

STATE OF ALASKA

Jay S. Hammond, Governor



Annual Performance Report for
SPORT FISH STUDIES

by

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RESEARCH PROJECT SEGMENT

State: Alaska Name: Sport Fish Investigations
of Alaska

Project No.: F-9-7

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

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

Period Covered: July 1, 1974 to June 30, 1975.

ABSTRACT

Bear Lake was restocked with 450,800 age 0.0 coho salmon, Oncorhynchus kisutch, fingerlings (1973 brood, Lake Miam, Kodiak stock) on July 15 and 16, 1974, to maintain smolt production.

The Bear Creek weir downstream migrant trap was operated continuously from May 16 through November 15. A total of 72,389 age 1.0 and 2.0 coho smolts and 409 age 1.0 and 0.0 fingerlings were enumerated. Smolt out-migration timing and abundance, condition factors, mean weekly Bear Creek water temperatures and stream flows are presented. Bear Lake's smolt production and growth declined, and residual fingerling age composition shifted from age 0.0 to age 1.0 dominance with decreased growth, suggesting that its coho rearing environment has been overstocked.

The Resurrection Bay creel census (July 2 to September 9) indicated an estimated 18,629 coho were harvested in 25,902 man-days of effort. The mean seasonal catch per hour was 0.109 coho. Marked (fin-clipped) adult coho contributed 13.5% to the sport harvest. Most of these fish (96.8%) resulted from survival of the 76,652 age 1.0 Bear Lake smolts Ad marked and released past Bear Creek weir in 1973. Marked immature coho contributed an additional 16.8% to the sport catch. Most of these juveniles (96.3%) resulted from 100,000 age 1.0 hatchery-reared, Ad-RV marked smolts stocked in Seward Lagoon in May 1974.

The Bear Creek weir upstream migrant trap was operated continuously from May 16 to November 15. The adult coho upstream migration extended from

August 29 to November 15, and peaked on September 22. The total migration consisted of 2,490 age 1.1 Ad marked adults, 92 (97.7% age 1.1) unmarked adults, eight Ad and four Ad-RV marked jacks. Marine survival of age 1.1 adults returning to the weir was 3.37%. Catch-to-escapement ratio of marked Bear Lake adult coho was 0.99:1. Total smolt-to-adult survival of the 1973 Bear Lake smolt out-migration was 6.58%. The adult male-to-female sex ratio was 1.38:1. An estimated 2,792,500 fertilized eggs were artificially spawned from 663 females and 157 males. Average fecundity was 4,212 eggs per female.

Data on the timing and abundance of other fish species ascending and descending Bear Creek to the weir are presented. Minimum coho escapements in seven local index streams, and construction of a natural coho rearing pond 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. Investigate the Resurrection Bay drainage for potential coho rearing pond sites.
3. Adjust the 1976 coho fingerling stocking density in Bear Lake according to 1975 smolt abundance, age composition and condition factor.

OBJECTIVES

1. To collect and analyze biological data concerning the distribution, abundance, and timing of out-migrant and adult silver salmon in the Resurrection Bay area.
2. To determine the age and size composition of out-migrant 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 determine the methods and means of increasing or extending the freshwater spawning and rearing areas of the watershed, and mitigating freshwater mortality.
5. 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 sockeye and coho smolts and coho 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 sockeye and coho 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 coho and Bear Lake sockeye and coho populations were determined by examining representative scale impressions on 0.02-inch cellulose acetate with a microprojector. Sockeye smolts were known age (1.0). Age and size compositions of Bear Lake coho smolt and fingerling populations were determined by weekly sampling at the weir and electrofishing in Bear Lake. Size compositions of Bear Lake's adult sockeye and coho escapements were 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.

Resurrection Bay coho 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 was determined by examining as many coho as feasible during creel census.

An index to coho 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 and 1973 coho fingerling plants.

FINDINGS

The findings presented are the result of the 1974-1975 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 (1970-1974).

Bear Lake Project

The Resurrection Bay coho, Oncorhynchus kisutch, sport fishery is the largest saltwater salmon sport fishery in Alaska. It increased from 6,002 man-days of angler effort in 1961 to 30,124 man-days in 1972, representing a 402% increase in 12 years. The coho 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 research project has gained importance in determining the life history information necessary to increase natural and artificial coho production for this demanding 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 450,000 age 0.0 (1971 brood, Bear Lake origin) coho 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 443,300 age 0.0 fingerlings (1972 brood, Bear Lake and Lake Rose Tead, Kodiak, stocks) on June 19, 1973, and 450,800 age 0.0 fingerlings (1973 brood, Lake Miam, Kodiak stock) on July 15 and 16, 1974 to maintain smolt production in this system.

Bear Lake Downstream Migration

The Bear Creek weir downstream migrant trap was operated continuously from May 16 through November 15. The downstream migrant screens and trap were removed on the latter date due to cessation of smolt and adult migrations. Abundance and timing of the smolt and fingerling downstream migrations are shown in Table 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 as "fingerling", regardless of size.

Table 1. Coho Salmon Smolts and Fingerlings Enumerated Through Bear Creek Weir by Weekly Periods, 1974.

