# FRED Reports

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*Oncorhynchus kisutch*,
TAGGING AND WEIR OPERATIONS
AT SPEEL LAKE 1976-1983
by
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**Alaska Department of Fish & Game**
Division of Fisheries Rehabilitation,
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Alaska Department of Fish and Game
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Enhancement and Development (FRED)

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December 1985

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ABSTRACT

At Speel Lake in 1976-1981 (excluding 1978), wild coho salmon, *Oncorhynchus kisutch Walbaum*, juveniles were tagged with coded wires. In 1978-1983 (excluding 1980), adults from the marking program were recovered at a weir on the system and in commercial and sport catches. The average survival rates of these coho salmon (from marking to adult return) ranged from 4.2% to 5.7%. From 32.2% to 60.9% of the harvest occurred in the commercial troll fishery. Adult returns were harvested in outside waters and entrance corridors by the troll fishery, in the Juneau area by sport fishermen, and in the Taku/Snettisham and Lynn Canal areas by gillnet and seine fisheries. Juvenile coho salmon were separated into two categories based on fork length (fl) and differentially tagged. Return rates for the two size categories were 5.6% and 4.2%, respectively, for small ($\bar{x}$ fl = 81.3 mm) and large ($\bar{x}$ fl = 106.1 mm) fish tagged in 1980. Returns were 4.2% and 8.3%, respectively, for small ($\bar{x}$ fl = 78.6 mm) and large ($\bar{x}$ fl = 104.6 mm) fish tagged in 1981. At the time when Speel Lake coho smolts emigrate to salt water, their average length is 100 mm. Results of the weir operations are discussed.

Key Words: Coho salmon, *Oncorhynchus kisutch*, tagging, fisheries contribution

# INTRODUCTION

Coho salmon, *Oncorhynchus kisutch*, are an important resource to Southeast Alaska and are harvested in commercial, sport, and subsistence fisheries. The commercial harvest has averaged 1.1 million fish annually since 1955 (Shaul et al. 1983).

Studies using marked coho salmon have been undertaken on many southeastern stocks (Shaul et al. 1983, 1984, 1985; Gray et al. 1978, 1981; Holland 1983). This research was conducted to gain a better understanding of migrating behavior, survival rates, and harvest patterns of the coho salmon stocks in Southeast Alaska. Speel Lake coho salmon were selected as a representative of the stocks present in northern-southeast lake systems. This stock is of particular interest to Fisheries Rehabilitation, Enhancement and Development (FRED) Division because it is the Snettisham Hatchery brood stock, and information on harvest patterns, migration behavior, and survival rates are desired for hatchery-management purposes. Coho salmon research activities were conducted at Speel Lake from 1976 to 1983. FRED Division and Commercial Fisheries Division worked cooperatively in those activities for the period 1978 to 1983.

Juvenile coho salmon were tagged with coded wire at Speel Lake in 1976, 1977, 1979, 1980, and 1981; fish that measured greater than 65 mm from snout to fork of tail (fl) were tagged. The majority were expected to return as adults in 2 years (Gray et al. 1981). Returning adults harvested in commercial and sport fisheries were sampled so that tagged fish could be recovered. A weir was located at the outlet of Speel Lake to count and sample escapement of coho salmon in 1978, 1979, 1981, 1982 and 1983.

## MATERIALS AND METHODS

### Juvenile Tagging

In August and September juvenile coho salmon were collected with wire-mesh minnow traps in Speel Lake and the outlet stream, marked by excision of the adipose fin, tagged with coded wire, and released, following Gray et al. (1978, 1985) and Koerner (1977). This operation occurred in 1976 and 1977 under the direction of the Commercial Fisheries Division and in 1979, 1980, and 1981 under FRED Division's direction.

In 1980 and 1981, juvenile coho salmon were graded into two size categories based on fork length and differentially tagged:

1) ≧65 mm and <90 mm in fork length
2) ≧90 mm in fork length

### Weir Operation

The Speel Lake weir is located on the outlet stream, approximately 400 m from Speel Lake. This stream is about 2 km long and drains into the Speel River at 10 km from tidewater. The stream is 10 to 20 m wide and up to 1 m deep at low water. As is usual for Southeast streams, severe flooding sometimes occurs. Water levels may rapidly increase by 2.5 m at the weir site.

The weir is constructed with wooden tripods, aluminum channel, and 3/4-inch electrical conduit, following Bertoni and Holland (1985). It has an attached 2.4-meter-square holding trap. From early September to early November, the weir is operated to count coho salmon and to recover marked fish.

During the period of weir operation, the trap is checked and emptied every morning; it is also checked periodically during the day and emptied as the number of captured fish dictates. The

immigrant salmonids are counted; separate counts of adults and jacks (marked or unmarked) are kept for coho salmon. Mideye-to-fork lengths are measured, sex determinations are made, and scales (3) are collected from a representative sample of the coho salmon escapement. In some years marked coho salmon were collected for tag extraction and analysis.

In 1982 and 1983, respectively, 36% and 34%, of the coho salmon that passed upstream were Floy tagged for recovery on the spawning grounds, for population estimates, and for migration-timing studies.

Fisheries Contribution

Commercial-catch sampling for coded-wire-tagged coho salmon was conducted by the Commercial Fisheries Division, which had samplers stationed at fish processors and buying stations throughout Southeast Alaska. During unloading and sorting operations, the samplers watched for coho salmon without adipose fins. Fishing vessel and tender captains were interviewed to determine fishing areas. The heads of all fish having excised adipose fins were processed for tag removal and decoding by FRED Division (Tag Lab). Areas used in expanding random recoveries were the nine Pacific Marine Fisheries Commission (PMFC) area groupings of the Alaska Department of Fish and Game (ADF&G) regulatory districts shown in Appendix Table 1.

