

STATE OF ALASKA

William A. Egan, Governor



Annual Report of Performance for
SPORT FISH STUDIES

by

Edward T. McHenry David C. Nelson
David A. Watsjold Alan H. Townsend
Phil P. Kepler Thomas T. Trent
Stanley W. Kubik

ALASKA DEPARTMENT OF FISH AND GAME

James W. Brooks, Commissioner

DIVISION OF SPORT FISH

Rupert E. Andrews, Director

Howard E. Metsker, Chief, Sport Fish Research

RESEARCH PROJECT SEGMENT

State: ALASKA Name: Sport Fish Investigations
of Alaska.

Project No.: F - 9 - 6

Study No.: G - II Study Title: SPORT FISH STUDIES.

Job No.: G - II - A Job Title: Silver Salmon Studies in the
Resurrection Bay Area.

Period Covered: July 1, 1973 to June 30, 1974.

ABSTRACT

The Bear Creek weir downstream migrant trap was operated continuously from May 15 through November 12. A total of 77,343 age 1.0 silver salmon smolts, Oncorhynchus kisutch, and 2,366 age 1.0 and 0.0 fingerling were enumerated from the trap. Electrofishing Bear Lake in mid-October showed that stocked young-of-the-year grew 50.1 mm (38.0-88.1 mm) and residual yearlings increased 56.0 mm (75.2-131.2 mm) mean fork length in four months. Smolt and fingerling outmigration timing and abundance, condition factors, mean weekly Bear Creek water temperatures and stream flows are presented.

Bear Lake was restocked with 443,000 age 0.0 (1972 brood, Bear Lake and Lake Rose Tead, Kodiak origins) silver salmon fingerling on June 19, 1973, to maintain smolt production in the rehabilitated system.

The Resurrection Bay creel census (July 7-September 9) indicated an estimated 13,911 silver salmon harvested in 24,301 man-days of effort. The mean seasonal catch per hour was 0.095 silver salmon. Marked (fin-clipped) adult silver salmon, surviving from 222,000 age 1.0 (1970 brood, Lake Miam, Kodiak origin) smolts planted in local waters, contributed 21.5% to the sport harvest. Most (86.3%) of these fish resulted from the 66,500 smolts released in Seward Lagoon.

The Bear Creek weir upstream migrant trap was operated continuously from May 16 to November 27. Due to the Bear Lake rehabilitation's effect on juvenile silver salmon rearing below the weir in 1971, no wild adults were captured in the trap and only four were observed spawning in lower Bear Creek.

Of the 155,500 marked smolts released below the weir in 1972, none returned to Bear Creek. An estimated 60 marked adults from this plant, however, returned to spawn in Upper Salmon and Lower Grouse creeks. An estimated 811,300 eggs were artificially spawned from 180 females (85.5% marked) which returned to Seward Lagoon. Average fecundity was 4,507 eggs per female.

Data on the timing and abundance of other species ascending Bear Creek to the weir are presented. Minimum silver salmon escapements in seven local index streams are discussed.

Additional and detailed data collected during this report segment are on file at the Seward field office.

RECOMMENDATIONS

1. Retain the present objectives of the study.
2. Adhere to the Alaska Board of Fish and Game's Bear Lake Management and Research Policy of February 22, 1971.
3. Investigate the Resurrection Bay drainage for potential sites to excavate natural rearing ponds for rearing juvenile silver salmon.
4. Adjust the 1975 silver salmon fingerling stocking density in Bear Lake according to 1974 smolt abundance, age structure and condition factor during peak migration.
5. Summarize all Bear Lake red and silver salmon production data collected since 1961 for inclusion in a single interim research report.

OBJECTIVES

1. To collect and analyze biological data concerning the distribution, abundance, and timing of outmigrant and adult silver salmon in the Resurrection Bay area.
2. To determine the age and size composition of outmigrant and adult silver salmon populations in selected tributaries.
3. To determine the sport harvest of silver salmon in Resurrection Bay and natural mortality in salt water.
4. To evaluate the freshwater environmental limitations on juvenile silver salmon production in this area.
5. To determine the methods and means of increasing or extending the freshwater spawning and rearing areas of the watershed, and mitigating freshwater mortality.

6. To provide recommendations for the management of silver salmon in these waters and direct the course of future studies.

TECHNIQUES USED

The timing and abundance of silver salmon smolts and fingerlings emigrating from Bear Lake downstream to Bear Creek weir were determined by enumerating these fish at the downstream migrant trap. Weir location and description of the downstream trapping facilities were presented by Logan (1969). The timing and abundance of adult salmon were measured by enumerating these fish at the weir's upstream migrant trap. Adult trapping facilities, rebuilt in 1969 and modified in 1970, were described by McHenry (1971). Bear Creek water temperatures and flows were recorded daily at the weir.

Age structures of adult Resurrection Bay silver salmon and Bear Lake red salmon populations were determined by examining representative scale impressions on 0.02 - inch cellulose acetate with a microprojector. Silver salmon smolts were known age (1.0). Size compositions of Bear Lake silver salmon smolt and fingerling populations were determined by weekly sampling at the weir and electrofishing in Bear Lake. Size composition of Bear Lake's adult red salmon escapement was determined by sampling most fish for fork length, weight and sex. All fish sampled were anesthetized in a 1:20,000 solution of MS-222 to facilitate handling and minimize mortality.

The Resurrection Bay silver salmon sport harvest and angler effort were measured by a stratified, random creel census conducted at the Seward small boat harbor. Sampling design and interview method were nearly identical to that described by Logan (1966). Fishing mortality of marked (fin-clipped) adults, resulting from the 1972 smolt plants in local waters, was determined by examining as many silver salmon as feasible during creel census interviews.

