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STATE OF ALASKA

William A. Egan, Governor



ANNUAL REPORT OF PROGRESS, 1965 - 1966
FEDERAL AID IN FISH RESTORATION PROJECT F-5-R-7
SPORT FISH INVESTIGATIONS OF ALASKA

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INTRODUCTION

This report of progress consists of Job Segment Reports conducted under the State of Alaska Federal Aid in Fish Restoration Project F-5-R-7, "Sport Fish Investigations of Alaska."

The project during this report period is composed of 18 separate studies. Some are specific to certain areas, species or fisheries, while others deal with a common need for information. Each job has been developed to meet the needs of various aspects of the State's recreational fishery resource. Seven jobs are designed to pursue the cataloging and inventory of the numerous State waters. These jobs, which are of a continuing nature, will eventually index the potential recreational fisheries. Four jobs are directed toward specific sport fish studies. These include specialized efforts toward the anadromous Dolly Varden of Southeastern Alaska, the silver salmon in Resurrection Bay, the king salmon stocks on the Lower Kenai Peninsula, the king salmon stocks in Upper Cook Inlet, and the Arctic grayling of the Tanana River system.

The statewide access program is developing rapidly. Our efforts in investigating existing and potential recreational sites and access has resulted in favorable action being taken on our proposals and recommendations submitted to the land management agencies at both the State and Federal levels.

The remaining jobs included a specialized creel census effort in Southeastern, an egg-take program designed to establish indigenous egg-take sources, and evaluation of the Fire Lake system.

Three special reports have been completed from past studies on the Dolly Varden study. These appear in the Department's "Research Report" series and are a direct result of the Federal Aid In Fish Restoration Program. To date, the following reports have been published: Research Report No. 3, "Some Migratory Habits of the Anadromous Dolly Varden Salvelinus malma (Walbaum) in Southeastern Alaska," 1965, Robert H. Armstrong; Research Report No. 4, "Annotated Bibliography on the Dolly Varden Char," 1965, Robert H. Armstrong; and Research Report No. 5, "Age and Growth of Anadromous Dolly Varden Char Salvelinus malma (Walbaum), in Eva Creek, Baranof Island, Southeastern Alaska," 1966, David W. Heiser.

The material contained in this progress report is often fragmentary in nature. The findings may not be conclusive and the interpretations contained herein are subject to re-evaluation as the work progresses.

RESEARCH PROJECT SEGMENT

STATE: ALASKA Name: Sport Fish Investigations
of Alaska.

Project No.: F-5-R-7 Title: Silver Salmon Studies in
the Resurrection Bay Area.

Job No.: 7-B-1

Period Covered: July 1, 1965 to June 30, 1966.

ABSTRACT

A creel census conducted at the Seward Small Boat Harbor from July 14 to August 27 showed an estimated 4,022 silver salmon, Oncorhynchus kisutch, were taken by 13,380 man-days of effort. The mean catch per hour was 0.051. The 12-day Seward Silver Salmon Derby accounted for 57.1 and 66.5 percent of the total sport harvest and effort, respectively.

The total minimum escapement of 536 silver salmon for 7 index streams was the lowest recorded. The low return of 48 fish to Dairy Creek evinces the damage to the Seward Lagoon by the earthquake of March 27, 1964. Information is presented on silver salmon timing, abundance, and sex ratios in index streams.

An estimated 17,185 marked silver salmon smolts were captured at Bear Creek weir from May 13 through November 10; a total of 4,762 (Ad-LV clip) were age-II and 12,423 (Ad-RV clip) were age-I. An appreciable autumn downstream migration of 4,361 smolts occurred for the first time. The mean fork lengths during the peak of migration of age I and II smolts were 116.4 mm and 167.5 mm, respectively. Gill netting in Bear Lake, after the cessation of smolt migration, showed that landlocking of some stocked silver salmon had occurred.

Two hundred twenty adult silver salmon were enumerated through the weir from September 1 through October 12 with a peak of the run occurring on September 23. The sex ratio of males to females was 1.4:1.

Information on the timing and abundance of other Bear Creek upstream and downstream-migrant salmonoids is also presented.

Detailed and additional data collected during this report segment are on file at the Seward Field Office.

RECOMMENDATIONS

1. Retain the present objectives of the project.
2. Determine the limnology, species composition, relative abundance and growth of fishes in the Seward Lagoon with major emphasis on silver salmon.
3. Modify the Bear Creek weir to facilitate the passage of upstream migrants and preclude salmonoids from "jumping" over it at all water levels.

OBJECTIVES

1. To collect and analyze biological data concerning the distribution, abundance and timing of adult and outmigrant silver salmon in the Resurrection Bay area.
2. To determine the period of silver salmon fry emergence in the waters of this area.
3. To determine the age composition of adult and juvenile silver salmon.
4. To determine the sport and commercial harvest of silver salmon in Resurrection Bay and the natural and fishing mortality in salt water.
5. To investigate the environmental limitations of the juvenile silver salmon in this area and provide recommendations for management practices.
6. To determine the methods and means of increasing or extending the fresh water spawning and rearing areas of the watershed and mitigating fresh water mortality.
7. To determine the rate of stickleback reinfestation in rehabilitated Bear Lake.
8. To determine species composition, relative abundance and growth of fishes and the limnology of the Seward Lagoon.

TECHNIQUES USED

Silver salmon (coho) sport harvest and effort on Resurrection Bay were determined by a creel census conducted at the Seward Small Boat Harbor. The number of boats fishing was ascertained using a Latin square sampling schedule having four 3.5-hour periods extending from 0800 to 2200 hours (A-0800 to 1130, B-1130 to 1500, etc.). Sampling was not done prior to 0800 hours because past creel census data showed that very few anglers completed fishing before this time. Two periods were sampled on each day selected for census; all boats which had completed fishing were enumerated.