The Sport Fisheries Division conducted creel censuses in the Juneau area recreational marine fishery. Coho salmon were examined for missing adipose fins, and the heads of these fish were processed for tag removal and decoding. Based on the sampling rates, Sport Fisheries Division staff calculated an expanded number of tags recovered.

## RESULTS

### Juvenile Tagging

A total of 39,138 juvenile coho salmon were tagged in 1976, 1977, 1979, 1980, and 1981 at Speel Lake. The number of coho salmon tagged annually varied from 5,358 to 12,120. Results of the study are shown in Table 1. The grading of coho juveniles into two size categories in 1980 and 1981 required little extra effort, because a separation based on size is necessary for tagging-machine adjustments. The portion of juveniles in the large-size category was 22% in 1980 and 35% in 1981. The increase in the 1981 proportion may be partially due to tagging that occurred 10 days later than in 1980. It may also be due to a change in age composition; scales were not collected from juveniles.

### Weir Operation

Escapement enumeration took place in 1978, 1979, 1981, 1982, and 1983. Each of these years corresponded with the expected adult return of juveniles that had been tagged 2 years before. Table 2 summarizes numbers of adults passing the weir for all years of operation. Appendix Tables 2-4 give the daily numbers of adult salmon for years 1981 to 1983.

Weir Operation 1978 and 1979:

During these years weir operations were conducted by research staff of the Commercial Fisheries Division; details will not be reported.

Weir Operation 1981:

The weir was installed on 1 September and operated through 10 November. Fish were allowed to move naturally through the weir,

Table 1. Estimated percentage adult return of juvenile coho salmon coded-wire tagged at Speel Lake in 1976, 1977, 1979, 1980, and 1981.

| Year | Code | Number tagged | Fork length (mm) | Mean fork length (mm) | % Adult return[2/] |
|---|---|---|---|---|---|
| 1976 | 4-04-10 | 7535 | ≧ 65 | ... | 4.2%[1/] |
| 1977 | 4-16-48 | 5358 | ≧ 65 | ... | 5.7%[1/] |
| 1979 | 4-17-52 | 6895 | ≧ 65 | ... | 4.6% |
| 1980 | 4-19-10 | 5614 | ≧ 65<90 | 81.27 | 5.6% |
| | 4-19-11 | 1618 | ≧ 90 | 106.14 | 4.2% |
| | Total | 7232 | ≧ 65 | | 5.3% |
| 1981 | 4-21-45 | 7910 | ≧ 65<90 | 78.62 | 4.2% |
| | 4-21-22 | 4210 | ≧ 90 | 104.62 | 8.3% |
| | TOTAL | 12,120 | ≧ 65 mm | | 5.6% |

1/ From unpublished data provided by Leon Shaul.

2/ Includes fisheries and escapement.

Table 2. Summary of adult coho salmon escapement, marked fish sampling, documented strays, and adjusted wild escapements by year for Speel Lake, 1978, 1979, 1981, 1982, and 1983.

| Year | Estimated adult escapement | No. examined for marks | No. of observed marks | Estimated no. of marked adults | Estimated Snettisham Hatchery strays | Estimated First Lake returns 1/ | Adjusted wild escapement |
|---|---|---|---|---|---|---|---|
| 1978 | 1300 | 1300 | 99 | 99 | ... | ... | 1300 |
| 1979 | 1811 | 1811 | 165 | 165 | ... | ... | 1811 |
| 1981 | 1937 | 1732 | 192 | 214 | 0 | 2 | 1935 |
| 1982 | 1183 | 1183 | 128 | 128 | 11 | 7 | 1165 |
| 1983 | 1799 | 1776 | 363 | 368 | 0 | 2 | 1797 |

1/ Adult returns from experimental lake stocking project on the Speel River.

and the greatest movement generally took place at night and during periods of high water. However, a large number of coho salmon were reluctant to enter the trap, and they collected in pools downstream. On 29 October, when it became evident that these fish might not enter the trap prior to freeze up, 482 adult and 24 jack coho salmon were seined and manually passed over the weir. Small numbers of salmon were also seined on 8 and 9 November.

There were 7 days during the operation when water rose over the weir: 7, 8, 9, 10, 11 September; 18 October; and 5 November.

Coho salmon escapement in 1981 was estimated at 1937 adults and 124 jacks. There were 1540 unmarked adults, 192 marked adults, 108 unmarked jacks, and 6 marked jacks counted at the weir. The additional escapement consisted of 80 coho salmon counted below the weir after its removal and an estimated 135 coho salmon that passed during high water. The 198 marked coho salmon observed at the weir were all collected for tag recovery. The tag analysis is displayed in Table 3.

Weir Operation 1982:

The weir was relocated in 1982 to a shallower location upstream. The increased current encouraged movement into the trap, and the effective additional height of the weir was a safeguard against flooding. The weir was installed on 5 September and operated until 10 November when the run ended. Coho salmon readily moved into the weir trap in 1982. During the latter part of the run, no coho salmon were observed downstream on most days; yet, they consistently moved into the weir during the nights.