| <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> |
| 5/13- 5/19 | 3 | 1 | | |
| 5/20- 5/26 | 276 | 7 | 17 | 3 |
| 5/27- 6/ 2 | 3,273 | 24 | 67 | |
| 6/ 3- 6/ 9 | 15,370 | 196 | 184 | 6 |
| 6/10- 6/16 | 16,312 | 549 | 95 | 10 |
| 6/17- 6/23 | 9,889 | 86 | 3 | 2 |
| 6/24- 6/30 | 7,347 | 118 | 8 | 2 |
| 7/ 1- 7/ 7 | 1,419 | 8 | | |
| 7/ 8- 7/14 | 2,907 | 39 | | |
| 7/15- 7/21 | 6,527 | 133 | | |
| 7/22- 7/28 | 1,936 | 103 | 11 | 1 |
| 7/29- 8/ 4 | 65 | 0 | | |
| 8/ 5- 8/11 | 0 | 0 | | |
| 8/12- 8/18 | 1,426 | 79 | | |
| 8/19- 8/25 | 148 | 2 | | |
| 8/26- 9/ 1 | 187 | 50 | | |
| 9/ 2- 9/ 8 | 269 | 20 | | |
| 9/ 9- 9/15 | 2,466 | 33 | | |
| 9/16- 9/22 | 791 | 51 | | |
| 9/23- 9/29 | 82 | 14 | | |
| 9/30-10/ 6 | 43 | 41 | | |
| 10/ 7-10/13 | 13 | 3 | | |
| 10/14-10/20 | 7 | 37 | | |
| 10/21-10/27 | 9 | 30 | ---- | --- |
| Total | 70,765 | 1,624 | 385 | 24 |

The total smolt out-migration to the downstream trap was 72,389 fish. Trap and handling mortalities claimed 1,624 smolts (2.2% of the out-migration), allowing 70,765 smolts to be released downstream. All smolts were marked with an adipose (Ad) fin-clip for recognition in the 1975 Resurrection Bay sport fishery and upon return to Bear Creek. Smolt out-migration began on May 18, peaked (50% of migration) on June 17, and terminated October 27. The highest daily count occurred on June 8, when 5,056 smolts (7.0% of the total run) were enumerated from the trap. The mean stream temperatures when smolt out-migration began, peaked, and terminated were 4.2°C (39.5°F), 10.0°C (50.0°F), and 5.3°C (41.5°F), respectively. Bear Creek stream flows ranged from 8 to 127 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. Mean length, weight and condition factor of all smolts sampled by weekly periods are shown in Table 2.

The smolt out-migration was comprised of 88.6% (64,119) age 1.0 and 11.4% (8,270) age 2.0 smolts. This was estimated by extrapolating the relative percentages of age 1.0 and 2.0 smolts in biweekly length-frequency samples to the total number of smolts emigrating during those periods. Tables 3 and 4 show the mean fork length, weight, condition factor and relative percentages of age 1.0 and 2.0 smolts in the biweekly samples. After July 28, sampling was intermittent. However, the two biweekly periods sampled after that date indicated a 97.5% age 1.0 and 2.5% age 2.0 composition for the remainder of the smolt out-migration.

The 64,119 age 1.0 smolts resulted from 443,300 age 0.0 fingerlings planted in Bear Lake in 1973, and represent a 14.5% fingerling-to-smolt survival thus far. Additional age 2.0 smolts from this fingerling plant are expected in 1975. The 8,270 age 2.0 smolts resulted from 450,000 age 0.0 fingerlings stocked in Bear Lake in 1972. With the possible exception of some age 3.0 smolts emigrating in 1975, the total fingerling-to-smolt survival for this plant was 19.0%. Age composition of the first Bear Lake smolt production cycle after rehabilitation was 90.3% age 1.0 and 9.7% age 2.0.

Migration timing differed between age 1.0 and age 2.0 smolts. Age 2.0 smolts peaked (50%) on June 10 while age 1.0 smolts peaked one week later on June 17. Trap and handling smolt mortality (2.2%) was considered proportional to both age groups during migration. Therefore, an estimated 62,698 age 1.0 and 8,067 age 2.0 smolts were released downstream.

Smolt growth was somewhat slower than that observed in 1973. Figure 2 shows the mean fork length-mean weight relationship of 1974 smolts (data taken from Tables 2, 3, and 4) with the 1973 smolt length-weight curve for reference. Age 1.0 smolts in 1974 had an estimated mean fork length of 117.8 mm during migration peak and averaged 164.6 mm by mid-September for a 47.8 mm growth increment. In 1973, age 1.0 smolts increased 63.4 mm in fork length from migration peak (June 24-30) to September 16-22. Age 2.0 smolts in 1974 averaged 147.6 mm fork length at migration peak and 197.2 mm by mid-September for a 49.6 mm growth increment. Weekly smolt condition factors (Table 2) in 1974 averaged 0.08 lower than those measured during the 1973 out-migration.

Table 2. Mean Fork Length, Weight and Condition Factor of Bear Lake Coho Salmon Smolts Sampled Weekly at Bear Creek Weir, 1974.

| <u>Weekly Periods</u> | <u>Number Sampled</u> | <u>Mean Length and Range (mm)</u> | <u>Mean Weight and Range (g)</u> | <u>Condition Factor (K)*</u> |
|-----------------------|-----------------------|-----------------------------------|----------------------------------|------------------------------|
| 5/20-5/26 | 100 | 125.7 (84-172) | 19.12 (5.6-46.8) | 0.96 |
| 5/27-6/ 2 | 100 | 134.6 (99-188) | 20.12 (8.5-45.5) | 0.83 |
| 6/ 3-6/ 9 | 99 | 114.9 (94-170) | 15.59 (8.5-40.2) | 1.03 |
| 6/10-6/16 | 100 | 117.2 (99-160) | 14.97 (8.6-31.6) | 0.93 |
| 6/17-6/23 | 100 | 127.1 (100-166) | 19.33 (10.2-38.0) | 0.93 |
| 6/24-6/30 | 100 | 127.2 (105-155) | 19.31 (11.1-32.1) | 0.94 |
| 7/ 1-7/ 7 | 100 | 129.3 (108-156) | 19.78 (12.1-32.9) | 0.92 |
| 7/ 8-7/14 | 100 | 129.5 (112-165) | 19.30 (13.2-33.6) | 0.89 |
| 7/15-7/21 | 99 | 133.0 (112-168) | 21.67 (13.9-39.2) | 0.92 |
| 7/22-7/28 | 100 | 134.2 (112-162) | 21.65 (13.3-34.5) | 0.90 |
| 8/19-8/25 | 100 | 155.5 (120-180) | 32.12 (15.1-49.0) | 0.85 |
| 8/26-9/ 1 | 100 | 163.5 (142-185) | 36.62 (25.5-51.8) | 0.84 |
| 9/ 9-9/15 | 100 | 161.8 (142-185) | 34.84 (21.6-51.2) | 0.82 |
| 9/16-9/22 | 100 | 169.1 (130-208) | 42.94 (18.5-97.2) | 0.89 |

