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STATE OF ALASKA

William A. Egan, Governor

ANNUAL REPORT OF PROGRESS, 1962 - 1963

FEDERAL AID IN FISH RESTORATION PROJECT F-5-R-4

SPORT FISH INVESTIGATIONS OF ALASKA

Alaska Department of Fish and Game

Walter Kirkness, Commissioner

E. S. Marvich, Deputy Commissioner

Alex H. McRea, Director

Sport Fish Division

Richard Haley, Coordinator

INTRODUCTION

This report of progress consists of Job Segment Reports from the State of Alaska Federal Aid in Fish Restoration Project F-5-R-4, "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. While some studies are of a more general nature and deal with gross investigational projects, others have been developed to evaluate specific problem areas. These include studies of king salmon, silver salmon, grayling and State Access requirements. The information gathered will provide the necessary background data for a better understanding of local management problems and development of future investigational studies.

The assembled progress reports may be considered fragmentary in many respects due to the continuing nature of the respective studies. The interpretations contained therein, therefore, are subject to re-evaluation as work progresses and additional information is acquired.

Volume 4 Report No. 7-B-1

JOB COMPLETION REPORT

RESEARCH PROJECT SEGMENT

State: ALASKA Name: Sport Fish Investigations of Alaska

Project No: F-5-R-4 Title: Silver Salmon Studies in the Resurrection Bay Area

Job No: 7-B-1

Period Covered: July 1, 1962 to June 30, 1963.

Abstract:

Information was collected on the distribution, timing and abundance of silver salmon in the Resurrection Bay drainages. A creel census was conducted at the Seward small boat harbor to provide an estimate of the harvest and effort by sport fishermen in Resurrection Bay. An estimate of the commercial silver salmon catch was obtained from cannery fish tickets. The Bear Creek weir was operated to provide information on the timing and abundance of all salmonid species migrating into Bear Lake. The abundance and timing of outmigrating salmon smolt and juveniles in Bear Creek was determined by fishing fykes nets and construction of a Wolf-trap on the weir. Foot surveys provided escapement data on silver salmon for all streams except the Resurrection River. Age determinations were made for outmigrant silver salmon in Bear Creek and for adult silver salmon in Resurrection Bay, Bear Creek and Dairy Creek. Limited information is presented on Dolly Varden migration patterns and food habits. Bear Lake was surveyed in preparation for possible rehabilitation.

Recommendations:

1. Retain the present objectives of the study.

2. Continue marking outmigrant silver salmon smolt to provide an estimate of the total Resurrection Bay run and measure marine mortality.

3. Further explore the possibilities of increasing the rearing potential of Bear Lake for juvenile salmon by population manipulation or rehabilitation and subsequent stocking with silver salmon fry.

4. Explore the possibilities of introducing green or eyed silver salmon eggs into waters not presently producing silver salmon or those with poor escapements.

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 all 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 of increasing or extending the fresh water rearing areas of the watershed.

Techniques Used:

Silver salmon sport harvest and effort in Resurrection Bay was determined by a creel census conducted at the Seward small boat harbor. This census sampled an eight-hour period, alternating between the hours of 0400 to 1200 and 1200 to 2000, on all weekends, holidays and one-half of the randomly

selected weekdays. Anglers leaving the small boat harbor during a census period were issued one numbered census card per boat with the following questions printed on it: (1) number of salmon caught; (2) time fishing stopped. On each dock a brightly painted box was placed for card deposition. Each card had the address of the local office so it could be returned by mail if taken home unintentionally. Fishermen returning to the small boat harbor during a census period who had not been given cards were asked the following questions: (1) number of anglers per boat; (2) number of salmon caught; (3) total hours fished. Aerial boat counts were made periodically to determine the number of boats not contacted during the census.

Silver salmon escapement was determined by aerial surveys on the Resurrection River and by foot surveys on all other known silver salmon streams. Salmon carcasses were mutilated to prevent recounting on subsequent surveys. Operation of the Bear Creek weir was continued in order to determine the timing and abundance of all salmonoid species using Bear Lake. Information on the abundance and timing of salmonoid downstream migrants was collected by fyke nets and by a modified Wolf-trap on the weir.

Silver salmon lengths, weights, and scale samples were collected at the Bear Creek weir and Seward small boat harbor. Age determinations were made using a micro-projector.

Findings:

The description of the Resurrection Bay area and the history of its silver salmon fishery has been described in detail by Dunn (1961) and Logan (1962).

Silver Salmon Harvest and Effort

A creel census to measure the sport harvest and effort on silver salmon in Resurrection Bay was conducted from July 7 to September 7, 1962. The total catch, based on the 5,028 fishermen contacted, was estimated at 14,482 silver salmon. This is over twice the 1961 harvest of 5,504 fish. The sport

harvest and effort by weekly periods is presented in Figure 1. The peak of the sport harvest occurred during the middle of August. The influence of the Seward Silver Salmon Derby on this fishery is shown by the estimated catch of 5,170 fish (35.7 per cent of the total sport harvest) during its four-day period. Personnel from the Army and Air Force recreational camps at Seward caught an estimated 2,980 silver salmon.

The total sport effort was estimated at 11,377 man-days. This was nearly double the 1961 effort of 6,002 man-days. The bulk of the fishing pressure (71.7 per cent) was concentrated on weekends. The 1962 Seward Silver Salmon Derby was the largest thus far (Table 1). An estimated 5,435 man-days of effort 47.3 per cent of the total sport effort) were expended during this period. The average catch per hour was 0.17. The mean number of fishermen per boat was 2.8 and the average number of hours fished was 7.3 per man. Analysis of the 505 creel census cards dispensed to anglers showed that 44.8 per cent of them were returned.