Based on weir counts, coho salmon escapement in 1982 was 1183 adults and 37 jacks. There were 1056 unmarked adults, 127 marked adults, 35 unmarked jacks, and 2 marked jacks. Floy tags were implanted in 369 coho salmon, for later recovery on the spawning

Table 3. Coded-wire tag analysis of marked adult coho salmon recovered at Speel Lake in 1981, 1982, and 1983.

| Year | Code | Number of Recoveries | | Comments |
|---|---|---|---|---|
| 1981 | | | | |
| | 4-17-52 | 171 | | Speel Lake 1979 tagging |
| | H4-04-00 | 3 | (includes 1 jack) | First Lake stocking |
| | 4-19-11 | 3 | (jacks) | Speel Lake 1980 tagging |
| | 4-19-10 | 2 | (jacks) | Speel Lake 1980 tagging |
| | lost tag | 2 | | We assume these are 4-17-52 |
| | No tag | 17 | | |
| | Total | 198 | | |
| 1982 | | | | |
| | 4-19-10 | 68 | (includes 1 jack) | Speel Lake 1980 tagging |
| | 4-19-11 | 33 | | Speel Lake 1980 tagging |
| | H4-04-00 | 7 | | First Lake stocking |
| | 4-19-19 | 2 | | Snettisham Hatchery 1979 brood |
| | 4-17-52 | 1 | | Speel Lake 1979 tagging |
| | 4-21-22 | 1 | (jack) | Speel Lake 1981 tagging |
| | lost head | 4 | | We assume 3 are 4-19-10 and 1 is 4-19-11. |
| | No tag | 14 | | |
| | Total | 130 | | |
| 1983 | | | | |
| | 4-21-22 | 89 | | Speel Lake 1981 tagging |
| | 4-21-45 | 77 | | Speel Lake 1981 tagging |
| | 4-19-10 | 4 | | Speel Lake 1980 tagging |
| | H4-04-00 | 1 | | First Lake stocking |
| | No tag | 14 | | |
| | Total | 185 | | |

grounds and for population estimates if the weir washed out. Most coho salmon had not begun spawning prior to 9 November (when the lake froze over); this restricted access to spawning grounds, and only 5 Floy tags were recovered. No analysis of these recoveries was made.

There were 130 marked coho salmon collected for tag recovery. The tag analysis is displayed in Table 3.

Weir Operation 1983:

The weir was installed in July 1983 by sockeye salmon research staff of the Division of Commercial Fisheries. The coho salmon research phase started on 2 September, and the weir was operated continually until 9 November. For the second year, the weir was placed in a shallow area; however, a large plastic tarp was anchored across the bottom (underneath the weir) to reduce scouring of the gravel substrate; this was also done in 1981. As in 1981, many coho salmon were reluctant to enter the trap and, instead, collected in pools below the weir. More than 300 coho salmon were seined from below the weir and passed upstream on 1, 2, and 4 November. There were no breechings of the weir in 1983.

On the basis of weir counts, the coho salmon escapement was 1799 adults and 69 jacks in 1983. There were 1413 unmarked adults, 363 marked adults, 68 unmarked jacks, and 1 marked jack counted at the weir. Floy tags were again placed on immigrant coho in 1983 but were not readily recovered, since very little spawning had taken place before the lake froze over in early November. There were 185 marked coho salmon collected for tag recovery in 1983; to minimize impacts on the natural stock, these tags were primarily taken from males. Tag analysis is displayed in Table 3.

Adult Studies:

The age, sex, and length information collected from returning adults was analyzed to provide information on sex and size for each age category; this information is provided in Table 4 for 1981, 1982, and 1983.

The age-2.1 adults were the predominant age class for all 3 years, ranging from 60% to 66.6% of the total return. Mesiar (1984) reports a trend toward higher portions of age-2.1 fish with increasing latitude in natural coho salmon stocks.

The percentage of jacks in the escapement ranged from 0.5% to 6.2% and averaged 3.7%.

The categorization of an age-2.0 class of female coho salmon (three in 1983 and one in 1981) may be the result of inaccurate sex determination or incorrect age classification by weir personnel. However, I do not discount the possibility of this age class of female.

The overall annual adult return rate of Speel Lake stocks has been relatively consistent, with a range of 4.2% to 5.7% for juveniles tagged in 1976, 1977, 1979, 1980, and 1981, (*see* Table 1).

Information on differential survival, relative to size, was sought in the tagging studies conducted in September 1980 and 1981. For coho salmon tagged in 1980, smaller juveniles had a slightly higher estimated return rate (5.6%), compared to the larger juveniles (4.2%). Although no statistical analysis was performed, coho salmon tagged in 1981 displayed a marked difference in survival; large juveniles had a return rate of 8.3%, which is almost twice the 4.2% rate of smaller juveniles.

A portion of the smaller juvenile coho salmon that were tagged was expected not to smolt the following spring. This occurred, and

Table 4. Mean length (± 95% C.I. in mm) by sex and age group of coho salmon at Speel Lake, 1981, 1982, 1983, and total of all years.

| | | 1981 Escapement Brood year and Age class | | | | |
|---|---|---|---|---|---|---|
| | | 1979 | 1978 | | 1977 | | 1976 |
| Sex | | 1.0 | 1.1 | 2.0 | 2.1 | 3.0 | 3.1 |
| Males | $\bar{x}$ length (mm) | | 663.1 | 385.5 | 652.5 | 370.0 | |
| | 95% C.I. | | 16.9 | 9.4 | 12.8 | | |
| | N | 0 | 45 | 21 | 106 | 2 | 0 |
| | % | | 11.6 | 5.4 | 27.3 | 0.5 | |
| Females | $\bar{x}$ length (mm) | | 672.7 | 400.0 | 676.7 | | 640.0 |
| | 95% C.I. | | 8.4 | | 5.7 | | |
| | N | 0 | 71 | 1 | 141 | 0 | 1 |
| | % | | 18.3 | 0.3 | 36.3 | | 0.3 |

