# Summary of the 1993 Coho Salmon Smolt Trapping Operations on the Lachmach River, British Columbia 



Biological Sciences Branch Department of Fisheries and Oceans
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Nanaimo, British Columbia V9R 5K6

1994

## Canadian Data Report of <br> Fisheries and Aquatic Sciences 936

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# SUMMARY OF THE 1993 COHO SALMON SMOLT TRAPPING OPERATIONS ON THE LACHMACH RIVER, BRITISH COLUMBIA 

by
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## ABSTRACT

S. J. Baillie. 1994. Summary of the 1993 coho salmon smolt trapping operations on the Lachmach River, British Columbia. Can. Data Rep. Fish. Aquat. Sci. 936: 43 p.

This report contains coho smolt (oncorhynchus kisutch) enumeration, coded wire tagging and sampling data from the Lachmach River, British Columbia for the period of April 14 to June 29, 1993. Enumeration and sampling data for outmigrant juvenile rainbow trout ( 0 . mykiss), Dolly Varden char (Salvelinus malma), cutthroat trout ( 0 . clarki), prickly sculpin (cottus asper) and coastrange sculpin (c. aleuticus) and adult steelhead trout ( 0 . mykiss) are also presented. Fish were trapped using either a smolt fence located near the mouth of the river or a rotary screw trap located in a pool approximately 50 m upstream of the smolt fence. The total smolt outmigration was 15,920 of which 14,393 were coded wire tagged. The age structure of the coho smolts was $43 \% 1.0,55 \% 2.0$ and $2 \%$ 3.0. The total outmigration of other species was 68 coho fry, 937 pink salmon fry ( 0 . gorbuscha), 1,323 rainbow trout, 930 Dolly Varden char, 362 sculpins, 7 cutthroat trout, 1 threespine stickleback (Gasterosteus aculeatus), 1 pacific lamprey (Lampetra tridentata) and 24 steelhead trout. Thirty adult steelhead trout were enumerated migrating upstream.

RESUME
S. J. Baillie. 1994. Summary of the 1993 coho salmon smolt trapping operations on the Lachmach River, British Columbia. Can. Data Rep. Fish. Aquat. Sci. 936: 43 p.

On donne les résultats des opérations de dénombrement, de marquage au fil métallique codé et l'échantillonnage des smolts de saumon coho (Oncorhynchus kisutch) de la rivière Lachmach, en Colombie-Britannique, effectuées du 14 avril au 29 juin 1993. On présente également les resultats du dénombrement et de l'échantillonnage des juvéniles en dévalaison des espèces suivantes : truite arc-en-ciel (ㅇ. mykiss), Dolly Varden (Salvelinus malma), truites fardée (ㅇ. clarki), chabot piquant (Cottus asper) et chabot cotier (c. aleuticus); on a egalement dénombré les truites arc-en-ciel anadromes adultes ( $\underline{0}$. mykiss). Pour capturer les poissons, on a utilisé une barriére à smolt, plès de l'embouchure de la rivière, ou un piège à vis dans un bassin, à quelque 50 m en amont de la barrière. Entout, on a compté 15920 smolts en dévalaison; 14393 ont été marqués au fil code. On a établi la pyramide des age des smolts de saumon coho : $43 \%$ d'âge $1.0,55 \%$ d'âge 2.0 et $2 \%$ d'áge 3.0 . On a également déterminé le nombre total d'individus de chaque espèce en dévalaison: 68 alevins de saumon coho, 937 alevins de saumon rose (ㅇ. gorbuscha), 1323 juvéniles de truite arc-en-ciel, 930 Dolly Varden, 362 chabots, 7 truites fardées, 1 épinoche à trois épines (Gasterosteus aculeatus), 1 lamproie du Pacifique (Lampetra tridentata) et 24 truites arc-en-ciel anadromes adultes. On a également 30 truites arc-en-ciel anadromes en montaison.
*

## INTRODUCTION

The Lachmach River is a small coastal stream approximately 8 km long, located 23 km east of Prince Rupert, British Columbia (Figures 1 and 2). It drains a steep mountainous catchment area of $41.3 \mathrm{~km}^{2}$ of which the western slope was clearcut logged during the 1970's and early 1980's. There is limited estuarine development where the river reaches the sea at the head of Work Channel. The river is characterized by sections of low to moderate gradients, a series of small passable falls in the 2 km to 3 km section and a series of riverine ponds in the upper 5 km of river. It supports populations of coho salmon (oncorhynchus kisutch), pink salmon ( $\underline{0}$. gorbuscha), chum salmon ( $\underline{0}$. keta), steelhead trout and resident rainbow trout ( 0. mykiss), sea-run and resident cutthroat trout ( 0. clarki) and Dolly Varden char (Salvelinus malma). In recent years a small number of adult chinook salmon ( $\underline{O}$. tshawytscha) have been observed in the river. Other fish species present include threespine stickleback (Gasterosteus aculeatus), prickly sculpin (Cottus asper) and coastrange sculpin (C. aleuticus). Scientific and common names of fishes follow Gillespie (1993).

The Lachmach River Project is one of the coho salmon research programs initiated in response to the Canada-United States Pacific Salmon Treaty. The program goals are to examine productivity and life history of coho salmon stocks in British Columbia. In 1986 Lachmach River was chosen as a representative north coast watershed suitable for investigations of coho salmon (Simpson 1991). As part of the program, coded wire nose tagging of smolts and summer juvenile population studies began in 1987 and adult coho escapement, spawning distribution and age structure data has been collected since 1988. Algal and benthic community studies were initiated in 1993.

Since 1988 the coho smolt run has been divided into two size groups ( $<85 \mathrm{~mm}$ and $>85 \mathrm{~mm}$ ) and marked with unique coded wire tag codes. The marine survival rate and commericial fishery exploitation rate of Lachmach coho in previous years were generally lower for the smaller size group than the larger group (B. O. Finnegan, unpublished data). To investigate further, each size group was further divided into two groups to get finer resolution (50-74 $\mathrm{mm}, 75-85 \mathrm{~mm}, 86-114 \mathrm{~mm}, 115+\mathrm{mm}$ ).

This report summarizes the data collected from the coho smolt fence trapping and tagging operations on the Lachmach River for the spring of 1993. This is the twelfth data report in the Lachmach series. For further information see: Finnegan et al. (1990), Finnegan (1991), Lane and Finnegan (1991), Davies (1991a,b), Finnegan and Davies (1991), Davies et al. (1992), Lane and Baillie (1994), and Lane et al. (1994). Reports on the fall sampling operations for 1991 and 1992 are in preparation.

## METHODS

A welded aluminum smolt fence (Finnegan, 1991) was installed and was in operation from April 22 to June 11. Cleaning was done as required and periodic snorkel inspections were conducted to check for fence integrity and to inspect the trap entrances for debris accumulation.

A 5 foot rotary screw trap (E.G. Solutions, 1005 SE Park, Corvallis, OR 97333) was set up in a pool approximately 50 m upstream of the smolt fence and was operational from April 19 to June 11. It was fished daily from April 19 to April 23, from May 1 to May 4, every second day from May 6 to May 20, and daily from May 21 to June 11.

The fence and rotary traps, when fishing, were checked daily at 0800. All coho were counted and a maximum of 100 were randomly selected and measurements of length ( $\pm 1 \mathrm{~mm}$ ) and weight ( $\pm 0.1 \mathrm{~g}$ ) were recorded. Sub-samples of coho smolts were obtained by rapidly moving a small dipnet through the barrel of fish and scooping fish into a pail until 100 fish was removed (Davies et al., 1992).

All other coho were sorted into 4 size categories (50-74 mm, $75-85 \mathrm{~mm}, 86-114 \mathrm{~mm}$, and $115+\mathrm{mm}$ ) and a coded wire tag and adipose clip was applied to each fish. These size categories roughly represent small age 1.0 smolts, large age 1.0 smolts, small age 2.0 smolts, and large age 2.0 and age 3.0 smolts, respectively. All coho were also checked for ventral (pelvic) fin and maxillary clips and cold brands prior to coded wire tagging. Tagging was performed with a Mk. II Tagging Unit (Northwest Marine Technologies, Shaw Island, WA 98286) following procedures as described in Argue et al. (1979), except 2phenoxyethanol was substituted for tricane methanesulfonate (MS222). Short term tag retention was determined by holding up to 100 fish from each size group for 24 hours. Mortalities and the incidence of tag loss were recorded. All fish with lost tags were retagged before release. Fish that were caught prior to the coded wire tagging machine was set up, or less than 50 mm in length, or appeared to be moribund were released untagged.