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

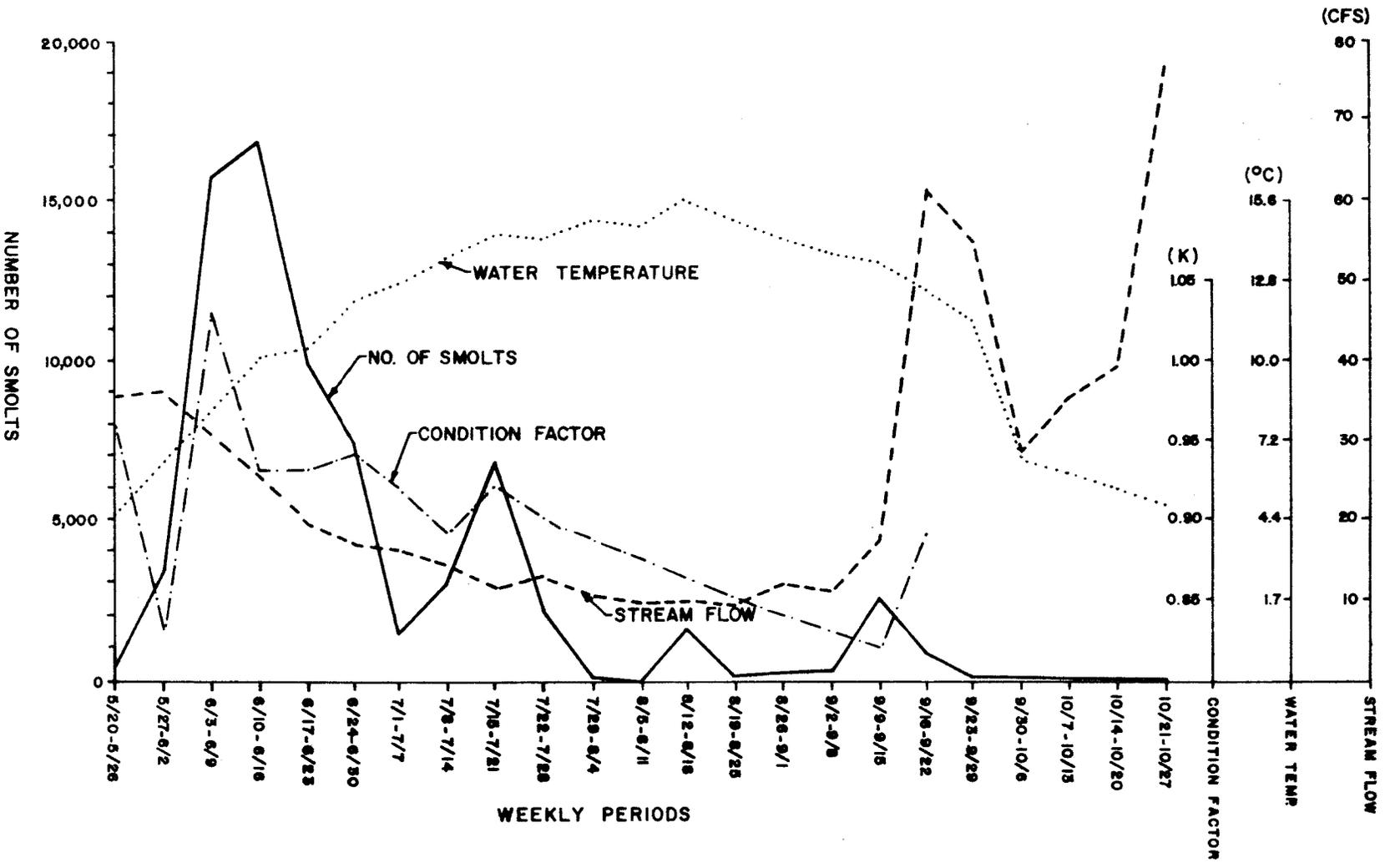


Figure 1. Bear Creek Mean Water Temperature, Stream Flow, Smolt Abundance, and Their Condition Factor by Weekly Periods in 1974.

Table 3. Mean Fork Length, Weight and Condition Factor of Bear Lake Age 1.0 Coho Salmon Smolts Sampled Biweekly at Bear Creek Weir, 1974.

| <u>Biweekly Periods</u> | <u>Number of Smolts</u> | <u>Percent of Sample</u> | <u>Mean Length and Range (mm)</u> | <u>Mean Weight and Range (g)</u> | <u>Condition Factor (K)</u> |
|-------------------------|-------------------------|--------------------------|-----------------------------------|----------------------------------|-----------------------------|
| 5/20-6/ 2 | 119 | 59.5 | 107.9 (84-131) | 11.41 (5.6-18.4) | 0.91 |
| 6/ 3-6/15 | 173 | 86.9 | 112.0 (94-134) | 13.34 (8.5-21.4) | 0.95 |
| 6/17-6/30 | 175 | 87.5 | 123.6 (100-143) | 17.69 (10.2-29.7) | 0.94 |
| 7/ 1-7/14 | 194 | 97.0 | 128.6 (108-149) | 19.10 (12.1-29.1) | 0.90 |
| 7/15-7/ | 194 | 98.5 | 132.8 (112-154) | 21.30 (13.3-30.7) | 0.91 |
| 8/19-9/ 1 | 195 | 97.5 | 158.9 (120-179) | 34.07 (15.1-50.0) | 0.85 |
| 9/ 9-9/22 | 195 | 97.5 | 164.6 (130-188) | 37.86 (18.5-67.0) | 0.85 |

Table 4. Mean Fork Length, Weight and Condition Factor of Bear Lake Age 2.0 Coho Salmon Smolts Sampled Biweekly at Bear Creek Weir, 1974.