An index to silver salmon escapement abundance was measured by conducting periodic foot surveys on seven local index streams. All carcasses were examined for clipped fins, sexed, and mutilated to preclude recounting on subsequent surveys.

Evaluation of the rehabilitated freshwater rearing environment in Bear Lake was continued by measuring the abundance, growth, and condition factors of smolts surviving from the 1972 silver salmon fingerling plant.

FINDINGS

The findings presented are the result of the 1973-1974 research segment of this project. For a description of the Resurrection Bay drainage and past information collected on the project, see Logan (1962-69), and McHenry (1970-73).

Bear Lake Project

The Resurrection Bay silver salmon sport fishery is the largest saltwater salmon sport fishery in Alaska. It has increased from 6,002 man-days of angler effort in 1961 to 30,124 man-days in 1972, representing a 402% increase over the past 12 years. The silver salmon sport harvest, however, has varied independently of the increased effort, resulting in widely fluctuating levels of fishing success from year to year. For this reason, the Bear Lake-Resurrection Bay silver salmon research project has gained in importance to acquire the life history information necessary to increase natural and artificial production of indigenous stocks for this expanding fishery.

The Bear Lake system was completely rehabilitated with emulsified rotenone in 1971 in order to reclaim its maximum rearing potential for juvenile salmon. The lake rehabilitation project was discussed in detail by McHenry (1972). After detoxification was assured, Bear Lake was stocked with 450,300 age 0.0 (1971 brood, Bear Lake origin) silver salmon, Oncorhynchus kisutch, fingerlings on June 26 and 27, 1972. Age 1.0 smolts resulting from this initial plant emigrated from Bear Lake in 1973. Bear Lake was restocked with 443,000 age 0.0 (1972 brood, Bear Lake and Lake Rose Tead, Kodiak stocks) fingerlings on June 19, 1973 to maintain continued smolt production in this system.

Bear Lake Downstream Migration

Silver Salmon:

The Bear Creek weir downstream migrant trap was operated continuously from May 15 through November 12. The downstream migrant screens and trap were removed on the latter date due to extreme icing above the weir. Abundance and timing of the smolt and fingerling downstream migrations are shown in Table 1 and Figure 1. Fish were designated "smolts" on the basis of typical smolt characteristics (silvery pigment, loss of parr marks) rather than size alone. If they did not have these traits they were defined "fingerling", regardless of size.

The total smolt outmigration to the downstream trap was 77,343 fish, or 17.2% of the 1972 fingerling plant. Trap and handling mortalities, as well as fungus disease, claimed 691 smolts (0.9% of the outmigration), allowing 76,652 smolts to be released downstream. All smolts were marked with an adipose (Ad) fin clip for recognition in the 1974 Resurrection Bay sport fishery and upon return to Bear Creek. Smolt outmigration began on May 30, peaked (50% of migration) on June 29, and terminated October 31. The highest daily count occurred on June 22 when 5,942 smolts (7.7% of the total run) were enumerated from the trap. The mean stream temperatures when smolt outmigration began, peaked, and terminated were 1.9° C (35.5°F), 7.8° C (46.0° F), and 1.7° C (35.0° F), respectively. Bear Creek stream flows ranged from 8 to 61 cfs during this period. Bear Creek mean water temperature, stream flow, smolt abundance and their condition factor (taken from Table 2) by weekly periods are presented in Figure 1.

TABLE 1. Silver Salmon Smolts and Fingerlings Enumerated Through Bear Creek Weir by Weekly Periods, 1973.

<u>Weekly Periods</u>	<u>Number of Smolts</u>		<u>Number of Fingerlings</u>	
	<u>Live</u>	<u>Dead</u>	<u>Live</u>	<u>Dead</u>
5/20- 5/26				1
5/27- 6/ 2	6		23	4
6/ 3- 6/ 9	208	3	80	19
6/10- 6/16	3,752	6	162	15
6/17- 6/23	17,340	51	575	19
6/24- 6/30	19,076	44	675	34
7/ 1- 7/ 7	6,843	76	103	11
7/ 8- 7/14	7,561	83	58	16
7/15- 7/21	3,330	50	21	10
7/22- 7/28	2,981	103	9	9
7/29- 8/ 4	4,760	222	11	6
8/ 5- 8/11	4,217	22	7	2
8/12- 8/18	1,190	6	5	4
8/19- 8/25	2,778	2	26	1
8/26- 9/ 1	364	1	19	3
9/ 2- 9/ 8	1,277	2	130	25
9/ 9- 9/15	246	1	130	
9/16- 9/22	241	3	32	3
9/23- 9/29	28		16	2
9/30-10/6	35		24	6
10/ 7-10/13	62	3	8	2
10/14-10/20	330	10	57	
10/21-10/27	21	3		
10/28-11/ 3	6		3	
Total	76,652	691	2,174	192