Table 1. Number of participants in the Seward Silver Salmon Derby by years.

Year	Number of Participants	Year	Number of Participants
1956	1100	1960	1700
1957	1400	1961	2200
1958	1562	1962	2406
1959	2273		

The commercial fishery in Resurrection Bay (statistical area 231-30) was extended from August 19 to September 8. The catch based on cannery fish tickets was 3,728 silver salmon with a mean catch per boat landing of 248.5 fish. The commercial silver salmon harvest by years is shown in Figure 2. A

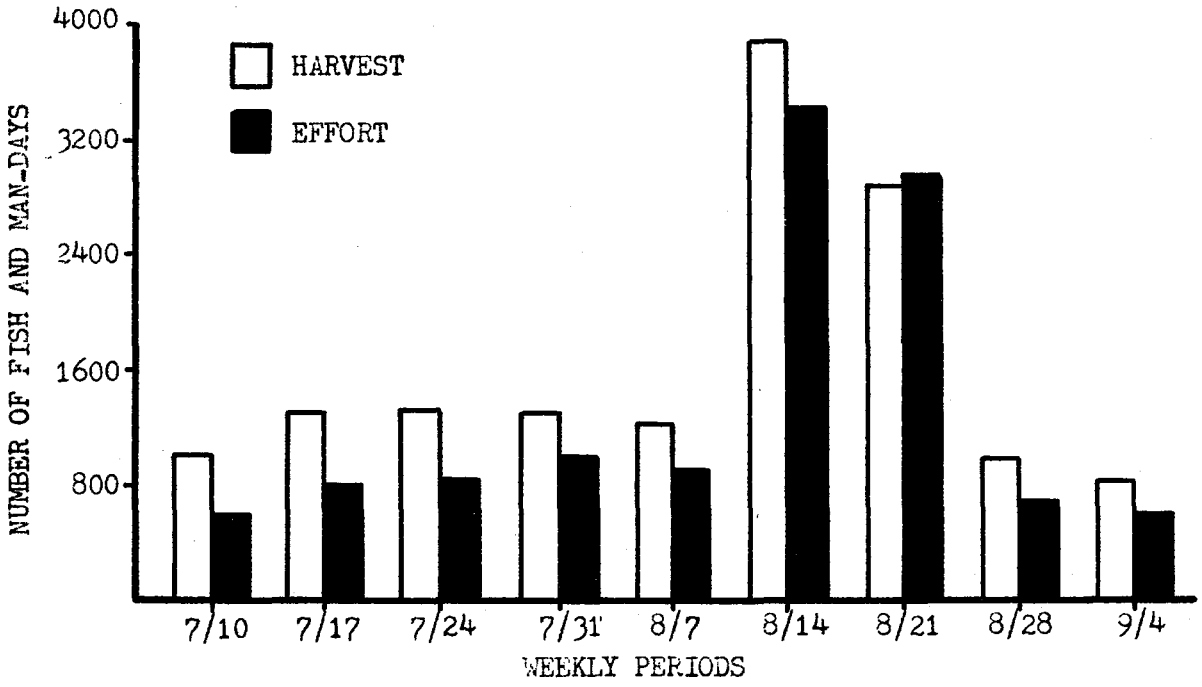

Figure 1. Resurrection Bay Sport Harvest And Effort - 1962.

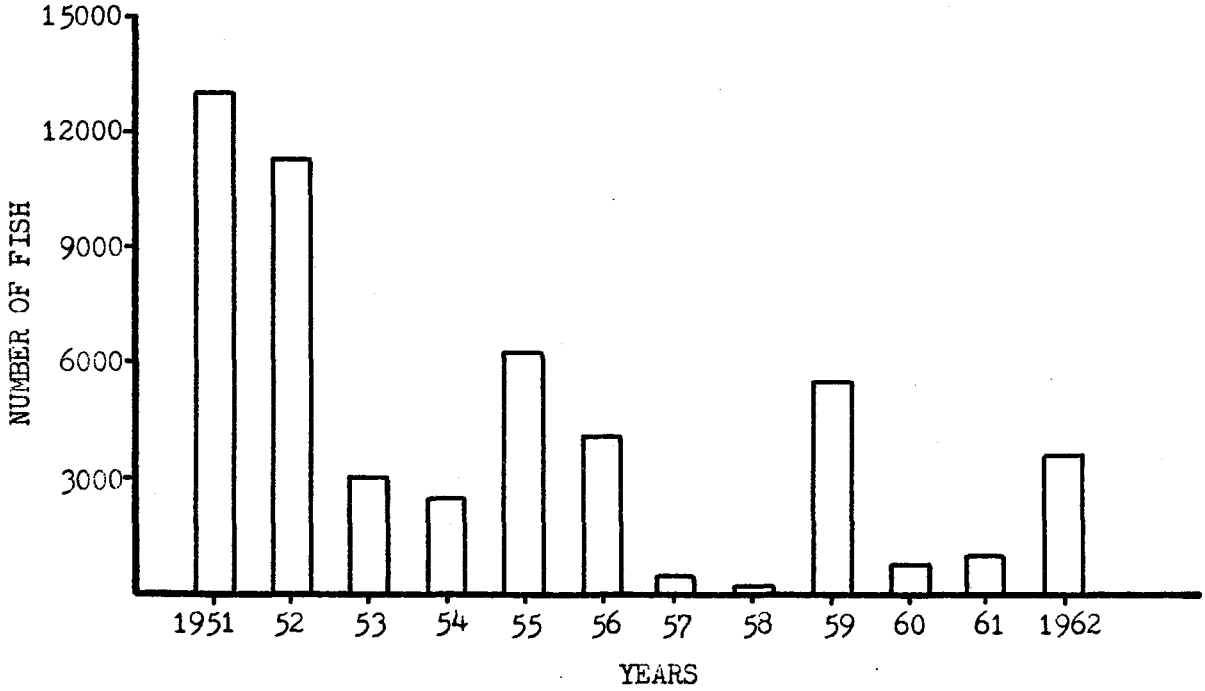

Figure 2. Resurrection Bay Silver Salmon Commercial Harvest 1951 - 1962.

subsistence fishery exists in Resurrection Bay which must conform to commercial seasons and legal gear. During this fishery a total of 15 permits were issured which accounted for 63 silver salmon.

