

Informational Leaflet 77

FRAZER LAKE ADULT SOCKEYE INVESTIGATION,

1965

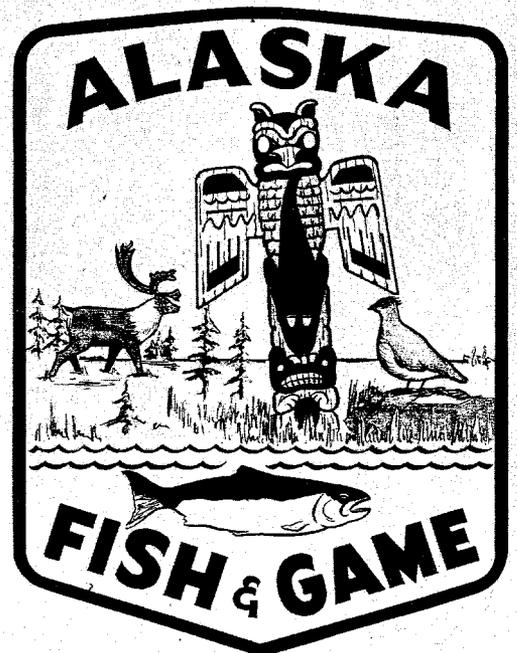
By:

Martin F. Eaton
Division of Commercial Fisheries
Research Section
Kodiak, Alaska

William R. Meehan
Division of Commercial Fisheries
Research Section
Kodiak, Alaska

April 15, 1966

STATE OF ALASKA
WILLIAM A. EGAN - GOVERNOR
**DEPARTMENT OF
FISH AND GAME**
WALTER KIRKNESS - COMMISSIONER
SUBPORT BUILDING, JUNEAU



FRAZER LAKE ADULT SOCKEYE INVESTIGATION, 1965

This investigation was financed by the Commercial Fisheries Research and Development Act (P.L. 88-309) for the period commencing July 8, 1965 under sub-project 5-7-R-1, Contract No. 14-17-0007-371.

TABLE OF CONTENTS

| | Page |
|---------------------------------------------|------|
| INTRODUCTION | 1 |
| PURPOSE | 3 |
| SAMPLING PROCEDURE | 3 |
| FISH ENUMERATION | 3 |
| AGE AND SIZE DISTRIBUTION OF ADULT MIGRANTS | 5 |
| CONDITION FACTOR | 9 |
| FRAZER LAKE WATER TEMPERATURES | 9 |
| STREAM SURVEYS | 9 |
| SUMMARY OF RESULTS | 13 |

FRAZER LAKE ADULT SOCKEYE INVESTIGATION, 1965

By

Martin F. Eaton, Fishery Biologist
Alaska Department of Fish and Game
Division of Commercial Fisheries
Research Section
Kodiak, Alaska

and

William R. Meehan, Fishery Biologist
Alaska Department of Fish and Game
Division of Commercial Fisheries
Research Section
Kodiak, Alaska

INTRODUCTION

Frazer Lake is located on the south end of Kodiak Island between two lake systems (Karluk Lake and Red Lake) which support large runs of sockeye salmon (Oncorhynchus nerka) (Figure 1). Until 1962, when fish passage facilities were installed by the Alaska Department of Fish and Game, Frazer Lake was blocked to salmon runs because of a 30-foot falls 1/2 mile below the lake outlet which stopped all fish passage into the lake.

In 1951 the first sockeye eggs were planted in one of the lake tributaries and plants of eggs, fry and/or spawning adults from nearby Red Lake have continued to be introduced as funds have allowed.

The first return of adult spawners from these plants occurred in 1956, when approximately 500 spawning adults returned to the base of the falls. However, due to extremely high water a collecting weir became inoperative and only six adults were trapped and carried over the falls.

Prior to construction of the fish passage facilities in 1962, returning adults were carried over the falls to continue their upstream migration.