| <u>Biweekly Periods</u> | <u>Number of Smolts</u> | <u>Percent of Sample</u> | <u>Mean Length and Range (mm)</u> | <u>Mean Weight and Range (g)</u> | <u>Condition Factor (K)</u> |
|-------------------------|-------------------------|--------------------------|-----------------------------------|----------------------------------|-----------------------------|
| 5/20-6/ 2 | 81 | 40.5 | 161.6 (135-188) | 31.76 (18.1-46.8) | 0.75 |
| 6/ 3-6/16 | 26 | 13.1 | 147.6 (135-170) | 28.13 (20.8-40.2) | 0.87 |
| 6/17-6/30 | 25 | 12.5 | 151.8 (145-166) | 29.92 (24.6-38.0) | 0.86 |
| 7/ 1-7/14 | 6 | 3.0 | 155.5 (150-165) | 31.47 (29.7-33.6) | 0.84 |
| 7/15-7/28 | 5 | 1.5 | 163.6 (159-168) | 35.46 (32.2-39.2) | 0.81 |
| 8/19-9/ 1 | 5 | 2.5 | 161.4 (180-185) | 45.02 (40.5-51.8) | 0.75 |
| 9/ 9-9/22 | 5 | 2.5 | 197.2 (190-208) | 75.10 (63.6-97.2) | 0.98 |

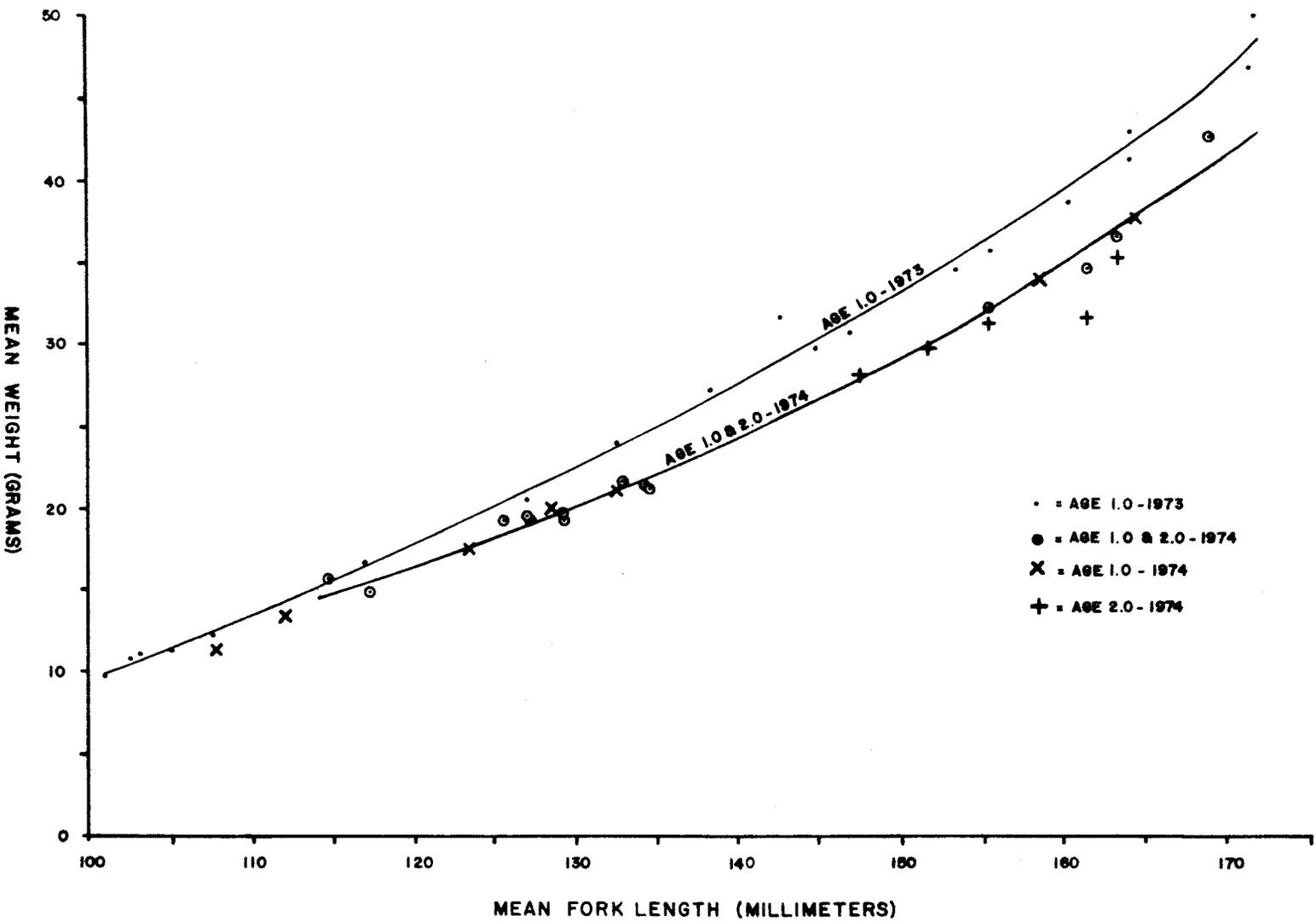


Figure 2. Mean Fork Length - Mean Weight Relationships of Bear Lake Coho Salmon Smolts in 1973 and 1974.

Comparing estimated total smolt biomass (grams) in 1973 and 1974 suggests that Bear Lake's juvenile coho rearing capability already has been exceeded. Multiplying the season's (May 20-September 22) mean smolt weight by the total smolts emigrating each year yielded 2,109,144 g in 1973 and 1,744,575 g of smolt biomass in 1974. Dividing the 364,569 g biomass discrepancy by the 1974 mean smolt weight indicated that Bear Lake's 1974 smolt production decreased by 15,127 smolts compared to the 1973 out-migration biomass. In actual relative abundance there were 4,954 fewer smolts emigrating in 1974.