| | | 1982 Escapement[1/] Brood year and Age class | | | | |
|---|---|---|---|---|---|---|
| | | 1980 | 1979 | | 1978 | | 1977 |
| Sex | | 1.0 | 1.1 | 2.0 | 2.1 | 3.0 | 3.1 |
| Males | $\bar{x}$ length (mm) | | 606.4 | 370.0 | 653.7 | 380.0 | 697.5 |
| | 95% C.I. | | 18.5 | | 14.0 | | 34.3 |
| | N | 0 | 92 | 1 | 105 | 1 | 2 |
| | % | | 23.4 | 0.3 | 26.7 | 0.3 | 0.5 |
| Females | $\bar{x}$ length (mm) | | 664.5 | | 669.9 | | 665.0 |
| | 95% C.I. | | 12.7 | | 8.3 | | 41.1 |
| | N | 0 | 56 | 0 | 131 | 0 | 5 |
| | % | | 14.2 | | 33.3 | | 1.3 |

- Continued -

Table 4. (continued) Mean length (± 95% C.I. in mm) by sex and age group of coho salmon at Speel Lake, 1981, 1982, 1983, and total of all years.

| | | 1983 Escapement[2/] Brood year and Age class | | | | | |
|---|---|---|---|---|---|---|---|
| | | 1981 | 1980 | | 1979 | | 1978 |
| Sex | | 1.0 | 1.1 | 2.0 | 2.1 | 3.0 | 3.1 |
| Males | $\bar{x}$ length (mm) | | 585.8 | 372.9 | 645.8 | 370.0 | 692.5 |
| | 95% C.I. | | 8.8 | 3.6 | 5.1 | | 42.5 |
| | N | 0 | 106 | 20 | 211 | 1 | 2 |
| | % | | 17.2 | 3.7 | 34.2 | 0.2 | 0.3 |
| Females | $\bar{x}$ length (mm) | 425.0 | 662.2 | 363.7 | 674.6 | | 655.0 |
| | 95% C.I. | | 4.5 | 10.2 | 2.6 | | |
| | N | 1 | 72 | 3 | 200 | 0 | 1.0 |
| | % | 0.2 | 11.7 | 0.5 | 32.4 | | 0.2 |

| | | Total all years Age class | | | | | |
|---|---|---|---|---|---|---|---|
| Sex | | 1.0 | 1.1 | 2.0 | 2.1 | 3.0 | 3.1 |
| Males | $\bar{x}$ length (mm) | | 607.9 | 379.1 | 649.4 | 372.5 | 695.0 |
| | N | 0 | 243 | 42 | 422 | 4 | 4 |
| | % | | 17.4 | 3.0 | 30.2 | 0.3 | 0.3 |
| Females | $\bar{x}$ length (mm) | 425.0 | 666.7 | 372.8 | 673.9 | | 660.0 |
| | N | 1 | 199 | 4 | 472 | 0 | 6 |
| | % | 0.1 | 14.2 | 0.3 | 33.8 | | 0.4 |

1/ Data for this year are from Mesiar, 1984.
2/ Data for this year are from Wood, 1985.

for the small groups, 5.6% and 10.0% of those fish tagged in 1980 and 1981, respectively, returned as adults 3 years after tagging. This did not occur to any of the fish in the large category.

Fisheries Contribution

The estimated total return, harvest by gear types, and escapement of Speel Lake coho salmon for the study years are shown in Table 5. The estimated total return, harvest by area, and escapement of Speel Lake coho salmon for the study years are shown in Table 6.

The predominant gear-type fishery harvesting Speel Lake coho salmon is the commercial-troll fishery; harvest rates have varied from a high of 60.9% in 1978 to a low of 32.2% in 1981. In only 1 year did any other gear group harvest more than 7% of the return; that was in 1982 when the purse seine fleet harvested an estimated 24.8%.

This was probably the result of an increased purse-seine effort to harvest a very large pink salmon return (Shaul et al. 1985).

The Juneau area marine sport-fishery harvest estimates of Speel Lake coho salmon ranged from 0.0% to 3.7% and averaged 1.9% for the 5 years of returns. The predominant harvest area for Speel Lake coho salmon stocks varied during the study years (Table 7). Because of the high troll catch, harvest has been highest in the outside and intermediate areas.

There is a noticeable harvest decrease in Stephens Passage (area 111) since 1978. This is because of a closure of Stephens Passage to commercial trolling (Shaul et al. 1985).

Table 5. Estimated total return, harvest by gear type, and escapement of Speel Lake coho salmon in 1978, 1979, 1981, 1982, and 1983.

| Year | Tags recovered in the fishery[1/] | Troll | Purse seine | Drift gillnet | Sport | Total catch | Escapement | Total return |
|---|---|---|---|---|---|---|---|---|
| 1978[2/] | 47 | 2,255 (60.9%) | - | 219 (2.2%) | 146 (3.7%) | 2,620 (66.8%) | 1,300 (33.2%) | 3,920 (100%) |
| 1979[2/] | 40 | 1,268 (36.0%) | 73 (2.1%) | 234 (6.7%) | 132 (3.7%) | 1,707 (48.5%) | 1,811 (51.5%) | 3,518 (100%) |
| 1981[2/] | 20 | 1,045 (32.2%) | 129 (4.0%) | 78 (2.4%) | 51 (1.6%) | 1,303 (40.2%) | 1,935 (59.8%) | 3,238 (100%) |
| 1982[2/] | 30 | 1,733 (42.5%) | 1,011 (24.8%) | 168 (4.1%) | - | 2,912 (71.4%) | 1,164 (28.6%) | 4,076 (100%) |
| 1983 | 78 | 1,510 (42.5%) | 182 (5.1%) | 35 (1.0%) | 25 (0.7%) | 1,753 (49.4%) | 1,797 (50.6%) | 3,550 (100%) |

1/ Includes only expandable random recoveries.