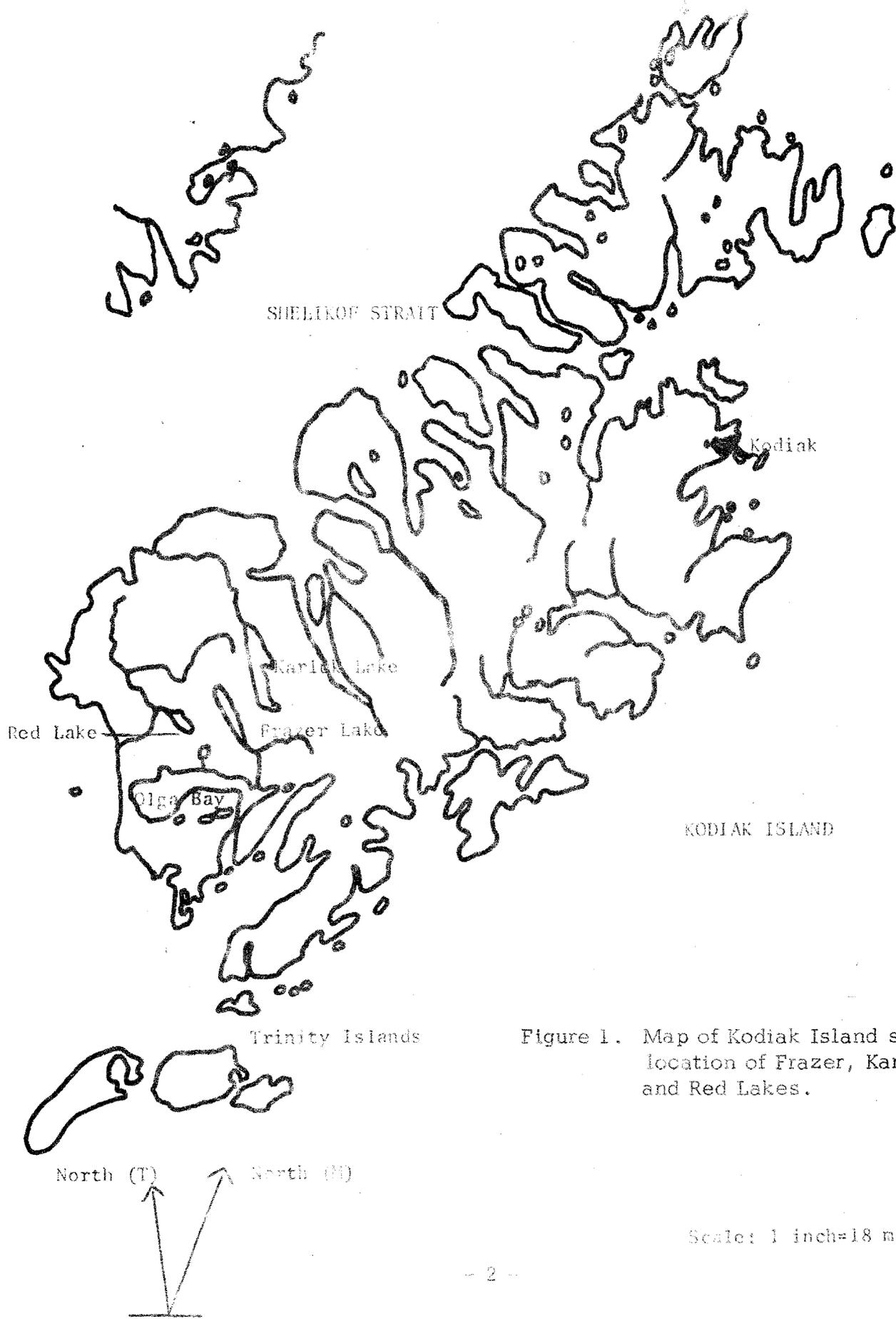


Figure 1. Map of Kodiak Island showing location of Frazer, Karluk, and Red Lakes.

Scale: 1 inch=18 miles

PURPOSE

The purpose of the 1965 adult sampling program was to enumerate and evaluate the returning spawners. Enumerations have been continuously made since 1956, but age, fork-length, sex and weight determinations have been limited or lacking. The data collected in 1965 will be compared and correlated with past data in a forthcoming comprehensive report.

SAMPLING PROCEDURE

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

All or a minimum of 25 adults were sampled daily to determine fork length and sex (visual determination) and a scale was taken from each of these fish for age analysis. Each week five males and five females in each 5-centimeter size group were weighed. The fish that were not sampled were counted and allowed to continue their upstream migration.

In conjunction with adult sampling, smolt sampling was conducted by means of a weir 1/4 mile upstream. Facilities were installed at the smolt weir to sample adults, but proved to be inadequate for adult capture. All adult sampling was then executed at the fish pass but the fish were also counted through the weir as a check against the count made at the fish pass.

The adipose fins of 293 male sockeye were clipped at the sampling station. The clips furnished identifying marks that were useful in two ways: (1) if there was a tendency for adults to drop over the falls once they had been sampled, the fish with clipped adipose fins would be easily recognizable on their second journey up the fish pass and would not be counted twice, and (2) the clipped adipose fins would help distinguish Frazer fish from transplanted Red Lake spawners in the spawning streams.