Three weekdays, selected with a Latin square design, and both weekend days were censused each week. However, each group was treated separately in the analysis. The number of boats launched at Lowell Point, the only other access to Resurrection Bay, was recorded by the owner of the boat livery there. A total census was conducted each day of the Seward Silver Salmon Derby.

Harvest and effort data were determined by interviewing completed fishermen at the small boat harbor with the following questions asked: (1) number of fishermen per boat, (2) number of silver salmon caught, and (3) total hours fished. Silver salmon were examined for clipped fins concomitantly with the interviews.

The estimated total number of boats (boat-days) was determined by expanding the average number of boats enumerated during each 3.5-hour sampling period for the entire season. The total effort in man-days was found by multiplying the mean number of anglers per boat by the total number of boats. Total harvest was computed by multiplying the average number of silver salmon per boat by the total number of boats.

Escapement was determined by conducting weekly foot surveys on seven silver salmon index streams. All silver salmon carcasses were sexed, then mutilated to prevent recounting on subsequent surveys. The abundance and timing of upstream migrants in Bear Creek were determined by use of a concrete weir situated 1,750 feet below Bear Lake. The timing and abundance of downstream migrants from Bear Lake through the weir were determined with a model "B" fishpass having adjustable louvers to control water flows into the trap. Fish were guided to the fishpass by vertical screen panels having 13/64-inch holes with 60 percent of the screen being open. A diagram of the Bear Creek weir is shown in Figure 1. Stream flows and temperatures were recorded daily at the weir.

Silver salmon fork lengths, weights and scale samples were collected at the Bear Creek weir and from the sport harvest in Resurrection Bay. Age determinations were made using a microprojector with a 12.0X objective from 0.02-inch-thick cellulose-acetate scale impressions.

The rate of threespine stickleback, Gasterosteus aculeatus, reinfestation in Bear Lake was determined by monthly beach seining off Inlet No. 3 during the summer.

FINDINGS

Past information collected on this project and a description of the Resurrection Bay area are presented in Dingell-Johnson Project Reports by Dunn (1960) and Logan (1961, 1962, 1963, 1964).

Silver Salmon Harvest and Effort

The silver salmon creel census was initiated on July 14 and extended until August 27, at which time Resurrection Bay was closed to sport fishing for silver salmon by an emergency regulation. The total sport harvest was estimated at 4,022 silver salmon, based on interviews with 4,531 fishermen who had caught 1,446 fish (Table 1). The peak of the harvest occurred during the first Seward Silver Salmon Derby (August 7-16). This Derby accounted for

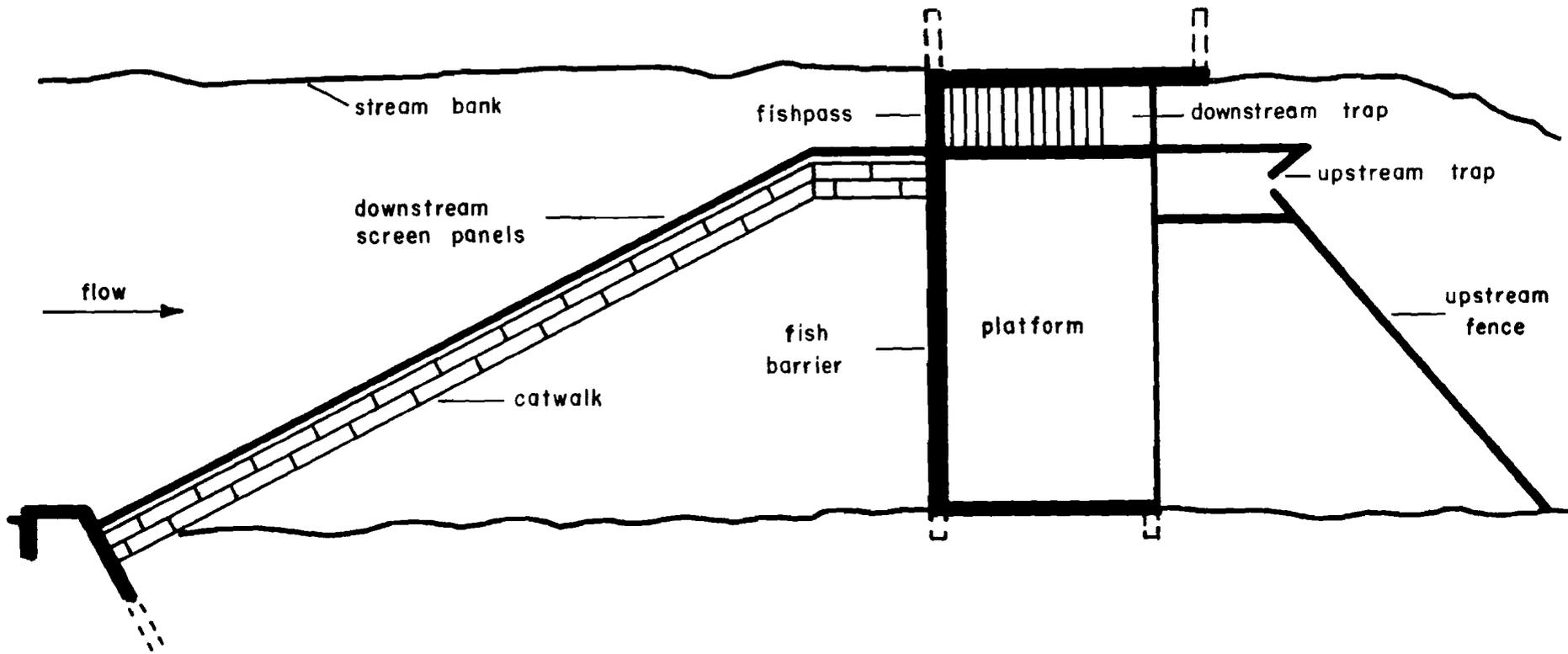


Figure 1. Diagram of Bear Creek weir (scale: 1 inch = 10 feet).