2/ Data for these years from Shaul et al. (1985).

Table 6. Estimated total return, harvest by area, and escapement of Speel Lake coho salmon in 1978, 1979, 1981, 1982, and 1983.

| Year | NOUT 116,157, 181,183, 186,189 | COUT 113,154 | SOUT 103,104, 152 | CNTR 112,114 | SNTR 105,109 110 | CIN 106,107 108 | LYNN 115 | STEP 111 | Escapement | Total return |
|---|---|---|---|---|---|---|---|---|---|---|
| 1978[1/] | 91 (2.3%) | 302 (7.7%) | - | 567 (14.5%) | 997 (25.4%) | - | - | 663 (16.9%) | 1,300 (33.2%) | 3,920 (100%) |
| 1979[1/] | 289 (8.2%) | 611 (17.4%) | - | 195 (5.5%) | 217 (6.2%) | - | - | 395 (11.2%) | 1,811 (51.5%) | 3,518 (100%) |
| 1981[1/] | 43 (1.3%) | 276 (8.5%) | - | 541 (16.7%) | 314 (9.7%) | - | - | 129 (4.0%) | 1,935 (59.8%) | 3,238 (100%) |
| 1982[1/] | 141 (3.5%) | 650 (15.9%) | 391 (9.6%) | 1,122 (27.5%) | 440 (10.8%) | - | 37 (0.9%) | 131 (3.2%) | 1,164 (28.6%) | 4,076 (100%) |
| 1983 | 424 (11.9%) | 594 (16.7%) | - | 478 (13.5%) | 189 (5.3%) | 6 (0.2%) | 54 (1.5%) | 8 (0.2%) | 1,797 (50.6%) | 3,550 (100%) |

[1/] Data for these years are from Shaul et al 1985.

NOUT -- Northern Outside
COUT -- Central Outside
SOUT - Southern Outside
CNTR - Central Intermediate
SNTR - Southern Intermediate
CIN - Central Inside
LYNN - Lynn Canal
STEP - Stephens Passage

Table 7. Estimated harvest rate[1/] by area for Speel Lake coho salmon stocks in 1978, 1979, 1981, 1982, and 1983.

| Year | Outside 103,104,113,152,154 157,181,183,186,189 | Intermediate 105,109,110 112,114 | Inside (Troll and sport) | Inside (Drift gillnet) | Total |
|---|---|---|---|---|---|
| 1978[2/] | 10.0% | 44.3% | 22.6% | 14.4% | 66.8% |
| 1979[2/] | 25.6% | 15.7% | 7.3% | 11.4% | 48.5% |
| 1981[2/] | 9.9% | 29.3% | 2.5% | 3.9% | 40.2% |
| 1982[2/] | 29.0% | 54.0% | - | 12.6% | 71.4% |
| 1983 | 28.7% | 26.7% | 1.4% | 1.9% | 49.4% |

[1/] Harvest rate is defined as percentage of total return taken by the harvest method.

[2/] Data for these years from Shaul et al. 1985.

## DISCUSSION

The average survival rate of the Speel Lake coho salmon has varied little (4.2% - 5.7%) for the 5 years that fish were tagged. This consistency is reflective of the stable environment that is desirable in an index system. During this study, the harvest rates (40.2% - 71.4%) and harvest areas varied as a function of changes in the commercial fishery.

With respect to size of juvenile coho salmon at tagging, the reasons for variations in the adult return rate are not clear. Bilton (1978) showed that an increasing percentage of returns for adults was directly related to an increase in smolt size at release (up to 20 grams for coho salmon). Based on our survival estimates, this was not the case for juvenile coho salmon tagged in 1980. However, it is highly unlikely that the differences were significant (confidence intervals were not provided for these estimates because of difficulties achieving them for catch statistics). For the coho salmon tagged in 1981, there was an expected higher return rate for larger juveniles: 8.3% compared to 4.2% for the smaller juveniles.

Smolt studies have not been carried out at Speel Lake, but juveniles tagged in the fall would be expected to gain additional growth before smolting. I estimated a growth potential of 0.14% per day between September and June, based on coho salmon studies by Crone and Bond (1976). Based on this growth rate, coho salmon juveniles tagged in 1980 and 1981 would have averaged 100 mm and 98 mm, respectively, on 28 May the following spring. This is larger than the 93.1-mm mean length for Taku River coho salmon smolts in 1960 (Meehan and Siniff 1962).

Average size of Snettisham Hatchery coho salmon releases have varied from 78 to 102 mm for the years 1980 to 1983; in 1984 the releases averaged 114 mm.

All of the coho salmon in the smaller size categories tagged at Speel Lake in 1980 and 1981 did not smolt the following spring.

A portion of the adult return (5.6% and 10.0% for the 1980 and 1981 tagging studies, respectively) occurred 3 years after tagging, as opposed to the expected 2 years; those fish elected to rear another year in fresh water before emigrating. A similar situation has occurred at Snettisham Hatchery; released fish have been age 1.0, but a portion of the adult returns (including tagged fish) have been age 2.1. At Snettisham there is very little freshwater habitat for a released fish to rear an additional year.

At Speel Lake weir, the tag recoveries of 513 coho salmon with excised adipose fins have revealed 2 marked fish from Snettisham Hatchery; this number expands to represent 11 strays. A similar estimate of straying to Snettisham Hatchery from Speel Lake of 10 adults is supported by tag recoveries at the hatchery.