FISH ENUMERATION

In 1965 the first adult passed through the ladder on June 12 and the last fish in early September. Figure 2 shows the numbers and timing of the migration. The run showed two distinct apexes with a sharp peak in early July and a larger

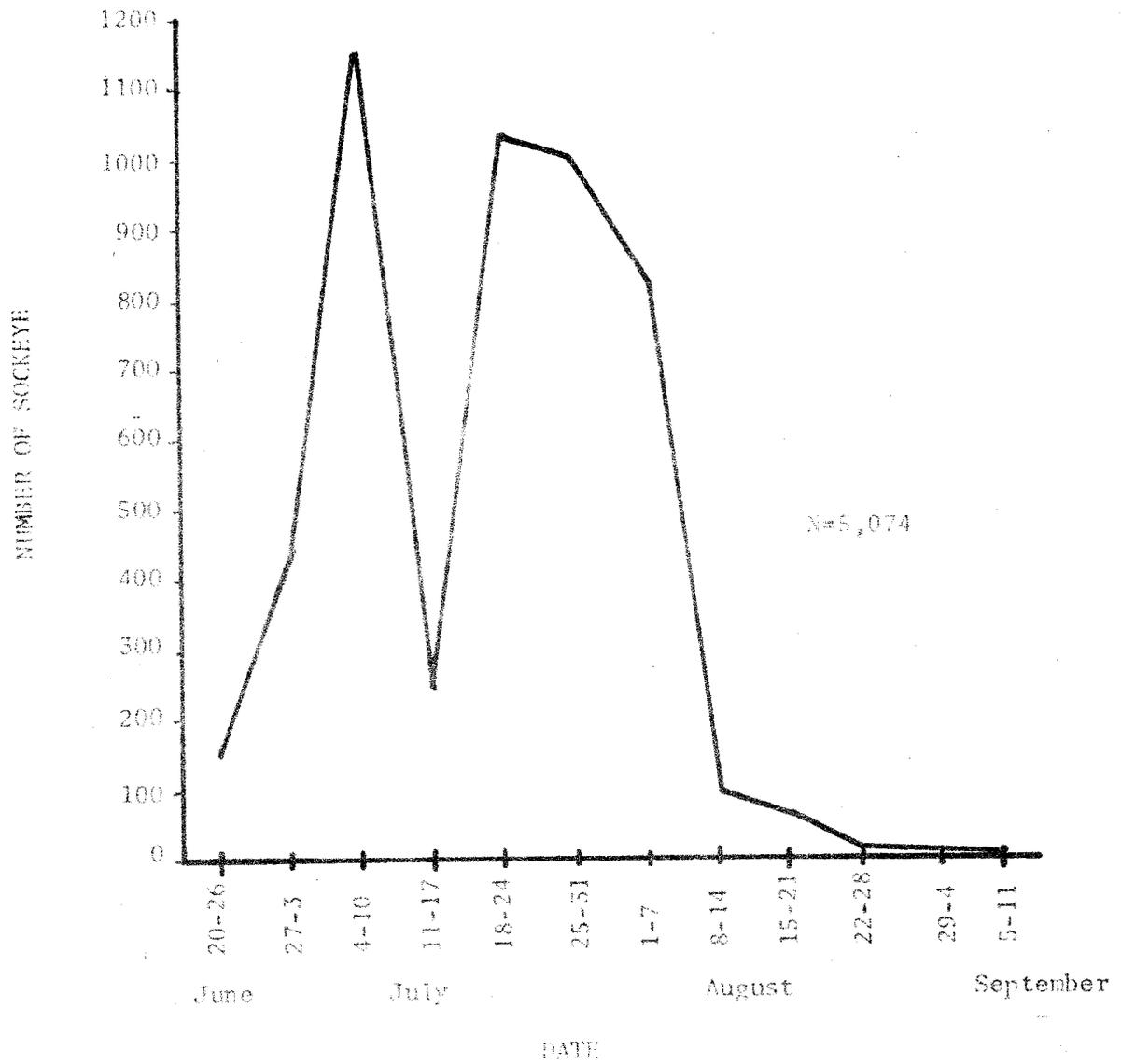


Figure 2. Migration and timing of upstream migrants, Frazer Lake, 1965.

and more prolonged peak from mid-July to the first week in August. Whether this bimodal run reflected two separate spawning stocks or environmental factors, e.g. low water, is unknown at this time.

The count of returning spawners has shown an upward trend for the years 1956 to 1965 with 500 adults in 1956 and 5,074 adults in 1965. Barring any severe natural mortality the run should continue to increase in the coming years.