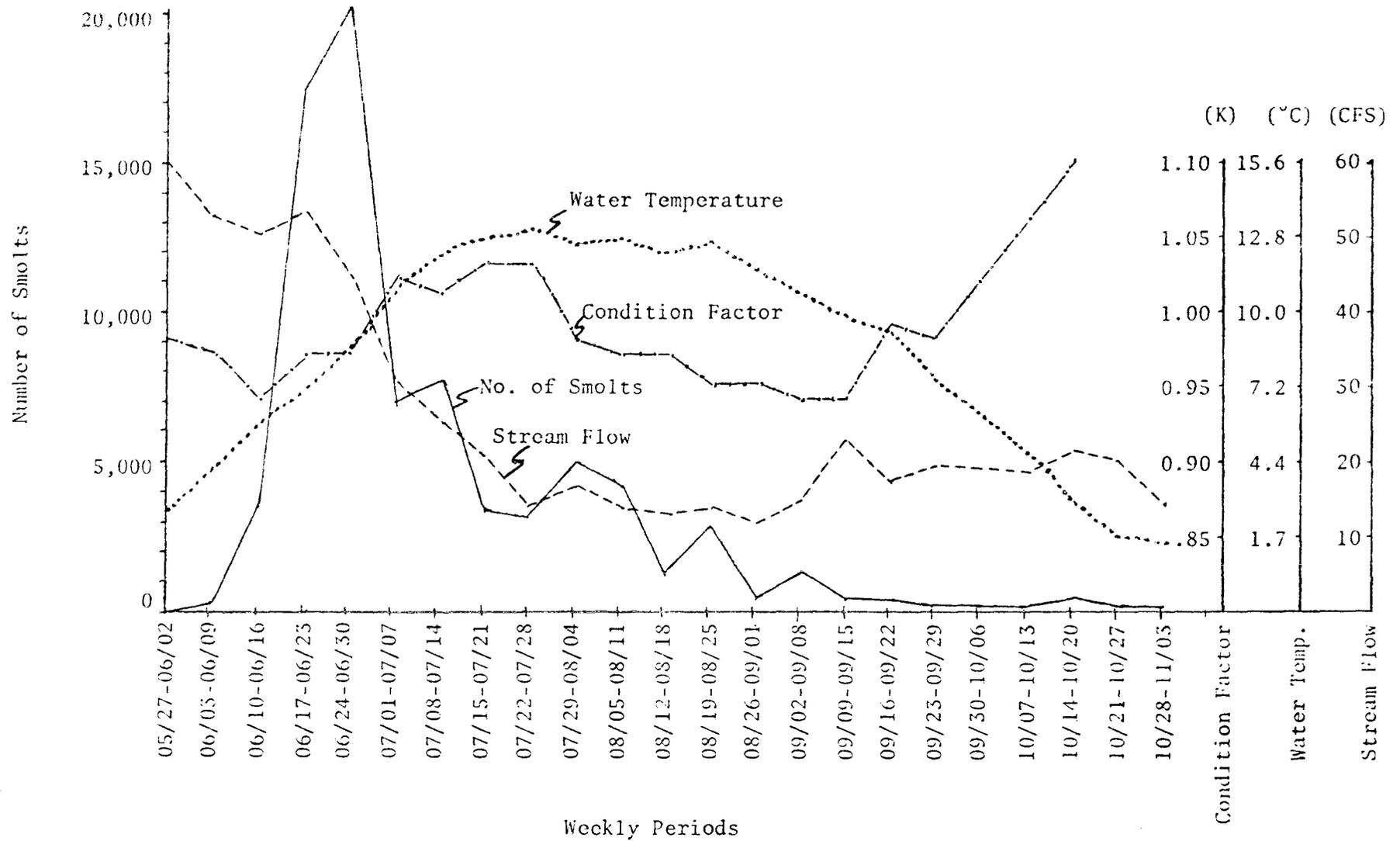


Figure 1. Bear Creek Mean Water Temperature, Stream Flow, Smolt Abundance and Their Condition Factor (from Table 2) by Weekly Periods in 1973.

The entire smolt migration was comprised virtually of yearling (age 1.0) fish. Table 2 shows the mean fork length, weight and condition factor of smolts sampled randomly each week during the outmigration. The presence of smaller smolts sampled after September 23 at the weir indicated that a few small yearlings and/or large young-of-the-year emigrated from Bear Lake in the fall. Population sampling by electrofishing in Bear Lake indicated a break-off point separating age 0.0 and 1.0 fish at 110 mm (age group overlap between 103-115 mm fork length) in mid-October. Young-of-the-year and yearlings averaged 88.1 and 131.2 mm fork length, respectively, in the Bear Lake sample (n=349).

Smolt growth was excellent for the 1,734 smolts sampled throughout the migration period (Table 2). Mean fork length of smolt samples from mid-June to mid-September increased from 101.0 to 170.3 mm, for an apparent 69.3 mm growth in three months. A 19.3 mm fork length increase was noted from the last week of June to the second week of July, and subsequent weekly growth increments ranged from 2.2 to 6.7 mm until mid-September. The mean fork length of smolts during the peak week (6/24-30) of migration was 107.5 mm, and mean weight, 12.05 g. Condition factors generally indicated robust smolts. Figure 2 illustrates the mean fork length versus mean weight relationship (from Table 2) of Bear Lake smolts in 1973.

Seventy-one smolts (36.2% survival) of the 196 fingerlings (80 mm) marked with an Ad-LV fin clip at Bear Creek weir and restocked in Bear Lake in 1972 were recovered from the trap in 1973. These fish averaged 88.5 and 117.4 mm fork length in 1972 and 1973, respectively. Most (71.8%) of these smolts emigrated during the latter half of June, and the last three were captured on August 22. The 17 Ad-LV smolts migrating downstream during July averaged 135.5 mm fork length, which was similar to the mean length of unmarked smolts during that period (131.8 mm).

The fingerling downstream migration to the weir totaled 2,366 fish. All fingerlings were retained above the weir. Handling mortality claimed 192 fish (8.1% of the migration). Timing and peak of the fingerling migration were similar to that of the smolt outmigration.

Fingerlings captured at the weir through July 7 were yearlings, except for 79 young-of-the-year which resulted from natural spawning in Bear Lake tributaries in the fall of 1972. A 36 mm breakoff point was used to separate age 1.0 from age 0.0 fish through July 7 because there were no fish in the 37-53 mm range observed in those weekly samples. Due to the rapid growth of stocked young-of-the-year in Bear Lake, however, it was not possible to identify age 1.0 and age 0.0 fish by size at the weir after July 7.

Yearlings sampled at the weir during the peak week of migration (6/24-30) averaged 75.2 mm in fork length. Mean fork length, weight, and condition factor of fingerlings randomly sampled weekly through September 29 are shown in Table 3.