The information on size, as it relates to survival, is valuable because significant portions of the smaller categories (5.6% and 10.0% for 1980 and 1981, respectively) did not return as adults in the expected year but, rather, returned 3 years after tagging. Therefore, it is risky to use one year class of returning fish to evaluate the total survival resulting from the original release of smolts.

The information from tagging studies at Speel Lake will be useful for predicting behavior of Snettisham Hatchery stocks in the marine environment. The harvest rate and migration routes are of particular interest. Future fishery-management efforts to harvest surplus Snettisham coho salmon may impact Speel Lake stocks because of their close proximity; continued studies in the Speel Lake system will test this hypothesis and will compare the behavior of each stock in the same year.

The Speel Lake weir has proven to be stable and secure; even when flooded, it has remained intact. Since the new location was adopted in 1982, breeching of the weir by high water has not occurred. The reluctance of coho salmon to enter the trap in 1981 and 1983 may have been due to the large tarp that was placed under the weir to alleviate scouring. In 1982 the tarp was not used, and fish readily entered the trap. For future years I recommend that the tarp not be used.

ACKNOWLEDGEMENTS

I would like to thank Tom Kron and Johnny Holland for their encouragement, persistence, and help in the preparation of this report. Thanks also to the many people that have assisted at Speel Lake in the collection of data and to Commercial Fisheries Division which worked on the project in cooperation with FRED Division. Also special thanks to Anne Fons of the FRED clerical staff for her patient work in the typing of this report.

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# APPENDIX

LIST OF APPENDIX TABLES

Appendix Table 1. Pacific Marine Fisheries Commission (PMFC) area groupings of Southeastern Alaska regulatory districts.

| PMFC Area | | Regulatory Districts |
|---|---|---|
| NOUT | Northern Outside | 116, 157, 181, 183, 186, 189 |
| COUT | Central Outside | 113, 154 |
| SOUT | Southern Outside | 103, 104, 152 |
| SIN | Southern Inside | 101, 102, 150 |
| SNTR | Southern Intermediate | 105, 109, 110 |
| CIN | Central Inside | 106, 107, 108 |
| STEP | Stephens Passage | 111 |
| CNTR | Central Intermediate | 112, 114 |
| LYNN | Lynn Canal | 115 |

Appendix Table 2. Speel Lake weir counts of adult coho salmon, 1981.

| Date | Numbers | | Proportion | |
|---|---|---|---|---|
| | Daily | Cumulative | Daily | Cumulative |
| September 2 | 1 | 1 | .0005 | .0005 |
| 3 | 4 | 5 | .0021 | .0026 |
| 4 | 0 | 5 | .0000 | .0026 |
| 5 | 0 | 5 | .0000 | .0026 |
| 6 | 0 | 5 | .0000 | .0026 |
| 7 | 0 | 5 | .0000 | .0026 |
| 8 | 0 | 5 | .0000 | .0026 |
| 9 | 0 | 5 | .0000 | .0026 |
| 10 | 0 | 5 | .0000 | .0026 |
| 11 | 0 | 5 | .0000 | .0026 |
| 12 | 14[1/] | 19 | .0072 | .0098 |
| 13 | 1 | 20 | .0005 | .0103 |
| 14 | 0 | 20 | .0000 | .0103 |
| 15 | 4 | 24 | .0021 | .0124 |
| 16 | 5 | 29 | .0026 | .0150 |
| 17 | 3 | 32 | .0015 | .0165 |
| 18 | 3 | 35 | .0015 | .0181 |
| 19 | 6 | 41 | .0031 | .0212 |
| 20 | 6 | 47 | .0031 | .0243 |
| 21 | 4 | 51 | .0021 | .0263 |
| 22 | 7 | 58 | .0036 | .0299 |
| 23 | 5 | 63 | .0026 | .0325 |
| 24 | 5 | 68 | .0026 | .0351 |
| 25 | 2 | 70 | .0010 | .0361 |
| 26 | 15 | 85 | .0077 | .0439 |
| 27 | 2 | 87 | .0010 | .0449 |
| 28 | 3 | 90 | .0015 | .0465 |
| 29 | 3 | 93 | .0015 | .0480 |
| 30 | 4 | 97 | .0021 | .0501 |
| October 1 | 101 | 198 | .0521 | .1022 |
| 2 | 76 | 274 | .0392 | .1415 |
| 3 | 16 | 290 | .0083 | .1497 |
| 4 | 27 | 317 | .0139 | .1637 |
| 5 | 23 | 340 | .0119 | .1755 |
| 6 | 16 | 356 | .0083 | .1838 |
| 7 | 4 | 360 | .0021 | .1859 |
| 8 | 4 | 364 | .0021 | .1879 |
| 9 | 7 | 371 | .0036 | .1915 |
| 10 | 29 | 400 | .0150 | .2065 |
| 11 | 3 | 403 | .0015 | .2081 |
| 12 | 5 | 408 | .0026 | .2106 |
| 13 | 56 | 464 | .0289 | .2395 |
| 14 | 193 | 657 | .0996 | .3392 |

