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



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1994

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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 (O. mykiss), Dolly Varden char (Salvelinus malma), cutthroat trout (O. clarki), prickly sculpin (Cottus asper) and coastrange sculpin (C. aleuticus) and adult steelhead trout (O. 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 (O. 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.

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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 (O. mykiss), Dolly Varden (Salvelinus malma), truites fardée (O. clarki), chabot piquant (<u>Cottus</u> <u>asper</u>) et chabot côtier (<u>C</u>. <u>aleuticus</u>); on a également dénombré les truites arc-en-ciel anadromes adultes (O. 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 15 920 smolts en dévalaison; 14 393 ont été marqués au fil codé. On a établi la pyramide des âge des smolts de saumon coho : 43% d'âge 1.0, 55% d'âge 2.0 et 2% d'âge 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 (<u>O</u>. <u>gorbuscha</u>), 1 323 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.

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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 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 The river is characterized by sections of low to Channel. 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 (O. gorbuscha), chum salmon (O. keta), steelhead trout and resident rainbow trout (O. mykiss), sea-run and resident cutthroat trout (O. clarki) and Dolly Varden char (<u>Salvelinus</u> malma). In recent years a small number of adult chinook salmon (O. tshawytscha) have been observed in the river. Other fish species present include threespine stickleback (Gasterosteus aculeatus), prickly sculpin (Cottus asper) and coastrange sculpin (<u>C. aleuticus</u>). 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 mm and >85 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 mm, 75-85 mm, 86-114 mm, 115+ 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 mm) and weight (\pm 0.1 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 mm, 86-114 mm, and 115+ 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 (MS-Short term tag retention was determined by holding up to 222). 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 (± 1 mm)

and weights (±0.1 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 (± 1 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 13 100 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 20 100 individuals (length range: 50 @ 75-85 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°C with a range of 8°C to 34°C. Mean minimum air temperature was 7°C with a range of 0°C to 13°C. Water temperature rose

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steadily through the study period, starting at 4°C and increasing to 14°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, SD=12.3), and the mean weight was 7.2 g (n=2862, 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 χ^2 goodness-of-fit test was used to see if the sample was representative of the entire run. The null hypothesis, H_o, that the sample was representative of the entire run was accepted based on a calculated χ^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.

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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 (<u>Gasterosteus aculeatus</u>) (65 mm, 2.9 g) caught on May 24, and one pacific lamprey (<u>Lampetra tridentata</u>) (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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Date	Precipitation (mm)	Air Tem (perature °C)	Water Temperature
		Maximum	Minimum	(°C)
Apr 1	6 0	15	5	5
Apr 1	7 2	14	1	5
Apr 1	в О	21	0	5
Apr 1	9 2	13	7	5
Apr 2	0 0	18	1	4
Apr 2	1 4	17	4	5
Apr 22	2 8	22	6	6
Apr 2	3 2	19	4	5
Apr 2	4 0	20	8	6
Apr 2	5 2	16	6	6
Apr 2	6 2	19	6	6
Apr 2	7 8	18	6	6
Apr 2	8 4	16	7	7
Apr 2	9 16	9	6	6
Apr 3	0 22	12	5	5
May 0	1 8	15	5	5
May O	2 8	12	5	5
May O	3 2	15	3	6
May O	4 0	19	2	6
May O	5 14	12	5	7
May O	6 4	10	3	7
May O	7 2	17	4	7
May O	8 13	12	6	7
May O	9 28	8	4	6
May 1	0 6	18	6	7
May 1	1 4	14	5	7
May 1	2 0	22	2	7
May 1	3 0	27	5	7
May 1	4 0	34	7	9
May 1	5 0	24	9	8
May 1	6 3	22	9	9

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

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Date	Precipitation (mm)	Air Temperature (°C)		Water Temperature
	_	Maximum	Minimum	(°C)
May 17	10	14	8	9
May 18	0	24	7	10.5
May 19	0	25	11	12
May 20	4	20	12	12.5
May 21	9	22	12	12
May 22	4	17	7	12
May 23	0	20	9	12
May 24	0	27	5	12
May 25	0	32	7	13
May 26	0	30	7	13
May 27	0	32	7	14
May 28	0	32	8	14
May 29	0	27	12	14
May 30	1	15	13	14
May 31	1	24	9.5	14
June 01	12	29	11	14
June 02	8	19	9	14
June 03	0	25	9	14
June 04	3	25	10	14
June 05	0	30	11	14
June 06	0	33	9	14
June 07	1	14	11	7
June 08	1	28	11.5	14
June 09	2	20	8	14
June 10	-	-	-	-
June 11	0	21	10	14
June 12	0	28	11	15
June 13	0	28	12	15
June 14	0	26	8	14
June 15	4	29	8	14.5
June 16	2	17	12	14

Table 1. (cont'd.)

