ANNUAL PROGRESS REPORT

FISH RESEARCH PROJECT
OREGON

PROJECT TITLE: Evaluation of the Effects of Elk Creek Dam on Migratory Salmonids

PROJECT PERIOD: 1 October 1995 to 30 September 1996

Prepared by: T.D. Satterthwaite
B.L. Bellerud
R.R. Leffler

Oregon Department of Fish and Wildlife
2501 S.W. First Avenue
P.O. Box 59
Portland, Oregon 97207

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SUMMARY

Objectives for 1996

Project objectives were to: (1) transport juvenile and adult salmonids around Elk Creek Dam, (2) determine the proportion of wild adult anadromous salmonids that returned to Elk Creek, (3) determine the amount of spawning habitat for coho salmon in large tributaries of Elk Creek, and (4) determine the length of coho salmon fry at time of emergence.

Accomplishments in 1996

All objectives were accomplished.

Findings in 1996

Trap catches of mature salmonids at the collection facility in the 1995-96 return year totaled 349 wild and 70 hatchery coho salmon (*Oncorhynchus kisutch*), 292 wild and 18 hatchery steelhead (*O. mykiss*), 77 unmarked and 5 marked chinook salmon (*O. tshawytscha*), and 68 wild cutthroat trout (*O. clarki*). Four adult salmonids died either in the trap or prior to release above Elk Creek Dam. Five adult salmonids were trapped twice because they moved downstream after transport. Trap catches of wild juvenile salmonids included 1 chinook salmon, 2 coho salmon, 308 steelhead, and 14 cutthroat trout. We also trapped and transported 189 adult Klamath smallscale suckers (*Catostomus rimiculus*).

Trap catches of wild salmonids in the 1995-96 return year represented 10.4% of the wild coho salmon and 2.3% of the wild steelhead that passed the counting station at Gold Ray Dam. This finding suggested that steelhead production remains depressed because the Elk Creek Basin accounts for 9.5% of the area accessible to anadromous salmonids that pass Gold Ray Dam.

We developed criteria to identify spawning sites that could be used by coho salmon. Measurements taken at four redd sites suggested the criteria were appropriate. Subsequent surveys indicated there were a minimum of 83 potential spawning sites in each of four tributaries of Elk Creek. These findings indicated that the lack of production of juvenile coho salmon in two of the tributaries during 1995 could not be explained by a lack of spawning habitat. Data also indicated that a minimum of 30% of the spawning sites in each tributary could be surveyed on an annual basis.

Based on measurements of 308 coho salmon fry at Cole M. Rivers Hatchery, we concluded that the small salmon fry caught in streams during 1995 were steelhead fry or cutthroat trout fry, as was previously assumed in the analyses of fry production rates in streams of the Elk Creek and Trail Creek basins.

Recommendations

Spawning surveys should be conducted annually in 1-2 km areas of four tributaries of Elk Creek to determine if coho salmon transported upstream of Elk Creek Dam spawn in widely distributed areas of the basin.

INTRODUCTION

Elk Creek enters the Rogue River at River Kilometer (RK) 244. Elk Creek Dam is located 2.7 km upstream from the creek mouth (Figure 1). The basin covers about 351 sq km, of which 343 sq km are upstream of Elk Creek Dam. Mean monthly flow is less than 10 cubic feet per second (cfs) in late summer and is 400-600 cfs in winter (Moffatt et al. 1990). Mean monthly flow in winter peaks between 1,000 and 1,800 cfs (Moffatt et al. 1990).

Coho salmon, steelhead, spring chinook salmon, fall chinook salmon, and cutthroat trout spawn in the Elk Creek Basin. Coho salmon and steelhead in southern Oregon and northern California have been proposed by the National Marine Fisheries Service as "threatened" under the Endangered Species Act. Small numbers of spring chinook salmon and fall chinook salmon spawn in Elk Creek when flow increases enough in autumn to permit upstream migration. Adult cutthroat trout also migrate into Elk Creek, although these fish do not appear to be anadromous.

Elk Creek Dam is one of three dams authorized by the United States Congress and constructed by the United States Army Corps of Engineers (USACE) in the Rogue River Basin of southwestern Oregon. The other dams, Lost Creek and Applegate, are fully operational. A court order halted construction of Elk Creek Dam in 1987 after dam height reached 83 feet.

Blockage of spawning areas used by anadromous fish in the Elk Creek Basin was to be mitigated by the production of coho salmon and steelhead at Cole M. Rivers Hatchery. Mitigation was to begin when the dam was fully constructed. During construction of the dam, the USACE built a diversion tunnel through the dam that was designed to pass juvenile and adult salmonids.

Spawning surveys and trap catches of juveniles suggested that few adult coho salmon or steelhead passed the dam during the 1991-92 run year even though staff with the Oregon Department of Fish and Wildlife (ODFW) observed hundreds of adult salmonids in the pool immediately downstream of the dam. These observations increased concern that adult salmonids were unable to pass Elk Creek Dam.