Bear Creek Weir

The Bear Creek weir was operated continuously from May 2 to November 25. A description of the weir and its location has been reported by Logan (1962). To determine any downstream movement prior to weir operation a fyke net was fished in Salmon Creek 75 yards below the weir from February 22 to May 2 but no fish were captured. Downstream migrating salmon were captured by using four fyke nets with wings extending across the entire forebay of the weir from May 17 to June 26. Smolt escaping around the nets were considered insignificant as determined by enumerating dead smolt collected on the weir screens behind the fyke nets. Due to limited manpower and the known tendency of silver salmon smolt to migrate downstream chiefly at night, the fyke nets were fished between the hours of 2000 to 0400. Nine 24-hour periods were sampled to determine the percentage of fish missed from 0400 to 2000. From June 28 to September 21 a modified Wolf-trap attached to the weir was employed to sample downstream migrants. The trap measured approximately one-third of the migration.

Downstream Movement

Silver Salmon:

The first silver salmon smolt was captured at the weir on May 25 and the last on August 3. The seasonal timing of the downstream migration is shown in Figure 3. A total of 1,824 fish were captured of which 83 (4.5 per cent) were found dead in the nets. All live smolt (1,741) were marked by excising the right ventral and adipose fins after the fish had been anesthetized with MS-222-SANDOZ and were released below the weir after recovery. The 24-hour sampling periods showed that 49.8 per cent of the silver salmon smolt migrated between 0400 to 2000. Based on this, the total smolt migration was estimated at 3,633 fish. A decrease in

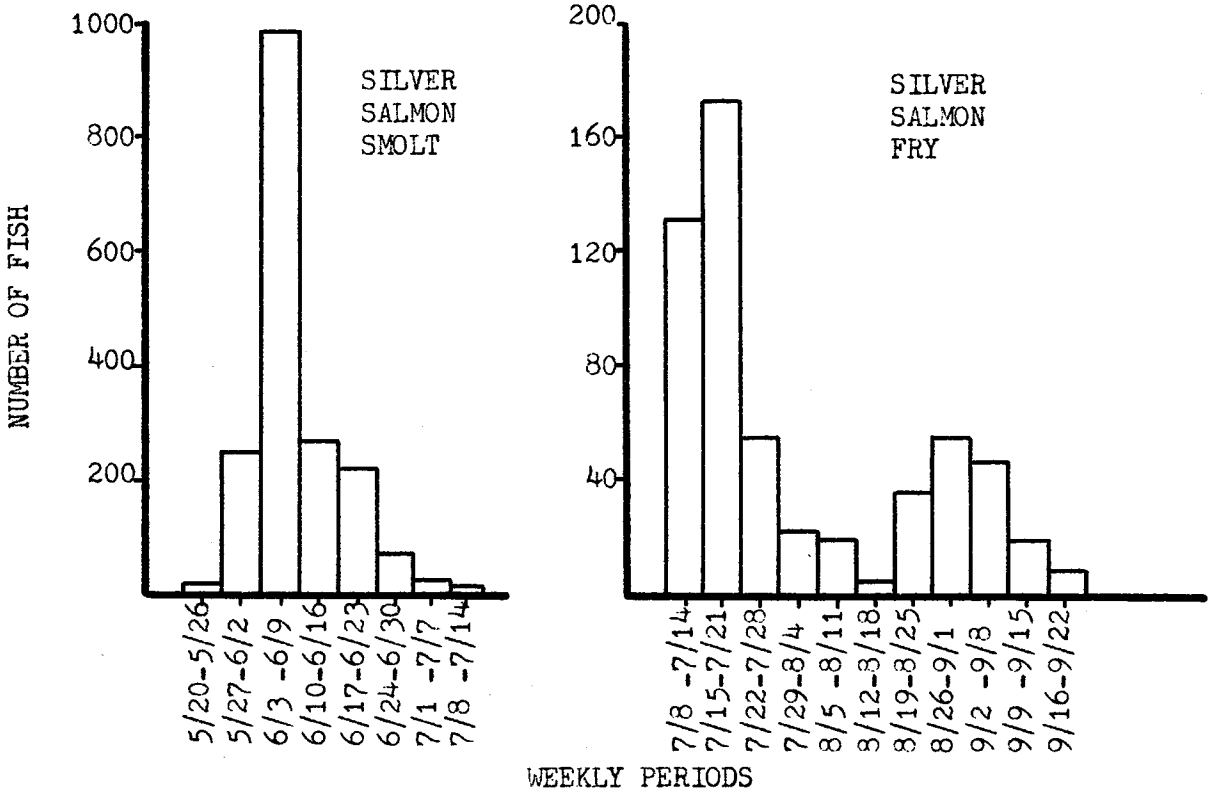

Figure 3. Downstream Migration Pattern of Silver Salmon Smolt and Fry in Bear Creek - 1962.