2,029 silver salmon. Due to the low rate of fishing success, a second Derby was held on August 21 and 22 during which 269 fish were taken. The combined catch of 2,298 silver salmon for both Derbies comprised 57.1 percent of the total sport harvest.

TABLE 1 - Sport and Commercial Harvests of Silver Salmon in Resurrection Bay, 1961-65.

<u>Year</u>	<u>Sport Harvest</u>	<u>Commercial Harvest</u>	<u>Total Harvest</u>
1961	5,504	1,332	6,836
1962	14,482	3,923	18,405
1963	7,293	2,250	9,543
1964	2,971	656	3,627
1965	4,022	No fishery	4,022

The commercial fishing season, which in recent years has opened after the Derby, remained closed because of the paucity of salmon and the emergency closure promulgated on the sport fishery. The commercial purse and beach seine fishery during the years the sport harvest was measured (1961-64) captured from 18.1 to 23.6 percent of the total catch. The Alaska Board of Fish and Game, in December, 1965, closed Resurrection Bay to commercial fishing for silver salmon north of a line from Callisto Head to the north tip of Hive Island to Cape Resurrection. The closure was predicated on the Board's recognition of the high recreational value of the sport fishery and its favorable economic impact on Seward as well as gradually declining silver salmon stocks in Resurrection Bay.

The total sport fishing effort on silver salmon from boats was estimated at 12,924 man-days with 35.1 percent of the anglers being contacted. A substantial shore fishery developed for the first time largely through the promotional efforts of the Derby. The bulk of the shore fishing occurred during the first Derby and 88.3 percent of the 456 anglers enumerated utilized the Lowell Point beaches. Their rate of success appeared lower than boat fishermen. The combined boat and shore effort was estimated at 13,380 man-days (Table 2). This year's effort was less than the record 1963 fishery due to the following: (1) lower rate of fishing success, due to lack of fish, (2) poor condition of the earthquake damaged Seward-Anchorage Highway, and (3) emergency closure on the sport fishery. The estimated 8,900 man days of effort expended during the 1965 Derby was the largest recorded and accounted for 66.5 percent of the total angling pressure. The 3,025 Derby tickets sold were a record high with ticket sales increasing 275 percent since the inception of the Derby in 1956 (Table 3). Military personnel using boats from the Army Recreation Camp accounted for an estimated 1,538 man-days (11.5 percent of the total effort). The mean silver salmon catch per hour of 0.051 was the lowest recorded in the history of the fishery (Table 2). The average angler fished 6.74 hours per boat trip, and the mean number of fishermen per boat was 2.69.

TABLE 2 - Silver Salmon Angler Effort, Catch Per Hour and Length of Census in Resurrection Bay, 1961-65.

<u>Year</u>	<u>Total Effort (Man-Days)</u>	<u>Derby Effort (Man-Days)</u>	<u>Catch Per Hour</u>	<u>Period of Census</u>
1961	6,002	2,870	0.103	7/11-9/9
1962	11,380	5,435	0.187	7/7-9/7
1963	15,430	7,480	0.069	7/17-9/10
1964	7,540	4,150	0.074	7/18-9/11
1965	13,380	8,900	0.051	7/14-8/27

TABLE 3 - Number of Tickets Sold and Length in Days for the Seward Silver Salmon Derby, 1956-65.

<u>Year</u>	<u>Number of Tickets</u>	<u>Number of Days</u>
1956	1,100	4
1957	1,400	4
1958	1,562	4
1959	2,273	4
1960	1,700	10
1961	2,200	4
1962	2,400	4
1963	2,625	5
1964	2,104	9
1965	3,025	12

The sex ratio of silver salmon males to females was 1.0:1. The average size of the males, "jacks" excluded, was 658 mm and 8.7 lbs. while that of the females was 676 mm and 10.1 lbs. Lengths, weights and sex ratios sampled for 1960-65 are summarized in Table 4.

Silver Salmon Escapement

Seven of the most important silver salmon streams have been foot-surveyed annually since 1961 to provide an escapement index. The Resurrection River, the largest single silver salmon producer, was not surveyed because its size and glacial water precluded direct survey methods. Bear Creek is also not discussed here because the rehabilitation and restocking of Bear Lake has altered its natural populations.

The total minimum escapement of 536 silver salmon for the index streams is the lowest observed since the surveys were initiated (Table 5). The annual escapement indexes for 1961-65 are shown graphically in Figure 2. From Figure 2 it appears that the greatest runs occur in even numbered years and that the silver salmon stocks returning to Resurrection Bay are gradually declining. The reason for the apparent "cyclic" behavior of the runs is not understood at this time. The gradually declining stocks are probably due, in

TABLE 4 - Fork Lengths, Weights and Sex Ratios of Silver Salmon from Resurrection Bay, 1960-65.

Year	Males*					Females					Sex Ratio ♂/♀
	Length (mm)		Weight (lbs)		No.	Length (mm)		Weight (lbs)		No.	
	Mean	Range	Mean	Range		Mean	Range	Mean	Range		
1960	661	500-780	9.0	3.3-19.5	129	654	545-735	8.4	5.0-12.8	79	1.6:1
1961	681	545-775	9.4	4.6-13.9	41	671	585-720	9.1	5.1-11.4	39	1.0:1
1962	664	545-750	8.9	4.5-14.1	74	663	545-760	8.8	4.5-12.5	56	1.3:1
1963	677	505-830			359	699	515-785			309	1.2:1
1964	681	535-790	10.3	5.0-14.8	111	673	570-740	9.8	6.4-14.0	86	1.3:1
1965	658	480-765	8.7	3.0-13.6	49	676	550-760	10.1	4.8-13.6	51	1.0:1
MEAN	670.3		9.26			672.7		9.24			1.2:1

* Precocious males "jacks" which are uncommon in this area are not included.

part to: (1) a substantial commercial fishery prior to state management in 1960 (1959 harvest was 8,954 silver salmon) and (2) a rapidly expanding sport fishery which has largely occurred since 1961 (Table 2).