Age composition of coho smolts was determined by taking scale samples from groups of 25 fish in each of 5 mm size ranges. The age composition from each range was then applied to the number of coho measured in that size range in the random sampling from the fence traps. By this method the age composition of the entire run was determined.

Daily catches of all other downstream migrating species of fish in both traps were identified, counted, and lengths ( $\pm 1 \mathrm{~mm}$ )
and weights ( $\pm 0.1 \mathrm{~g}$ ) were recorded. Upstream migrating adult steelhead trout were caught in a wooden trap attached to the smolt fence and tagged with a numbered anchor tag (Floy FD-68B 2.54 cm , Seattle, WA). An opercular punch was applied to check for subsequent tag loss during the downstream kelt (spawned steelhead trout) migration. Steelhead trout were measured for lengths ( $\pm 1 \mathrm{~mm}$ ) and a scale sample was obtained. Untagged kelts were examined for opercular punch marks, retagged and released downstream of the smolt fence.

After the fence was repaired on May 3 minimum fence efficiency tests were conducted on two occasions. On May 13100 individuals (length range: 86-114 mm), marked with an upper caudal fin clip, were released approximately 50 m upstream of the smolt fence. On May 20100 individuals (length range: 50 @ 75$85 \mathrm{~mm}, 45$ @ 86-114 mm, and 5 @ 115+ mm), marked with a lower caudal fin clip, were released in the same area.

## RESULTS

FENCE

The fence was operated from April 22 to June 11. On April 30 an 8 metre section of the fence collapsed due to high water levels. Consequently the fence traps were not checked on April 30 and the fence was not 'fish-tight' from April 30 until repairs were finished on May 3. Some fence panels were removed on May 8 due to high water levels. They were replaced on May 9. During these periods of lost fence integrity the passage of fish was unimpeded. Seven adult steelhead were observed migrating upstream. It is unknown how many other fish were able to pass undetected.

ENVIRONMENTAL DATA

Environmental data collected at the Lachmach River is shown in Table 1 and Figure 3. Total precipitation for the observation period of April 16 to June 28 was 340 mm . Peak periods of rainfall occurred on April 29-30 (38 mm), May 8-9 (41 mm) and June 22-23 ( 62 mm ) (Table 1). Mean maximum air temperature was $21^{\circ} \mathrm{C}$ with a range of $8^{\circ} \mathrm{C}$ to $34^{\circ} \mathrm{C}$. Mean minimum air temperature was $7^{\circ} \mathrm{C}$ with a range of $0^{\circ} \mathrm{C}$ to $13^{\circ} \mathrm{C}$. Water temperature rose
steadily through the study period, starting at $4^{\circ} \mathrm{C}$ and increasing to $14^{\circ} \mathrm{C}$.

## COHO SMOLTS

Total smolt enumeration from both fence and rotary traps was 15,920 (Figure 4). Comparisons with smolt migration of previous years (Lane and Baillie, 1994) are presented in Table 2. A complete enumeration was not possible due to the undetected passage of fish during the high water events. Of the number trapped 14,393 were tagged with coded wire tags. The tagged fish were divided into 4 size categories and tagged with unique codes. Table 3 shows the number of smolts that were tagged in each size group, and Table 4 shows the total that were tagged with each code, with the tag retention and estimated number of tags at large included.

Biological information from coho smolts is summarized in Table 5 and Figure 5. Generally, the mean length and weight increased in the first two weeks of the run, and decreased over the next four weeks. The mean length was 92 mm ( $n=2865$, $S D=12.3)$, and the mean weight was $7.2 \mathrm{~g}(\mathrm{n}=2862, \mathrm{SD}=2.78)$.

Table 6 shows the breakdown of ages of the samples that were used for age determination and includes the biological data obtained from these samples. Ages were obtained from 539 scale samples. There was considerable overlap in length range for each age group. To determine the age composition of the entire run, the aged fish were broken down into 5 mm length groups, and the proportion of age $1.0,2.0$, and 3.0 fish for each group was applied to the breakdown of the length frequency sample taken at the fence (Table 7). The age composition was estimated to be $43 \%$ age 1.0 , $55 \%$ age 2.0 and $2 \%$ age 3.0 .

A summary of the number of smolts captured with fin clip marks and the history of mark applications is presented in Table 8. Recaptures of marks in previous years is also presented (Lane and Baillie, 1994). Table 9 summarizes the effective survival rates for the ventral and maxillary clips over the years 1990-1993, calculated by dividing the marks seen at the fence by the number of marks applied to coho during the summer productivity studies from 1989 to 1991. It should be noted that since each mark was applied to age $0.0,1.0$ and 2.0 fry, there will be different survival rates within each mark group to smolting.

In the summer of 1992 cold brands (Everest and Edmundson, 1967) were applied to coho fry in various sites along the

Lachmach River. These brands were looked for on coho smolts at the fence and noted. Unfortunately the data collected was insufficient to draw conclusions and is presented in Table 10 for reference purposes only.

Table 11 shows the recaptures of coho smolts which were caudal clipped and released above the fence to obtain fence trapping efficiency. Trapping efficiency was $72 \%$ and $76 \%$ for the two releases, respectively. These are the minimum estimates because they do not account for mortality after release or fish that do not migrate back downstream after release. The mean of 9 complete tests done from 1989 - 1993 is $82 \%$ (S.D. 7.45). The range of values are 72\% to 93\% (Table 12).

Because the entire run was sorted into four size categories, it was possible to compare the length distribution of the fence sample to the distribution of the entire run. Table 13 shows the proportion of the entire run of coho smolts in each of the four size groups, and the proportion of coho smolts that were sampled randomly from the entire run. A $\chi^{2}$ goodness-of-fit test was used to see if the sample was representative of the entire run. The null hypothesis, $H_{0}$, that the sample was representative of the entire run was accepted based on a calculated $\chi^{2}$ of 6.57. This was below the $\chi^{2}{ }_{0.05}$ value of 7.815 (Walpole, 1974).

To show that the rotary trap accurately sampled the entire run, the mean lengths of fish caught in the rotary trap and the fence were compared. The rotary trap was not used continuously, and lengths were not measured on all trapped fish. In order to accurately compare, only data from days in which both apparatus were used and measurements of coho smolts were taken can be used. There were only four days which met this criteria. Table 14 shows the results and as can be seen the means and standard deviations are virtually identical. This would indicate that the rotary trap is accurately sampling the smolt run.

To examine the proportion of the run that was being caught by the rotary trap, the number of fish caught by the rotary trap was compared to the total catch of the day (rotary + fence). Only days in which both apparatus were in operation were used. Table 15 summarizes the data. $39 \%$ of the coho smolt run was caught in the rotary trap.

## OTHER SPECIES

Daily enumeration of rainbow trout, steelhead trout, cutthroat trout, Dolly Varden char, prickly sculpin, and coastrange sculpin are presented in Table 16 and Figure 4.

Biological information and tag numbers for steelhead trout is presented in Table 17 (upstream) and Table 18 (downstream). Biological information for other salmonids is presented in Table 19 (length) and Table 20 (weight), and for sculpins in Table 21 (length) and Table 22 (weight). Figure 6 depicts the length frequency of coastrange and prickly sculpin, Dolly Varden char and rainbow trout.

There were 30 upstream and 24 downstream steelhead trout migrants enumerated during the study period. Seven of the upstream migrants passed by the fence during the period in which several panels had been removed from the fence due to high water. These numbers represent only a sample of the entire steelhead trout run, which starts before the fence is installed and can carry on after the fence is removed. Three of the downstream migrants had been originally tagged as upstream migrants. Residence time for these three fish were 20, 17, and 6 days.

In addition, there was one threespine stickleback (Gasterosteus aculeatus) ( $65 \mathrm{~mm}, 2.9 \mathrm{~g}$ ) caught on May 24, and one pacific lamprey (Lampetra tridentata) ( 470 mm ) caught on June 11. There were also 68 coho fry caught between May 14 and June 5, and 937 pink salmon fry caught between April 20 and April 24.