The results of the adipose clip showed that the sockeye, once through the ladder, did not drop back over the falls and ascend the fish pass again. Only one missing adipose fin was observed on a fish entering the ladder and this mark was considered questionable.

The Frazer Lake tributaries and beaches were surveyed for amount and suitability of spawning area in 1952 and it was estimated that the lake had suitable spawning area for 100,000 sockeye.^{1/} This estimate is now believed conservative and it will probably be several years before optimum density can be approached by means of a stocking program.

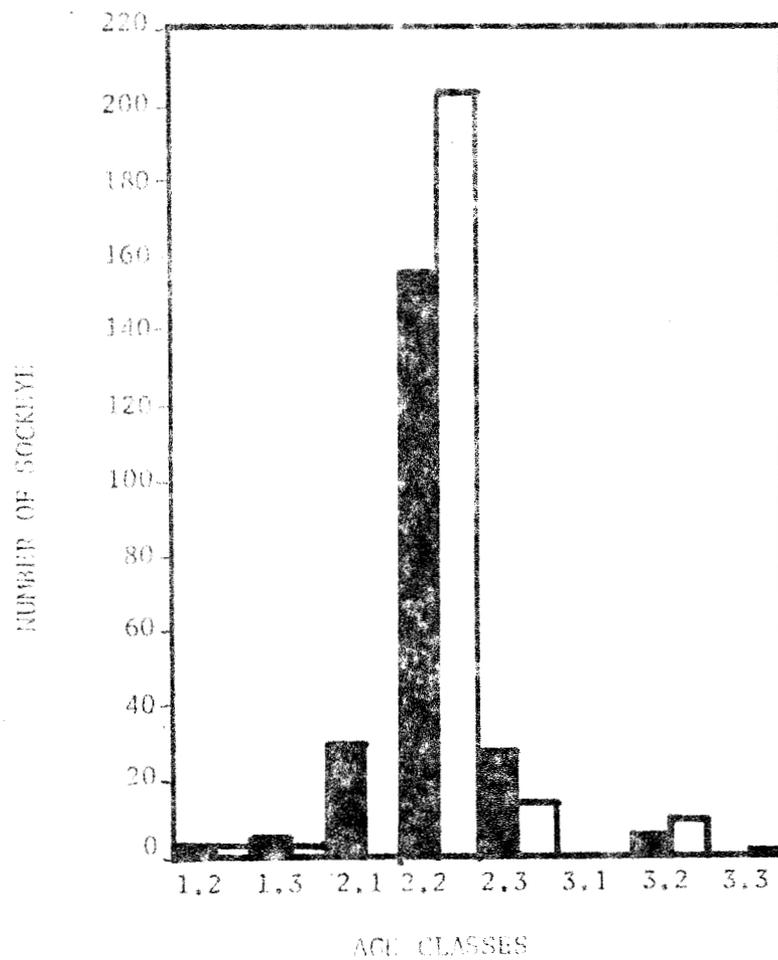
AGE AND SIZE DISTRIBUTION OF ADULT SPAWNERS

Scale analysis showed that the sockeye escapement in 1965 consisted of eight separate groups (Figure 3, Table 1). The dominant age group was 2.2, i.e., fish that spent two summers in fresh water, migrated to sea in their third year, and returned to spawn in their fifth year after spending two years at sea. Approximately 93.5 percent of the 1965 adults had spent two years in fresh water before migration seaward. Females were smaller than the males in all age groups ranging from 1.0 percent to 3.2 percent smaller.

The dominant size group in the 1965 Frazer Lake sockeye escapement was 540-559 millimeters, fork length, for females and 560-579 millimeters for males (Figure 4). One age group (2.2) accounted for the great majority of the fish in the migration which explains the apparent lack of more than one age group in the length-frequency histogram, the exception being the precocious males (jacks) in the size groups of 450 millimeters or smaller.

^{1/} Field notes of Clint Stockley, Alaska Department of Fish and Game.

Figure 3. Age distribution of adult male and female sockeye salmon, Frazer Lake, 1965.