TABLE 5 - Minimum Silver Salmon Escapements in Seven Index Streams in the Resurrection Bay Area, 1961-65.

Name of Stream	Minimum Escapements				
	1961	1962	1963	1964	1965
Airport Creek	162	55	42	52	50
Clear Creek	96	78	40	217	56
Dairy Creek	249	603	188	245	48
Grouse Creek	24	210	76	294	106
Jap Creek	91	92	72	152	86
Mayor Creek	21	30	15	95	16
Salmon Creek	90	212	175	79	174
TOTAL	733	1,280	608	1,134	536

Silver salmon sex ratios, determined by the examination of carcasses, for index streams for 1961-65 are summarized in Table 6. The mean sex ratio for most streams is slightly in favor of males; however, there exists a wide divergence from year to year within the same stream.

TABLE 6 - Ratio of Male to Female Silver Salmon in Seven Index Streams in the Resurrection Bay Area, 1961-65. (Number of Fish Examined in Parentheses.)

Name of Stream	Year					Average
	1961	1962	1963	1964	1965	
Airport Creek	1.1:1 (58)	1.2:1 (38)	1.1:1 (32)	1.2:1 (11)	0.8:1 (10)	1.1:1
Clear Creek	0.8:1 (7)	1.1:1 (47)	1.0:1 (29)	1.4:1 (39)	0.5:1 (20)	1.0:1
Dairy Creek	1.7:1 (229)	1.0:1 (593)	1.2:1 (69)	0.8:1 (208)	1.4:1 (33)	1.2:1
Grouse Creek		1.1:1 (70)	1.3:1 (39)	1.5:1 (70)	1.1:1 (34)	1.2:1
Jap Creek	1.0:1 (38)	0.9:1 (52)	1.0:1 (41)	1.2:1 (107)	1.2:1 (28)	1.1:1
Mayor Creek				0.9:1 (27)	0.8:1 (7)	0.9:1
Salmon Creek	1.0:1 (10)	0.9:1 (94)	1.0:1 (45)	1.0:1 (10)	1.0:1 (22)	1.0:1

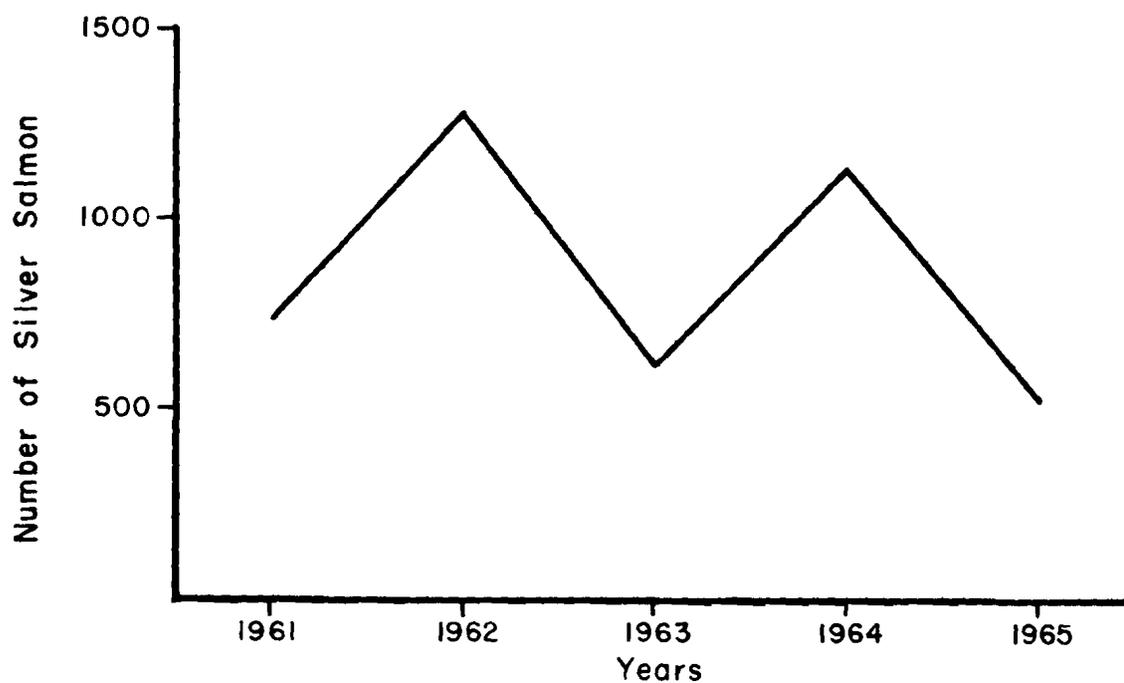


Figure 2. Total minimum silver salmon escapement for seven index streams in the Resurrection Bay area, 1961-1965.

Silver Salmon Timing

The timing of the silver salmon escapement into the Resurrection Bay index streams has been determined since 1961 by weekly foot surveys. These surveys showed fish first appeared between September 20 and 24 and usually completed spawning by December 1. The peaks of the various escapements usually occurred in late October, but ranged from September 28 to November 19 (Table 7). The dates of the highest counts vary considerably from stream to stream and even within the same stream, making it difficult to select an optimum date to measure peak escapement.

TABLE 7 - Dates of Highest Silver Salmon Escapement Counts for Seven Index Streams in the Resurrection Bay Area, 1961-65.