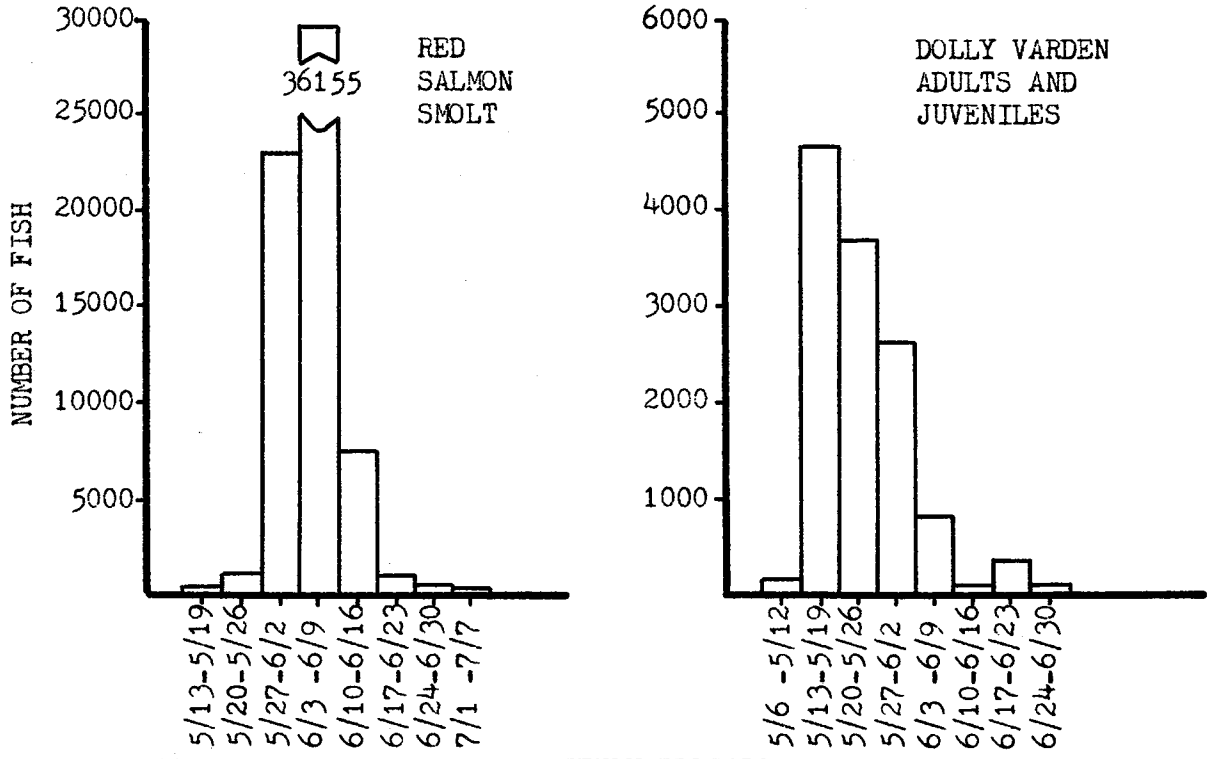

Figure 4. Downstream Migration Pattern of Red Salmon Smolt and Dolly Varden Adults and Juveniles in Bear Creek - 1962.

the size of the smolt as the run progressed is evident in Table 2.

Table 2. Ranges and mean fork lengths in millimeters of silver salmon smolt by weekly periods at Bear Creek, 1962.

Weeks	Number	Range	Mean fork length
5/27 - 6/2	230	84-178	117.7
6/3 - 6/9	325	95-168	116.7
6/10 - 6/16	87	86-151	110.8
6/17 - 6/23	122	85-140	106.7
6/24 - 6/30	7	91-128	103.0

Table 3. Ranges and mean fork lengths in millimeters of silver salmon fry at Bear Creek, 1962.

Date	Number	Range	Mean fork length
7/8 - 7/14	30	28-36	32.8
8/5 - 8/11	21	37-64	50.2
9/2 - 9/8	54	41-84	56.1

The first silver salmon fry (young of the year) was collected in the Wolf-trap on July 8, and became numerous until the end of the month. The seasonal downstream movement of fry is presented in Figure 3 and the size of the fry during different periods is shown in Table 3. A total of 550 fry were captured, of which 77 (14.0 per cent) were found dead. Fry movement during a 24-hour period, which was determined by checking the Wolf-trap daily at the same

time, is as follows: 2000 to 0900, 84.0 per cent; 0900 to 1400, 11.1 per cent; and 1400 to 2000, 4.9 per cent.

Red Salmon:

The first red salmon smolt occurred at the weir on May 17 and the last was observed on July 29. The largest movement during a 24 hour period was 9,321 smolt on June 2. The seasonal timing of downstream migrants is shown in Figure 4. A total of 68,556 fish were captured of which 2,887 (4.2 per cent) were found dead in the nets. The size of red salmon smolt at different times is presented in Table 4.

Table 4. Ranges and mean lengths in millimeters of red salmon smolt at Bear Creek, 1962.

Date	Number	Range	Mean fork length
5/24	50	61-120	75.0
5/29	51	60-95	74.1
6/6	55	53-80	65.7

Dolly Varden:

Dolly Varden were the earliest downstream migrants (May 10). A total of 12,340 fish were enumerated. Their egress from Bear Lake by weekly periods is shown in Figure 4. Fishing Bear Lake with standard experimental gill nets from June 8 to June 15, after the main outmigration was over, showed the absence of a large resident population. Fifteen Dolly Varden were taken in 648 net hours. To determine the distribution of Dolly Varden after migration from Bear Lake, a marking program was carried on from May 14 to May 30. A total of 419 fish ranging in fork length from 351 to 620 mm with a mean of 440 mm were tagged using numbered strap tags on the caudal peduncle. A total of 571 smaller Dolly Varden ranging from 150 to 345 mm with a mean of 271 mm were marked by clipping the left pectoral and adipose fins.