Male (N=220)
Female (N=234)

TABLE 1. AGE COMPOSITION AND LENGTH ^{1/} OF MALE AND FEMALE SOCKEYE SALMON ESCAPEMENT, FRAZER LAKE, 1965 ^{2/}

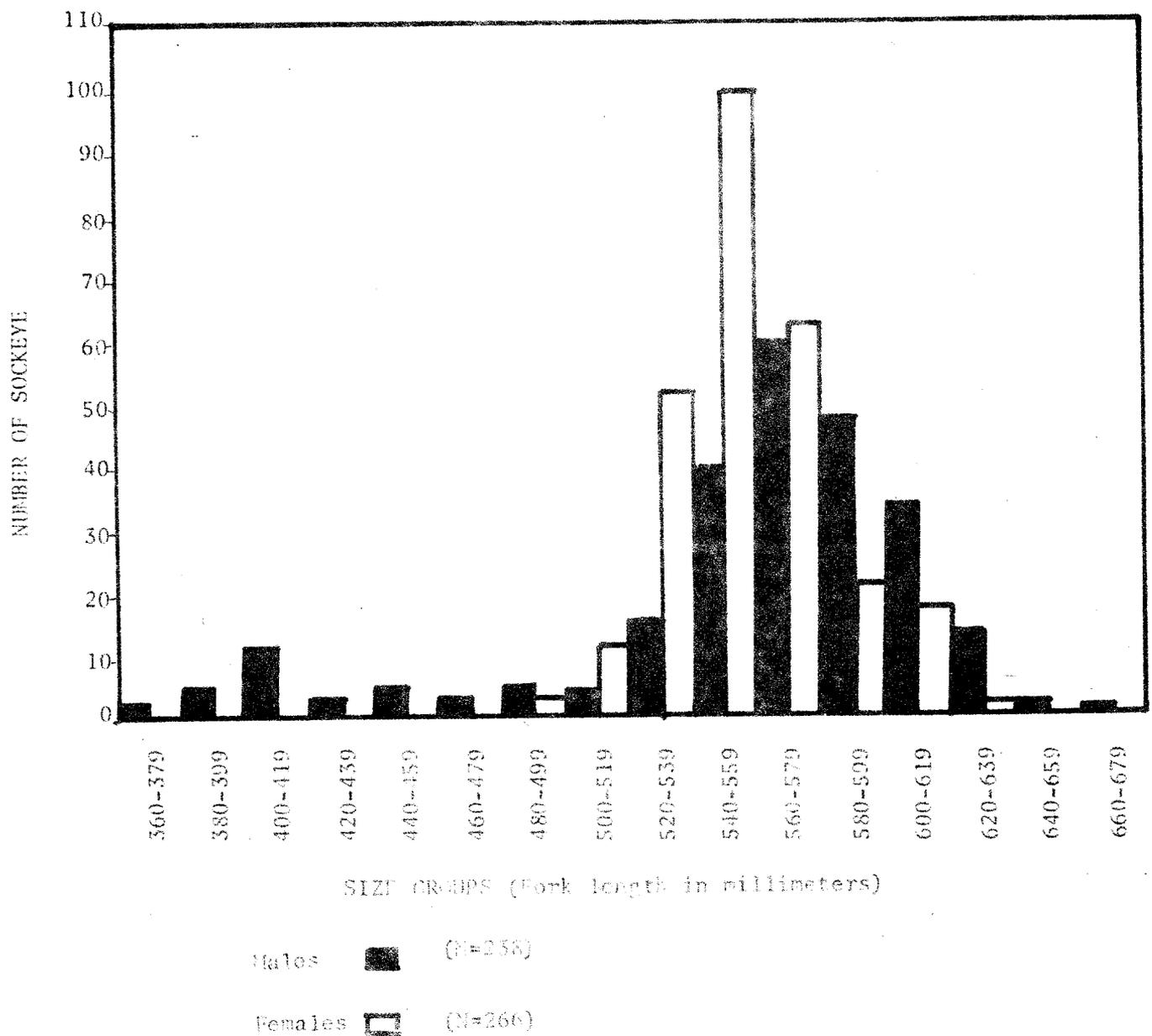
| | AGE GROUP | | | | | | | | Total or Average |
|------------------------------------|-----------------------|-------|-------|-------|-------|-------|-------|-------|---------------------|
| | 1.2 | 1.3 | 2.1 | 2.2 | 2.3 | 3.1 | 3.2 | 3.3 | |
| | <u>Combined Sexes</u> | | | | | | | | |
| Number of Fish | 43 | 87 | 329 | 3,956 | 460 | 12 | 175 | 12 | 5,074 |
| Percent of escapement | 0.9 | 1.7 | 6.5 | 78.0 | 9.0 | 0.2 | 3.5 | 0.2 | 100.0 |
| | <u>Males</u> | | | | | | | | |
| Number of fish | 2 | 5 | 30 | 156 | 27 | 1 | 4 | 0 | 225 |
| Mean length | 526.0 | 579.6 | 423.9 | 564.2 | 617.6 | 495.0 | 594.5 | - | 543.0 ^{3/} |
| Percent of escapement | 0.5 | 1.1 | 6.5 | 34.3 | 5.9 | 0.2 | 0.9 | - | 49.4 |
| | <u>Females</u> | | | | | | | | |
| Number of fish | 2 | 3 | 0 | 206 | 18 | 0 | 0 | 1 | 230 |
| Mean length | 520.5 | 561.0 | - | 550.2 | 597.6 | - | - | 600.0 | 565.9 ^{3/} |
| Percent of escapement | 0.5 | 0.7 | - | 45.3 | 3.9 | - | - | 0.2 | 50.6 |
| | <u>Differences</u> | | | | | | | | |
| Mean difference | 5.5 | 18.6 | - | 14.0 | 20.0 | - | - | - | 14.5 ^{3/} |
| Percent females smaller than males | 1.0 | 3.2 | - | 2.4 | 3.2 | - | - | - | 2.5 ^{3/} |