A total of 1 Ad-LV and 411 Ad marked smolts were recaptured in the downstream trap. The age 2.0 Ad-LV smolt was one of 196 fingerlings (80+ mm) marked at Bear Creek weir and restocked in Bear Lake in 1972. With the 71 age 1.0 Ad-LV smolts captured in 1973, the total smolt survival of these marked fingerlings was 36.7%. The 411 age 1.0 and 2.0 Ad smolts survived from 2,416 fingerlings captured by electrofishing in Bear Lake and Ad clipped for a population estimation experiment in mid-October, 1973. Smolt survival of the 2,416 Ad fingerlings was 17.0%, with few additional age 2.0 and 3.0 Ad smolts expected in 1975.

The fingerling downstream migration to the weir totaled 409 fish. All but 12 were either age 1.0 fingerlings stocked in 1973 or age 0.0 fish resulting from natural spawning above the weir in 1973. The remaining 12 fingerlings, which entered the trap during July 22-28, probably resulted from "downstream drift" of the 1974 age 0.0 fingerling plant in Bear Lake. All fingerlings were retained above the weir. Handling mortality claimed 24 fish (5.9% of the migration). Timing and peak of the fingerling migration were similar to that of the smolt out-migration. Fingerlings were not sampled for fork length and weight at the weir due to their scarcity.

Population sampling in Bear Lake suggests that increased intraspecific competition has resulted in extended rearing for juveniles to reach smolt stage. Electrofishing the littoral zone along Bear Lake's southern shoreline in mid-October, 1973 and 1974 captured 4,016 fingerlings in 8.7 hours (462 fish/hr) and 1,225 fingerlings in 1.9 hours (645 fish/hr) respectively. These catch rates are believed to reflect some degree of relative abundance, though shocking conditions (weather) were slightly improved in 1974. Length-frequency analysis of the 1973 and 1974 population subsamples indicated that juvenile age dominance has shifted from primarily age 0.0 fingerlings in 1973 to age 1.0 residuals in 1974. Population age compositions, as well as mean fork lengths and ranges per age group in 1972-1974 are shown in Table 5.

Average growth also declined per juvenile age group in 1974. Annual growths of the 1974 residuals (age 1.0 and 2.0 fish) were 36.3 and 32.6 mm, respectively. Annual growth of age 1.0 residuals in 1973, however, was 54.6 mm, or 18.3 mm longer than 1974 age 1.0 fingerlings. Age 0.0 fingerlings in 1972 and 1973 realized average growth increments of 41.6 and 50.1 mm in 3.5 and 4.0 rearing months. Age 0.0 fish in 1974, however, averaged only 32.4 mm growth in three months despite being the largest (41 mm fork length-490/lb.) fingerlings stocked in Bear Lake since the rehabilitation. Age 0.0 fingerlings in 1972 and 1973 had mean fork lengths estimated at 35 mm (862/lb.) and 38 mm (684/lb.) when stocked.

Table 5. Age Composition and Mean Fork Length and Range (mm) of Bear Lake Juvenile Coho Populations Sampled by Electrofishing in Mid-October, 1972-1974.

| Year | No. Fish Sampled | Age Composition (%) | | | Mean Fork Length and Range *(mm) | | |
|------|------------------|---------------------|------|-----|----------------------------------|-----------------|-----------------|
| | | 0.0 | 1.0 | 2.0 | 0.0 | 1.0 | 2.0 |
| 1972 | 105 | 100.0 | | | 76.6 (56-90) | | |
| 1973 | 349 | 75.4 | 24.6 | | 88.1 (50-109) | 131.2 (110-177) | |
| 1974 | 325 | 40.9 | 52.3 | 6.8 | 73.4 (56-94) | 124.4 (96-153) | 163.8 (155-180) |

*Determined by age group separation points in length-frequency analyses.

Bear Lake's coho smolt production and growth have already declined, and residual fingerling age composition has shifted from age 0.0 to age 1.0 dominance with decreasing growth. These suggest that Bear Lake's coho rearing environment has been overstocked.

Other Species:

The total sockeye salmon, O. nerka, smolt out-migration enumerated from the trap was 4,402 fish. Trap mortalities claimed 34 smolts, or 0.8% of the downstream migration. The first smolt was captured on May 21 and the last on August 18. The highest daily count occurred on May 27 when 1,736 smolts (39.4% of the migration) were enumerated. The majority (93.7%) of these smolts emigrated from May 27 to June 16 when water temperatures ranged from 3.9° to 10.6°C (39°-51°F) and stream flows from 20 to 37 cfs. All smolts were age 1.0, as they resulted from the first (1972) sockeye escapement to spawn in Bear Lake after the 1971 rehabilitation. Age 1.0 smolts produced by the 390 females and 331 males spawning in 1972 averaged only 11.3 smolts per female. Growth was exceptional for age 1.0 smolts, however. One hundred smolts averaged 109.3 mm in fork length with a condition factor of 1.00 during the migration peak (May 27-June 2). It is believed that intense depredation of emergent sockeye fry by juvenile coho may now be the main limiting factor on Bear Lake's sockeye smolt production.

No Dolly Varden, Salvelinus malma, or threespine stickleback, Gasterosteus aculeatus, were captured in the downstream migrant trap.

Resurrection Bay Coho Harvest and Effort

A stratified, random creel census to determine the Resurrection Bay coho sport harvest and effort was initiated at the Seward small boat harbor on July 2 and terminated September 9. Although the first coho was taken on June 14, very few were caught before creel census began. Most sport fishing effort was directed toward the more abundant rockfish, Sebastes spp., from mid-May through early July.

The season's total harvest was estimated at 18,629 coho. This estimate was extrapolated from interviews with 6,377 completed anglers harvesting 4,684 coho during the creel census period. Peak of the harvest occurred on August 10, the first day of the Seward Silver Salmon Derby, when an estimated 1,279 fish (6.9% of the season's harvest) were taken. The season's total and derby harvests are summarized for 1970-1974 in Table 6. A large portion (30.3%) of the 1974 total sport harvest occurred during the nine-day derby, August 10-18.