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Date	Precipitation (mm)	Air Tem ('	perature °C)	Water Temperature
		Maximum	Minimum	(°C)
June 17	_	-	-	-
June 18	10	15	11	13.5
June 19	18	14	11	12
June 20	6	19	11	-
June 21	0	23	4	13
June 22	38	22	11	-
June 23	24	19	8	12
June 24	2	23	10	13
June 25	0	26	9	-
June 26	8	21	9	13
June 27	0	22	5	12
<u>June 28</u>	8	27	9	13

Table 1. (cont'd.)

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

	Coh	o Smolts	ot	Other Species					
Year	Total	Coded Wire Tagged and Released	Rainbow Trout	Dolly Varden Char	Cut. trout				
1987	1,909	1,790	5	13	97				
1988 ^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.

Date	Cod Le	ed Wire ngth Cat	Tagged Co egory (mm	oho 1)	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. Summary of daily enumeration of coho at Lachmach River, spring 1993.

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Date	Cod Le	ed Wire ngth Cat	Tagged Co egory (mn	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
Мау 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
June 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 3. (cont'd.)

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Table 4. Summary of coded wire tagged coho by code, tagged at the Lachmach River fence, spring 1993.

Code	Date	Length Range (mm)	Total	Tag Retention	Tags at Large
08/01/29	Apr 25 - June 11	50-74	631	0.981 (417)	619
08/01/53	3 Apr 25 - 75-85 2121 May 18		0.970 (516)	2057	
08/01/51	May 18 - June 11	75-85	460	1.000 (226)	460
08/01/25	Apr 25 - May 22	86-114	10,248	.978 (1368)	10,023
08/01/52	May 22 - June 11	86-114	360	1.000 (229)	360
08/01/27	Apr 25 - June 11	115 - 170	573	.918 (326)	526
TOTALS			14,393		14,045

() denotes number used in estimating tag retention.

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	

scale	sampl	ed at the	Lachma	is and we	r fence, spring	g 1993.	Smolts
Age	Age N Fork Length (mm) Weight (g)						
		Range	Mean	SD	Range	Mean	SD

13.1

12.8

8.66

1.0

2.0

3.0

222

303

14

52-111

69-161

101-130

77

104

114

d woights by ago Trable for ocho amalta

Table 7	7.	Age	composition	of	coho	smolt	population	of	Lachmach	River,
spring	199	3.								

1.20-12.80

2.80-75.00

9.40-20.20

2.20

5.36

3.25

4.6

10.3

13.1

Range	Coho	Age	1.0		Age	2.0	Age	2.0
(mm)	N	þ	₿(N)		þ	р́(N)	þ	\$(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		1,239 (43%)	_		1,578 (55%)		48 (2%)

Table 8. Summary of fin clipped coho smolts captured at the Lachmach River fence, spring 1993.

⁽⁾ denote totals for the years 1989 to 1993.

Mark Type	Release Site	Release Dates and Number	Recaptures
Left Maxillary	Fence	June-July 89 109 (109)	12 " (19)
Right Ventral/ Left Maxillary	500 m ^b	June-Sept 89 136 Aug 90 27 June-Oct 91 197 (360)	0 (73)
Left Ventral/ Right Maxillary	2000 m	June-Aug 89 224 Aug 90 63 June-Oct 91 263 (550)	0 (36)
Left Ventral/ Left Maxillary	2600 m	Sept 89 322 Aug 90 42 July-Oct 91 341 (705)	1 (32)
Left Ventral	3820 m 3390 m	Sept 89 696 June-Oct 91 199 Aug 90 400 July-Oct 91 310 (1605)	2 (198)
Right Ventral/ Right Maxillary	4500 m	Sept 89 356 Aug 90 200 June-Oct 91 264 (820)	0 (98)
Right Ventral	5000 m	Aug 89 897 Aug 90 19 June-Oct 91 709 (1625)	8 (463)
Right Maxillary	7000 m	Sept 89 286 Aug 90 114 June-Oct 91 222 (622)	17 (74)
Right Ventral/ Left Ventral ^c			0 (3)

 There have been no LM clips applied since 1989. These marks have been misidentified.

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^b - Numbers indicate distance in meters upstream from fence.

^c - There were no RVLV marks officially applied. These fish were incorrectly marked.

Site	Mark	Habitat Type	<pre># survive/ # marked</pre>	Survival 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 m/3820 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 9. Survival of fin clips to the Lachmach River fence, 1990 - 1993

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

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	Brand ty	vpe		Date	Len	Wt	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
тт	?	?	?	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
\mathbf{TT}	?	?	dorsal	May 11	101	9.2	2.0
TT	?	?	dorsal	May 11	95	7.7	2.0
\mathbf{TT}	?	?	dorsal	May 12	107	9.9	2.0
ТT	?	?	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
ТТ	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.)