TABLE 2. Mean Fork Length, Weight and Condition Factor of Bear Lake Silver Salmon Smolts Sampled Weekly at Bear Creek Weir, 1973.

<u>Weekly Reports</u>	<u>Number Sampled</u>	<u>Mean Length and Range (mm)</u>	<u>Mean Weight and Range (g)</u>	<u>Condition Factor (K)*</u>
5/27- 6/ 2	6	103.3 (95-112)	10.85 (9.3- 12.9)	0.98
6/ 3- 6/ 9	100	102.5 (89-126)	10.41 (6.5- 18.1)	0.97
6/10- 6/16	100	101.0 (82-118)	9.67 (6.1- 16.0)	0.94
6/17- 6/23	100	105.0 (84-144)	11.23 (4.0- 26.7)	0.97
6/24- 6/30	100	107.5 (92-119)	12.05 (6.9- 16.7)	0.97
7/ 1- 7/ 7	100	117.1 (87-128)	16.31 (6.8- 20.7)	1.02
7/ 8- 7/14	100	126.8 (112-146)	20.50 (13.8- 27.1)	1.01
7/15- 7/21	100	132.6 (117-149)	24.11 (17.3- 34.4)	1.03
7/22- 7/28	100	138.0 (106-151)	27.03 (13.5- 37.6)	1.03
7/29- 8/ 4	100	144.5 (125-161)	29.65 (20.0- 38.2)	0.98
8/ 5- 8/11	100	146.7 (126-170)	30.61 (22.6- 48.8)	0.97
8/12- 8/18	100	152.8 (120-174)	34.61 (17.8- 49.0)	0.97
8/19- 8/25	100	155.0 (138-174)	35.56 (24.0- 52.7)	0.95
8/26- 9/ 1	100	159.7 (140-180)	38.56 (26.2- 55.2)	0.95
9/ 2- 9/ 8	100	163.6 (131-188)	41.08 (24.8- 62.9)	0.94
9/ 9- 9/15	100	170.3 (150-199)	46.65 (32.8- 72.0)	0.94
9/16- 9/22	100	170.9 (118-204)	49.28 (17.1- 88.3)	0.99
9/23- 9/29	28	163.5 (111-203)	42.91 (14.3- 76.4)	0.98
10/14-10/20	100	142.6 (110-252)	31.90 (12.9-164.6)	1.10

*K = $\frac{W \times 10^5}{L^3}$, where W = mean weight in grams and L = mean fork length in millimeters.

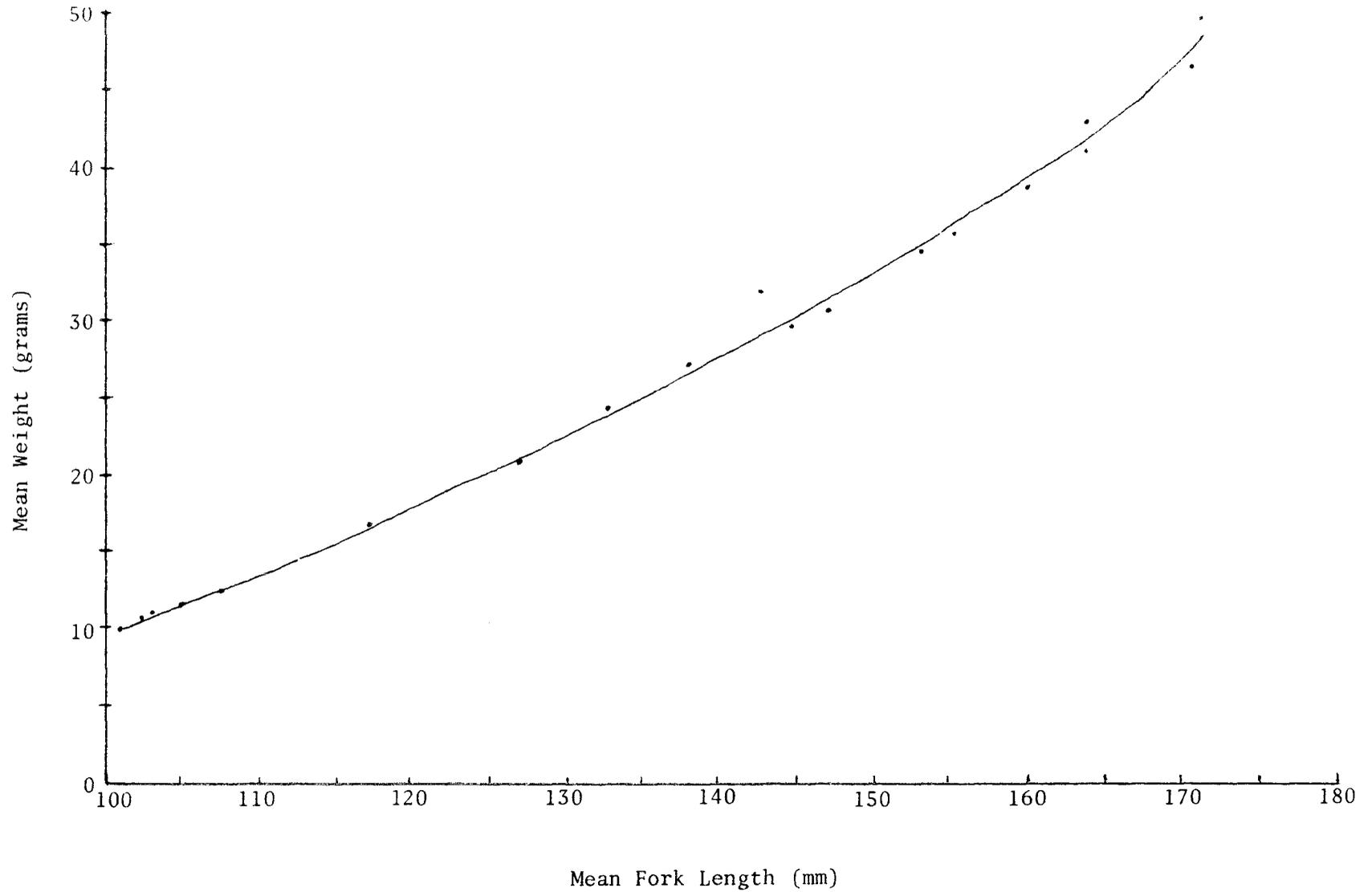


Figure 2. Mean Fork Length -- Mean Weight Relationship of Bear Lake Silver Salmon Smolts in 1973, (from Table 2).