Table 6. Derby and Total Sport Harvests of Coho Salmon in Resurrection Bay, 1970-1974.

| <u>Year</u> | <u>Total Sport Harvest</u> | <u>Derby Harvest</u> | <u>% Derby Harvest</u> |
|-------------|----------------------------|----------------------|------------------------|
| 1970 | 14,863 | 5,440 | 36.6 |
| 1971 | 20,593 | 9,488 | 46.1 |
| 1972 | 15,236 | 4,755 | 31.2 |
| 1973 | 15,911 | 4,334 | 31.2 |
| 1974 | 18,629 | 5,646 | 30.3 |

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 7. Returning boats were not counted from 8:00-11:30 a.m. in 1974 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.

Table 7. The Mean Number and Percentage of Sport Fishing Boats Returning to the Seward Small Boat Harbor During Each Sampling Period, 1974.

| <u>Periods (hours)</u> | <u>Weekends</u> | | <u>Weekdays</u> | |
|------------------------|-----------------------------|----------------|-----------------------------|----------------|
| | <u>Mean Number of Boats</u> | <u>Percent</u> | <u>Mean Number of Boats</u> | <u>Percent</u> |
| 8:00 a.m.-11:30 a.m.* | 12.3 | 11.6 | 5.3 | 14.3 |
| 11:30 a.m.- 3:30 p.m. | 27.0 | 25.5 | 6.5 | 17.6 |
| 3:00 p.m.- 6:30 p.m. | 45.6 | 43.1 | 18.1 | 48.9 |
| 6:30 p.m.-10:00 p.m. | 21.0 | 19.8 | 7.1 | 19.2 |
| Total | 105.9 | 100.0 | 37.0 | 100.0 |

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

The total sport fishing effort exerted for Resurrection Bay coho was an estimated 25,902 man-days. Approximately 25% of the season's effort was sampled during the creel census period. 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 - 3.46, weekends - 3.28, and salmon derby - 3.35. Fishing effort and mean catch per hour from 1970-1974 are summarized in Table 8. The fishing effort on weekdays and weekends, excluding the derby, was 8,442 and 7,235 man-days, respectively. Military personnel and dependents, angling from boats provided by the Army and Air Force recreation camps at Seward, contributed 17.4% (4,519 man-days) of the total effort.

Table 8. Derby and Total Sport Effort (Man-Days) Exerted for Coho Salmon and Mean Catch Per Hour in Resurrection Bay, 1970-1974.

| <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> |
|-------------|-------------------------|---------------------|---------------------|-----------------------|-----------------------|
| 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 |
| 1974 | 7/ 2-9/ 9 | 25,902 | 10,225 | 39.5 | 0.109 |

The seasonal mean catch per hour was 0.109 coho. Civilian anglers fishing during weekdays realized the highest catch per hour (0.16 fish) whereas the lowest catch rate (0.06 fish) occurred during the derby when effort was the greatest. The average number of hours each angler fished per day was as follows: weekdays - 6.07, weekends - 6.31, and during the salmon derby - 7.18.

Examination of 236 scale samples randomly collected throughout the sport fishery disclosed that the wild coho population was comprised of 49.1% age 1.1, 49.2% age 2.1, and 1.7% age 3.1 adults. Mean fork lengths of wild fish are presented in Table 9. The male-to-female sex ratio was 1.91:1 in the fishery.

Table 9. Mean Fork Length and Range (mm) of Wild Adult Coho Salmon Sampled from the 1974 Resurrection Bay Sport Fishery.

| | <u>Number</u> | <u>Range</u> | <u>Mean</u> |
|---------|---------------|--------------|-------------|
| Males | 155 | 450-737 | 622.8 |
| Females | 81 | 440-693 | 601.8 |
| Total | 236 | 440-737 | 615.6 |

King (chinook), *O. tshawytscha*, and pink salmon, *O. gorbuscha*, were taken incidentally with coho during the season. An estimated 850 king salmon were harvested during the census period at an average rate of 0.18 fish per boat. King salmon were most abundant in July when anglers averaged 0.32 fish per boat. Most

king salmon taken were "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. Pink salmon were in their typical even-year cyclic abundance, as evidenced by anglers averaging 0.42 pink salmon per boat for the 1974 season. The total pink salmon sport harvest was estimated at 2,784 fish. This species was also most abundant in July, when anglers caught 0.97 pink salmon per boat.

Bear Lake Upstream Migration

The upstream migrant trap was operated continuously from May 16 to November 15. Coho first entered the trap on August 29 and the last one was captured November 15. A stream survey of lower Bear Creek on November 15 disclosed that only three coho remained below the weir.

A total of 2,594 coho (including 12 precocious males, or jacks) were enumerated from the trap. Abundance and timing of the adult coho upstream migration are shown in Table 10. The migration peaked (50%) on September 22, and the highest daily count of 196 (7.6% of the run) occurred on September 23. Mean stream temperatures at the beginning, peak and end of migration were 13.6°C (56.5°F), 11.7°C (53.0°F) and 1.4°C (34.5°F), respectively. Most of the migration (69.7%) occurred from September 13-27 when Bear Creek temperatures ranged from 10.0° to 13.3°C (50°-56°F) and flows, from 22 to 72 cfs. A secondary migration peak occurred in late October when stream flows rapidly increased from 42 to 127 cfs after heavy fall rains.