## ACKNOWLEDGEMENTS

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Table 1. Environmental parameters measured at Lachmach River, spring 1993.

| Date | Precipitation (mm) | Air Temperature ( ${ }^{\circ} \mathrm{C}$ ) |  | Water Temperature$\left({ }^{\circ} \mathrm{C}\right)$ |
| :---: | :---: | :---: | :---: | :---: |
|  |  | Maximum | Minimum |  |
| Apr 16 | 0 | 15 | 5 | 5 |
| Apr 17 | 2 | 14 | 1 | 5 |
| Apr 18 | 0 | 21 | 0 | 5 |
| Apr 19 | 2 | 13 | 7 | 5 |
| Apr 20 | 0 | 18 | 1 | 4 |
| Apr 21 | 4 | 17 | 4 | 5 |
| Apr 22 | 8 | 22 | 6 | 6 |
| Apr 23 | 2 | 19 | 4 | 5 |
| Apr 24 | 0 | 20 | 8 | 6 |
| Apr 25 | 2 | 16 | 6 | 6 |
| Apr 26 | 2 | 19 | 6 | 6 |
| Apr 27 | 8 | 18 | 6 | 6 |
| Apr 28 | 4 | 16 | 7 | 7 |
| Apr 29 | 16 | 9 | 6 | 6 |
| Apr 30 | 22 | 12 | 5 | 5 |
| May 01 | 8 | 15 | 5 | 5 |
| May 02 | 8 | 12 | 5 | 5 |
| May 03 | 2 | 15 | 3 | 6 |
| May 04 | 0 | 19 | 2 | 6 |
| May 05 | 14 | 12 | 5 | 7 |
| May 06 | 4 | 10 | 3 | 7 |
| May 07 | 2 | 17 | 4 | 7 |
| May 08 | 13 | 12 | 6 | 7 |
| May 09 | 28 | 8 | 4 | 6 |
| May 10 | 6 | 18 | 6 | 7 |
| May 11 | 4 | 14 | 5 | 7 |
| May 12 | 0 | 22 | 2 | 7 |
| May 13 | 0 | 27 | 5 | 7 |
| May 14 | 0 | 34 | 7 | 9 |
| May 15 | 0 | 24 | 9 | 8 |
| May 16 | 3 | 22 | 9 | 9 |

Table 1. (cont'd.)

| Date | Precipitation <br> $(\mathrm{mm})$ | Air <br>  <br>  |  | Temperature <br> $\left({ }^{\circ} \mathrm{C}\right)$ |
| :---: | :---: | :---: | :---: | :---: |
| Maximum | Minimum | Water <br> Temperature |  |  |
| May 17 | 10 | 14 | 8 | $\left({ }^{\circ} \mathrm{C}\right)$ |

Table 1. (cont'd.)

| Date | Precipitation <br> $(\mathrm{mm})$ | AirTemperature <br> $\left({ }^{\circ} \mathrm{C}\right)$ |  | Water <br> Temperature |
| :---: | :---: | :---: | :---: | :---: |
|  |  | Maximum | Minimum | $\left({ }^{\circ} \mathrm{C}\right)$ |

Table 2. Captures of coho smolts and other fish species from the Lachmach River fence from 1987 to 1993.

| Year | Coho Smolts |  |  | Other Species |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | TotalCoded Wire <br> Tagged and <br> Released |  | Rainbow <br> Trout | Dolly <br> Varden <br> Char | Cut. <br> trout |  |
|  | 1,909 | 1,790 |  | 5 | 13 | 97 |
| $1988^{\text {b }}$ | 9,983 | 9,192 |  | 103 | 351 | 175 |
| 1989 | 21,410 | 19,482 |  | 1,176 | 1,592 | 767 |
| 1990 | 25,860 | 24,639 |  | 1,189 | 1,964 | 1,387 |
| 1991 | 14,572 | 13,469 |  | 855 | 1,506 | 738 |
| 1992 | 21,282 | 20,362 |  | 1,472 | 1,299 | 798 |
| 1993 | 15,920 | 14,287 |  | 1,302 | 924 | 358 |

-     - A wood fence used in 1987 was frequently inoperable and provided a poor enumeration of downstream migrant fish.
b - The aluminum fence allowed undetected passage of fish resulting in a lower than expected enumeration.

Table 3. Summary of daily enumeration of coho at Lachmach River, spring 1993.

| Date | Coded Wire Tagged Coho Length Category (mm) |  |  |  | Untagged Coho | Morts | Totals |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | 50-74 | 75-85 | 86-114 | 115+ |  |  |  |
| Apr 20 | - | - | - | - | 17 | 0 | 17 |
| Apr 21 | - | - | - | - | 22 | 1 | 23 |
| Apr 22 | - | - | - | - | 110 | 2 | 112 |
| Apr 23 | - | - | - | - | 236 | 1 | 237 |
| Apr 24 | - | - | - | - | 288 | 7 | 295 |
| Apr 25 | 18 | 45 | 72 | 3 | 0 | 9 | 147 |
| Apr 26 | 8 | 16 | 38 | 0 | 0 | 4 | 66 |
| Apr 27 | 17 | 32 | 56 | 0 | 2 | 3 | 110 |
| Apr 28 | 9 | 39 | 109 | 2 | 0 | 7 | 166 |
| Apr 29 | 18 | 106 | 371 | 18 | 2 | 16 | 531 |
| Apr 30 | - | - | - | - | - | - | - |
| May 1 | 6 | 36 | 83 | 6 | 0 | 0 | 131 |
| May 2 | 0 | 8 | 12 | 1 | 2 | 2 | 25 |
| May 3 | 1 | 4 | 15 | 5 | 0 | 0 | 25 |
| May 4 | 3 | 4 | 32 | 4 | 5 | 1 | 49 |
| May 5 | 4 | 36 | 208 | 10 | 1 | 1 | 260 |
| May 6 | 13 | 58 | 382 | 23 | 0 | 3 | 479 |
| May 7 | 18 | 83 | 635 | 48 | 0 | 5 | 789 |
| May 8 | 3 | 43 | 320 | 25 | 0 | 7 | 398 |
| May 9 | 15 | 84 | 787 | 75 | 0 | 383 | 1,344 |
| May 10 | 12 | 93 | 507 | 21 | 2 | 3 | 638 |
| May 11 | 21 | 77 | 339 | 19 | 0 | 6 | 462 |
| May 12 | 32 | 151 | 924 | 50 | 6 | 10 | 1,173 |
| May 13 | 38 | 195 | 759 | 19 | 2 | 17 | 1,030 |
| May 14 | 59 | 347 | 1,604 | 60 | 3 | 209 | 2,282 |
| May 15 | 41 | 171 | 871 | 41 | 6 | 41 | 1,171 |
| May 16 | 48 | 164 | 481 | 23 | 6 | 0 | 722 |
| May 17 | 34 | 181 | 661 | 30 | 10 | 2 | 918 |

Table 3. (cont'd.)

| Date | Coded Wire Tagged Coho Length Category (mm) |  |  |  | Untagged Coho | Morts | Totals |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | 50-74 | 75-85 | 86-114 | 115+ |  |  |  |
| May 18 | 35 | 162 | 354 | 24 | 5 | 5 | 585 |
| May 19 | 31 | 97 | 316 | 20 | 9 | 0 | 473 |
| May 20 | 35 | 67 | 127 | 5 | 1 | 3 | 238 |
| May 21 | 24 | 43 | 62 | 1 | 6 | 0 | 136 |
| May 22 | 25 | 80 | 190 | 18 | 7 | 4 | 324 |
| May 23 | 5 | 33 | 83 | 4 | 1 | 1 | 127 |
| May 24 | 6 | 36 | 65 | 5 | 1 | 1 | 114 |
| May 25 | 4 | 13 | 34 | 5 | 1 | 1 | 58 |
| May 26 | 13 | 8 | 22 | 5 | 6 | 2 | 56 |
| May 27 | 5 | 6 | 5 | 0 | 0 | 1 | 17 |
| May 28 | 9 | 13 | 18 | 0 | 1 | 1 | 42 |
| May 29 | 9 | 20 | 25 | 1 | 6 | 1 | 62 |
| May 30 | 3 | 10 | 11 | 0 | 0 | 0 | 24 |
| May 31 | 4 | 3 | 9 | 0 | 0 | 1 | 17 |
| June 1 | 1 | 6 | 6 | 2 | 0 | 1 | 16 |
| June 2 | 3 | 6 | 12 | 0 | 0 | 0 | 21 |
| June 3 | 1 | 1 | 2 | 0 | 1 | 0 | 5 |
| June 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| June 5 | 0 | 1 | 1 | 0 | 0 | 0 | 2 |
| June 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| June 7 | 0 | 3 | 0 | 0 | 0 | 0 | 3 |
| June 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| June 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Jurie 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| June 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Totals | 631 | 2,581 | 10,608 | 573 | 765 | 762 | 15,920 |