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Appendix Table 2, (continued)

| Date | | Numbers | | Proportion | |
|---|---|---|---|---|---|
| | | Daily | Cumulative | Daily | Cumulative |
| October | 15 | 119 | 776 | .0614 | .4006 |
| | 16 | 59 | 835 | .0305 | .4311 |
| | 17 | 130 | 963 | .0671 | .4982 |
| | 18 | 108[2/] | 1073 | .0558 | .5539 |
| | 19 | 23 | 1096 | .0119 | .5658 |
| | 20 | 6 | 1102 | .0031 | .5689 |
| | 21 | 4 | 1106 | .0021 | .5710 |
| | 22 | 5 | 1111 | .0026 | .5736 |
| | 23 | 6 | 1117 | .0031 | .5767 |
| | 24 | 3 | 1120 | .0015 | .5782 |
| | 25 | 47 | 1167 | .0243 | .6025 |
| | 26 | 12 | 1179 | .0062 | .6087 |
| | 27 | 3 | 1182 | .0015 | .6102 |
| | 28 | 2 | 1184 | .0010 | .6113 |
| | 29 | 482[3/] | 1666 | .2488 | .8601 |
| | 30 | 13 | 1679 | .0067 | .8668 |
| | 31 | 6 | 1685 | .0031 | .8699 |
| November | 1 | 5 | 1690 | .0026 | .8725 |
| | 2 | 0 | 1690 | .0000 | .8725 |
| | 3 | 0 | 1690 | .0000 | .8725 |
| | 4 | 0 | 1690 | .0000 | .8725 |
| | 5 | 25[4/] | 1715 | .0129 | .8854 |
| | 6 | 0 | 1715 | .0000 | .8854 |
| | 7 | 0 | 1715 | .0000 | .8854 |
| | 8 | 52[3/] | 1767 | .0268 | .9122 |
| | 9 | 90[3/] | 1857 | .0465 | .9587 |
| ., | 10 | 80[5/] | 1937 | .0413 | 1.0000 |

1/ An estimated 125 adult coho salmon passed the weir during high water; 14 were attributed to 12 September.

2/ An estimated 125 adult coho salmon passed the weir during high water; 86 were attributed to 18 October.

3/ Coho salmon holding below the weir were seined and passed upstream on these dates.

4/ An estimated 125 adult coho salmon passed the weir during high water; 25 were attributed to 5 November.

5/ An estimated 80 adult coho salmon were below the weir on 10 November when the weir was removed or dismantled.

Appendix Table 3. Speel Lake weir counts of adult coho salmon, 1982.

| Date | Numbers | | Proportion | |
|---|---|---|---|---|
| | Daily | Cumulative | Daily | Cumulative |
| September 8 | 1 | 1 | .0008 | .0008 |
| 9 | 0 | 1 | .0000 | .0008 |
| 10 | 0 | 1 | .0000 | .0008 |
| 11 | 0 | 1 | .0000 | .0008 |
| 12 | 0 | 1 | .0000 | .0008 |
| 13 | 0 | 1 | .0000 | .0008 |
| 14 | 0 | 1 | .0000 | .0008 |
| 15 | 0 | 1 | .0000 | .0008 |
| 16 | 0 | 1 | .0000 | .0008 |
| 17 | 0 | 1 | .0000 | .0008 |
| 18 | 25 | 26 | .0211 | .0220 |
| 19 | 25 | 51 | .0211 | .0431 |
| 20 | 3 | 54 | .0025 | .0456 |
| 21 | 4 | 58 | .0034 | .0490 |
| 22 | 2 | 60 | .0017 | .0507 |
| 23 | 2 | 62 | .0017 | .0524 |
| 24 | 8 | 70 | .0068 | .0592 |
| 25 | 10 | 80 | .0085 | .0676 |
| 26 | 5 | 85 | .0042 | .0719 |
| 27 | 4 | 89 | .0034 | .0752 |
| 28 | 8 | 97 | .0068 | .0820 |
| 29 | 13 | 110 | .0110 | .0930 |
| 30 | 95 | 205 | .0803 | .1733 |
| October 1 | 50 | 255 | .0423 | .2156 |
| 2 | 5 | 260 | .0042 | .2198 |
| 3 | 31 | 291 | .0262 | .2460 |
| 4 | 51 | 342 | .0431 | .2891 |
| 5 | 66 | 408 | .0558 | .3449 |
| 6 | 68 | 476 | .0575 | .4024 |
| 7 | 61 | 537 | .0516 | .4539 |
| 8 | 19 | 556 | .0161 | .4700 |
| 9 | 45 | 601 | .0380 | .5080 |
| 10 | 37 | 638 | .0313 | .5393 |
| 11 | 8 | 646 | .0068 | .5461 |
| 12 | 10 | 656 | .0085 | .5545 |
| 13 | 0 | 656 | .0000 | .5545 |
| 14 | 31 | 687 | .0262 | .5807 |
| 15 | 28 | 715 | .0237 | .6044 |
| 16 | 80 | 795 | .0676 | .6720 |
| 17 | 33 | 828 | .0279 | .6999 |
| 18 | 21 | 849 | .0178 | .7177 |
| 19 | 9 | 858 | .0076 | .7253 |
| 20 | 32 | 890 | .0270 | .7523 |
| 21 | 12 | 902 | .0101 | .7625 |