<u>Name of Stream</u>	<u>Date First Observed</u>	<u>Dates of Highest Counts</u>				
		<u>1961</u>	<u>1962</u>	<u>1963</u>	<u>1964</u>	<u>1965</u>
Airport Creek	9/21	11/7	10/6	10/31	10/25	11/1
Clear Creek	9/22	11/10	11/5	10/17	10/22	11/1
Dairy Creek	9/21	10/25	11/15	10/17	10/9	10/26
Grouse Creek	9/20	11/19	9/28	10/17	10/22	10/27
Jap Creek	9/24	11/2	11/1	10/17	10/13	10/28
Mayor Creek	9/24	10/20	11/5	10/17	10/25	10/28
Salmon Creek	*	11/5	11/5	11/7	11/4	11/5

* Surveys were not initiated until October 30 to preclude enumerating fish destined for Bear or Grouse Creek.

Seward Lagoon

Dairy Creek, which since 1961 has had a mean annual escapement of 321 silver salmon, declined to a run of 48. The drastic decline, despite the low abundance of the entire run, was probably a result of the March 27, 1964 earthquake and its seismic sea waves which destroyed the Seward Lagoon dyke and tide gates. Seward Lagoon, a 10.2 acre brackish-water lagoon with a volume of 40.7 acre-feet and a maximum depth of 8 feet, was a good rearing area for juvenile salmon. The sudden intrusion of salt water, during a period when the rearing salmon were becoming acclimated to higher salinities prior to "smolting," probably caused a high mortality. Also, some juvenile fish were undoubtedly washed out into Resurrection Bay.

The Corps of Engineers, during the spring of 1965, restored the dyke and installed two tide gates (a standard 48-inch and an adjustable 24-inch). A measuring pole in the lagoon showed the water depth increased 2.5 inches from mean low tide (1.4 feet) to mean high tide (9.6 feet) with the 24-inch tide gate open. The July 15 to September 15 surface temperatures of Dairy Creek, Seward Lagoon, and Resurrection Bay at the lagoon outlet are presented by weekly periods in Table 8. This table shows that the lagoon's temperature patterns are influenced primarily by Resurrection Bay tides.

TABLE 8 - Weekly Surface Temperatures of Dairy Creek, Seward Lagoon and Resurrection Bay from July 15 to September 15, 1965.

Weekly Period	Dairy Creek		Seward Lagoon		Resurrection Bay	
	Mean (°F.)	Range	Mean (°F.)	Range	Mean (°F.)	Range
7/15-7/21	41.8	40-43	47.0	43-51	48.6	48-50
7/22-7/28	42.7	41-44	49.0	46-55	48.7	47-51
7/29-8/4	43.0	41-45	50.6	45-55	50.3	48-54
8/5-8/11	42.8	40-46	51.2	47-56	51.0	48-55
8/12-8/18	41.2	40-42	49.8	45-54	50.0	48-52
8/19-8/25	41.8	40-44	50.4	48-55	50.0	48-53
8/26-9/1	44.7	42-46	52.7	50-56	53.3	48-56
9/2-9/8	43.8	42-47	51.8	48-54	52.3	50-54
9/9-9/15	45.3	43-47	50.8	49-52	53.0	51-55
MEAN	43.0		50.4		50.8	

Bear Lake System

The Bear Lake system was selected for intensive study because it is the largest accessible silver salmon-producing body of water in the Resurrection Bay area. An attempt to mitigate freshwater mortality and increase its rearing potential for juvenile silver salmon was made in 1963 when the lake was rehabilitated with rotenone (Logan, 1963). Bear Lake has been restocked annually with young-of-the-year silver salmon (Table 9). The effects of the rehabilitation on the survival, timing, and growth rate of the restocked fish were determined by measuring the number and size of downstream migrants at the Bear Creek Weir from May 11 to November 13.

TABLE 9 - Number and Size of Young-of-the-Year Silver Salmon Stocked in Bear Lake, 1963-65.

<u>Date</u>	<u>Number</u>	<u>Number Per Pound</u>	<u>Source of Eggs</u>
11/13- 12/8/63	148,000	88	Swanson River, Bear Creek
9/16/64	43,000	168	Swanson River, Ketchikan
8/25- 9/3/65	69,800	95	Swanson River, Dairy Creek

Silver Salmon Downstream Migration

The first silver salmon smolt was checked at the weir on May 13. This

occurred before stream temperatures reached 39°F. on May 17, and before the Bear Lake ice breakup (lake water over 50 percent open) on June 4. Wild fish sampled in 1962 and 1963 initiated their seaward migration after ice breakup and water temperatures had attained 39°F. (Table 10).

TABLE 10 - Relationship Between Initiation of Silver Salmon Smolt Seaward Migration and Date of Ice Breakup on Bear Lake and First Occurrence of 39°F. Water at Bear Creek Weir, 1962-65.

<u>Year</u>	<u>Rearing Background</u>	<u>Date Sampling Initiated</u>	<u>Date First Smolt Taken</u>	<u>Date of Ice Breakup</u>	<u>Date of First 39° F. Water</u>
1962	Wild	May 2	May 25	May 19	May 20
1963	Wild	May 11	May 21	May 13	May 15
1964	Hatchery	April 9	April 9	June 8	June 2
1965	Hatchery	May 11	May 13	June 4	May 17

An estimated 17,185 silver salmon smolts migrated out of Bear Lake with a small number probably migrating before and after the period of weir operation. A flood caused by unusually heavy rains and rapidly melting snow occurred in Bear Creek from June 7 through 10. A record stream flow of 118 cfs. was recorded and the screen panels had to be removed to prevent the weir from washing out. An estimate of the number of fish migrating during this interval was determined by averaging the counts preceding and following this four-day period.

The seaward migration was comprised of 4,762 age-II smolts with an adipose and left ventral clip (Ad-LV) and 12,423 age-I smolts with an adipose and right ventral clip (Ad-RV). The greatest number of fish captured in 1 day was 875 (5.1 percent of the total run) on June 5. The timing and abundance of the smolt migrations by weekly periods for 1962-65 are presented in Table 11. An appreciable fall migration of 4,361 smolts (25.4 percent of the total run) occurred for the first time since the study was initiated. This late run was composed of virtually all age-I smolts (Ad-RV).