Table 10. Bear Lake Adult Coho Salmon Enumerated Through Bear Creek Weir By Weekly Periods, 1974.

| Weekly Periods | Brood Year and Fin Mark | | Male | Female | Total |
|-------------------|-------------------------|-------------------|-------|--------|-------|
| | 1971 Ad | 1971 Unmarked* | | | |
| 8/26- 9/ 1 | 47 | 2 | 38 | 11 | 49 |
| 9/ 2- 9/ 8 | 60 | 3 | 46 | 17 | 63 |
| 9/ 9- 9/15 | 364 | 26 | 239 | 151 | 390 |
| 9/16- 9/22 | 845 | 29 | 521 | 353 | 874 |
| 9/23- 9/29 | 584 | 16 | 297 | 303 | 600 |
| 9/30-10/ 6 | 113 | 5 | 74 | 44 | 118 |
| 10/ 7-10/13 | 41 | 1 | 23 | 19 | 42 |
| 10/14-10/20 | 45 | 2 | 27 | 20 | 47 |
| 10/21-10/27 | 233 | 5 | 136 | 102 | 238 |
| 10/28-11/ 3 | 135 | 2 | 79 | 58 | 137 |
| 11/ 4-11/10 | 19 | 1 | 14 | 6 | 20 |
| 11/11-11/17 | 14 | | 4 | | 4 |
| Total | 2,490 | 92 | 1,498 | 1,084 | 2,582 |

*Returns from smolts inadvertently released unmarked in 1973.

Virtually all returning adults resulted from the 1973 out-migration of 76,652 age 1.0 Bear Lake smolts. Analyzing scales from 86 of the 92 unmarked adults captured showed that 84 (97.7%) resulted from age 1.0 Bear Lake smolts which had emigrated past the weir without being marked. The two age 2.1 adults detected in the sample evidently had strayed into Bear Creek from their parent streams, either before smolting in 1973 or upon returning to spawn. Marine survival of the 76,652 age 1.0 smolts, therefore, was 3.37% as adult spawning escapement to the weir. The catch-to-escapement ratio of marked Bear Lake adult coho was 0.99:1.

Eight Ad marked jacks enumerated from the trap returned prematurely from the 1974 Bear Lake smolt out-migration. The four Ad-RV marked jacks captured at Bear Creek weir in November had strayed from Seward Lagoon where they were released as hatchery-reared smolts in May, 1974. One Ad-RV marked jack was also observed in Box Canyon Creek during a spawning escapement survey.

Most of the Department's coho egg requirements for the Southcentral Alaska region were obtained from surplus adults in the Bear Lake return. A total of 814 females and 204 males were held to ripen for varying lengths of time in the Bear Creek holding facility from August 30 to November 8. Stream temperatures ranged from 2.2° to 14.4°C (36°-58°F) during this period. Male and female holding mortalities were 11.3 and 15.6%, respectively. A total of 663 females and 157 males were artificially spawned, yielding an estimated 2,792,500 fertilized eggs. Average fecundity was 4,212 eggs per female. Approximately one male was used to fertilize eggs from four females. Dead egg loss after shocking at Fire Lake Hatchery averaged only 5.2% (Rosenbalm, personal communication).

Mean fork lengths of adult coho measured at the weir are shown in Table 11. The male-to-female sex ratio, excluding jacks, in the Bear Creek escapement was 1.38:1.

Table 11. Mean Fork Length and Range (mm) of Adult Coho Salmon Measured at Bear Creek Weir, 1974.

| | <u>Number of Fish</u> | <u>Range (mm)</u> | <u>Mean</u> |
|---------|-----------------------|-------------------|--------------|
| Males | 375 | 425-760 | 587.6 |
| Females | <u>456</u> | <u>447-735</u> | <u>641.4</u> |
| Total | 831 | 425-760 | 617.1 |

Of the total escapement, 1,312 males (87.6%) and 293 females (27.0%) were released upstream for natural spawning in Bear Lake inlets. Natural spawning area is limited to only 180 square yards of suitable gravel in the three Bear Lake tributaries (Logan, 1968). Therefore, only a small portion of the female escapement was required to fully utilize the available spawning area.

A tagging study was conducted to determine the average migration/maturation period in Bear Lake and spawning duration in Bear Lake inlets. Fifty-three males and 83 females were tagged with serially-numbered Petersen disc tags and released at Bear Creek weir from September 26 through October 21. Of these, 17 males (32.1%) and 20 females (24.1%) observed on the spawning areas, spent 19.0 and 15.9 days, respectively, migrating and maturing in Bear Lake before entering the tributaries.

Escapement surveys enumerated 344 adults spawning in the three tributaries during the spawning peak in early November. A total of 288 spawners (83.7%) were counted in inlet #3, while inlets #1 and #2 had 26 (7.6%) and 30 (8.7%) spawners, respectively. Nearly all spawning in inlet #3 occurred within the lower 500 feet of stream. Spawning was confined to the lower 300 feet in inlets #1 and #2. Tagged fish observations showed that few adults spawned in more than one tributary, but limited interchange did occur. Spawning had terminated by November 18 when water temperatures lowered to 0°C (32°F).

Despite foot surveys conducted on alternate days along these tributaries, recovering tagged carcasses was extremely difficult due to the abundance of scavenging birds and mammals. Only three male and two female tagged carcasses were recovered, of which three had returned to the weir and died. Average "spawning duration" for males and females in this small sample was 13.3 and 11.5 days, or 12.6 days for both sexes combined. Adding the migration/maturation and spawning durations for males and females, therefore, yields 32.3 and 27.4 days, respectively, or approximately 30 days (sexes combined) average longevity after leaving Bear Creek weir to complete their life cycle.

Other Species:

The first adult sockeye was captured in the upstream migrant trap on June 12 and the last one on September 10. A total of 61 fish were enumerated, with the highest daily count of six (9.8% of the run) occurring on June 22. The migration consisted of 24 males, 36 females, and 1 jack. The adult male-to-female sex ratio was 0.67:1. Analysis of 56 scale samples disclosed that the adult age structure was 66.1% age 1.3 and 33.9% age 2.3. One age 2.1 jack and one age 1.2 female detected in the sample apparently strayed into Bear Creek while enroute to the Grouse Lake system. One or two-ocean fish could not have originated from Bear Lake because no Bear Lake sockeye smolts emigrated in 1972 or 1973 due to the 1971 lake rehabilitation. Mean fork lengths of age 1.3 and 2.3 adults were 601.6 and 616.5 mm. Water temperatures from June 12 to July 28, when 95.1% of the migration occurred, ranged from 9.4° to 16.1°C (49°-61°F) and flows from 10 to 27 cfs.