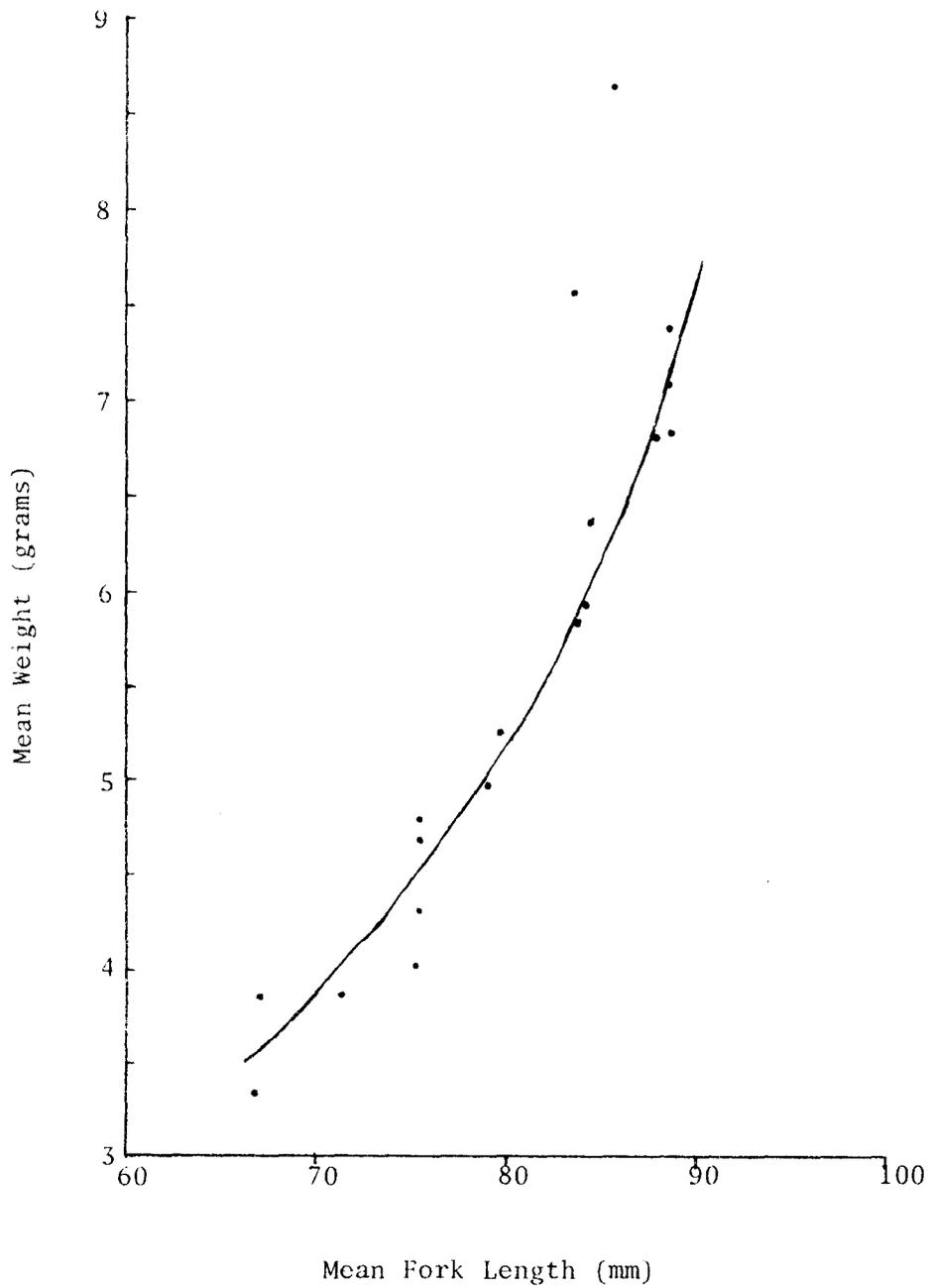


Figure 3. Mean Fork Length -- Mean Weight Relationship of Age 1.0 and 0.0 (>50 mm) Bear Lake Fingerlings in 1973 (from Table 3).

TABLE 5. Mean Fork Length, Weight, and Condition Factor of Bear Lake Silver Salmon Fingerling Sampled Weekly at Bear Creek Weir, 1973.

