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STATE OF ALASKA

William A. Egan, Governor



ANNUAL REPORT OF PROGRESS, 1963 - 1964

FEDERAL AID IN FISH RESTORATION PROJECT F-5-R-5

SPORT FISH INVESTIGATIONS OF ALASKA

ALASKA DEPARTMENT OF FISH AND GAME

Walter Kirkness, Commissioner

E. S. Marvich, Deputy Commissioner

Alex H. McRea, Director

Alaska, Sport Fish Division

Louis S. Bandirola, Coordinator

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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-5-R-5, "Sport Fish Investigations of Alaska."

The project is composed of 25 separate studies designed to evaluate the various aspects of the State's recreational fishery resources. Of these, eight jobs are designed to continue the cataloging and inventory of the numerous State waters in an attempt to prepare an index of the recreational waters. Four jobs are designed for specific sport fishery creel census while the remainder of the jobs are more specific in nature. These include independent studies on king salmon, silver salmon, grayling, Dolly Varden, a statewide access evaluation program, egg take program and a residual toxaphene study. The information gathered from the combined studies will provide the necessary background data for a better understanding of local management problems and assist in the development of future investigational studies.

The subject matter contained within these reports is often fragmentary in nature. The findings may not be conclusive and the interpretations contained therein are subject to re-evaluation as the work progresses.

JOB COMPLETION REPORT

RESEARCH PROJECT SEGMENT

STATE: ALASKA Name: Sport Fish Investigations of Alaska.

Project No: F-5-R-5 Title: Silver Salmon Studies in the Resurrection Bay Area.

Job No: 7-B-1

Period Covered: July 1, 1963 to June 30, 1964.

Abstract:

Information is presented on the distribution, timing and abundance of silver salmon in the Resurrection Bay drainages. In this area 860 adults were enumerated in 7 major streams. At the Bear Creek weir 7,208 smolt were captured and fin clipped. Seaward migration of smolt did not commence until the breakup of lake ice and the temperature of the water reached 39.5°F. Information is also presented on the seaward migration of red salmon smolt and Dolly Varden. Creel census at the Seward small boat harbor showed an estimated 7,293 silver salmon were taken in 15,430 man-days of effort. The commercial harvest was 2,250 fish. An estimated 1.72 per cent of the silver salmon smolt marked in the out-migration of 1962 at Bear Creek returned as adults in 1963. The marked fish catch-to-escapement ratio in the Resurrection Bay was 1.5:1. Age determinations made for silver salmon smolt from Bear Creek showed 71 per cent migrated to sea in their third year of life. The dominant age group of adult silver salmon in Resurrection Bay was 43's and comprised 75.4 per cent of the sample. A brief description of the Bear Lake rehabilitation is presented.

Recommendations:

1. Retain the present objectives of the study.

2. Evaluate the success of the Bear Lake rehabilitation for improving juvenile silver salmon rearing. This will be accomplished by measuring the production of smolt which result from the restocking with fry.

3. Explore the possibility of establishing a small, artificial spawning channel on one of the inlets of Bear Lake to increase the spawning area for silver salmon.

Objectives:

To collect and analyze biological data concerning the distribution, abundance and timing of adult and juvenile silver salmon in the Resurrection Bay area.

To determine the age composition of these adult and juvenile silver salmon.

To determine the sport and commercial harvest of silver salmon in Resurrection Bay.

To investigate the environmental limitations of the juvenile silver salmon in this system and provide recommendations for management practices.

To determine the methods and means to increase or extend the fresh water rearing areas of the watershed.

Techniques Used:

Silver salmon sport harvest and effort in Resurrection Bay was determined by creel census at the Seward small boat harbor and enumeration of boats in Resurrection Bay. The sampling method used is similar to that outlined by Neuhold and Lu (1957). Three of the five weekdays and all weekend days were sampled, but weekdays and weekends were treated separately in the analysis. The length of the fishing day, 18 hours, was divided into three 6-hour periods. Prior studies on the Bay have shown there is very little fishing between the hours of 2200 and 0400 and boat anglers fished an average of about 6 hours a day. Each of the three daily periods was further divided into six 1-hour periods. Approximately 1 hour was required to enumerate all boats, using a 21-foot skiff, from the boat harbor to Renard Island which delimits the area of nearly all silver salmon fishing. Two boat counts

were conducted on each census day when weather permitted and were stratified on the basis of each daily and hourly period. Completed fishermen were interviewed at the small boat harbor to determine the number of silver salmon caught and the hours of effort expended.

Fishing effort for the season was determined by expanding the mean number of fishermen per count by the total possible fishing hours in the season. Total harvest was computed by multiplying the total fishing pressure in fishermen hours by the average catch per hour.

Escapement was determined by periodic foot surveys on all major silver salmon streams except the Resurrection River. Dead silver salmon were mutilated to prevent re-counting on subsequent surveys. The Bear Creek weir was operated during the downstream migration of all salmonoids from Bear Lake and the red salmon upstream migration. Downstream migrants were captured by a modified Wolf trap constructed on the weir.

Silver salmon scale samples, lengths and weights were collected at the Bear Creek weir, Bear Lake and from the commercial catch in Resurrection Bay. Age determinations were made using a micro-projector after the scales had been impressed on 0.02-inch thick cellulose acetate.

Findings:

The Resurrection Bay area has been described in earlier reports by Dunn (1961) and Logan (1962).

Silver Salmon Harvest and Effort

The Resurrection Bay creel census which extended from July 17 to September 10 sampled nearly all the fishing effort on silver salmon. The total sport harvest was estimated at 7,293 silver salmon. This estimate was based on interviews with 3,839 anglers which had taken 1,725 silver salmon. This year's catch was approximately half of the 1962 catch of 14,482 fish (TABLE 1). The harvest followed the pattern of previous years by gradually building up to a peak during the middle of August when the Seward Silver Salmon Derby occurred and then dropping off sharply until it ceased in late September. The Derby lasted 5 days (August 10, 12, 16, 17, 18) and accounted for 2,699 fish (37.0 per cent of the total catch).

The commercial harvest in Resurrection Bay (Statistical Area 231-30), based on cannery fish tickets, was 2,250 silver salmon, 1 red salmon and 11 pink salmon. All fish were taken by purse seiners and the silver salmon catch per boat was 107.1. This is less than half the 1962 catch per boat of 245.8. For the past 2 years the commercial catch has constituted 21.3 to 23.6 per cent of the total harvest (TABLE 1).