From the 1963 plant of 148,000 Ad-LV fry, 13,258 smolts were counted during 1964 (64.1 percent) and 1965 (35.9 percent). This represents 9.0 percent of the fish originally stocked. The Ad-LV smolt production is lower than expected and is, in part, due to a segment of the population apparently becoming landlocked. Three experimental 125-foot gill nets (3/4 to 2-inch bar measure), fished 144 net-hours, from October 22 to 25, captured 7 Ad-LV fish ranging from 287 to 372 mm in length with a mean of 333.6 mm. Because these fish were about three times longer than the average smolt, and they had remained in the lake after the seaward migration had ceased, landlocking is strongly suggested. Also, 49 Ad-RV fish, ranging from 117 to 312 mm with a mean of 165.1 mm, were captured. The large size of these fish suggests that they also may have been landlocked. Another possible factor affecting the smolt production of the 1963 plant may be due to the fish being stocked in Bear Lake through the ice from November 13 to December 12. Planting hatchery-reared fish into a new environment during the winter when lake food production is low could be deleterious. The high smolt production of 12,423

TABLE 11 - Wild and Hatchery-Reared Silver Salmon Smolts Checked Through the Bear Creek Weir by Weekly Periods, 1962-65.

Weekly Periods	Wild Fish		Hatchery-Reared Fish			Total
	<u>1962</u> Ad-LV	<u>1963</u> Ad-LV	<u>1964</u> Ad-LV	<u>1965</u> Ad-LV	<u>1965</u> Ad-RV	
4/1-4/7	0	-	-	-	-	-
4/8-4/14	0	-	17	-	-	-
4/15-4/21	0	-	44	-	-	-
4/22-4/28	0	-	26	-	-	-
4/29-5/5	0	-	34	-	-	-
5/6-5/12	0	0	68	0	0	0
5/13-5/19	0	0	78	3	117	120
5/20-5/26	4	18	112	13	889	902
5/27-6/2	512	264	68	852	1,808	2,660
6/3-6/9	1,970	2,451	136	1,692	907	2,599
6/10-6/16	530	3,743	124	1,306	672	1,978
6/17-6/23	440	665	6,045	730	593	1,323
6/24-6/30	252	67	419	123	554	677
7/1-7/7	70	-	418	26	710	736
7/8-7/14	20	-	238	2	755	757
7/15-7/21	5	-	32	0	501	501
7/22-7/28	0	-	86	0	429	429
7/29-8/4	25	-	102	0	112	112
8/5-8/11	0	-	32	0	24	24
8/12-8/18	0	-	28	0	3	3
8/19-8/25	5	-	28	0	0	0
8/26-9/1	0	-	26	1	2	3
9/2-9/8	5	-	11	0	0	0
9/9-9/15	0	-	3	9	19	28
9/16-9/22	-	-	30	2	199	201
9/23-9/29	-	-	124	2	2,527	2,529
9/30-10/6	-	-	35	0	1,219	1,219
10/7-10/13	-	-	92	0	144	144
10/14-10/20	-	-	11	1	113	114
10/21-10/27	-	-	27	0	48	48
10/28-11/3	-	-	2	0	69	69
11/4-11/10	-	-	-	0	9	9
11/11-11/17	-	-	-	0	0	0
TOTAL	3,838	7,208	8,496	4,762	12,423	17,185
No. dead	83	97	831	10	645	655
No. released	3,755	7,111	7,665	4,752	11,778	16,530
No. clipped	1,741	All	All	All	All	All

- Not sampled

Ad-RV fish, 28.9 percent of the 43,000 fry planted in 1964, is in sharp contrast to the 1963 plant. These fish were planted in the fall under more favorable climatic conditions.

The mean fork lengths of silver salmon smolts checked through the Bear Creek weir by weekly periods for 1962-65 are shown in Table 12. The average length of the age-II smolts (Ad-LV) during the peak of the 1965 spring migration was 167.5 mm while that of the age-I smolts (Ad-RV) was 116.4 mm. The mean lengths for the 1962 and 1963 wild smolts (primarily age-II) during the peak of migration were 116.7 and 115.7 mm, respectively. The effects of the rehabilitation in increasing the rearing potential of Bear Lake are readily apparent. Planted fry which migrated at age-I were nearly the same size as the age-II wild smolts; planted fry which migrated at age-II were 44 percent longer than age-II wild smolts. Examination of Table 12 indicates there is little evidence that the larger fish consistently tend to initiate migration first as previously supposed. The largest Ad-LV and Ad-RV fish, both captured on October 25, were 372 and 312 mm, respectively.

Wild silver salmon fry were first recorded at the weir on June 13. They were not observed in past years until after July 8. Because the chances of seaward-migrant fry surviving to return as adults are virtually nonexistent, all fry captured at the weir were returned to Bear Lake. The numbers of fry captured by month were as follows: June - 50, July - 303, August - 3,244, September - 3,780, October - 314, November - 21. A sample of 54 fry had an average length of 58.4 mm during the peak of their downstream migration on August 28.

An estimated 69,800 silver salmon fry with a mean weight of 95 per pound were stocked in Bear Lake on August 25 and September 3. These fish originated primarily from the Swanson River and had been marked at the Fire Lake Hatchery with an adipose and left ventral clip. The first 1965 planted fish was taken at the weir on August 27. All planted fish were returned to the lake because they were smaller than "smolt size" and were probably the result of straying. The numbers captured each month were as follows: August - 503, September - 2,410, October - 420, November - 43.