^{1/} Fork length in mm.

^{2/} Based on analysis of scales taken from 463 fish throughout migration.

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

Figure 4. Length-frequency distribution of sockeye salmon escapement, Frazer Lake, 1965.



CONDITION FACTOR

Condition factors for both male and female adults were relatively high (Table 2). The mean condition factor was 1.08 for males and 1.10 for females. The condition factor of males tended to decrease somewhat during the season, while female condition factor increased slightly. These observations indicated that sockeye condition factors were high even after their 8-mile journey from salt water and energy expenditure at the falls. Instead of entering the fish pass immediately the sockeye had a tendency to jump at the falls, many of them sustaining injuries. As soon as jumping ceased, mass migration up the pass occurred. Salmon usually moved up the pass in large groups and on sunny afternoons.

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 on a battery-operated thermometer. In all instances the bottom of the lake was not reached. The temperatures that appear on Figure 5 are averages from the four sampling stations.

The first temperatures were taken July 8 and at that time only a 2-degree difference existed from surface to 46 meters. Temperatures taken throughout the field season indicated that Frazer Lake, an oligotrophic lake, lacked a definite thermocline during 1965. The absence of a thermocline in the lake could have been caused by the wind. The lake is long and narrow, bounded on both shores by mountain ranges and the winds are constantly funneled over the lake between the mountains during the summer months. The winds could have, therefore, affected the water mass, keeping the water in a state of constant motion and mixing, thus preventing stratification.

STREAM SURVEYS

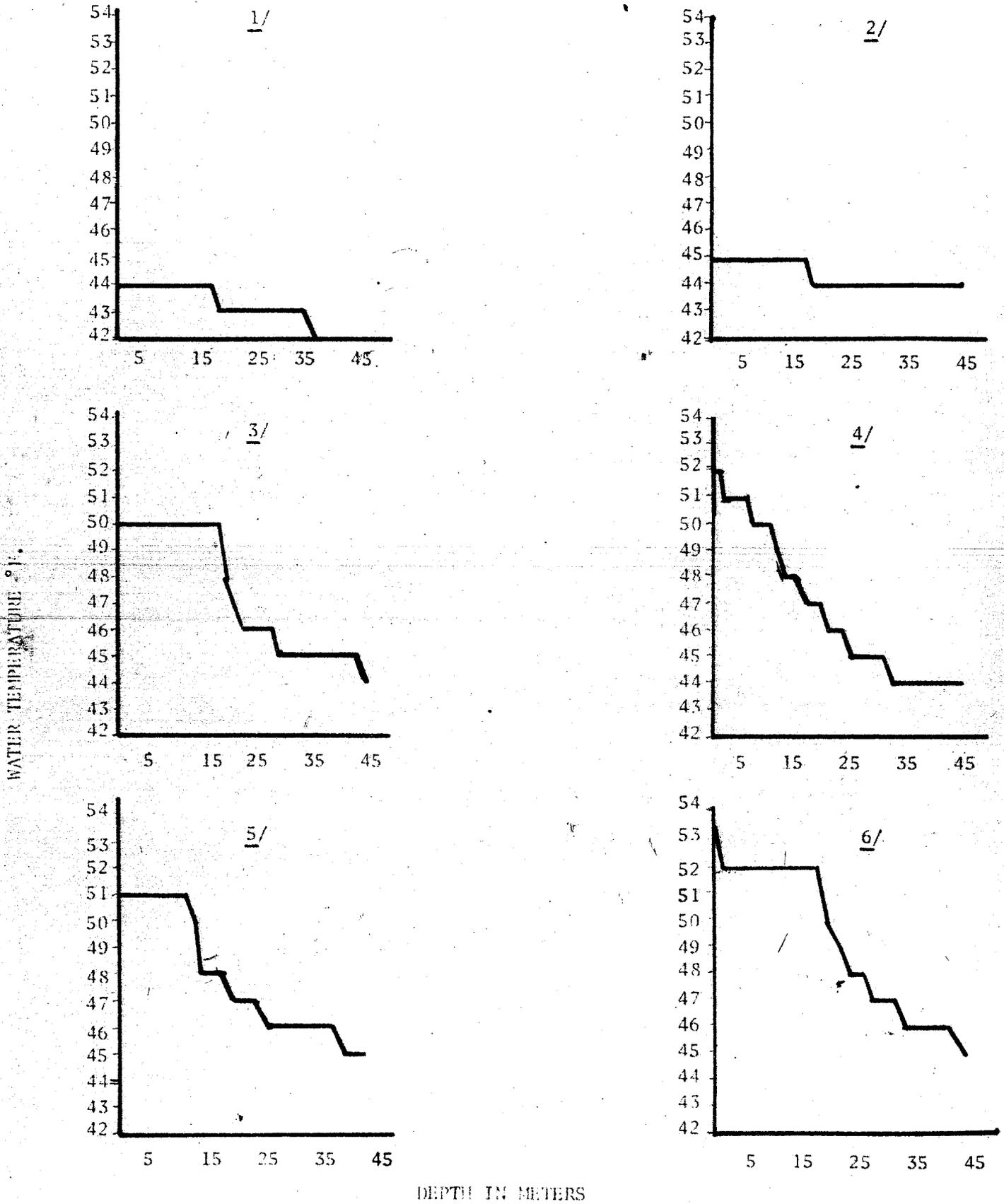
Surveys were made during peak spawning periods of the four major spawning streams emptying into Frazer Lake and the outlet stream (Dog Salmon River) above the smolt weir (Table 3). The number of salmon in each of the inlet streams was nearly proportional to the size and spawning area of the stream.