TABLE 1. Resurrection Bay silver salmon sport and commercial harvests from 1961 to 1963.

Year	Total Harvest	Sport Harvest	Per Cent of Total	Commercial Harvest	Per Cent of Total
1961	-	5,504	-	No Record	-
1962	18,405	14,482	78.7	3,923	21.3
1963	9,543	7,293	76.4	2,250	23.6

The total sport fishing effort was estimated at 15,430 man-days with 24.9 per cent of the fishermen being contacted. This effort was the highest recorded and has increased 157 per cent from the first complete census made in 1961. The 1963 Derby was the largest thus far with 2,625 tickets sold (TABLE 2). This was a 139 per cent increase from its inception in 1956. The total effort, Derby effort, catch per hour and period of census for the past 3 years are shown in TABLE 3. Military personnel fishing from boats provided by the Army and Air Force recreation camps at Seward accounted for about 20 per cent of the total effort.

Nearly all fishing was done from boats and 81 per cent of the fishing pressure was on weekend days. A catch per hour of 0.07 was the lowest recorded. The mean number of fishermen per 1-hour count was 138.5 on weekends and 23.4 on weekdays. The average number of fishermen per boat was 2.9 and the mean number of hours fished per angler was 5.9, except during the Derby when it increased to 8.7.

TABLE 2. Number of tickets sold for the Seward Silver Salmon Derby from 1956 to 1963.

Year	Number of Tickets
1956	1,100
1957	1,400
1958	1,562
1959	2,273
1960	1,700
1961	2,200
1962	2,400
1963	2,625

TABLE 3. The Resurrection Bay silver salmon total sport effort, Salmon Derby effort, catch per hour and period of census from 1961 to 1963.

Year	Total Effort	Derby Effort	Catch Per Hour	Period of Census
1961	6,002	2,870	0.10	7/11 - 9/9
1962	11,377	5,435	0.17	7/7 - 9/7
1963	15,430	7,478	0.07	7/17 - 9/10

Bear Creek Weir

The Bear Lake system was selected for intensive study of juvenile silver salmon because it is an important spawning and rearing area. The timing and abundance of out-migrating salmonoids from the system was measured by a modified Wolf trap constructed across Bear Creek, the outlet of Bear Lake, from May 11 to June 30. The Wolf trap was checked daily at approximately 0600, 1300 and 2000.

The first silver salmon smolt was captured May 21 and a few were still migrating downstream when the Wolf trap

was removed on June 30. The seasonal timing of the smolt migration is shown in FIGURE 1-A. A total of 7,208 smolt was captured with 97 (1.3 per cent) found dead in the trap. The smolt were marked to provide an estimate of the total Resurrection Bay adult run and to measure the fishing and natural mortality. The left pelvic and adipose fins were clipped after the fish were anesthetized with 1:10,000 MS-222. Fish were held in live boxes until recovery and then released downstream.

Various workers on red salmon investigations have noted that seaward migration followed shortly after breakup of lake ice and that cessation of seaward migration has been related to increasing minimum water temperatures, usually about 50°F. The date of ice breakup in Bear Lake, water temperatures and timing of silver salmon smolt migration for 1962 and 1963 is shown in FIGURE 2. Comparison of the two years indicates climate is an important factor in determining time of seaward migration. Downstream movement did not begin until the ice had broken up and the water reached 39.5°F. Ninety per cent of the migration occurred between 41 and 56°F. This suggests silver salmon may have greater temperature tolerance limits than red salmon, whose migration is usually terminated at 50°F.

The coefficient of condition (K) was determined for silver salmon smolt using the condition alignment charts presented in Carlander (1950). Fork length was used instead of standard length. The coefficient of condition for 68 smolt in 1962 was 1.08 and for 70 smolt in 1963 was 1.03. The length-weight relationship for silver salmon smolt with the curve fitted by inspection is presented in FIGURE 3.

The first red salmon smolt was captured on May 19 and a small number were still being taken on June 30, when the trap was removed. The seasonal timing of their downstream migration is presented in FIGURE 1-B. A total of 33,908 smolt was captured with 9.1 per cent found dead. This high mortality is believed to be due to crowding in the receiving box on nights when large smolt migrations coincided with those of Dolly Varden. The mean fork length of 273 smolt was 84.4 mm with a range of 49 to 132 mm.

Dolly Varden were the earliest downstream migrants, occurring at the trap on May 11. The seasonal timing of