Table 4. Summary of coded wire tagged coho by code, tagged at the Lachmach River fence, spring 1993.
() denotes number used in estimating tag retention.

| code | Date | Length Range (mm) | Total | Tag Retention | Tags at Large |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 08/01/29 | Apr 25 June 11 | 50-74 | 631 | $\begin{aligned} & 0.981 \\ & (417) \end{aligned}$ | 619 |
| 08/01/53 | $\begin{gathered} \text { Apr } 25- \\ \text { May } 18 \end{gathered}$ | 75-85 | 2121 | $\begin{aligned} & 0.970 \\ & (516) \end{aligned}$ | 2057 |
| 08/01/51 | May 18 June 11 | 75-85 | 460 | $\begin{aligned} & 1.000 \\ & (226) \end{aligned}$ | 460 |
| 08/01/25 | $\begin{gathered} \text { Apr } 25- \\ \text { May } 22 \end{gathered}$ | 86-114 | 10,248 | $\begin{gathered} .978 \\ (1368) \end{gathered}$ | 10,023 |
| 08/01/52 | May 22 June 11 | 86-114 | 360 | $\begin{aligned} & 1.000 \\ & (229) \end{aligned}$ | 360 |
| 08/01/27 | Apr 25 June 11 | 115-170 | 573 | $\begin{array}{r} .918 \\ (326) \\ \hline \end{array}$ | 526 |
| TOTALS |  |  | 14,393 |  | 14,045 |

Table 5. Weekly summaries of biological sampling of coho smolts at the Lachmach River fence, spring 1993.

| Week | Fork Length (mm) |  |  | Weight (g) |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | N | Mean | SD | N | Mean | SD |
| Apr 22-28 | 603 | 87 | 10.8 | 602 | 6.1 | 2.29 |
| Apr 29 - May 5 | 325 | 94 | 11.2 | 325 | 7.6 | 2.79 |
| May 6-12 | 699 | 96 | 11.4 | 6.99 | 8.3 | 2.90 |
| May 13-19 | 687 | 93 | 11.8 | 685 | 7.3 | 2.67 |
| May 20-26 | 434 | 89 | 13.0 | 434 | 6.5 | 2.65 |
| May 27 - June 2 | 111 | 87 | 14.4 | 111 | 6.4 | 2.71 |
| June 3-9 | 6 | 84 | 13.3 | 6 | 5.7 | 2.33 |
| June 10-11 | 0 | - | - | 0 | - | - |
| Total | 2865 | 92 | 12.3 | 2862 | 7.2 | 2.78 |

Table 6. Summary of lengths and weights by age for coho smolts scale sampled at the Lachmach River fence, spring 1993.

| Age | N | Fork Length (mm) |  |  | Weight (g) |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | Range | Mean | SD |  | Range | Mean | SD |
| 1.0 | 222 | $52-111$ | 77 | 13.1 |  | $1.20-12.80$ | 4.6 | 2.20 |
| 2.0 | 303 | $69-161$ | 104 | 12.8 |  | $2.80-75.00$ | 10.3 | 5.36 |
| 3.0 | 14 | $101-130$ | 114 | 8.66 |  | $9.40-20.20$ | 13.1 | 3.25 |

Table 7. Age composition of coho smolt population of Lachmach River, spring 1993.

| Range(mm) | Coho N | Age 1.0 |  | Age 2.0 |  | Age 3.0 |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | $\beta$ | $B(N)$ | $\beta$ | $\beta(N)$ | $\beta$ | $\underline{\beta}(\mathrm{N})$ |
| 55-59 | 10 | 1.00 | 10 | 0 | 0 | 0 | 0 |
| 60-64 | 28 | 1.00 | 28 | 0 | 0 | 0 | 0 |
| 65-69 | 70 | 0.95 | 67 | 0.05 | 3 | 0 | 0 |
| 70-74 | 114 | 0.85 | 97 | 0.15 | 17 | 0 | 0 |
| 75-79 | 233 | 0.84 | 196 | 0.16 | 37 | 0 | 0 |
| 80-84 | 375 | 0.79 | 296 | 0.21 | 79 | 0 | 0 |
| 85-89 | 426 | 0.69 | 294 | 0.31 | 132 | 0 | 0 |
| 90-94 | 418 | 0.27 | 113 | 0.73 | 305 | 0 | 0 |
| 95-99 | 393 | 0.18 | 71 | 0.82 | 322 | 0 | 0 |
| 100-104 | 348 | 0.17 | 59 | 0.81 | 282 | 0.02 | 7 |
| 105-109 | 243 | 0.02 | 5 | 0.86 | 209 | 0.12 | 29 |
| 110-114 | 133 | 0.02 | 3 | 0.95 | 126 | 0.03 | 4 |
| 115-119 | 44 | 0 | 0 | 0.92 | 40 | 0.08 | 4 |
| 120-124 | 16 | 0 | 0 | 0.87 | 14 | 0.13 | 2 |
| 125-129 | 9 | 0 | 0 | 0.89 | 8 | 0.11 | 1 |
| 130-134 | 4 | 0 | 0 | 0.86 | 3 | 0.14 | 1 |
| 135-159 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 160-164 | 1 | 0 | 0 | 1.00 | 1 | 0 | 0 |
| Total | 2,865 |  | $\begin{aligned} & 1,239 \\ & (43 \%) \end{aligned}$ |  | $\begin{aligned} & 1,578 \\ & (55 \%) \end{aligned}$ |  | $\begin{gathered} 48 \\ (2 \%) \\ \hline \end{gathered}$ |


| Mark Type | Release Site | Release Dat Number | es and $r$ | Recaptures |
| :---: | :---: | :---: | :---: | :---: |
| Left Maxillary | Fence | June-July 89 | $\begin{gathered} 109 \\ (109) \end{gathered}$ | $\begin{gathered} 12^{\mathbf{a}} \\ (19) \end{gathered}$ |
| Right Ventral/ <br> Left Maxillary | $500 \mathrm{~m}^{\text {b }}$ | $\begin{aligned} & \text { June-Sept } 89 \\ & \text { Aug 90 } \\ & \text { June-Oct } 91 \end{aligned}$ | $\begin{array}{r} 136 \\ 27 \\ 197 \\ (360) \end{array}$ | $\begin{gathered} 0 \\ (73) \end{gathered}$ |
| Left Ventral/ <br> Right Maxillary | 2000 m | $\begin{aligned} & \text { June-Aug } 89 \\ & \text { Aug } 90 \\ & \text { June-Oct } 91 \end{aligned}$ | $\begin{array}{r} 224 \\ 63 \\ 263 \\ (550) \end{array}$ | $\begin{gathered} 0 \\ (36) \end{gathered}$ |
| Left Ventral/ <br> Left Maxillary | 2600 m | Sept 89 <br> Aug 90 <br> July-oct 91 | $\begin{array}{r} 322 \\ 42 \\ 341 \\ (705) \end{array}$ | $\begin{gathered} 1 \\ (32) \end{gathered}$ |
| Left Ventral | $\begin{aligned} & 3820 \mathrm{~m} \\ & 3390 \mathrm{~m} \end{aligned}$ | Sept 89 <br> June-Oct 91 <br> Aug 90 <br> July-Oct 91 | $\begin{array}{r} 696 \\ 199 \\ 400 \\ 310 \\ (1605) \end{array}$ | $\begin{gathered} 2 \\ (198) \end{gathered}$ |
| Right Ventral/ <br> Right Maxillary | 4500 m | Sept 89 <br> Aug 90 <br> June-Oct 91 | $\begin{gathered} 356 \\ 200 \\ 264 \\ (820) \end{gathered}$ | $\begin{gathered} 0 \\ (98) \end{gathered}$ |
| Right Ventral | 5000 m | Aug 89 <br> Aug 90 <br> June-Oct 91 | $\begin{array}{r} 897 \\ 19 \\ 709 \\ (1625) \end{array}$ | $\begin{gathered} 8 \\ (463) \end{gathered}$ |
| Right Maxillary | 7000 m | Sept 89 <br> Aug 90 <br> June-Oct 91 | $\begin{gathered} 286 \\ 114 \\ 222 \\ (622) \end{gathered}$ | $\begin{gathered} 17 \\ (74) \end{gathered}$ |
| ```Right Ventral/ Left Ventralc``` |  |  |  | $\begin{gathered} 0 \\ (3) \\ \hline \end{gathered}$ |