The extent of char predation on salmon was investigated by examination of Dolly Varden stomachs. Stomachs from 71 Dolly Varden taken from one overnight gill-net set at the outlet of Bear Lake on May 22, before smolt outmigration, were analyzed and found to be empty. Twenty-two stomachs from fish ranging in size from 257 to 505 mm were collected in the forebay of the weir from June 6 to June 9 during the smolt downstream migration. Frequency of occurrence of different items in stomachs is as follows: empty 50.0 per cent; fish 36.4 per cent; insects (mainly Diptera and Trichoptera), 13.6 per cent; and snails, 9.1 per cent. All of the 82 fish found in stomachs were red salmon smolt and one 485 mm Dolly Varden had accounted for 67 of them. From the size range of the smolt found in the stomachs (51 to 70 mm), it was apparent that the Dolly Varden preyed on the smaller migrants. The lack of silver salmon smolt in the char stomachs was probably due to their larger size (84 to 178 mm) and because they were relatively less abundant.

Upstream Movement

Red Salmon:

The earliest upstream migrants were adult red salmon. A total of 3,563 fish were enumerated. The first fish was captured on June 4 and the last on September 17. Their seasonal migration pattern by weeks is shown in Figure 5.

Pink Salmon:

The pink salmon migration extended from July 30 to September 5 and 5,457 fish were counted through the weir. Their weekly movement is presented in Figure 5.

Dolly Varden:

The first upstream migrant was observed on July 12 and the last on November 18. A total of 9,475 fish were enumerated. Their seasonal migration pattern is shown in Figure 6. Of the 419 Dolly Varden tagged during May at the weir 24 (5.7 per cent) returned to Bear Creek during the upstream migration. Two fish tagged on May 16 and 20 were

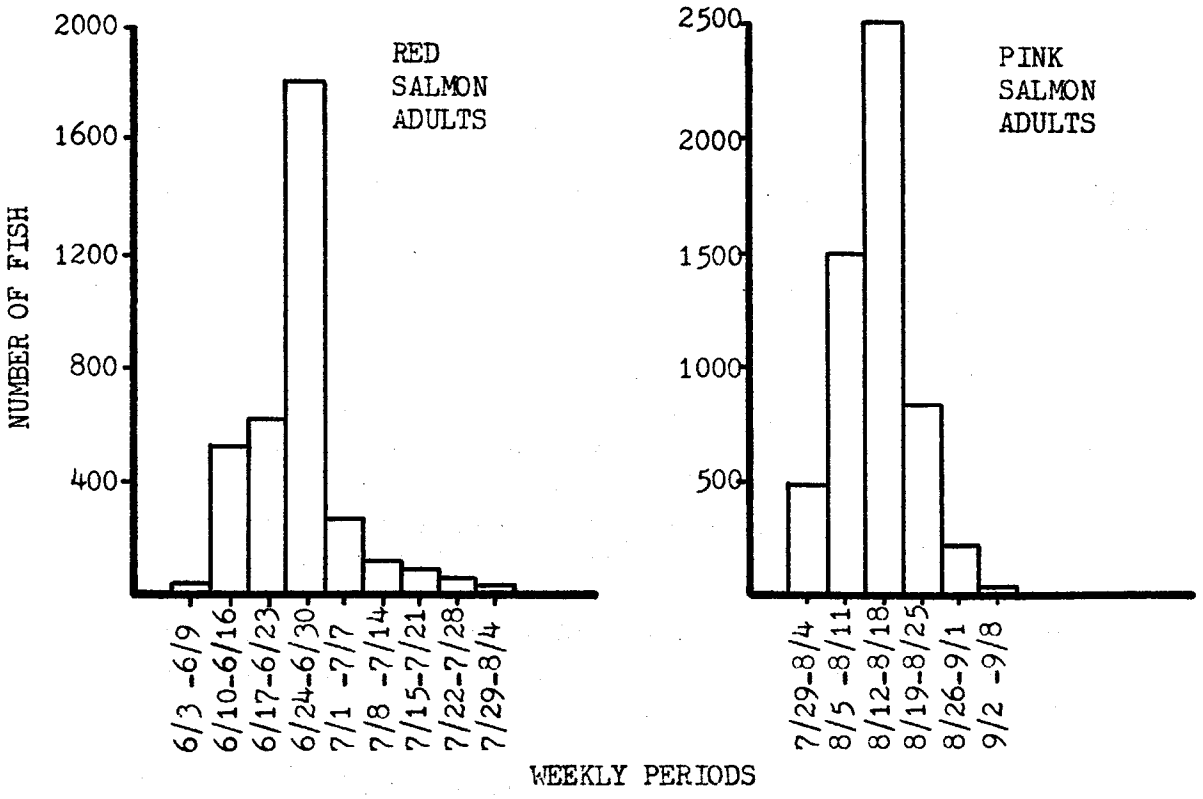

Figure 5. Upstream Migration Pattern of Red and Pink Salmon Adults in Bear Creek - 1962.