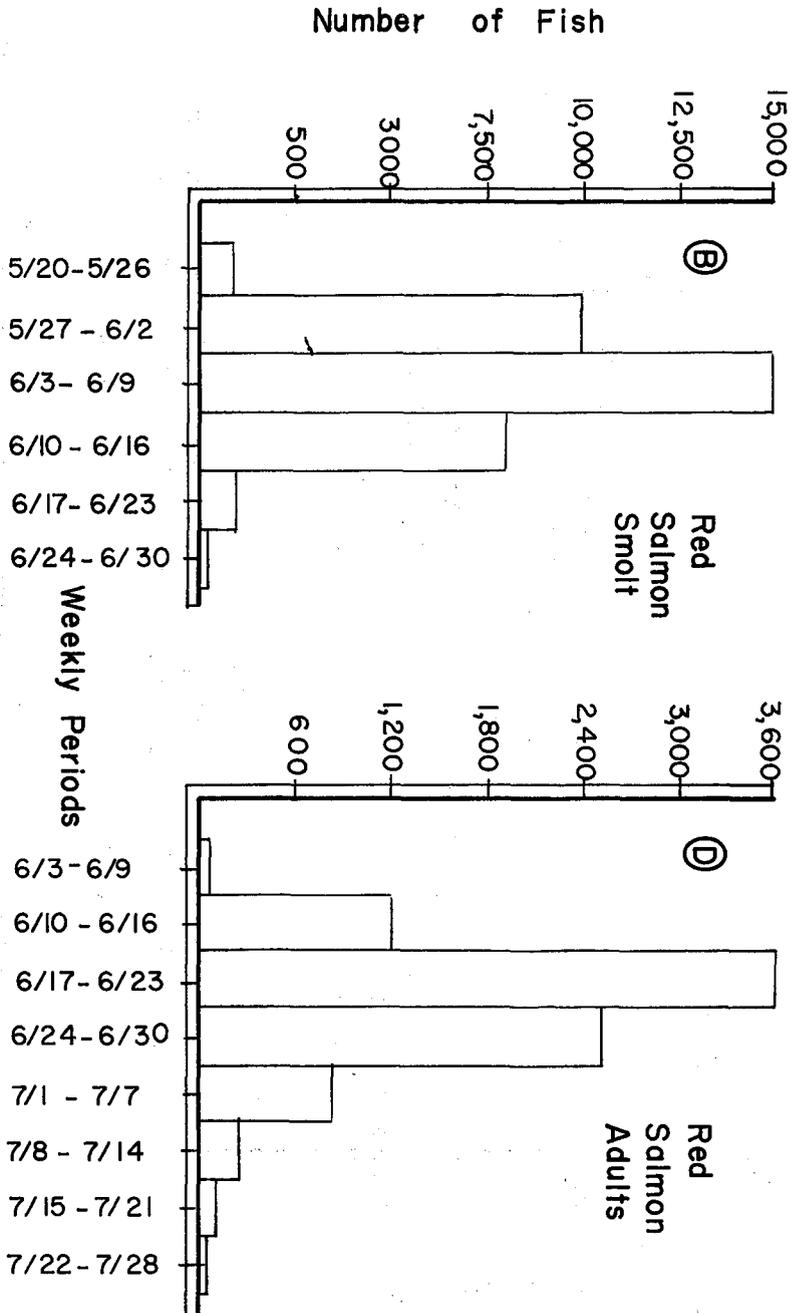
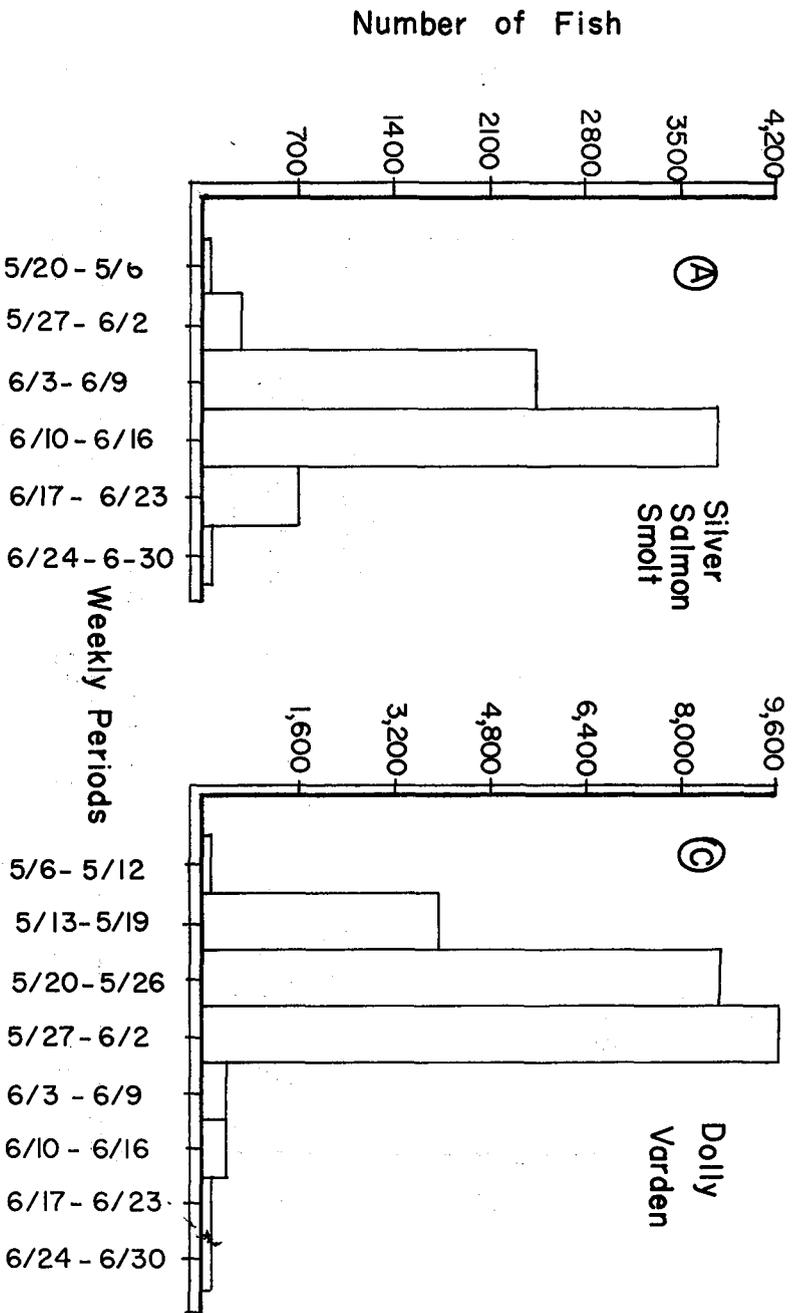


Figure 1. Timing of salmonid fishes by weekly periods at the Bear Creek weir in 1963.