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Table	10.	(cont'd.)

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	Brand ty	pe		Date	Len	Wt	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
тт	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

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Table 10. (cont'd.)

<u> </u>	Brand ty	/pe		Dat	te	Len	Wt	Age
Brand	l Orientation	Side	Place			mm	g	
TT	up	left	dorsal	May	13	116	12.6	2.0
TT	up	left	dorsal	Мау	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	?	?	Мау	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	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	down fwd down	left	dorsal	May	13	107	10.4	2.0
TVT	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	?	?	?	Мау	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	-

-	2	1	-
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	Brand ty	ype		Date	Len	Wt	Age
Brand	Orientation	Side	Place		mm	g	
U	down	left	dorsal	May 1	3 82	4.8	2.0
U	down	left	gill	Apr 2	2 78	5.0	-
U	down	left	gill	Apr 2	5 84	5.9	-
U	down	left	gill	Apr 2	5 85	5.4	-
U	down	left	gill	Apr 2	6 83	4.9	-
U	down	left	gill	Apr 2	8 90	6.7	-
U	down	left	gill	May	4 85	5.8	-
U	down	left	gill	May 1	3 82	5.9	2.0
U	down	left	gill	May 1	4 97	8.3	2.0
U	down	left	gill	May 1	5 92	6.5	2.0
U	down	left	gill	May 1	5 103	9.6	2.0
U	down	right	gill	Apr 2	5 107	10.5	-
U	up	?	?	May 1	4 101	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 1	3 83	4.5	1.0
U	up	right	gill	May 1	4 98	9.3	2.0
UVT	up up down	left	dorsal	May 1	5 108	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 1	4 111	11.9	2.0
v	down	?	?	May 1	7 108	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.)

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	Brand ty	ype		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 10. (cont'd.)

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

F = smolt fenceR = rotary trap

Date	Release #1		_		Releas	e #2			
	86-114	1 mm	75-8	75-85 mm 86-114 mm			11!	115 +	
	F	R	F	R	F	R	F	R	
May 13	releas	e date					_		
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			release	date			
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	
<u>Ma</u> y 29	0	0	0	0	3	0	0	0	
Subtotal	65	7	29	2	38	4	1	2	
Total	72				76				

Year	n	<pre>% recovered at fence</pre>
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 12. Summary of fence efficiency tests performed at the Lachmach River fence, 1989 - 1993

Table 13. Comparison of fence sample with entire run.

Length Range (mm)	Entire Run (%)	Fence Sample (%)
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	F	otary Tra	p	1	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		

Date	Nur	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	4088 61%	2656 39%	6744					

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

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Date Rainbow Trout		Ste	elhead rout	Cutt. Trout	Dolly Varden Char	Prickly Sculpin	Coast. Sculpin
		Up	Down		Char		
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

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

Date	Rainbow Trout	Rainbow Stee Trout <u>Tr</u>		Cutt. Trout	Dolly Varden	Prickly Sculpin	Coast. Sculpin
		Up	Down		Char		
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

Table 16. (cont'd.)

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

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	Male				Female	
Date	Length	Tag Number	Da	te	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	Мау	75	810	339
May 11	730	912	Мау	76	760	341
May 24	835	594	Мау	76	815	343
			Мау	79	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
N Mear S.D.	h Length	6 794 72.5		N Me S.	an Length D.	17 768 56.6

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

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		Male			Female					
Dat	ce	Length	Old Tag	New Tag	 Dat	te	L	ength	Old Tag	New Tag
May	17	730	912		May	12		745		913
May	24	815		596	May	12				914
Мау	25	792		579	May	14		775		923
May	26	775		584	May	19		822	335	
Мау	28	735		587	May	19		788		949
					May	19		682		948
					May	19		665		947
					May	19		555		946
					May	22		698		945
					May	23		600		598
					May	24		649		595
					May	25		805		580
					May	25		760		581
					May	25		728		583
					May	28		705		588
					May	28		735		589
					May	28		755	925	
					May	28		798		669
					 May	28		700		668
	N Mean S.D.	Length	5 769 32.7				N Mean S.D.	Length	18 720 69.7	

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

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Date	Rainbow Trout		rout	Cutthroat Trout		Dolly	Dolly Varden C		
	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	о			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	o			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 19. Weekly summary of lengths of other salmonids from Lachmach River fence, spring 1993.

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	ο			1	22.5	-
Total	913	19.1	13.2	7	13.9	6.48	584	22.9	23.5

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

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

Date	Pr	ickly Scul	pin	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.

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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.

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

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

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

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