Bear activity in 1965 appeared to be greater than in 1964. In 1964, bear trails along the stream banks were absent or newly-formed. In 1965, trails followed both stream banks on all streams and were well-used. Bears were observed on every stream in 1965.

TABLE 2. AVERAGE WEEKLY CONDITION FACTOR (K) FOR MALE AND FEMALE SOCKEYE SALMON, FRAZER LAKE, 1965.

| Date | Average condition factor (K) and sample size (N). | | | |
|---------------|---------------------------------------------------|-----|---------|----|
| | Males | | Females | |
| | K | N | K | N |
| June 12 - 18 | 1.09 | 2 | 0 | 0 |
| 19 - 25 | 0 | 0 | 0 | 0 |
| July 26 - 2 | 1.09 | 22 | 1.11 | 13 |
| 3 - 9 | 1.12 | 17 | 1.09 | 15 |
| 10 - 16 | 1.10 | 16 | 1.10 | 11 |
| 17 - 23 | 1.10 | 24 | 1.10 | 12 |
| 24 - 30 | 1.07 | 22 | 1.11 | 14 |
| August 31 - 6 | 1.06 | 16 | 1.12 | 13 |
| 7 - 13 | 0 | 0 | 0 | 0 |
| 14 - 20 | 1.07 | 5 | 1.10 | 10 |
| Seasonal | 1.08 | 124 | 1.10 | 88 |

Figure 5. Mean water temperatures, Frazer Lake, 1965.



| | |
|------------|--------------|
| 1/ July 8 | 4/ August 4 |
| 2/ July 17 | 5/ August 13 |
| 3/ July 28 | 6/ August 31 |

TABLE 3. SPAWNING STREAM SURVEY AND NUMBER OF TAG RECOVERIES IN FRAZER LAKE SYSTEM, 1965

| INLET STREAM-SURVEY | | | | | | | | | | | | |
|---------------------|------------|--------------|------|--------------|--------|---------|-----------|--------|-----------|--------|-----|-----|
| Date | Stream No. | Temp. (° F.) | Live | Dead-Natural | | | Bear Kill | | Tags | | | Tot |
| | | | | Male | Female | Unknown | Male | Female | Frazer L. | Red L. | | |
| 8/6 | 9 | 54 | 183 | 0 | 14 | 34 | 26 | 20 | 4 | 6 | 28 | |
| 8/7 | 12 | 54 | 40 | 0 | 0 | 3 | 3 | 0 | 0 | 0 | 4 | |
| 8/9 | 1 | 57 | 54 | 16 | 25 | 229 | 128 | 107 | 1 | 5 | 56 | |
| 8/11 | 10 | 46 | 586 | 24 | 4 | 116 | 86 | 48 | 9 | 3 | 87 | |
| Total | | | 863 | 40 | 43 | 382 | 243 | 175 | 14 | 14 | 177 | |
| Percent Total | | | 48.6 | 2.3 | 2.4 | 21.5 | 13.7 | 9.9 | 0.8 | 0.8 | 100 | |