<u>Weekly Period</u>	<u>Number Sampled</u>	<u>Mean Length and Range (mm)</u>	<u>Mean Weight and Range (g)</u>	<u>Condition Factor (K)</u>
5/27- 6/ 2	14	83.5 (63- 94)	5.81 (3.1- 8.6)	1.00
6/ 3- 6/ 9	70	79.7 (54- 89)	5.24 (1.6- 8.1)	1.04
6/10- 6/16	92	75.1 (54- 88)	4.13 (1.2- 7.0)	0.98
6/17- 6/23	94	75.4 (57- 88)	4.33 (1.8- 6.5)	1.01
6/24- 6/30	99	75.2 (56- 89)	4.70 (1.9- 7.7)	1.11
7/ 1- 7/ 7	24	75.3 (62- 87)	4.80 (2.2- 6.9)	1.12
7/ 8- 7/14	23	66.7 (54- 86)	3.34 (1.6- 7.1)	1.13
7/15- 7/21	13	67.0 (53- 81)	3.76 (2.3- 5.6)	1.25
7/22- 7/28	6	71.3 (63- 80)	3.87 (2.9- 4.9)	1.07
7/29- 8/ 4	7	85.6 (52-101)	8.63 (3.1-13.0)	1.38
8/ 5- 8/11	5	83.6 (58-103)	7.58 (2.3-15.9)	1.30
8/12- 8/18	3	79.0 (72- 85)	4.97 (3.0- 6.8)	1.01
8/19- 8/25	13	84.0 (73- 94)	5.92 (3.6- 7.8)	1.00
8/26- 9/ 1	15	84.2 (68- 94)	6.37 (3.4- 8.6)	1.07
9/ 2- 9/ 8	100	88.4 (72-127)	7.37 (3.2-20.3)	1.07
9/ 9- 9/15	29	88.4 (73-130)	6.98 (3.5-24.3)	1.01
9/16- 9/22	31	88.6 (74-105)	6.71 (3.5-11.8)	0.96
9/23- 9/29	16	87.7 (74-103)	6.81 (3.4-10.7)	1.01

Total growth was measured for each age group in Bear Lake by the difference between their mean lengths at the beginning and end of the 1973 growing season. Young-of-the-year averaged 38.0 mm (684 fish/pound weighed by brood source) when stocked on June 19, and 88.1 mm in mid-October for 50.1 mm total growth in four months. Residual yearlings increased from 75.2 mm during peak of migration to 131.2 mm in mid-October for a 56.0 mm growth increment during that period. Figure 3 shows the mean length versus mean weight relationship (from Table 3) of Bear Lake yearlings and stocked young-of-the-year (50 mm) in 1973.

Resurrection Bay Silver Salmon Harvest and Effort

A stratified random creel census to determine the Resurrection Bay silver salmon sport harvest and effort was initiated at the Seward small boat harbor on July 7 and terminated on September 9. Although the first silver salmon was taken on June 22, a very few were caught before the creel census began. Most sport fishing effort was directed toward the more abundant rockfish, Sebastes spps., from mid-May through early July.

The season's total harvest was estimated at 13,911 silver salmon. This estimate was extrapolated from interviews with 6,850 completed anglers harvesting 3,708 silver salmon during the creel census period.

Peak of the harvest occurred on August 11, the first day of the Seward Silver Salmon Derby, when an estimated 800 fish (5.8% of the season's harvest) were taken. The season's total and derby harvest are summarized for 1969-1973 in Table 4. A large portion (31.2%) of the total 1973 harvest occurred during the nine-day derby, extending from August 11-19.

TABLE 4. Derby and Total Sport Harvests of Silver Salmon in Resurrection Bay, 1969-1973.

<u>Year</u>	<u>Total Sport Harvest</u>	<u>Derby Harvest</u>	<u>% Derby Harvest</u>
1969	15,039	5,150	34.2
1970	14,863	5,440	36.6
1971	20,593	9,488	46.1
1972	15,236	4,755	31.2
1973	13,911	4,334	31.2

The average number and percentage of sport fishing boats returning to the Seward small boat harbor were determined for each of three 3.5-hour sampling periods extending from 11:30 a.m. to 10:00 p.m. These are presented in

Table 5. Returning boats were not counted from 8:00-11:30 a.m. in 1973 because only 11.6% and 14.3% of weekend and weekday sport craft, respectively, returned during this period in the three years sampled (1964-1966).

The mean number of boats returning during this morning period was extrapolated using the above percentages. These estimates were then added to those determined for the three periods sampled to estimate the total daily boats. As in past years, the greatest number of boats returned from 3:00 - 6:30 p.m.

TABLE 5. The Mean Number and Percentage of Sport Fishing Boats Returning to the Seward Small Boat Harbor During Each Sampling Period, 1973.

Sampling Periods (hours)	Weekends		Weekdays	
	Mean Number of Boats	Percent	Mean Number of Boats	Percent
8:00 a.m.-11:30 a.m.*	15.7	11.6	5.4	14.3
11:30 a.m.-3:30 p.m.	32.8	24.2	7.4	19.6
3:00 p.m.-6:30 p.m.	58.5	43.1	18.1	47.9
6:30 p.m.-10:00 p.m.	<u>28.7</u>	<u>21.1</u>	<u>6.9</u>	<u>18.2</u>
Total	135.7	100.0	37.8	100.0

*Percentage for this period determined by three-year mean, 1964-1966.

Sport fishing effort was calculated by multiplying the total number of boats by the average number of anglers per boat. The average number of anglers per boat was as follows: weekdays - 3.07, weekends - 3.25, and salmon derby - 3.16.

The total sport fishing effort exerted for silver salmon was an estimated 24,301 man-days, or 5,824 less than the 30,124 man-days recorded in 1972. The main contributions to this reduction were fewer military man-days due to the loss of most Air Force recreation camp boats during the previous winter, and less overall effort expended on weekdays and during the salmon derby. A total of 28.2% of the season's effort was sampled during the creel census period. Fishing effort and mean catch per hour from 1969-1973 are summarized in Table 6. The fishing effort on weekdays and weekends, excluding the derby, was 6,565 and 7,851 man-days, respectively. Military personnel and dependents, angling from boats provided by the Army and Air Force recreation camps at Seward, contributed 13.7% (3,330 man-days) of the total effort.

TABLE 6. Derby and Total Sport Effort (Man-Days) Exerted for Silver Salmon and Mean Catch Per Hour in Resurrection Bay, 1969-1973.