-     - There have been no LM clips applied since 1989. These marks have been misidentified.
b - Numbers indicate distance in meters upstream from fence.
c - There were no RVLV marks officially applied. These fish were incorrectly marked.

Table 9. Survival of fin clips to the Lachmach River fence, 1990-1993

| Site | Mark | Habitat <br> Type | \# survive/ <br> \# marked | Survival <br> Rate |
| :---: | :---: | :---: | :---: | :---: |
| fence | LM | mainstem | $19 / 109$ | 0.17 |
| 500 m | RV LM | side channel | $73 / 360$ | 0.20 |
| 2000 m | LV RM | mainstem | $36 / 550$ | 0.07 |
| 2600 m | LV LM | mainstem | $32 / 705$ | 0.05 |
| $3390 \mathrm{~m} / 3820 \mathrm{~m}$ | LV | pond | $198 / 1605$ | 0.12 |
| 4500 m | RV RM | mainstem | $98 / 820$ | 0.12 |
| 5000 m | RV | pond | $463 / 1625$ | 0.28 |
| 7000 m | RM | tributary | $74 / 622$ | 0.12 |

Table 10. Cold brands on coho smolts at the Lachmach River fence, spring 1993.

Brand refers to the symbol used. There could be up to three. Orientation refers to the direction the bottom of the brand is facing. DOWN indicates a 'normal' symbol, FWD (forward) indicates the symbol is on its side with the bottom orientated anterior and the top is posterior, UP indicates an inverted symbol and BACK indicates a symbol on its side with the bottom posterior and the top anterior.
Side refers to the left or right side of the fish, when looking down onto the dorsal surface.
Place refers to either a spot posterior to the operculum (gill), or to a spot below the dorsal fin (dorsal).

| Brand type |  |  |  | Date |  | Len | Wt | Age |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Brand | Orientation | Side | Place |  |  | mm | g |  |
| Q | down | ? | dorsal | May | 6 | 102 | 9.2 | - |
| T | down | ? | dorsal | May | 6 | 109 | 11.8 | 2.0 |
| T | down | ? | dorsal | May | 7 | 92 | 6.5 | 2.0 |
| T | down | ? | dorsal | May | 7 | 96 | 7.9 | 2.0 |
| T | down | ? | dorsal | May | 8 | 81 | 4.5 | 2.0 |
| T | down | ? | dorsal | May | 9 | 113 | 12.4 | - |

Table 10. (cont'd.)

| Brand type |  |  |  | Date |  |  | Age |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Brand | Orientation | Side | Place |  | mm | $g$ |  |
| T | up | ? | dorsal | May 6 | 93 | 7.5 | 2.0 |
| TT | ? | ? | ? | May 12 | 112 | 12.1 | 2.0 |
| TT | ? | ? | ? | May 12 | 105 | 10.0 | 3.0 |
| TT | ? | ? | ? | May 14 | 104 | 10.0 | 2.0 |
| TT | ? | ? | ? | May 14 | 105 | 9.4 | - |
| TT | ? | ? | ? | May 17 | 103 | 8.7 | 2.0 |
| TT | ? | ? | ? | May 18 | 105 | 9.6 | 2.0 |
| TT | ? | ? | ? | May 18 | 99 | 8.7 | 2.0 |
| TT | ? | ? | dorsal | May 8 | 110 | 10.7 | 2.0 |
| TT | ? | ? | dorsal | May 8 | 115 | 12.6 | 2.0 |
| TT | ? | ? | dorsal | May 8 | 104 | 9.6 | 2.0 |
| TT | ? | ? | dorsal | May 9 | 110 | 12.7 | 2.0 |
| TT | ? | ? | dorsal | May 9 | 115 | 13.0 | - |
| TT | ? | ? | dorsal | May 9 | 112 | 11.8 | 2.0 |
| TT | ? | ? | dorsal | May 9 | 114 | 12.1 | - |
| TT | ? | ? | dorsal | May 11 | 110 | 10.9 | 2.0 |
| TT | ? | ? | dorsal | May 11 | 101 | 9.2 | 2.0 |
| TT | ? | ? | dorsal | May 11 | 95 | 7.7 | 2.0 |
| TT | ? | ? | dorsal | May 12 | 107 | 9.9 | 2.0 |
| TT | ? | ? | dorsal | May 12 | 90 | 6.1 | 2.0 |
| TT | ? | ? | dorsal | May 12 | 92 | 6.5 | 2.0 |
| TT | ? | ? | dorsal | May 12 | 106 | 10.9 | 3.0 |
| TT | ? | ? | dorsal | May 15 | 112 | 12.2 | 2.0 |
| TT | back | left | ? | May 19 | 91 | 7.8 | 2.0 |
| TT | back | left | dorsal | May 14 | 102 | 9.3 | 2.0 |
| TT | back | left | dorsal | May 14 | 103 | 9.4 | 2.0 |
| TT | back | left | dorsal | May 15 | 99 | 8.3 | 2.0 |
| TT | down | ? | ? | May 7 | 107 | 10.4 | - |
| TT | down | ? | ? | May 12 | 110 | 11.0 | 2.0 |

Table 10. (cont'd.)

| Brand type |  |  |  | Date | Len |  | Age |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Brand | Orientation | side | Place |  | mm | g |  |
| TT | down | ? | dorsal | May 8 | 97 | 8.5 | 2.0 |
| TT | down | ? | dorsal | May 8 | 106 | 10.2 | 2.0 |
| TT | down | ? | dorsal | May 9 | 101 | 9.6 | 2.0 |
| TT | down | ? | dorsal | May 9 | 114 | 13.7 | 2.0 |
| TT | down | ? | dorsal | May 9 | 111 | 11.1 | 2.0 |
| TT | down | ? | dorsal | May 9 | 108 | 10.8 | 2.0 |
| TT | down | ? | dorsal | May 12 | 106 | 9.6 | 2.0 |
| TT | down | left | ? | May 19 | 103 | 9.1 | 2.0 |
| TT | down | left | dorsal | May 10 | 106 | 10.5 | 2.0 |
| TT | down | left | dorsal | May 13 | 109 | 10.9 | 2.0 |
| TT | down | left | dorsal | May 14 | 103 | 9.9 | 1.0 |
| TT | down | left | dorsal | May 14 | 111 | 12.2 | 2.0 |
| TT | down | left | dorsal | May 14 | 103 | 9.3 | 2.0 |
| TT | down | left | dorsal | May 14 | 111 | 12.8 | 1.0 |
| TT | down | left | dorsal | May 14 | 106 | 10.3 | 3.0 |
| TT | down | left | dorsal | May 15 | 98 | 7.6 | - |
| TT | down | left | dorsal | May 15 | 108 | 10.7 | 2.0 |
| TT | down | left | dorsal | May 15 | 106 | 10.4 | 2.0 |
| TT | down back | left | dorsal | May 13 | 103 | 9.4 | 2.0 |
| TT | fwd | left | ? | May 16 | 110 | 11.5 | 2.0 |
| TT | fwd | left | ? | May 16 | 110 | 10.5 | - |
| TT | fwd | left | ? | May 16 | 112 | 12.9 | 2.0 |
| TT | fwd | left | dorsal | May 15 | 112 | 12.5 | 2.0 |
| TT | fwd | left | dorsal | May 15 | 103 | 9.4 | 2.0 |
| TT | up | ? | ? | Apr 29 | 121 | 16.7 | 2.0 |
| TT | up | ? | dorsal | May 8 | 111 | 11.1 | 2.0 |
| TT | up | left | ? | May 16 | 108 | 10.5 | 2.0 |
| TT | up | left | ? | May 16 | 115 | 12.2 | 2.0 |
| TT | up | left | ? | May 16 | 115 | 12.0 | 2.0 |