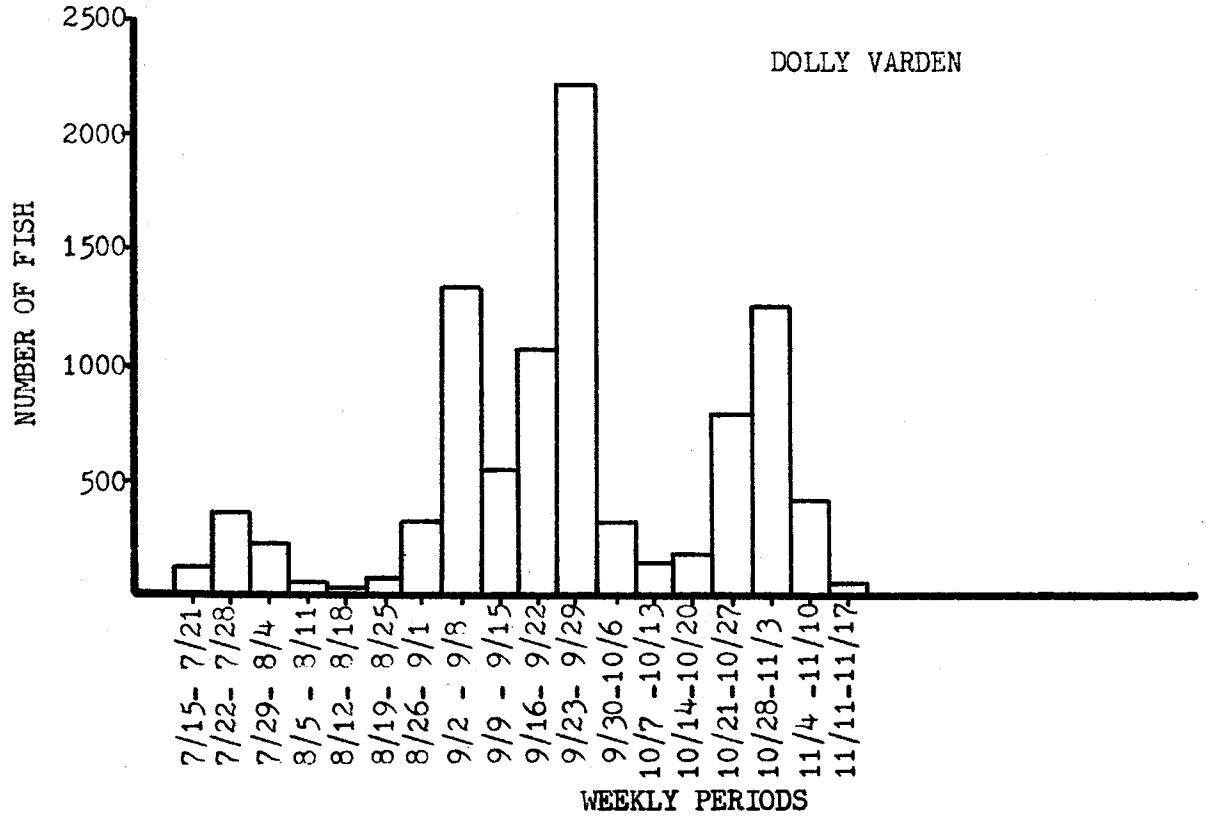

Figure 6. Upstream Migration Pattern of Dolly Varden in Bear Creek - 1962.

recovered by sport fishermen in Resurrection Bay, approximately 14 miles from the weir, on June 20 and 24. Thirty-four (6.0 per cent) of the 571 fin-clipped fish were recaptured at the weir during the upstream migration.

Silver Salmon:

The first adult silver salmon was captured at the weir on August 21 although the peak of the run did not occur until September 24 when 519 fish were enumerated. A total of 1,484 silver salmon passed through the weir. A relationship between high stream flows and upstream movements by weekly periods in shown in Figure 7.

A foot survey of the Bear Lake inlets and Bear Creek conducted on November 2 showed the following numbers of silver salmon and their location:

Stream	Number of silver salmon Alive	Dead
Bear Creek	260	5
Bear Lake Inlet No. 1	13	4
Bear Lake Inlet No. 2	40	2
Bear Lake Inlet No. 3	35	5
Bear Lake Inlet No. 4	25	7
Bear Lake Inlet No. 5	0	0
Total	373	23

From this it can be seen that over half of the fish counted through the weir were not accounted for and were probably still in the lake. Though only one pair of silver salmon was observed spawning in Bear Lake, it is quite possible that there is extensive spawning on the shoal areas. Lake spawning is not uncommon for this species in other areas of Alaska. The peak of spawning in Bear Creek is believed to

occur between October 20 and November 20.

Silver Salmon Escapement

Silver salmon escapements were generally higher than in past years particularly in Bear Creek, Dairy Creek and Salmon Creek. A very poor escapement was evident in Airport Creek. The minimum escapement for all streams foot surveyed is presented in Table 5. The largest silver salmon run is believed to occur in the Resurrection River. Determination of the extent of the run is difficult as the size of the river precludes foot surveying. Aerial surveys are hampered by its glacial water, frequent inclement weather, low angle of the sun, and high winds in the canyon through which it flows. The 272 fish observed by air are believed to be only a small fraction of those actually in the stream

To prepare for the restocking of Bear Lake, should it eventuate in 1963, silver salmon eggs were collected at the Bear Creek weir and from Dairy Creek. Dairy Creek had an overescapement for the spawning area available. The number of fish spawned and eggs taken are:

Area	Number of females	Number of eggs	Mean number of eggs per female
Bear Creek	174	731,283	4,203
Dairy Creek	103	430,841	4,183
Total	277	1,162,124	-

Silver Salmon Age Analysis

Age designation methods follow those suggested by Koo (1962).

Silver salmon smolt were sampled throughout their downstream migration at the Bear Creek weir. Circuli were enumerated to determine the position of the annuli in the different age groups. Counts were made along the ventral 20^{o} radial line for consistency in results. The analysis of circuli is presented in Table 6. Smolt with two winters of lacustrine life (age II) comprised 68.7 per cent of the

Table 5. Minimum escapements of silver salmon in the Resurrection Bay area from 1960 to 1962.