<u>Year</u>	<u>Period of Census</u>	<u>Total Effort</u>	<u>Derby Effort</u>	<u>% Derby Effort</u>	<u>Catch Per Hour</u>
1969	7/9-9/ 9	24,653	11,266	45.7	0.091
1970	7/3-9/ 8	27,125	14,955	55.1	0.084
1971	7/12-9/8	26,485	12,988	49.0	0.112
1972	7/4-9/10	30,124	12,850	42.7	0.079
1973	7/7-9/ 9	24,301	9,885	40.7	0.095

The seasonal mean catch per hour was 0.095 silver salmon. Civilian anglers fishing during weekdays realized the highest catch per hour (0.14 fish) whereas the lowest catch rate (0.06 fish) occurred during the derby when effort was greatest. The average number of hours each angler fished per day was as follows: weekdays - 5.48, weekends - 5.47, and during the salmon derby - 6.89.

Examination of 201 scale samples randomly collected from sport-caught silver salmon throughout the sport fishery disclosed that the wild population was comprised of 52.8% age 1.1, 49.7% age 2.1, and 7.5% age 3.1 adults. Mean fork lengths of wild fish are presented in Table 7. The male-to-female sex ratio was 1.59:1 in the fishery.

TABLE 7. Mean Fork Length and Range (mm) of Wild Adult Silver Salmon Sampled from the 1973 Resurrection Bay Sport Fishery.

	<u>Number</u>	<u>Range</u>	<u>Mean</u>
Males	130	445-800	661.5
Females	82	490-710	648.4
Total	212	445-800	656.4

King, *O. tshawytscha*, and pink salmon, *O. gorbuscha*, were taken incidentally with silver salmon during the season. An estimated 981 king salmon were harvested during the census period at an average rate of 0.14 fish per boat. Though this catch rate is slightly lower than the 0.16 king salmon per boat average in 1972, it was twice that of the 1968-1970 mean (0.07 fish per boat) in Resurrection Bay. King salmon were most abundant in July when anglers averaged 0.20 fish per boat. Most king salmon taken appeared to be "feeders," or immature fish in their first and second ocean-years. The origins of these stocks are unknown since king salmon rarely ascend

Resurrection Bay streams. Anglers averaged 0.16 pink salmon per boat for the 1973 season. The total pink salmon sport harvest was estimated at 1,372 fish. This species was most abundant in July.

Bear Lake Upstream Migration

Silver Salmon:

The upstream migrant trap was operated continuously from May 16 to November 27. Only one adult silver salmon was observed briefly in the trap in early October. This fish, however, descended Bear Creek to spawn in the lower reaches. Foot surveys on October 21 and 30 disclosed that four silver salmon were spawning in lower Bear Creek. Few wild adult silver salmon were expected at Bear Creek weir in 1973 due to the Bear Lake rehabilitation's effects on juveniles rearing in lower Bear Creek in 1971.

Adult silver salmon, surviving from the 155,500 Ad-marked age 1.0 (1970 brood-Lake Miam, Kodiak origin) smolts released below the weir in May, 1972, were expected to return to Bear Creek in 1973. However, no marked fish were observed in Bear Creek. High mortality due to extensive seagull predation during and after smolt stocking was observed. An estimated 60 Ad-marked adults resulting from this release spawned in upper Salmon and lower Grouse creeks in late November and December.

Since silver salmon eggs were required for the 1974 Bear Lake fingerling plant, surplus adults in the Seward Lagoon escapement were beach seined and hauled live to the Bear Creek holding facility for artificial spawning. A total of 238 fish, comprised of 45 males and 193 females, were held to ripen for varying lengths of time between October 19 and November 27. Stream temperatures ranged from 0°-3.3°C (32°-38°F) during this period. Male and female holding mortalities were 15.6% and 6.7%, respectively. A total of 180 females were spawned, yielding an estimated 811,300 eggs. Average fecundity was 4,507 eggs per female. Approximately one male was used to fertilize eggs from five females. Most (85.8%) of the spawned fish returned from the 66,500 Ad-marked, age 1.0 smolts (1970 brood-Lake Miam, Kodiak origin) released in Seward Lagoon on May 31, 1972. The mean fork length of marked and wild adults held at Bear Creek weir are presented in Table 8. The wild fish were of Dairy Creek (Seward Lagoon) origin. Both the Kodiak and Seward Lagoon fish averaged considerably larger than Resurrection Bay adults (Table 7), though sample sizes may not be comparable.

TABLE 8. Mean Fork Length and Range (mm) of Adult Silver Salmon Held For Spawning at Bear Creek Weir in 1973.

	<u>Wild Fish (Dairy Creek)</u>			<u>Ad Fish (Lake Miam, Kodiak)</u>		
	<u>No.</u>	<u>Range</u>	<u>Mean</u>	<u>No.</u>	<u>Range</u>	<u>Mean</u>
Males	5	695-737	708.8	34	638-835	700.8
Females	28	585-760	712.5	165	625-800	722.4
Total	33	585-760	712.0	199	625-835	718.7

Other Species:

The first adult red salmon, O. nerka, was captured in the upstream trap on June 12 and the last on August 28. A total of 239 fish were enumerated, with the highest daily count of 26 (10.9% of the run) occurring on June 25. The migration consisted of 91 males, 145 females, and 3 "jacks". The male-to-female sex ratio was 0.63:1. Analysis of 167 scale samples collected periodically at Bear Creek weir disclosed that the adult age structure was 3.6% age 1.2, 0.6% age 2.2, 66.5% age 1.3, 25.7% age 2.3, and 1.8% age 3.3. Age 1.1 "jacks" comprised 1.8% of the upstream migration. Mean fork lengths of age 1.2, 2.2, 1.3, 2.3, and 3.3 fish were 569, 520, 660, 597, and 590 mm, respectively. Bear Creek water temperatures during the upstream migration ranged from 4.4°-15.0°C (40-59°F) and the flows from 8 to 61 cfs. No red salmon commercial fishery was permitted in Resurrection Bay in 1973 due to the anticipated poor adult return to Bear Lake.