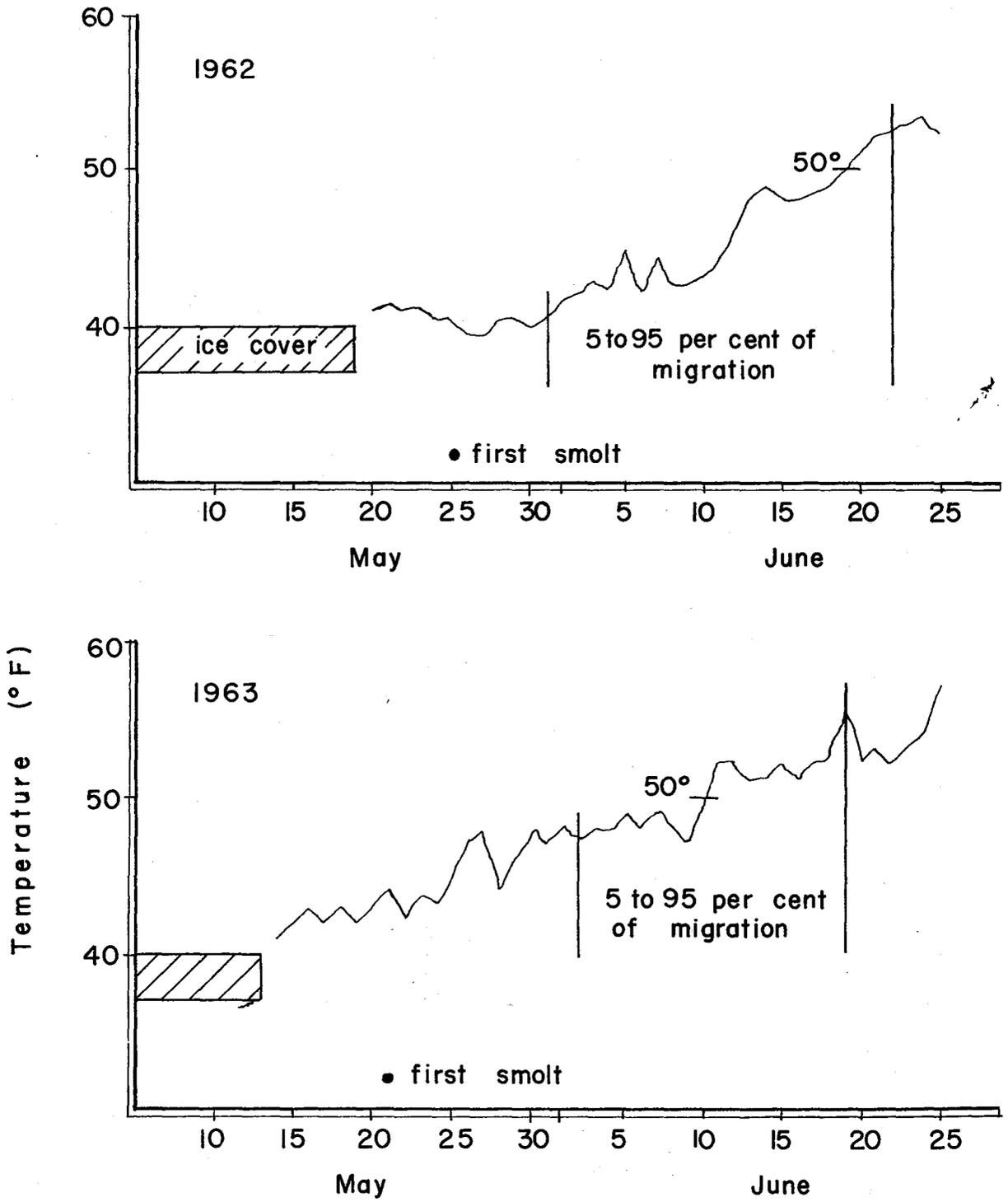


Figure 2. Ice breakup on Bear Lake, water temperatures and period between dates that 5 and 95 per cent of silver salmon smolt migration occurred.

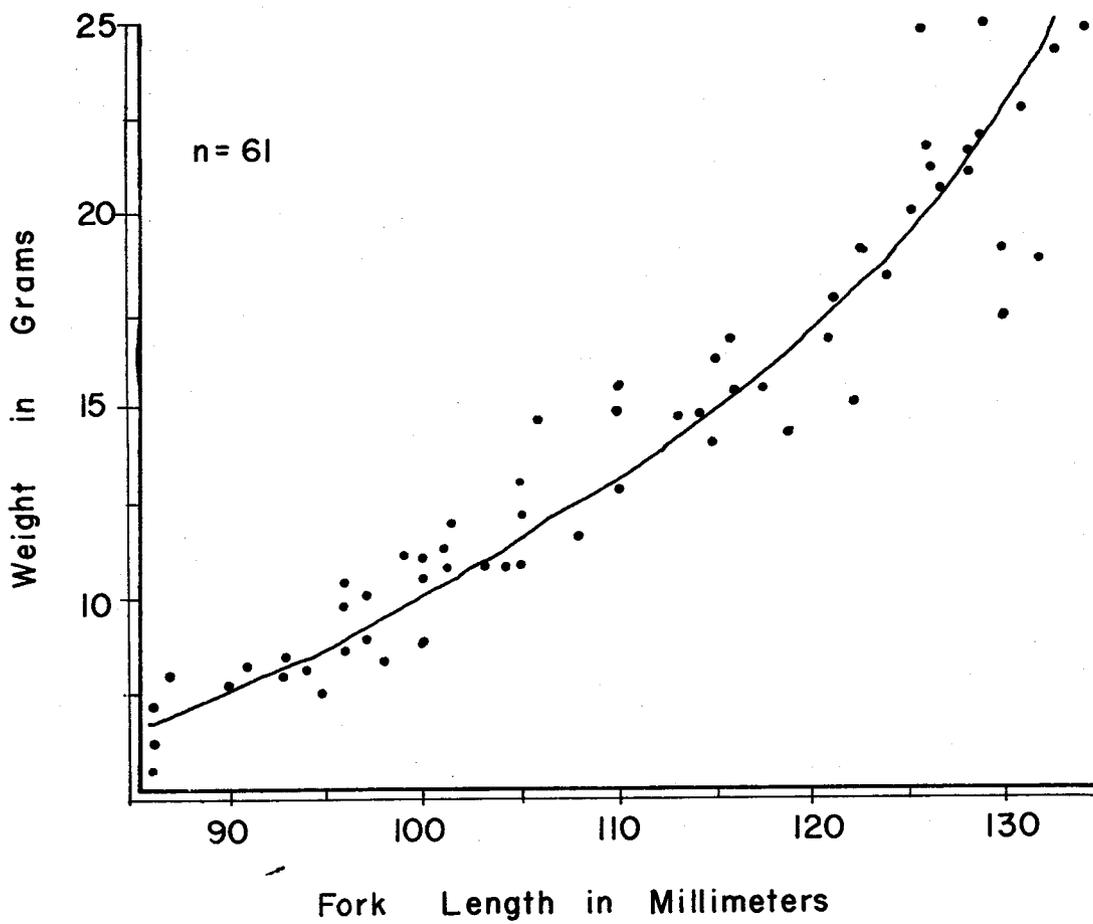


Figure 3. Length-weight relationship of silver salmon smolt in Bear Creek in 1963

their migration is shown in FIGURE 1-C. The length frequencies of fish collected at different dates show a tendency for the larger fish to migrate earlier in the run (FIGURE 4). A total of 23,336 was enumerated out of Bear Lake and among these were 10 Dolly Varden tagged during the 1962 out-migration. A tagging program was conducted from May 15 to May 25 at the trap to collect further data on the distribution and homing tendency of these fish after migration from Bear Lake. In all, 372 Dolly Varden ranging in fork length from 306 to 501 mm with a mean of 364.8 mm were tagged with a numbered strap tag on the caudal peduncle.

Because the weir panels were removed on July 25, the only upstream migrants measured were adult red salmon; 8,651 fish were enumerated. The first fish was captured on June 1 and there were still a few on July 25. Their seasonal migration pattern is presented in FIGURE 1-D.