| OUTLET STREAM - WEIR CARCASS COUNT | | | | | | | | | | | |
|------------------------------------|-------------------|---------|---------------|-----------|-------|-----------|-----------|--------|------|-----|--|
| Date | Ave. Temp. (° F.) | Females | | | Males | Bear Kill | Tags | | | Tot | |
| | | Spawned | Partially Sp. | Unspawned | | | Frazer L. | Red L. | | | |
| July 31-6 | 52.5 | 3 | 0 | 7 | 2 | 0 | 0 | 0 | 0 | 12 | |
| July 7-13 | 51.5 | 7 | 3 | 15 | 29 | 2 | 0 | 1 | 57 | | |
| July 14-20 | 51.5 | 36 | 3 | 3 | 33 | 25 | 0 | 4 | 104 | | |
| Aug 21-27 | 51.0 | 2 | 1 | 1 | 3 | 0 | 0 | 0 | 7 | | |
| Aug 28-9/3 | 52.0 | 2 | 0 | 1 | 1 | 0 | 0 | 0 | 4 | | |
| Sept 4-9 | 49.5 | 2 | 0 | 1 | 1 | 0 | 0 | 1 | 5 | | |
| Total | | 52 | 7 | 28 | 69 | 27 | 0 | 6 | 189 | | |
| Percent Total | | 27.5 | 3.7 | 14.8 | 36.5 | 14.3 | 0 | 3.2 | 100. | | |

The total number of sockeye spawners in Frazer Lake in 1965 was 9,074; 4,000 of these were transplanted from Red Lake and 5,074 ascended the fish passage facilities into Frazer Lake. In an effort to obtain some indication of spawning ground utilization and preference by the two stocks of fish, 172 Red Lake fish were tagged with red and white Petersen disc tags, and 81 Frazer Lake fish were tagged with Petersen yellow and red tags (Table 3).

Each year since 1961, sockeye adults have been transplanted from Red Lake to Frazer Lake. The percentage of these which actually spawned in Frazer was unknown until 1965, when the construction of the smolt weir prevented transplanted Red Lake fish from backing out of the system. That the weir actually did prevent this "backing-out" in 1965 was demonstrated when approximately 500 sockeye were observed in front of the weir. These were Red Lake fish, since the Frazer fish had not yet begun to enter the lake and nine Red Lake tags were observed within the school. The Red Lake fish gradually dispersed, and probably eventually spawned either in the stretch of Dog Salmon Creek above the weir or in the inlet streams.

Beginning on August 7, the 189 sockeye carcasses which floated down onto the screens of the weir were examined (Table 3). These fish spawned upstream from the weir and in a small tributary 100 yards upstream from the weir. The percentage of spawned female salmon was 58.4 percent compared to 31.5 percent which did not spawn and 10.1 percent which had only partially spawned.

SUMMARY OF RESULTS

1. From the first 500 returning spawners in 1956 the Frazer Lake run has increased to 5,074 sockeye in 1965.
2. Condition factors averaged 1.08 for male sockeye and 1.10 for females.
3. The majority of returning spawners were age 2.2.
4. Frazer Lake lacked a thermocline in 1965.
5. The number of spawners in the streams was in proportion to the available spawning area.
6. Bear activity on the tributary streams was greater in 1965 than in 1964.
7. Approximately 4,000 Red Lake fish were transported into Frazer Lake in 1965.
8. Installation of the smolt weir is believed to have prevented introduced Red Lake spawners from leaving the Frazer Lake system.

The Alaska Department of Fish and Game administers all programs and activities free from discrimination based on race, color, national origin, age, sex, religion, marital status, pregnancy, parenthood, or disability. The department administers all programs and activities in compliance with Title VI of the Civil Rights Act of 1964, Section 504 of the Rehabilitation Act of 1973, Title II of the Americans with Disabilities Act of 1990, the Age Discrimination Act of 1975, and Title IX of the Education Amendments of 1972.

If you believe you have been discriminated against in any program, activity, or facility, or if you desire further information please write to ADF&G, P.O. Box 25526, Juneau, AK 99802-5526; U.S. Fish and Wildlife Service, 4040 N. Fairfax Drive, Suite 300 Webb, Arlington, VA 22203 or O.E.O., U.S. Department of the Interior, Washington DC 20240.

For information on alternative formats for this and other department publications, please contact the department ADA Coordinator at (voice) 907-465-6077, (TDD) 907-465-3646, or (FAX) 907-465-6078.