Table 10. (cont'd.)

| Brand type |  |  |  | Date | Len mm | Wt$\qquad$ g | Age |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Brand | Orientation | Side | Place |  |  |  |  |
| TT | up | left | dorsal | May 13 | 116 | 12.6 | 2.0 |
| TT | up | left | dorsal | May 14 | 107 | 11.2 | 2.0 |
| TT | up | left | dorsal | May 15 | 109 | 14.1 | 2.0 |
| TTT | down | ? | ? | May 12 | 108 | 11.2 | 2.0 |
| TTT | up down up | ? | ? | May 9 | 110 | 9.3 | 2.0 |
| TVT | ? up ? | ? | ? | May 9 | 110 | 11.0 | 2.0 |
| TVT | ? up ? | ? | ? | May 9 | 113 | 12.6 | 2.0 |
| TVT | ? up ? | ? | ? | May 9 | 110 | 11.8 | 2.0 |
| TVT b | back fwd back | left | dorsal | May 14 | 100 | 8.8 | 1.0 |
| TVT | back fwd down | left | dorsal | May 14 | 99 | 9.1 | 2.0 |
| TVT | back up back | left | dorsal | May 13 | 111 | 11.4 | 2.0 |
| TVT | down | ? | ? | May 25 | 100 | 8.4 | 2.0 |
| TVT dow | down fwd down | left | dorsal | May 13 | 107 | 10.4 | 2.0 |
| TVT dond | down fwd down | left | dorsal | May 14 | 100 | 8.7 | - |
| TVT | down up down | left | dorsal | May 13 | 104 | 9.3 | 2.0 |
| TVT | down up down | left | dorsal | May 14 | 100 | 9.7 | 2.0 |
| TVT | up down up | ? | dorsal | May 22 | 114 | 13.0 | 2.0 |
| TVT | up down up | left | dorsal | May 13 | 116 | 12.2 | 2.0 |
| U | ? | ? | ? | May 14 | 99 | 8.6 | - |
| U | ? | ? | ? | May 14 | 94 | 6.8 | - |
| U | ? | ? | ? | May 16 | 101 | 8.6 | - |
| U | down | ? | ? | May 14 | 117 | 14.4 | 3.0 |
| U | down | ? | ? | May 14 | 81 | 6.1 | - |
| U | down | ? | dorsal | May 5 | 99 | 8.3 | 2.0 |
| U | down | ? | dorsal | May 8 | 98 | 7.7 | - |
| U | down | ? | gill | May 6 | 98 | 8.7 | 2.0 |
| U | down | ? | gill | May 7 | 83 | 5.4 | 2.0 |
| U | down | ? | gill | May 8 | 101 | 10.3 | 2.0 |
| U | down | left | ? | May 19 | 91 | 6.2 | - |

Table 10. (cont'd.)

| Brand | Brand type |  |  | Date | Len mm | $\begin{gathered} \text { Wt } \\ \mathrm{g} \end{gathered}$ | Age |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Orientation | Side | Place |  |  |  |  |
| U | down | left | dorsal | May 13 | 82 | 4.8 | 2.0 |
| U | down | left | gill | Apr 22 | 78 | 5.0 | - |
| U | down | left | gill | Apr 25 | 84 | 5.9 | - |
| U | down | left | gill | Apr 25 | 85 | 5.4 | - |
| U | down | left | gill | Apr 26 | 83 | 4.9 | - |
| U | down | left | gill | Apr 28 | 90 | 6.7 | - |
| U | down | left | gill | May 4 | 85 | 5.8 | - |
| U | down | left | gill | May 13 | 82 | 5.9 | 2.0 |
| U | down | left | gill | May 14 | 97 | 8.3 | 2.0 |
| U | down | left | gill | May 15 | 92 | 6.5 | 2.0 |
| U | down | left | gill | May 15 | 103 | 9.6 | 2.0 |
| U | down | right | gill | Apr 25 | 107 | 10.5 | - |
| U | up | ? | ? | May 14 | 101 | 9.1 | 2.0 |
| U | up | ? | dorsal | May 5 | 94 | 8.1 | 2.0 |
| U | up | ? | dorsal | May 6 | 113 | 13.0 | 2.0 |
| U | up | ? | dorsal | May 6 | 104 | 9.9 | 2.0 |
| U | up | right | gill | May 13 | 83 | 4.5 | 1.0 |
| U | up | right | gill | May 14 | 98 | 9.3 | 2.0 |
| UVT | up up down | left | dorsal | May 15 | 108 | 10.4 | 2.0 |
| v | ? | ? | dorsal | May 3 | 120 | 14.4 | - |
| v | ? | ? | dorsal | May 3 | 120 | 14.4 | 2.0 |
| v | ? | ? | dorsal | May 6 | 105 | 10.3 | 1.0 |
| v | ? | ? | dorsal | May 7 | 104 | 9.1 | 2.0 |
| V | back | left | dorsal | May 14 | 111 | 11.9 | 2.0 |
| v | down | ? | ? | May 17 | 108 | 10.4 | 2.0 |
| v | down | ? | dorsal | May 5 | 114 | 10.9 | 2.0 |
| V | down | ? | dorsal | May 6 | 108 | 11.4 | 2.0 |
| V | down | ? | dorsal | May 6 | 96 | 8.0 | 1.0 |
| v | down | ? | dorsal | May 7 | 110 | 11.0 | 2.0 |

Table 10. (cont'd.)

| Brand type |  |  |  | Date | Len | Wt | Age |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Brand | Orientation | Side | Place |  | mm | $g$ |  |
| V | down | ? | gill | May 7 | 97 | 7.1 | 2.0 |
| v | down | ? | gill | May 8 | 88 | 5.8 | 2.0 |
| v | down | ? | gill | May 9 | 107 | 10.3 | 3.0 |
| V | down | left | ? | May 16 | 118 | 14.6 | 2.0 |
| v | down | left | dorsal | May 13 | 114 | 13.5 | 2.0 |
| v | down | left | dorsal | May 14 | 113 | 12.1 | 2.0 |
| V | down | left | dorsal | May 15 | 121 | 14.9 | 2.0 |
| V | fwd | left | dorsal | May 15 | 99 | 8.2 | 2.0 |
| V | up | ? | ? | May 14 | 115 | 13.2 | 2.0 |
| v | up | ? | dorsal | May 6 | 110 | 10.9 | 2.0 |
| v | up | ? | dorsal | May 9 | 108 | 10.8 | 2.0 |
| V | up | ? | dorsal | May 9 | 109 | 11.5 | - |
| V | up | ? | dorsal | May 22 | 111 | 11.2 | 2.0 |
| v | up | left | dorsal | May 13 | 106 | 9.3 | 2.0 |
| V | up | left | dorsal | May 13 | 111 | 10.6 | 2.0 |
| v | up | left | dorsal | May 13 | 105 | 9.8 | 2.0 |
| v | up | left | dorsal | May 14 | 105 | 10.7 | 2.0 |
| v | up | left | dorsal | May 15 | 114 | 13.1 | 2.0 |
| v | up | left | dorsal | May 15 | 108 | 10.3 | 2.0 |
| V | up | left | dorsal | May 15 | 112 | 11.5 | 2.0 |
| V | up | left | dorsal | May 15 | 113 | 12.6 | 2.0 |

Table 11. Minimum fence efficiency, Lachmach River fence, spring 1993.