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Appendix Table 3, (continued)

| Date | | Numbers | | Proportion | |
|---|---|---|---|---|---|
| | | Daily | Cumulative | Daily | Cumulative |
| October | 22 | 18 | 920 | .0152 | .7777 |
| | 23 | 9 | 929 | .0076 | .7853 |
| | 24 | 3 | 932 | .0025 | .7878 |
| | 25 | 5 | 937 | .0042 | .7921 |
| | 26 | 17 | 954 | .0144 | .8064 |
| | 27 | 31 | 985 | .0262 | .8326 |
| | 28 | 25 | 1010 | .0211 | .8538 |
| | 29 | 22 | 1032 | .0186 | .8724 |
| | 30 | 36 | 1068 | .0304 | .9028 |
| | 31 | 37 | 1105 | .0313 | .9341 |
| November | 1 | 10 | 1115 | .0085 | .9425 |
| | 2 | 9 | 1124 | .0076 | .9501 |
| | 3 | 15 | 1139 | .0127 | .9628 |
| | 4 | 8 | 1147 | .0068 | .9696 |
| | 5 | 14 | 1161 | .0118 | .9814 |
| | 6 | 13 | 1174 | .0110 | .9924 |
| | 7 | 4 | 1178 | .0034 | .9958 |
| | 8 | 0 | 1178 | .0000 | .9958 |
| | 9 | 1 | 1179 | .0008 | .9966 |
| | 10 | 4 | 1183 | .0034 | 1.0000 |

Appendix Table 4. Speel Lake weir counts of adult coho salmon, 1983.

| Date | Numbers | | Proportion | |
|---|---|---|---|---|
| | Daily | Cumulative | Daily | Cumulative |
| September 2 | 0 | 0 | | |
| 3 | 3 | 3 | .0017 | .0017 |
| 4 | 2 | 5 | .0011 | .0028 |
| 5 | 0 | 5 | .0000 | .0028 |
| 6 | 0 | 5 | .0000 | .0028 |
| 7 | 1 | 6 | .0006 | .0033 |
| 8 | 0 | 6 | .0000 | .0033 |
| 9 | 2 | 8 | .0011 | .0044 |
| 10 | 2 | 10 | .0011 | .0056 |
| 11 | 6 | 16 | .0033 | .0089 |
| 12 | 6 | 22 | .0033 | .0122 |
| 13 | 1 | 23 | .0006 | .0128 |
| 14 | 2 | 25 | .0011 | .0139 |
| 15 | 3 | 28 | .0017 | .0156 |
| 16 | 0 | 28 | .0000 | .0156 |
| 17 | 4 | 32 | .0022 | .0178 |
| 18 | 3 | 35 | .0017 | .0195 |
| 19 | 0 | 35 | .0000 | .0195 |
| 20 | 1 | 36 | .0006 | .0200 |
| 21 | 3 | 39 | .0017 | .0217 |
| 22 | 4 | 43 | .0022 | .0239 |
| 23 | 18 | 61 | .0100 | .0339 |
| 24 | 25 | 86 | .0139 | .0478 |
| 25 | 7 | 93 | .0039 | .0517 |
| 26 | 12 | 105 | .0067 | .0584 |
| 27 | 32 | 137 | .0178 | .0762 |
| 28 | 17 | 154 | .0094 | .0856 |
| 29 | 6 | 160 | .0033 | .0889 |
| 30 | 7 | 167 | .0039 | .0928 |
| October 1 | 4 | 171 | .0022 | .0951 |
| 2 | 20 | 191 | .0111 | .1062 |
| 3 | 145 | 336 | .0806 | .1868 |
| 4 | 3 | 339 | .0017 | .1884 |
| 5 | 11 | 350 | .0061 | .1946 |
| 6 | 86 | 436 | .0478 | .2424 |
| 7 | 105 | 541 | .0584 | .3007 |
| 8 | 145 | 686 | .0806 | .3813 |
| 9 | 11 | 697 | .0061 | .3874 |
| 10 | 35 | 732 | .0195 | .4069 |
| 11 | 6 | 738 | .0033 | .4102 |
| 12 | 75 | 813 | .0417 | .4519 |
| 13 | 13 | 826 | .0072 | .4591 |
| 14 | 14 | 840 | .0078 | .4669 |
| 15 | 19 | 859 | .0106 | .4775 |

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Appendix Table 4, (continued)

| Date | | Numbers | | Proportion | |
|---|---|---|---|---|---|
| | | Daily | Cumulative | Daily | Cumulative |
| October | 16 | 11 | 870 | .0061 | .4836 |
| | 17 | 6 | 876 | .0033 | .4869 |
| | 18 | 8 | 884 | .0044 | .4914 |
| | 19 | 17 | 901 | .0094 | .5008 |
| | 20 | 85 | 986 | .0472 | .5481 |
| | 21 | 56 | 1042 | .0311 | .5792 |
| | 22 | 12 | 1054 | .0067 | .5859 |
| | 23 | 34 | 1088 | .0189 | .6048 |
| | 24 | 2 | 1090 | .0011 | .6059 |
| | 25 | 22 | 1112 | .0122 | .6181 |
| | 26 | 21 | 1133 | .0117 | .6298 |
| | 27 | 22 | 1155 | .0122 | .6420 |
| | 28 | 11 | 1166 | .0061 | .6481 |
| | 29 | 7 | 1173 | .0039 | .6520 |
| | 30 | 14 | 1187 | .0078 | .6598 |
| | 31 | 8 | 1195 | .0044 | .6643 |
| November | 1 | 217[1/] | 1412 | .1206 | .7849 |
| | 2 | 230[1/] | 1642 | .1278 | .9127 |
| | 3 | 17 | 1659 | .0094 | .9222 |
| | 4 | 98[1/] | 1757 | .0545 | .9767 |
| | 5 | 9 | 1766 | .0050 | .9817 |
| | 6 | 7 | 1773 | .0039 | .9855 |
| | 7 | 1 | 1774 | .0006 | .9861 |
| | 8 | 2 | 1776 | .0011 | .9872 |
| | 9 | 23[2/] | 1799 | .0128 | 1.000 |

1/ Coho salmon holding below the weir were seined and passed upstream on these dates.

2/ Count of coho salmon below weir on the day the weir was removed.