In response to that concern, a trap-and-haul operation began at Elk Creek Dam in autumn of 1992. Adult salmonids were trapped below the dam and were trucked and released upstream of the dam during the 1992-93 and 1993-94 run years. Trap catches totaled 38 coho salmon and 119 steelhead in 1992-93 and 86 coho salmon and 120 steelhead in 1993-94. Returns in both run years were very low compared with ODFW estimates of historic returns that averaged 1,560 coho salmon, 1,000 summer steelhead, and 2,000 winter steelhead (USACE 1980).

The USACE funded the Elk Creek Dam Fisheries Evaluation Project in spring of 1995. The project goal is to develop strategies to restore the natural production of self-sustaining migratory salmonids to a level appropriate for the habitat available in the Elk Creek Basin. Primary findings from the first year of work indicated that (1) juvenile coho salmon were produced in only two of four large tributaries of Elk Creek and (2) production rates of subyearling trout (steelhead and cutthroat trout) were fourfold greater in large tributaries of Trail Creek as compared to large tributaries of Elk Creek (Satterthwaite et al. 1996).

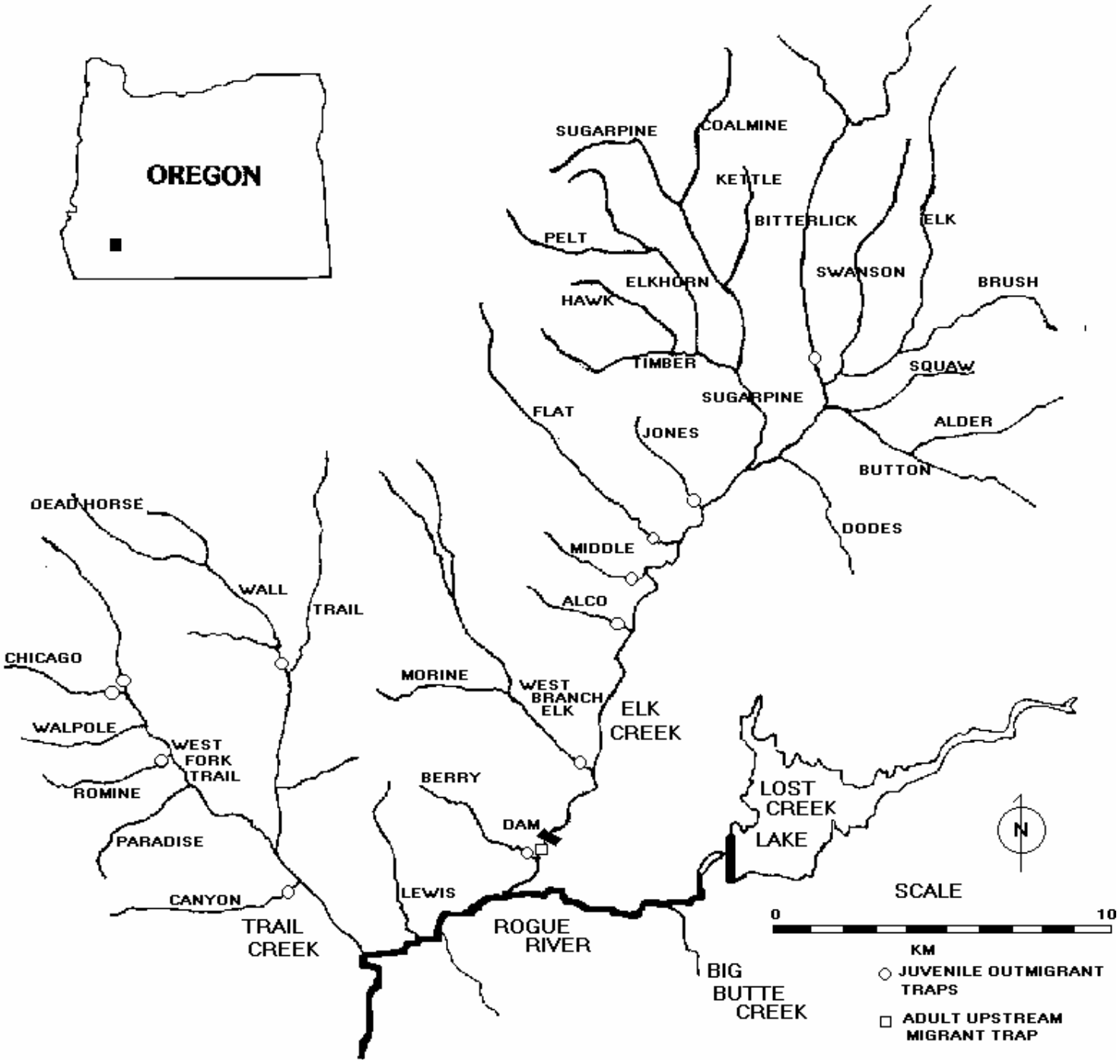

Figure 1. Map of the Elk Creek Basin.