Name of Stream	Method of Survey	Time First Observed	1962 Escapement	1961 Escapement	1960 Escapement
Airport Creek	Foot	8/28	39	162	381
Bear Creek	Weir	8/21	1,484[1]	972	-
Clear Creek	Foot	9/22	78	96	267
Dairy Creek	Foot	9/21	603[2]	249	-
Grouse Creek	Foot	10/19	63	24	105
Jap Creek	Foot	10/4	92	91	127
Salmon Creek	Foot	9/20	242	90	-

[1] 283 of these fish were artificially spawned.

[2] 206 of these fish were artificially spawned.

Table 6. Scale analysis of silver salmon smolt from Bear Creek, 1962. (frequency of circuli counts to end of annuli)

Number of Circuli	Single Annulus	Two Annuli		Three Annuli		
		1st	2nd	1st	2nd	3rd
1						
2						
3						
4		7				
5		1				
6		6		1		
7		6		1		
8	1	10		3		
9		2		2		
10		11				
11	4	3				
12	1					
13	5		1		1	
14	3		1		2	
15			5		1	
16			2		2	
17			2			
18			4		1	
19			8			
20			3			
21			8			2
22			5			2
23			5			1
24			2			1
25						
26						
27						1
Total	14	46	46	7	7	7
Mean Number of Circuli	12.2	7.7	19.4	7.9	15.1	22.9

Table 7. The age-length relationship of silver salmon smolt from Bear Creek, 1962

Fork Length in Millimeters	Age (Number of Annuli) I	II	III
85- 86		1	
87- 88	2		
89- 90	3	1	
91- 92	1	1	
93- 94	1	2	
95- 96	4	2	
97- 98	1	2	
99-100		2	1
101-102		1	1
103-104		1	
105-106	2	5	
107-108		3	1
109-110		3	
111-112		3	
113-114		1	
115-116		5	
117-118		5	1
119-120		4	
121-122			
123-124		1	2
125-126		1	
127-128			
129-130			
131-132			
133-134		1	
135-136		1	1
Total	14	46	7
Per cent of Total	20.9	68.7	10.4

sample collected. The age-length relationship of the smolt is shown in Table 7. Figure 8 presents the length-frequency of 771 smolt measured at the Bear Creek weir.

Silver salmon moving downstream after the smolt outmigration were collected at the weir to determine time of scale formation and age. The first fry with scales was captured on July 20 and the smallest fry taken with scales was 37 mm (fork length). Forty-nine fish ranging from 37 to 69 mm were captured from July 20 to September 11 and aged as yound of the year (0+). A sample of 46 fish collected by seining in Bear Lake near the outlet on September 8 were comprised of 71.7 per cent 0+'s and 28.3 per cent 1+'s.

Scale samples were collected from adult silver salmon in Resurrection Bay, Bear Creek and Dairy Creek. The age composition of these fish is shown in Table 8. No scales were collected from precocial males (jacks) although they were observed on the spawning grounds. The dominant age group in Resurrection Bay and near Bear Creek is 4_3's. A 4_3 refers to a fish which migrated to sea in the third year and returned as an adult in the fourth year. A very small sample from Dairy Creek indicates the majority of these fish are 3_2's. Dairy Creek is a small stream which flows into a brackish water lagoon. This lagoon provides an excellent rearing area as can be shown by the high percentage of fish (83.3) residing only one year in freshwater and by the continually good escapements in Dairy Creek (Table 5).

Table 8. The age composition of adult silver salmon from Resurrection Bay, Bear Creek and Dairy Creek, 1962.

Place of Capture	Number in Sample	Age Composition (per cent) 3_2	4_3	5_4
Resurrection Bay	119	36.1	62.7	1.7
Bear Creek	59	27.1	71.1	1.8
Dairy Creek	12	83.3	16.7	-