| Date | Release \#1 |  | Release \#2 |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | 86-114 mm |  | $75-85 \mathrm{~mm}$ |  | 86-114 mm |  | $115+$ |  |
|  | F | R | F | R | F | R | F | R |
| May 13 | rele | da |  |  |  |  |  |  |
| May 14 | 15 | 1 |  |  |  |  |  |  |
| May 15 | 10 | - |  |  |  |  |  |  |
| May 16 | 11 | 4 |  |  |  |  |  |  |
| May 17 | 14 | - |  |  |  |  |  |  |
| May 18 | 4 | 0 |  |  |  |  |  |  |
| May 19 | 4 | - |  |  |  |  |  |  |
| May 20 | 0 | 0 |  |  | lea | dat |  |  |
| May 21 | 3 | 0 | 15 | 0 | 19 | 0 | 1 | 0 |
| May 22 | 4 | 0 | 10 | 0 | 6 | 0 | 0 | 0 |
| May 23 | 0 | 1 | 1 | 1 | 3 | 2 | 0 | 0 |
| May 24 | 0 | 0 | 3 | 1 | 2 | 1 | 0 | 1 |
| May 25 | 0 | 0 | 0 | 0 | 3 | 1 | 0 | 1 |
| May 26 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| May 27 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 |
| May 28 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| May 29 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 |
| Subtotal | 65 | 7 | 29 | 2 | 38 | 4 | 1 | 2 |
| Total | 72 |  | 76 |  |  |  |  |  |

Table 12. Summary of fence efficiency tests performed at the Lachmach River fence, 1989 - 1993

| Year | n | \% recovered at fence |
| :---: | :---: | :---: |
| 1989 | 100 | 74 |
|  | 100 | 91 |
| 1990 | 100 | 83 |
|  | 100 | 93 |
| 1991 | 100 | 79 |
| 1992 | 100 | 79 |
|  | 100 | 87 |
| 1993 | 100 | 72 |
|  | 100 | 76 |
| Total | 900 | mean $=82 \%$ |
|  |  | S.D. $=7.45$ |

Table 13. Comparison of fence sample with entire run.

| Length Range <br> $(\mathrm{mm})$ | Entire Run <br> $(\%)$ | Fence Sample <br> $(\%)$ |
| :---: | :---: | :---: |
| $50-74$ | 4.4 | 7.7 |
| $75-85$ | 17.9 | 24.7 |
| $86-114$ | 73.7 | 65.0 |
| $115-170$ | 4.0 | 2.6 |

Table 14. Comparison of mean length of coho smolts caught in rotary trap and fence traps on selected days at the Lachmach River, spring 1993.

| Date | Rotary Trap |  |  | Fence Traps |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | N | Mean Length | S.D. | N | Mean Length | S.D. |
| Apr 22 | 75 | 84 | 11.7 | 37 | 83 | 8.95 |
| Apr 23 | 100 | 87 | 10.6 | 100 | 85 | 11.4 |
| May 4 | 17 | 98 | 11.5 | 32 | 97 | 12.6 |
| May 29 | 25 | 88 | 14.4 | 37 | 85 | 14.1 |
| Total | 217 | 87 | 12.0 | 206 | 87 | 12.6 |

Table 15. Comparison of rotary and fence catches of coho smolts on selected days at Lachmach River, spring 1993.

| Date | Number of Coho Captured |  |  |
| :---: | :---: | :---: | :---: |
|  | Fence | Rotary | Both |
| Apr 22 | 37 | 75 | 112 |
| Apr 23 | 112 | 125 | 237 |
| May 4 | 32 | 17 | 49 |
| May 6 | 259 | 220 | 479 |
| May 12 | 639 | 534 | 1173 |
| May 14 | 1491 | 791 | 2282 |
| May 16 | 392 | 330 | 722 |
| May 18 | 405 | 180 | 585 |
| May 20 | 116 | 122 | 238 |
| May 22 | 286 | 38 | 324 |
| May 23 | 80 | 47 | 127 |
| May 24 | 81 | 33 | 114 |
| May 25 | 33 | 26 | 59 |
| May 26 | 22 | 34 | 56 |
| May 28 | 20 | 20 | 40 |
| May 29 | 37 | 25 | 62 |
| May 30 | 18 | 6 | 24 |
| May 31 | 8 | 9 | 17 |
| June 1 | 7 | 9 | 16 |
| June 2 | 10 | 11 | 21 |
| June 3 | 3 | 2 | 5 |
| June 5 | 0 | 2 | 2 |
| Total | $\begin{gathered} 4088 \\ 61 \% \end{gathered}$ | $\begin{gathered} 2656 \\ 39 \% \end{gathered}$ | 6744 |

Table 16. Combined daily counts of other species of fish from the Lachmach River fence and rotary traps, spring 1993.

| Date | Rainbow <br> Trout | Steelhead <br> Trout | Cutt. <br> Trout | Dolly <br> Varden <br> Char | Prickly <br> Sculpin | Coast. <br> Sculpin |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Apr 20 | 1 | 0 | 0 | 0 | 2 | 9 | 0 |
| Apr 21 | 0 | 0 | 0 | 0 | 1 | 7 | 0 |
| Apr 22 | 2 | 0 | 0 | 0 | 6 | 10 | 0 |
| Apr 23 | 7 | 0 | 0 | 0 | 6 | 20 | 1 |
| Apr 24 | 5 | 0 | 0 | 0 | 6 | 24 | 6 |
| Apr 25 | 2 | 0 | 0 | 0 | 2 | 25 | 7 |
| Apr 26 | 1 | 0 | 0 | 0 | 3 | 22 | 4 |
| Apr 27 | 3 | 0 | 0 | 0 | 3 | 22 | 4 |
| Apr 28 | 3 | 0 | 0 | 0 | 2 | 13 | 3 |
| Apr 29 | 6 | 5 | 0 | 0 | 28 | 3 | 0 |
| Apr 30 | - | - | - | - | - | - | - |
| May 1 | 2 | 0 | 0 | 0 | 13 | 5 | 0 |
| May 2 | 1 | 0 | 0 | 0 | 0 | 1 | 0 |
| May 3 | 0 | 0 | 0 | 0 | 2 | 1 | 0 |
| May 4 | 1 | 0 | 0 | 0 | 12 | 1 | 0 |
| May 5 | 4 | 1 | 0 | 0 | 6 | 0 | 0 |
| May 6 | 2 | 3 | 0 | 0 | 15 | 3 | 1 |
| May 7 | 2 | 0 | 0 | 0 | 6 | 0 | 0 |
| May 8 | 1 | 7 | 0 | 0 | 2 | 0 | 0 |
| May 9 | 7 | 1 | 0 | 0 | 36 | 7 | 1 |
| May 10 | 10 | 2 | 0 | 0 | 37 | 6 | 2 |
| May 11 | 5 | 7 | 0 | 0 | 22 | 1 | 1 |
| May 12 | 16 | 1 | 2 | 0 | 59 | 5 | 9 |
| May 13 | 11 | 0 | 0 | 0 | 68 | 2 | 3 |
| May 14 | 65 | 0 | 1 | 1 | 61 | 6 | 5 |
| May 15 | 31 | 0 | 0 | 1 | 46 | 6 | 0 |
| May 16 | 60 | 0 | 0 | 0 | 57 | 5 | 2 |
| May 17 | 20 | 0 | 1 | 0 | 31 | 3 | 0 |


| Date | Rainbow Trout | Steelhead Trout |  | Cutt. <br> Trout | Dolly Varden Char | Prickly <br> Sculpin | Coast. <br> Sculpin |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | Up | Down |  |  |  |  |
| May 18 | 51 | 0 | 0 | 0 | 75 | 4 | 1 |
| May 19 | 40 | 0 | 5 | 0 | 50 | 0 | 0 |
| May 20 | 109 | 0 | 0 | 0 | 44 | 2 | 3 |
| May 21 | 28 | 0 | 0 | 0 | 5 | 3 | 0 |
| May 22 | 122 | 0 | 1 | 0 | 43 | 10 | 5 |
| May 23 | 58 | 0 | 1 | 0 | 31 | 10 | 3 |
| May 24 | 91 | 1 | 2 | 0 | 20 | 6 | 4 |
| May 25 | 66 | 1 | 4 | 0 | 55 | 1 | 1 |
| May 26 | 90 | 0 | 1 | 0 | 24 | 10 | 5 |
| May 27 | 11 | 0 | 0 | 0 | 3 | 8 | 4 |
| May 28 | 103 | 1 | 6 | 0 | 12 | 3 | 0 |
| May 29 | 78 | 0 | 0 | 1 | 24 | 12 | 2 |
| May 30 | 42 | 0 | 0 | 0 | 1 | 0 | 1 |
| May 31 | 30 | 0 | 0 | 2 | 2 | 0 | 0 |
| June 1 | 43 | 0 | 0 | 0 | 5 | 0 | 1 |
| June 2 | 31 | 0 | 0 | 1 | 1 | 1 | 2 |
| June 3 | 12 | 0 | 0 | 0 | 1 | 0 | 0 |
| June 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| June 5 | 5 | 0 | 0 | 1 | 1 | 0 | 1 |
| June 6 | 13 | 0 | 0 | 0 | 0 | 0 | 0 |
| June 7 | 9 | 0 | 0 | 0 | 0 | 0 | 0 |
| June 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| June 9 | 6 | 0 | 0 | 0 | 1 | 0 | 0 |
| June 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| June 11 | 17 | 0 | 0 | 0 | 0 | 2 | 1 |
| ALL | 1,323 | 30 | 24 | 7 | 930 | 279 | 83 |

2 - These 7 steelhead were observed passing the fence at high water.