Silver Salmon Escapement

The seven major streams in which silver salmon can be accurately enumerated by foot have been surveyed each year since 1961 to provide an escapement index. The Resurrection River, believed to be the greatest producer in the area, is not included because it is a large glacial stream which cannot be surveyed using direct methods of aerial and foot counts. The minimum escapement for the index streams is presented in TABLE 4. This year's total count of 860 is the lowest recorded and is only 33.1 per cent of the 1962 and 51.1 per cent of the 1961 escapement.

Marked Fish Returns

During May and June 1962, the adipose and left pelvic fins of 1,741 silver salmon smolt were clipped at the Bear Creek weir. An effort was made to examine as many of these fish, which returned as adults in 1963, as possible for marks during the escapement surveys conducted by foot on Bear Creek. Of 60 fish, 7 (11.7 per cent) were clipped. The high ratio of unmarked fish to marked fish indicates the 1962 estimated smolt migration of 3,633, of which 49.8 per cent were believed to be unmarked, may be in error. The disparity of marked to unmarked returning adults is probably due to some or all of the following:

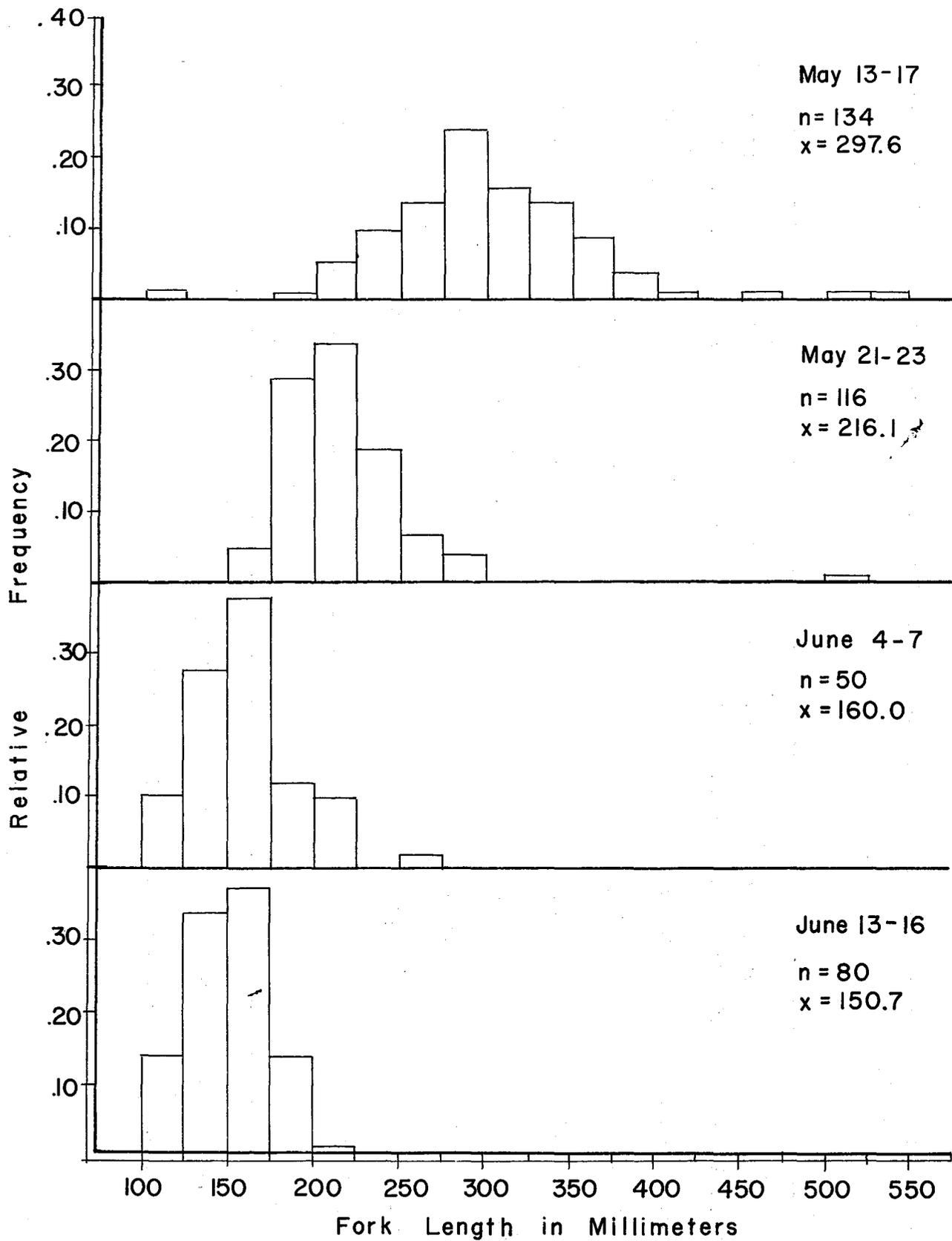


Figure 4. Length frequencies of downstream migrating Dolly Varden in Bear Creek in 1963.

TABLE 4. Minimum escapement of silver salmon in the Resurrection Bay area from 1960 to 1963.

Name of Stream	Date Fish First Observed	1963 Escapement	1962 Escapement	1961 Escapement	1960 Escapement
Airport Creek	8/28	42	39	162	381
Bear Creek	8/21	258	1,484*	972	-
Clear Creek	9/22	40	78	96	267
Dairy Creek	9/21	188	603**	249	-
Grouse Creek	10/17	76	63	24	105
Jap Creek	10/4	81	92	91	127
Salmon Creek	9/20	175	242	90	-
Total		860	2,601	1,684	-

* 293 of these fish were artificially spawned.

** 206 of these fish were artificially spawned.

higher survival of unmarked fish, adults straying from other streams, fyke nets not obtaining a representative sample of the seaward migrants.

The survival of marked smolt to returning adults (marine survival) in Bear Creek was calculated by expanding the 11.7 percentage of marked fish in the sample of 60 for the entire escapement of 258. This yielded an estimated 30 marked fish. The survival of marked smolt to returning adults was 1.72 per cent (30/1741) (100). Precocious males returning the same year as the seaward migration were not considered in survival estimates. An estimate of the rate of exploitation by the total fishery was computed by sampling the catch from Resurrection Bay. The commercial catch at the cannery was sampled because a large number of fish could be easily checked in a short period of time. In all, 1,260 adult silver salmon were examined of which 6 (4.8 per cent) were marked. The percentage of marked fish expanded for the total harvest of 9,543 fish yielded an estimated 46 marked silver salmon. The estimated rate of exploitation was 2.64 per cent (46/1741) (100). The marked fish catch-to-escapement ratio was 1.5:1 (46/30).