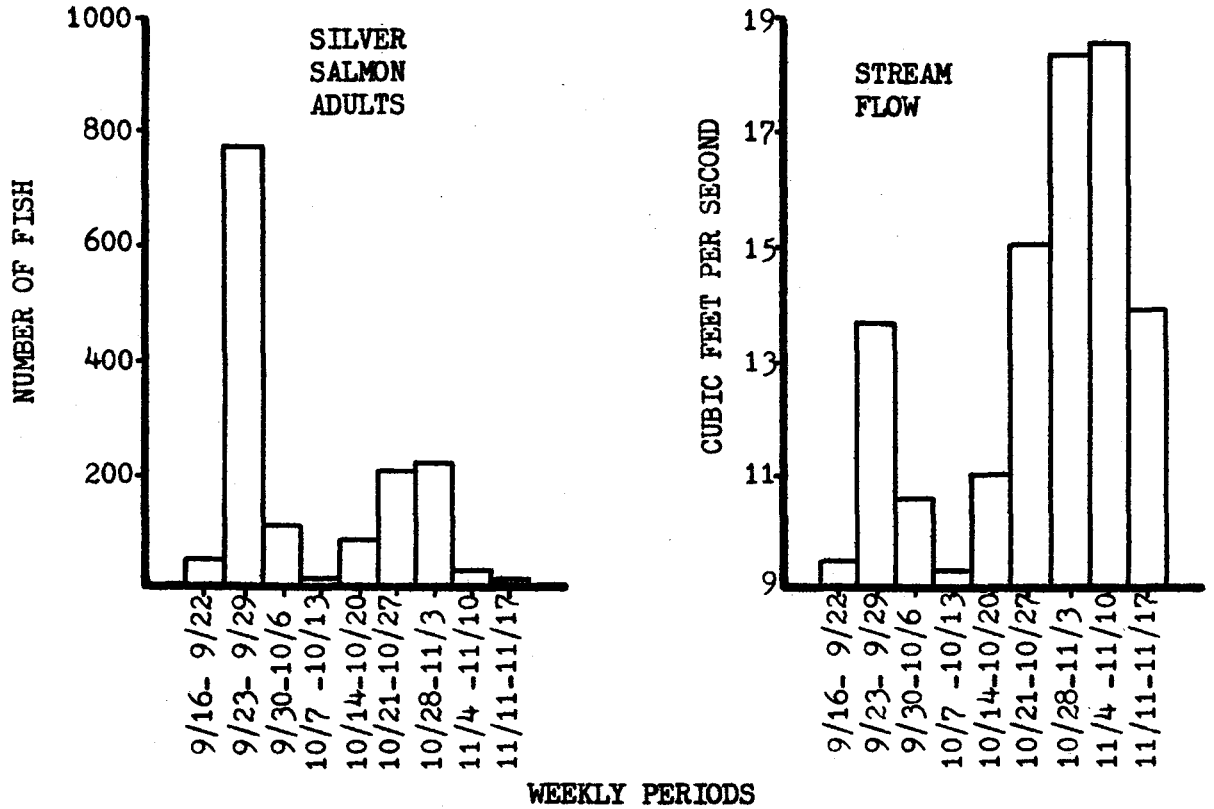

Figure 7. Upstream Migration Pattern of Adult Silver Salmon and Stream Flow in Bear Creek - 1962.

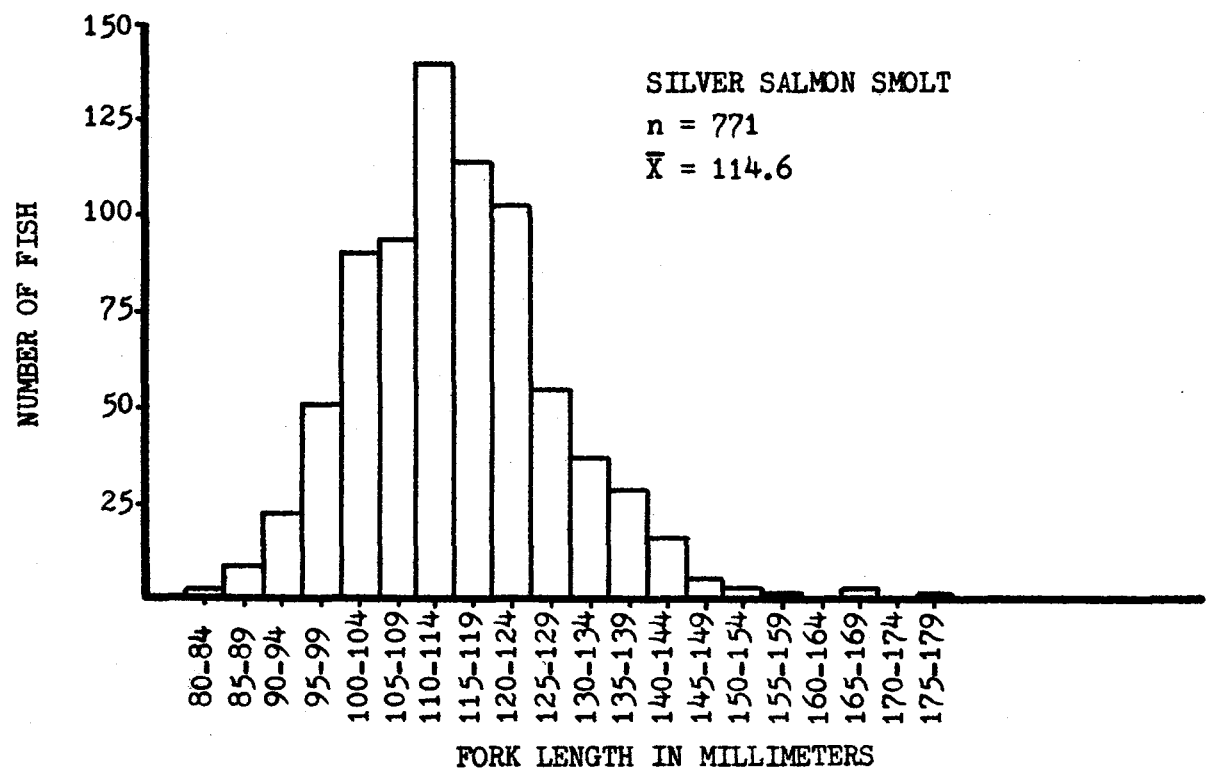

Figure 8. Length - Frequency Distribution of Silver Salmon Smolt in Bear Creek - 1962.

Bear Lake Survey

One possible method of increasing silver salmon production in the Resurrection Bay area is to improve the freshwater rearing areas utilized by the juvenile salmon. Bear Lake is the largest lake in the area and offers the greatest latent potential for rearing salmon to smolt size. This lake could be more fully utilized by rearing salmon if it were rehabilitated with rotenone to eliminate competitor and predator fishes (sticklebacks, sculpins and Dolly Varden). A permanent barrier would have to be constructed to prevent the ingress of undesirable fishes.

Bear Lake has a surface area of 445 acres, a maximum depth of 62 feet and an estimated volume of 15,128 acre-feet. It has five inlets that fish can ascend with flows ranging from 0.4 to 1.5 cubic feet per second. Bear Creek, the outlet, has a mean summer flow of 10.3 c.f.s. The lake is generally covered by ice (maximum 31 inches) from early November until late April. The thermocline is located at about 30 to 35 feet during midsummer and the highest surface temperature recorded was 63° F. It has a silt bottom with abundant submerged vegetation in the shallow water on the southeast end. The pH is 6.6 to 6.9 and there is adequate oxygen for fish life the entire winter.

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Prepared by:

Sidney M. Logan
Fishery Biologist

Approved by:

Richard Haley
D-J Coordinator

Date: March 15, 1963.

Alex H. McRea, Director
Sport Fish Division