Downstream Migration - Other Species

The first red salmon, Oncorhynchus nerka, smolt was taken at the weir on May 15 with a total of 12,253 being enumerated. The numbers taken each month were as follows: May - 6,481, June - 5,712, July - 35, August - 19, September - 6. All smolts were age-I, based on the knowledge that the rehabilitation of Bear Lake had eliminated all juvenile age classes except for eggs buried in the gravel by the 1963 adult run. The peak of the migration was May 29 when 1,844 fish passed through the weir. A sample of 126 smolts, measured between May 27 and June 3, ranged from 98 to 150 mm with a mean of 116.4 mm. The effect of the rehabilitation in increasing the growth of rearing fish is evinced by comparing the 1965 mean smolt size of 116.4 mm to the 1962 and 1963 means of 65.7 and 68.7 mm, respectively, during the peak of migration.

TABLE 12 - The Mean Fork Lengths (mm) of Samples from Wild and Hatchery-Reared Smolts Checked Through the Bear Creek Weir by Weekly Periods, 1962-65.

Weekly Periods	Wild Fish				Hatchery-Reared Fish					
	1962		1963		1964		1965			
	No.	Mean	No.	Mean	Ad-LV		Ad-LV		Ad-RV	
	No.	Mean	No.	Mean	No.	Mean	No.	Mean	No.	Mean
4/1-4/7										
4/8-4/14					4	73.7				
4/15-4/21					15	78.9				
4/22-4/28					5	82.4				
4/29-5/5					4	82.0				
5/6-5/12					23	83.3				
5/13-5/19					23	83.6				
5/20-5/26					26	85.2			92	115.7
5/27-6/2	230	117.7	132	115.0	7	84.0	5	166.6	50	116.4
6/3-6/9	325	116.7	101	113.2	19	90.8	50	167.5	55	117.2
6/10-6/16	87	110.8	203	115.7	6	97.3	50	160.4	50	121.0
6/17-6/23	122	106.7	83	119.4	50	95.2	50	156.7	50	125.0
6/24-6/30	7	103.0	11	111.3	83	95.6	10	159.3	52	136.1
7/1-7/7							12	160.3	50	139.3
7/8-7/14									50	146.7
7/15-7/21					9	113.1			50	157.6
7/22-7/28					63	126.6			50	160.9
7/29-8/4					79	129.1			10	132.6
8/5-8/11					26	138.5			8	112.1
8/12-8/18										
8/19-8/25										
8/26-9/1										
9/2-9/8										
9/9-9/15									16	155.8

TABLE 12 (Cont.) - The Mean Fork Lengths (mm) of Samples from Wild and Hatchery-Reared Smolts Checked Through the Bear Creek Weir by Weekly Periods, 1962-65.

Weekly Periods	Wild Fish				Hatchery-Reared Fish					
	1962		1963		1964		1965			
	No.	Mean	No.	Mean	Ad-LV		Ad-LV		Ad-RV	
	<u>No.</u>	<u>Mean</u>	<u>No.</u>	<u>Mean</u>	<u>No.</u>	<u>Mean</u>	<u>No.</u>	<u>Mean</u>	<u>No.</u>	<u>Mean</u>
9/16-9/22					30	142.0			16	153.8
9/23-9/29					121	143.8			45	149.3
9/30-10/6					33	139.3			52	152.5
10/7-10/13					67	141.3			34	150.7
10/14-10/20					11	133.2			16	150.9
10/21-10/27					27	137.6				
10/28-11/3										
11/4-11/10										
11/11-11/17										

Pink salmon, Oncorhynchus gorbuscha, were captured from the first date of weir operation on May 11 to June 10 with 782 fry being counted. Because the daily number of fry captured declined gradually from May 11, it appeared that only the end of the pink salmon fry seaward migration was sampled.

Dolly Varden, Salvelinus malma, were taken the first day of weir operation with the peak of the downstream migration occurring on May 29 when 95 fish were enumerated. A total of 827 Dolly Varden were counted from May 11 through June 19 with a few fish undoubtedly moving downstream prior to weir installation. The bulk of these fish originally gained access to Bear Lake, where they spent the winter, from July 9 through August 27, 1964 when the present weir was still under construction.

Silver Salmon Upstream Migration

The first adult silver salmon was captured at the weir on September 1 and the last was recorded on October 12, although weir operation was not terminated until November 13. A total of 220 fish was checked, with the peak of the migration occurring on September 23 when 60 silver salmon (27.3 percent of the total run) were counted. The weekly adult upstream migrations by sexes for 1961-62 and 1964-65 are presented in Table 13. Data collected in 1963 are not included because the escapement was determined by foot surveys due to the Bear Lake rehabilitation. The timing of adults with a hatchery-reared background was similar to that of natural populations. The sex ratio of males to females was 1.4:1.

The weir was checked daily at 0800 and 1700 hours with most fish (71.4 percent) migrating between 1700 and 0800 hours. All fish were examined for fin clips with the following observed: Ad-LV - 212, Ad-RV - 6, unmarked - 2. The Ad-LV adults were age 1.1 as determined by scale readings from a sample of 69 fish.

A sample of 37 males had lengths ranging from 417 to 682 mm with a mean 537 mm while 32 females ranged from 475 to 675 mm with a mean of 579 mm. Most of these fish are the result of eggs taken at the Swanson River, a tributary of Cook Inlet. The bulk of these silver salmon are age 2.1 with, as yet, an undetermined percentage having a lake-rearing background (Engel, 1965). The mean fork lengths of Swanson River females in 1964 and 1965 were 624 and 616 mm, respectively. This stock of fish is smaller than those found in Resurrection Bay (Table 4). The desirability of stocking fish similar to those in Resurrection Bay is recognized. However, at the present time the Swanson River is the only dependable egg source. Use of Resurrection Bay fish is not considered sound management at this time because the stocks are apparently at a low level of abundance and an intensive fishery exists.

The water temperature at the inception of the adult migration was 56°F., gradually declining to 42°F. when the run terminated. Stream flows ranged from 12.7 to 50.4 cfs. during this period.

Upstream Migration - Other Species

The adult red salmon upstream migration extended from June 15 through August 17 with 3,787 fish being enumerated. The peak of the run occurred on June 23 when 686 fish (18.1 percent of the total run) were counted.