Silver Salmon Age Analysis

Scale smears were collected from silver salmon smolt periodically throughout their seaward migration at the Bear Creek weir. Smolt with two winters of lacustrine residence (age II) comprised 70.9 per cent of the sample. The sample size and percentage of fish in each age group for the 1962 and 1963 smolt migrations is presented in TABLE 5. The length frequency of 807 smolt measured randomly during the seaward migration is shown in FIGURE 5. After Bear Lake was rehabilitated with rotenone, 37 juvenile silver salmon were collected on its shores on August 28. The age composition of this sample was: 2.7 per cent II+'s; 86.5 per cent I+'s and 10.8 per cent 0+'s. These fish ranged in fork length from 57 to 113 mm. This sample was not considered to be representative of the total population due to the small number of young of the year. Samples of silver salmon fry (0+) were collected by dip netting in Bear Creek. The fork lengths and weights of these fish are shown in TABLE 6.

Age designations for adult silver salmon followed those of Gilbert and Rich (1927); for example, a 4₃ denotes a fish which migrated to sea in its third year and returned

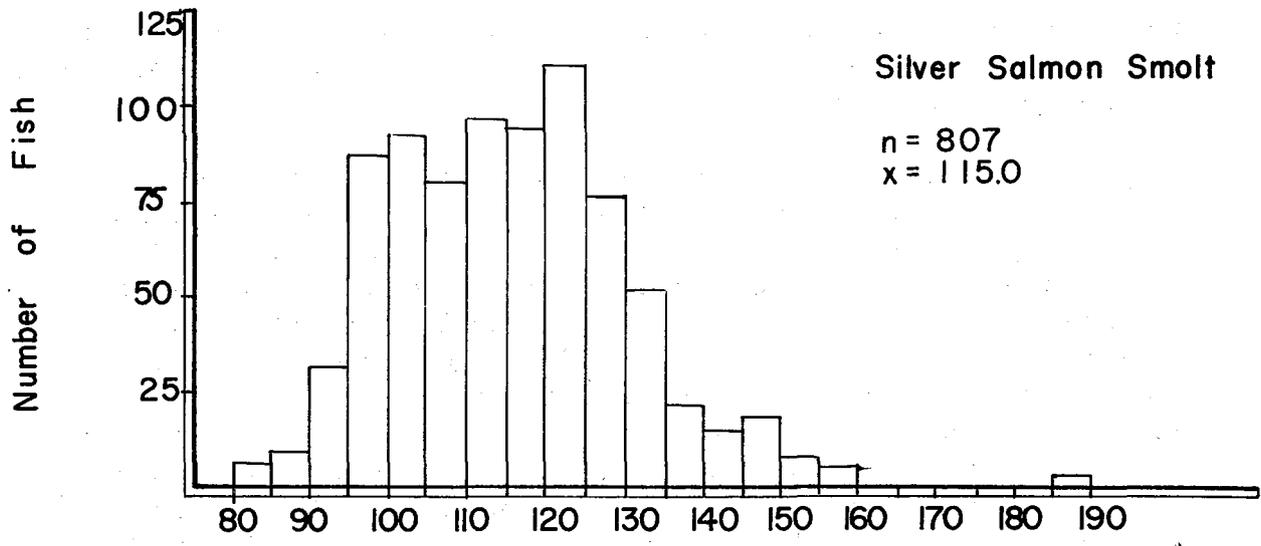


Figure 5. Length frequency of silver salmon smolt in Bear Creek during 1963

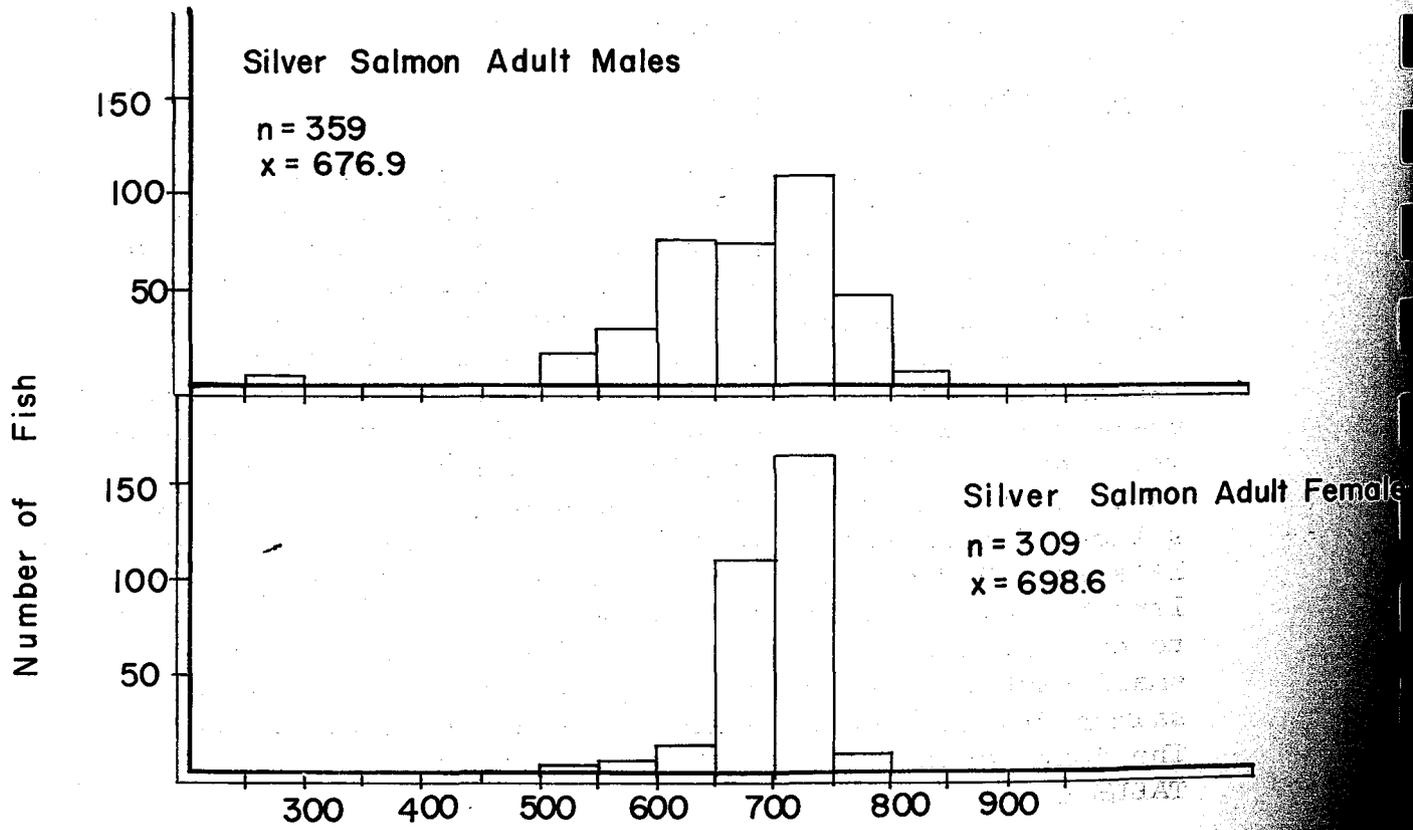