Upstream migrant Dolly Varden, Salvelinus malma, ascended Bear Creek to the weir in early July and continued moving in and out of the trap through the remaining field season. Three pink salmon were observed in the trap in early August. All fish other than red or silver salmon were retained below the weir.

Adult Silver Salmon Timing and Abundance in Index Streams

Selected index areas of seven clear streams were foot surveyed periodically throughout immigration until peak of spawning terminated. Timing of the 1973 escapement was in late October, and peak of spawning occurred within the following three weeks in most index streams. Minimum silver salmon escapements in each stream index area since 1969 are presented in Table 9. The period from 1969 to 1973 encompasses one complete life cycle, which is typically four years (age 2.1) for Resurrection Bay silver salmon.

TABLE 9. Minimum Silver Salmon Escapement in Seven Index Streams in the Resurrection Bay Area, 1969-1973.

Name of Stream	Minimum Escapement					Mean 1969-72
	1969	1970	1971	1972	1973	
Airport	56	26	13	15	4	22
Box Canyon	54	19*	56*	59	36	47
Clear	59	91	93	55	37	75
Dairy	115*	66*	46*	49*	63*	69
Grouse	168	131	150	42	34	123
Jap	78	79	79	68	40	76
Mayor	64	38	19	22	4	36
Total	574	450	456	310	218	448

*Does not include marked "jacks" or adults returning from hatchery-reared smolt releases.

The total combined escapement of 218 adults returning in 1973 marks the lowest recorded in the 13 years these surveys have been conducted. This escapement is only 38.0% of the 1969 parent brood escapement which mainly (age 2.1 adults) produced it. The factors responsible for this reduced return are not yet understood, although an analysis of past temperature and precipitation records may show some correlation to production.

Silver Salmon Smolt Stocking Evaluation

Marked age 1.1 adults contributed 21.5%, or an estimated 2,994 fish, to the 1973 Resurrection Bay sport harvest. These fish resulted from 222,000 Ad-marked age 1.0 smolts released in Bear Creek and Seward Lagoon in May, 1972. The 60 marked adults estimated spawning in upper Salmon and lower Grouse creeks in 1973 represent only 0.04% marine survival of the 155,500 smolts released in Bear Creek. Marked smolt plants in Bear Creek were discontinued after 1972 because sufficient Bear Lake smolts were expected in 1973.

In contrast to the poor survival of the Bear Creek smolt release, the Seward Lagoon plant realized much higher survival despite the latter smolts being smaller (averaged 16.8 versus 14.8 per pound) when stocked. An estimated 379 marked adult escapement, including 35 taken in the shore fishery near the lagoon outlet culvert, resulted in 0.58% marine survival of the plant. Marked smolt releases will be continued in Seward Lagoon due to favorable survival rates.

Since the escapement timing and spawning peak were similar in both groups, their contributions to the marked sport harvest were calculated on the basis of relative escapements. Thus, an estimated 410 (13.7%) and 2,584 (86.3%) marked adults taken by sport boat fishermen were produced by the Bear Creek and Seward Lagoon smolt releases, respectively. Total smolt-to-

adult survivals for each group, therefore, were 0.30% (470/155,500 x 100) and 4.52% (2,963/65,500 x 100), respectively.

A total of 30,300 Ad-LV marked, age 1.0 (1971 brood, Bear Lake origin) smolts, averaging 8.9 per pound, were stocked in Seward Lagoon on May 7-9, 1973. A high smolt-to-adult survival is anticipated for this release in 1974 due to their large size when stocked.

LITERATURE CITED

- Logan, Sidney M. 1962. Silver Salmon Studies in the Resurrection Bay Area. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1961-1962, Project F-5-R-3, 3:57-74.
- _____. 1963. Silver Salmon Studies in the Resurrection Bay Area. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1962-1963, Project F-5-R-4, 4:175-194.
- _____. 1964. Silver Salmon Studies in the Resurrection Bay Area. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1963-1964, Project F-5-R-5, 5:133-151.
- _____. 1965. Silver Salmon Studies in the Resurrection Bay Area. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1964-1965. Project F-5-R-6, 6:129-145.
- _____. 1966. Silver Salmon Studies in the Resurrection Bay Area. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1965-1966, Project F-5-R-7, 7:79-99.
- _____. 1967. Silver Salmon Studies in the Resurrection Bay Area, Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1966-1967, Project F-5-R-8, 8:83-102.
- _____. 1968. Silver Salmon Studies in the Resurrection Bay Area. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1967-1968, Project F-5-R-9, 9:117-134.
- _____. 1969. Silver Salmon Studies in the Resurrection Bay Area. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1968-1969, Project F-9-1, 10:131-149.
- McHenry, Edward T. 1970. Silver Salmon Studies in the Resurrection Bay Area. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1969-1970, Project F-9-2, 11:75-89.
- _____. 1971. Silver Salmon Studies in the Resurrection Bay Area. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1970-1971, Project F-9-3, 12:1, 1-20.

. 1972. Silver Salmon Studies in the Resurrection Bay Area.
Alaska Department of Fish and Game. Federal Aid in Fish Restoration,
Annual Report of Progress, 1971-1972, Project F-9-4, 13: 1-20.

. 1973. Silver Salmon Studies in the Resurrection Bay Area.
Alaska Department of Fish and Game. Federal Aid in Fish Restoration,
Annual Report of Progress, 1972-1973, Project F-9-5, Vol. 14.

Prepared by:

Approved by:

Edward T. McHenry
Fishery Biologist

s/Howard E. Metsker
Chief, Sport Fish Research

s/Rupert E. Andrews, Director
Division of Sport Fish