Upstream migrant Dolly Varden ascended Bear Creek to the weir in early July and continued moving in and out of the trap through the remaining field season. Pink salmon first entered the trap on July 16 and the last in early September. An estimated 4,900 pink salmon were spawning in lower Bear Creek on August 20. All fish other than sockeye or coho were retained below the weir.

Adult Coho Timing and Abundance in Index Streams

Selected index areas of seven clear streams were foot surveyed periodically throughout immigration until peak of spawning terminated. Peak of the 1974 escapement was in late October and peak of spawning generally occurred within the following two weeks. Minimum coho escapements in each stream index area since 1970 are presented in Table 12. The period from 1970 to 1974 encompasses one complete life cycle, which is typically four years (age 2.1) for Resurrection Bay coho.

Table 12. Minimum Coho Salmon Escapement in Seven Index Streams in the Resurrection Bay Area, 1970-1974.

| Name of Stream | Minimum Escapement | | | | | Mean 1969-73 |
|----------------|--------------------|------|------|------|------|--------------|
| | 1970 | 1971 | 1972 | 1973 | 1974 | |
| Airport | 26 | 13 | 15 | 4 | 23 | 19 |
| Box Canyon | 19* | 56* | 59 | 36 | 28 | 45 |
| Clear | 91 | 93 | 55 | 37 | 60 | 67 |
| Dairy | 66* | 46* | 49* | 63* | 114* | 68 |
| Grouse | 131 | 150 | 42 | 34 | 64 | 105 |
| Jap | 79 | 79 | 68 | 40 | 77 | 69 |
| Mayor | 38 | 19 | 22 | 4 | 51 | 29 |
| Total | 450 | 456 | 310 | 218 | 417 | 402 |

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

The total combined escapement of 417 adults in 1974 marks a 199 fish improvement over that of 1973, and is the first return in six years which approximated the parent brood escapement (1970) that mainly produced it.

Fin Marked Coho Returns

Marked age 1.1 adults contributed 13.6%, or an estimated 2,540 fish, to the 1974 Resurrection Bay sport harvest. These fish mainly resulted from the aforementioned 76,652 Bear Lake smolts Ad marked and released past Bear Creek weir in 1973. Adult survival of these smolts contributed an estimated 2,458 coho (13.2%) to the season's sport catch. An additional 82 Ad-LV coho contributed 0.4% to the sport harvest. These fish returned from the 30,300 hatchery-reared and Ad-LV marked age 1.0 smolts (1971 brood, Bear Lake origin) stocked in Seward Lagoon in May, 1973.

Marked coho spawning escapements in Bear Creek and Seward Lagoon were 2,582 Ad and 43 Ad-LV adults, respectively. The latter includes an estimated 28 fish which were taken in the beach sport fishery adjacent to the Seward Lagoon outlet culvert in September. Total smolt-to-adult survivals for the Bear

Lake and Seward Lagoon fish, therefore, were 6.58% and 0.41%. The overall catch-to-escapement ratio of marked Bear Lake and Seward Lagoon adult coho was 1.00:1.

The factor responsible for the very poor adult survival of the 1973 Seward Lagoon smolt release is unknown. These smolts were of local origin, the largest (averaged 8.9 smolts/lb.) ever stocked in Seward Lagoon, and in good condition when released. This smolt plant was the first to fail utilizing local stock coho. The remote possibility of Ad-LV smolt residuality in Seward Lagoon was investigated with a 100 x 6- foot variable mesh (1/2" - 1-1/4" stretch measure) nylon gillnet fished on September 5. Eight Ad-RV smolts, but not Ad-LV residuals, were captured in the six-hour set. Therefore, smolt residuality evidently was not a cause for the poor adult return.

In addition to the marked adult catch, 3,120 marked immature coho contributed 16.8% to the sport boat harvest. Most of these fish resulted from the 100,000 age 1.0 (1972 brood, Bear Lake origin) hatchery-reared Ad-RV smolts stocked in Seward Lagoon May 6-11, 1974. A total of 3,004 Ad-RV immatures (16.1% of the harvest) were estimated caught by sport trolling. Also, an estimated 116 Ad immatures taken resulted from the 70,765 Bear Lake smolts marked and released past Bear Creek weir in 1974. The total marked coho contribution to the Resurrection Bay fishery, including adult and immature fish, was 30.4%.

An estimated 1,722 Ad-RV jacks returning to Seward Lagoon were caught by shore anglers in the September beach sport fishery. With the 38 Ad-RV jacks enumerated in Seward Lagoon tributaries, the total Ad-RV smolt survival thus far was 4.8%. A substantial Ad-RV adult return is expected in 1975 due to this favorable smolt survival.

Increasing Coho Spawning and Rearing Areas

Natural Coho Rearing Ponds:

Restoration of Box Canyon Creek's former coho abundance may eventually be realized with the recent construction of a natural rearing pond in that system. The 0.8-acre basin was excavated by a D-9 Caterpillar while the lowered fall water level at the site was drawn down three feet deeper by continuous pumping for one week. Three depressions ranging from six to eight feet were created in the gravel basin to ensure adequate depth and dissolved oxygen for juvenile coho survival over winter. A small tributary, draining from Resurrection River into Box Canyon Creek was incorporated in the pond's design to serve both as inlet and outlet for coho migration access. The gravel banks were recovered with salvaged topsoil to hasten revegetation and prevent erosion.

The purpose of these ponds is to provide extra, stable rearing area for juvenile coho which are constantly subject to, and their survival thus limited by, fluctuating stream levels in the Resurrection Bay drainage. Additional natural rearing ponds are planned for the lower Resurrection River valley, contingent upon future research and evaluation of the Box Canyon Creek pond production.

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