TABLE 13 - Adult Silver Salmon Checked Through the Bear Creek Weir by Weekly Periods, 1961-65.

Weekly Period	1961			1962			1964			1965		
	♂	♀	Total*	♂	♀	Total**	♂	♀	Total***	♂	♀	Total
8/19-8/25	2	0	2	1	0	1			0			0
8/26-9/1			0			0			0	2	0	2
9/2-9/8			0	1	0	1	15	6	65	2	1	3
9/9-9/15	13	4	62			0	21	4	25	5	3	8
9/16-9/22	24	10	107	43	5	53	120	33	153	25	21	46
9/23-9/29	74	31	116	315	240	775	306	136	442	83	60	143
9/30-10/6	70	66	454	50	57	107	29	31	60	5	5	10
10/7-10/13	13	18	31	2	2	4	84	80	164	5	3	8
10/14-10/20			0	36	42	78	2	8	10			0
10/21-10/27			0	99	111	210	9	9	18			0
10/28-11/3			0	103	112	215	3	4	7			0
11/4-11/10			0	16	25	41	4	5	9			0
TOTAL	196	129	772	666	594	1,485	593	316	953	127	93	220

* 447 fish were not sexed.

** 225 fish were not sexed.

*** 44 fish were not sexed.

Four adult pink salmon were enumerated between July 17 and August 11. Nearly complete absence of this species in Resurrection Bay tributary streams is common in odd numbered years.

A female king salmon, Oncorhynchus tshawytscha, with a fork length of 985 mm was taken at the weir on September 22. This is the first official record for this system.

An undetermined number of Dolly Varden were able to swim through the 3/4-inch bars of the adult counting fence with some of these fish jumping the weir. No estimate can be made of the number entering Bear Lake, but 144 hours of gill netting from October 22 to 25, after the main run was over, captured 19 fish. The catch per hour was 0.13.

Recovery of Fin-Clipped Silver Salmon

A total of 7,665 silver salmon smolts with a Ad-LV clip were released through the Bear Creek weir in 1964. Two hundred twelve of these smolts returned to the weir as adults after approximately 15 to 18 months of ocean life. The marine survival, defined as the percentage of smolts to returning adults at the weir, was 2.77 percent.

TABLE 14 - Observed and Calculated Recoveries of Silver Salmon Smolts, Marked at Bear Creek, in the Sport and Commercial Fisheries, in Resurrection Bay, 1963-65.

<u>Year of Recovery</u>	<u>Number of Fish Sampled</u>	<u>Estimated Total Catch</u>	<u>Percentage of Catch Sampled</u>	<u>Number of Marked Fish Recovered</u>	<u>Calculated Number of Marked Fish</u>
1963	1,260	9,543	13.2	6	45
1964	630	3,627	17.4	27	155
1965	1,454	4,022	36.2	63	174

The rate of exploitation was determined by examining the catch for marked silver salmon concomitant with creel census. Exploitation in this case is defined as the percentage of adults caught in the fishery compared to the original number of smolts. A total of 1,454 fish was examined of which 63 (4.33 percent) were fin-clipped (Ad-LV). The percentage of marked fish, expanded for the estimated total harvest of 4,022, yielded an estimated 174 marked silver salmon caught (Table 14). The rate of exploitation was 2.27 percent. The chief source of error in calculating the rate of exploitation is the a priori assumption that these fish do not enter substantially into a commercial troll fishery. The total survival rate of marked smolts to adults (harvest plus escapement) was 5.04 percent. The different survival rates for 1963-65 are shown in Table 15. It is recognized that a differential mortality rate exists between marked and unmarked smolts so the survival rates discussed are minimal. The efficiency of the sport fishery in harvesting silver salmon in Resurrection Bay is evinced by the marked fish catch-to-escapement ratio of 0.82:1. The catch-to-escapement ratios for 1963-65 are shown in Table 16.

TABLE 15 - Survival Rates of Silver Salmon Smolts, Marked at Bear Creek, to Returning Adults, 1963-65.

<u>Year of Recovery</u>	<u>Number* of Smolts</u>	<u>Marine Survival</u>	<u>Rate of Exploitation</u>	<u>Total Smolt Survival Rate</u>
1963	1,741	1.72	2.58	4.30
1964	7,111	6.13	2.18	8.31
1965	7,665	2.77	2.27	5.04

*Smolts migrated to sea one year prior to recovery.

TABLE 16 - The Catch-to-Escapement Ratio of Silver Salmon Marked at Bear Creek, 1963-65.

<u>Year of Recovery</u>	<u>Calculated Number Taken in Fishery</u>	<u>Number of Adults Returning to Weir</u>	<u>Total Adults</u>	<u>Catch to Escapement Ratio</u>
1963	45	30	75	1.50:1
1964	155	436	591	0.36:1
1965	174	212	386	0.82:1

Bear Lake Seine Samples

During the summer two seine hauls were made at monthly intervals in Bear Lake off Inlet No. 3 to determine the rate of threespine stickleback reinfestation. A 35- by 5-foot seine with 1/4-inch mesh was used. The only stickleback seined was on August 26. However, 4 sticklebacks were taken in the downstream trap at the Bear Creek weir on August 3 and 28 and September 16 and 25. The fish composition of the monthly seine hauls were as follows: June 29 - 3 silver salmon (Ad-RV), 150 to 200 red salmon fry; July 29 - 70 juvenile red salmon; August 26 - 54 wild juvenile silver salmon, 1 threespine stickleback.

Incubation Channel Water Supply Evaluation

Data are being collected on stream flows, temperatures, snow depths and other physical and chemical features of Inlet No. 3 on Bear Lake. These data will be used to evaluate Bear Lake as a source of water for an artificial incubation channel. This information is on file at the Seward Field Office.

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Marking (Fin Clipping) Silver Salmon Smolts to Determine their Contribution to the Fishery.