Figure 6. Length frequency of adult silver salmon from the commercial catch in Resurrection Bay during 1963

TABLE 5. The age composition of silver salmon smolt collected at the Bear Creek weir in 1962 and 1963.

Year	No. of Fish	Per Cent of Total Age Composition		
		I	II	III
1962	67	20.9	68.7	10.4
1963	55	27.3	70.9	1.8

TABLE 6. The mean fork length, mean weights and ranges of silver salmon fry collected in Bear Creek during 1963.

Dates of Capture	No. of Fish	Mean Length (Millimeter)		Mean Weight (Grams)	
			Range		Range
7/16-17	18	46.8	35-65	1.46	0.4-3.8
7/23-24	32	48.7	40-67	1.67	0.8-3.5
8/13	8	55.4	47-60	1.76	1.1-2.0

as an adult in its fourth year. A sampling of the commercial catch taken by purse seiners in Resurrection Bay yielded 220 scale samples, but 41 per cent of the scales were regenerated in the nuclear area. These were eliminated from the sample. The dominant age group was 4₃'s, which comprised 75.4 per cent of the sample. The age composition of silver salmon from Resurrection Bay for 1962 and 1963 is presented in TABLE 7. The length frequency of 668 adult silver salmon by sex, from the commercial catch, is presented in FIGURE 6. The mean fork length of males was 677 mm and the mean fork length of females was 699 mm. The sex ratio of males to females was 1.2:1.

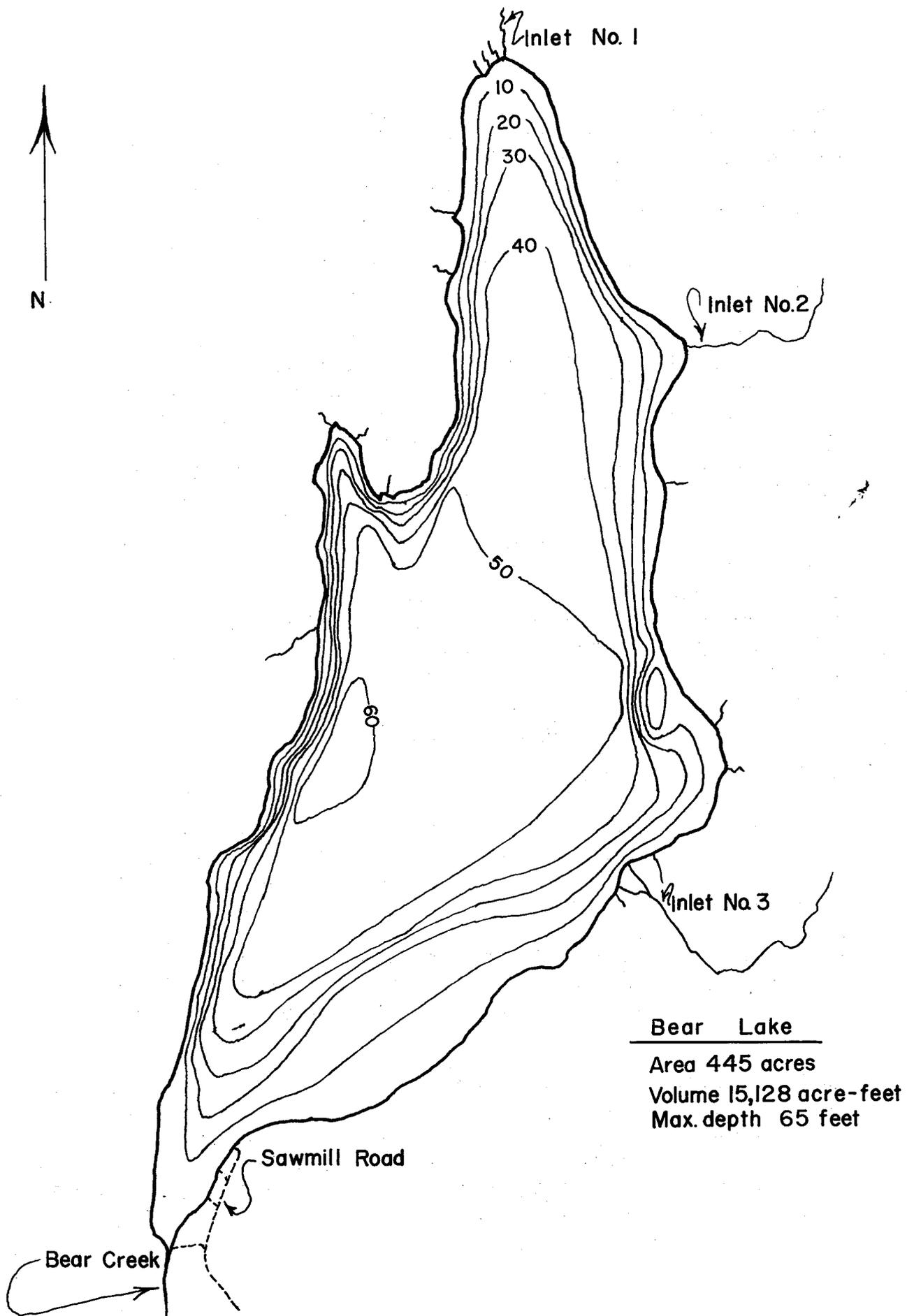
TABLE 7. The age composition of silver salmon adults collected from Resurrection Bay in 1962 and 1963.