Table 17. Upstream migrant steelhead trout data collected from Lachmach River fence, spring 1993.

| Male |  |  | Female |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Date | Length | Tag Number | Date | Length | Tag Number |
| Apr 29 | 709 | 336 | Apr 29 | 729 | 334 |
| Apr 29 | 758 | 338 | Apr 29 | 822 | 335 |
| May 6 | 805 | 342 | Apr 29 | 753 | 337 |
| May 11 | 925 | 348 | May 5 | 810 | 339 |
| May 11 | 730 | 912 | May 6 | 760 | 341 |
| May 24 | 835 | 594 | May 6 | 815 | 343 |
|  |  |  | May 9 | 865 |  |
|  |  |  | May 10 | 700 |  |
|  |  |  | May 10 | 737 | 345 |
|  |  |  | May 11 | 785 | 346 |
|  |  |  | May 11 | 620 | 347 |
|  |  |  | May 11 | 855 | 349 |
|  |  |  | May 11 | 750 | 350 |
|  |  |  | May 11 | 755 | 925 |
|  |  |  | May 12 | 750 |  |
|  |  |  | May 25 | 780 | 582 |
|  |  |  | May 28 | 765 | 586 |
| NNS |  | 6 |  |  | 17 |
|  | Length | 794 |  | $n$ Length | 768 |
|  |  | 72.5 |  |  | 56.6 |

Table 18. Downstream migrant steelhead trout data collected from the Lachmach River fence, spring 1993.


Table 19. Weekly summary of lengths of other salmonids from Lachmach River fence, spring 1993.

| Date | Rainbow Trout |  |  | Cutthroat Trout |  |  | Dolly Varden |  | Char |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | N | Mean | S.D. | N | Mean | S.D. | N | Mean | S.D. |
| Apr 20-26 | 18 | 114 | 25.5 | 0 |  |  | 26 | 179 | 62.6 |
| Apr 27 - May 3 | 15 | 114 | 32.6 | 0 |  |  | 46 | 185 | 54.0 |
| May 4-10 | 22 | 126 | 36.4 | 0 |  |  | 56 | 132 | 35.8 |
| May 11 - 17 | 150 | 125 | 36.6 | 2 | 123 | 23 | 246 | 124 | 14.5 |
| May 18-24 | 328 | 127 | 32.1 | 0 |  |  | 144 | 126 | 17.7 |
| May 25-31 | 244 | 125 | 31.9 | 3 | 100 | 21.9 | 59 | 127 | 24.3 |
| June 1-7 | 133 | 106 | 28.8 | 2 | 128 | 3.50 | 8 | 141 | 40.6 |
| June 8-11 | 23 | 90 | 9.28 | 0 |  |  | 1 | 140 | - |
| Total | 913 | 122 | 33.2 | 7 | 115 | 22.7 | 586 | 133 | 33.6 |

Table 20. Weekly summary of weights of other salmonids from Lachmach River fence, spring 1993.

| Date | Rainbow Trout |  | Cutthroat Trout |  | Dolly Varden Char |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | N | Mean | S.D. | N | Mean | S.D. | N | Mean | S.D. |
| Apr 20-26 | 18 | 16.3 | 8.52 | 0 |  |  | 25 | 64.4 | 49.4 |
| Apr 27-May 3 | 15 | 16.3 | 11.1 | 0 |  |  | 46 | 59.1 | 40.0 |
| May 4-10 | 22 | 21.8 | 16.4 | 0 |  |  | 56 | 22.7 | 23.4 |
| May 11-17 | 150 | 20.9 | 15.8 | 2 | 16.9 | 8.15 | 245 | 16.6 | 7.13 |
| May 18-24 | 328 | 20.6 | 13.0 | 0 |  |  | 144 | 16.9 | 8.32 |
| May 25-31 | 244 | 19.9 | 12.4 | 3 | 10.0 | 4.91 | 59 | 17.9 | 11.4 |
| June 1-7 | 113 | 13.1 | 10.2 | 2 | 16.7 | 2.20 | 8 | 26.1 | 18.2 |
| June 8-11 | 23 | 7.5 | 2.22 | 0 |  |  | 1 | 22.5 | - |
| Total | 913 | 19.1 | 13.2 | 7 | 13.9 | 6.48 | 584 | 22.9 | 23.5 |

Table 21. Weekly summary of lengths of sculpin species from Lachmach River fence, spring 1993.

| Date | Prickly Sculpin |  | Coastrange Sculpin |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | N | Mean | S.D. | N | Mean | S.D. |
| Apr 20-26 | 117 | 109 | 18.7 | 18 | 83 | 16.8 |
| Apr 27- May 3 | 44 | 114 | 17.3 | 7 | 84 | 19.8 |
| May 4-10 | 9 | 114 | 20.4 | 1 | 78 | - |
| May 11-17 | 17 | 107 | 20.3 | 15 | 92 | 37.3 |
| May 18-24 | 29 | 105 | 19.7 | 14 | 75 | 16.7 |
| May 25-31 | 27 | 100 | 23.6 | 13 | 75 | 26.4 |
| June 1-7 | 1 | 123 | - | 4 | 98 | 17.6 |
| June 8-11 | 2 | 110 | 14.5 | 1 | 91 | - |
| Total | 246 | 108 | 19.7 | 73 | 83 | 25.4 |

Table 22. Weekly summary of weights of sculpin species from Lachmach River fence, spring 1993.

| Date | Prickly Sculpin |  |  | Coastrange Sculpin |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | N | Mean | S.D. | N | Mean | S.D. |
| Apr 20-26 | 111 | 19.40 | 12.2 | 16 | 6.6 | 4.01 |
| Apr 27- May 3 | 41 | 20.20 | 11.6 | 6 | 8.3 | 5.49 |
| May 4-10 | 9 | 19.50 | 12.2 | 1 | 5.3 | - |
| May 11-17 | 17 | 17.15 | 10.3 | 12 | 10.7 | 9.89 |
| May 18-24 | 29 | 13.90 | 7.01 | 13 | 4.7 | 3.26 |
| May 25-31 | 27 | 13.70 | 11.0 | 13 | 6.2 | 7.22 |
| June 1-7 | 1 | 19.70 | - | 3 | 6.9 | 2.33 |
| June 8-11 | 2 | 23.55 | 4.55 | 1 | 9.8 | - |
| Total | 237 | 18.10 | 11.52 | 65 | 7.1 | 6.46 |



Figure 1. Locations of the Work Channel and Lachmach River areas.


Figure 2. Map of the Lachmach River area showing locations of study sites and adjacent systems:


Figure 3. Environmental data recorded at the Lachmach River fence from April 14 to June 28, 1993.


Figure 4. Daily captures of coho smolts, rainbow trout, Dolly Varden char and sculpin species trapped at the Lachmach River fence, spring


Figure 5. Length frequency distributions of coho smolts, combined and by age class, trapped at the Lachmach River fence, spring.


Figure 6. Length frequency distributions of coastrange sculpin, prickly sculpin, Dolly Varden char and rainbow trout trapped at the Lachmach River fence, spring 1993.

