10. A sow and two cubs were observed on stream 1. Three single bears were observed on the lake shores. Evidence of bear predation in all major spawning streams was observed, but no visual observations of bear were made except on stream 1.

Bear predation in 1966 appeared to be on the decrease from that observed in 1965 although there were more fish in the spawning streams.

Stocking Program

In 1966, much effort and time was expended in supplementing the Frazer Lake sockeye run. Methods that had previously been explored were again applied in 1966 (Table 12).

Table 12. Introduced species into Frazer Lake, 1966

Date	Species	Development Stage	Location	Number	Methods
June	<u>O. nerka</u>	Adult	Upper end of lake	4,728	Air transport
June	<u>O. tshawytscha</u>	Fry	Lake outlet	21,000	Air transport
June	<u>O. nerka</u>	Fry	Upper end of lake	602,700	Air transport
October	<u>O. nerka</u>	Eyed Eggs	Stream 9	600,000	Cylinder

Starting in June, a super cub was chartered to fly sockeye fry from the Kitoi Research Station hatchery to Frazer Lake (Figure 1). The flight usually originated in Kodiak. Kitoi Bay personnel were notified by radio when to expect the super cub. Upon arrival at Kitoi Bay, the live tanks were loaded with fry for transfer to Frazer Lake. The weather had to be flyable in all three locations before a successful trip could be completed. The trip required two to five hours depending on wind conditions.

On the first trip 20,000 fry were hauled with little or no mortality. On each additional trip, the number was increased until a maximum of 50,000 fry were moved successfully.

The fry were taken off feed for 24 hours prior to being transported to Frazer Lake. By denying feed to the fry nitrogenous wastes were kept at a minimum in the live tanks during transport time. This increased the number of fry that could be hauled successfully. After completion of the fry move, the super cub was used to carry adults from Red Lake to Frazer Lake. Weather conditions and small numbers of sockeye at Red Lake made the 1966 adult transplant of 4,728 fish lower than expected.

In early October, 600,000 eyed eggs were flown from the Kitoi Research Station hatchery via super widgeon. Planting was extremely difficult due to high water conditions in the stream, however, all eggs were successfully placed in the gravel. Petersen disc tags were placed in the redds to mark the locations. In early spring the redds will be examined for evidence of survival of mortality.

Moser-Olga Bay Fishery

In the Moser-Olga Bay complex (Figure 1), six streams have sockeye runs of importance. The major producer is Olga Creek on the Upper Station lakes. The Department of Fish and Game maintains an adult weir on Olga Creek and at Frazer Lake. Aerial counts are made on the other four streams. The Moser-Olga Bay catch and the Upper Station escapements are listed along with the Frazer Lake escapements (Table 13).

The sockeye returning to spawn in Frazer Lake must pass an extremely efficient set net fishery in the Moser-Olga Bay complex. This fishery in 1966 accounted for 63,334 fish or 90.6 percent of the total catch. At present there is no possible way of knowing the percentage of Frazer Lake fish taken

Table 13. Escapements and catch, Moser - Olga Bay fishery, 1956-1966^{1/}

Year	Upper Station Escapement	Frazer Lake Escapement	Combined Catch ^{3/}	Total
1956	185,257	6 ^{2/}	91,079	276,342
1957	73,207	165 ^{2/}	23,289	96,661
1958	87,848	71 ^{2/}	37,779	125,698
1959	92,895	62 ^{2/}	24,723	117,680
1960	45,193	440 ^{2/}	67,415	113,048
1961	73,884	273 ^{2/}	151,003	225,160
1962	39,531	1,290	124,497	165,318
1963	30,270	2,357	54,999	87,626
1964	37,249	8,166	48,055	93,470
1965	22,603	5,074	68,865	96,542
1966	44,931	11,728	69,939	126,598
TOTAL	732,868	29,632	761,643	1,524,143

^{1/} Alaska Department of Fish and Game Annual Reports

^{2/} Number carried over falls - escapement unknown

^{3/} Includes fish caught from the four other streams in Moser Bay.

in the fishery. This presents a rather difficult problem when attempting to assess the total productivity of Frazer Lake. Plans are now being formulated to solve this unknown by initiating a tag and recovery program.

It is possible that very few Frazer fish are caught during the even years as the opening date in Olga Bay is later than on odd years. For example: in 1964 the season was open July 13 and the run was very good, 8,000 sockeye. In 1965 the season opened June 21 and the escapement was 3,000 fish less than 1964. Whether the decrease was the result of the fishing pressure or of a natural consequence is unknown.

SUMMARY

1. Two hundred adult sockeye were sampled each week for age analysis. Of the 1,668 scales collected, 91 scales were unreadable due to regeneration, or 5.3 percent.
2. The escapement of 11,728 sockeye was the largest in Frazer Lake history.
3. The escapement consisted of 11 separate age classes with the 2.2 age comprising 57.1 percent.
4. Precocious males comprised 2.3 percent of the escapement.
5. Condition factors for males and females averaged 1.14 for the season.
6. It was found that 6.5 percent of 6,339 adult fish examined at the fishway had signs of injuries.
7. There were 16,455 fish in Frazer Lake in 1966; 6,339 of these were tagged.
8. There were 632 tags recovered and another 2,026 observed on the spawning grounds.
9. The tagging program showed indiscriminate mixing of tag color combinations on the spawning areas.

10. Stream surveys were made of all streams capable of supporting spawning sockeye. Major streams were surveyed twice at 2-week intervals.
11. Beach spawners were noted for the first time.
12. Bear predation appeared lighter in 1966 than 1965. Nineteen tags were recovered in bear feces and 639 bear kill sockeye were observed in streams 1 and 10.
13. Frazer Lake was stocked with 4,728 live adults, 600,000 fry and 600,000 eyed eggs.

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