Year	No. of Fish	Method of Capture	Per Cent of Total Age Composition		
			3 ₂	4 ₃	5 ₄
1962	119	Hook and Line	36.1	62.2	1.7
1963	130	Purse Seine	24.6	75.4	-

Bear Lake Rehabilitation

An attempt is being made to increase silver salmon production by improving the fresh water rearing areas utilized by juvenile salmon through elimination of competitor and predator fishes. This attempt was instigated in 1963 by rehabilitating Bear Lake (FIGURE 7). This lake offers the greatest potential for rearing salmon in the Resurrection Bay area.

Prior to the rehabilitation, the volume of the lake was gradually lowered from 15,128 acre-feet to 13,850 acre-feet by dredging the outlet. A barrier 5 feet high was then constructed to hold the treated water until detoxication, and to prevent the ingress of nonsalmon species. The lake was treated on August 26 with derris root (7.4-8.5 per cent rotenone) at a concentration of 1.0 p.p.m. with an average rotenone level of 5 per cent. The shoreline and



Bear Lake

Area 445 acres

Volume 15,128 acre-feet

Max. depth 65 feet

Figure 7. Map of Bear Lake
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inlets were treated with 2.5 per cent emulsified rotenone. Destroyed fish consisted of threespine sticklebacks, sculpins, Dolly Varden, juvenile and spent adult red salmon, and juvenile and a few adult silver salmon. No chum or pink salmon were observed.

Fish placed in five test cages at various depths before the treatment were all dead when checked after the treatment. Extensive fishing with baited minnow traps and 2,448 hours of netting with variable mesh gill nets revealed no live fish. Toxic water flowed over the barrier on October 5, after 41 days of impoundment, and killed 31 female and 28 male silver salmon in Bear Creek. Of the dead and moribund females, 19 were artificially spawned and yielded 76,498 eggs. The lake was considered detoxicated on October 17, about 52 days after treatment.

Bear Lake was restocked from November 13 to December 8 with 148,057 juvenile silver salmon (0+) from the Fire Lake Hatchery. The fish ranged in fork length from 56 to 99 mm with a mean of 81 mm and weighed an average of 88 per pound. These fish are the result of eggs taken at Bear Creek in the fall of 1962.

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Prepared by:

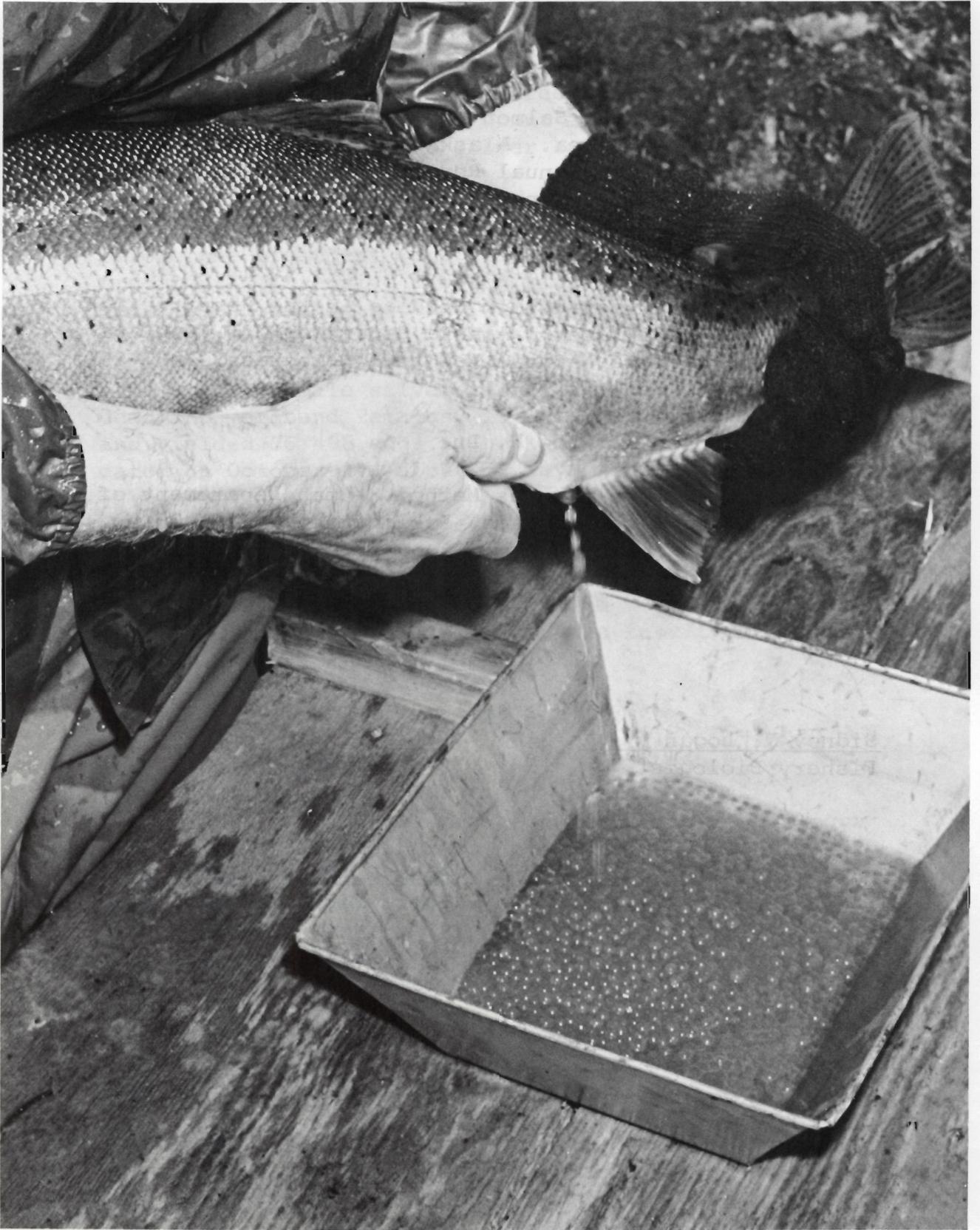
Approved by:

Sidney M. Logan
Fishery Biologist

Louis S. Bandirola
D-J Coordinator

Date: August 7, 1964

Alex H. McRea, Director
Sport Fish Division



Steelhead eggs artificially fertilized in the field and taken to hatcheries for incubation and subsequent planting in waters near population centers.