In autumn of 1995, the USACE announced plans to remove a portion of, or all of, the spillway of Elk Creek Dam to provide unobstructed passage for juvenile and adult salmonids. As a consequence of this decision, ODFW reduced the scope of the Elk Creek Dam Fisheries Evaluation Project. Revised project objectives for 1996 were to: (1) transport juvenile and adult salmonids around Elk Creek Dam, (2) for wild coho salmon and wild steelhead that passed Gold Ray Dam, determine the proportion that returned to Elk Creek, (3) determine the amount of spawning habitat for coho salmon in large tributaries of Elk Creek, and (4) determine the length of coho salmon fry at time of emergence.

METHODS

Analytical procedures followed those described by Zar (1984). We selected $P \leq 0.05$ as the criterion for statistical significance.

Collection and Transport of Salmonids

We operated the fish collection facility in Elk Creek from 11 October 1995 through 14 May 1996. The trap was checked a minimum of once daily. We recorded the species, sex, fork length to the nearest 0.5 cm, and looked for marks or tags on each fish. Fish longer than 30 cm received left and right opercle punches. We obtained scale samples from steelhead and cutthroat trout. About 20 scales were taken immediately above the lateral line and immediately posterior to the dorsal fin. We transported and released fish in Elk Creek about 1 km upstream from the dam.

We checked the diversion weir daily for carcasses and recorded data as for trapped fish. The weir operated continuously during the season. On some days when no adult fish entered the trap, we opened sections of the weir to permit steelhead and cutthroat trout to migrate downstream after spawning.

Proportion of Fish that Returned to Elk Creek

We estimated the Elk Creek contribution to runs of wild adult coho salmon and steelhead in the upper portion of the Rogue River by dividing the number of fish trapped in Elk Creek by the number of counterparts that passed the fish counting station at Gold Ray Dam on the Rogue River at RK 204. We assumed that catches in the trap below Elk Creek Dam reflected the number of fish that attempted to return and spawn in the Elk Creek Basin.

We obtained estimates of the number of wild adult coho salmon and wild adult steelhead that passed Gold Ray Dam from Michael Evenson, ODFW, Central Point. We assumed no difference in identification rates of fin clips on salmonids trapped in Elk Creek or counted at Gold Ray Dam. We assumed that all coho salmon and steelhead of hatchery origin were all marked. This assumption seemed reasonable because adult fish of hatchery origin should have all been marked with fin clips while reared as juvenile fish at Cole M. Rivers Hatchery. We did not attempt to estimate the proportion of wild chinook salmon that returned to Elk Creek because less than 10% of the juvenile spring chinook salmon released from Cole M. Rivers Hatchery in 1990-94 were marked with fin clips.

Spawning Habitat for Coho Salmon

We surveyed four large tributaries of Elk Creek to estimate the number of sites that could be used for spawning by coho salmon. Tributaries surveyed included West Branch, Flat Creek, Sugarpine Creek, and Bitterlick Creek (Figure 1). We surveyed only those areas that were upstream of juvenile fish traps operated in 1995.

Two surveyors independently counted potential spawning sites within each stream. Criteria used to identify potential spawning sites were developed from data reported by Gribanov (1962), Burner (1951), Briggs (1953), Smith (1973), and Reiser and Bjornn 1979) and are listed in Table 1.

We evaluated the propriety of selection criteria by measuring some parameters of redds excavated by spawning coho salmon. We measured redd length as the distance, to the nearest 0.1 m, between the upstream edge and the downstream edge of the gravel mound produced by spawning females. We measured the maximum width of redds to the nearest 0.1 m and estimated the area of redds by multiplying the length and the width. We estimated sill depth by averaging the depth of water (measured to the nearest 1 cm) on both sides of the redd. We measured water velocity with an electronic current meter by placing the sensor in the middle of the water column at the upstream edge of redds. We estimated mean size of the substrate as the mean diameter (measured to the nearest 0.1 cm) of all rocks that touched a 1 m rod placed on the side of the redd closest to the middle of the stream.

Length of Coho Salmon Fry

We measured the fork length, to the nearest 0.1 cm, of coho salmon fry at the “button up” stage of development that were incubated at Cole M. Rivers Hatchery. We chose to measure fry at this stage of development because we observed very few exposed yolk sacs on salmonid fry captured in streams during 1995. Fry were obtained from two incubation trays and those that had not reached the appropriate stage of development were not measured.

Table 1. Criteria used to identify potential spawning sites of coho salmon in four tributaries of Elk Creek in 1996.

Redd parameter	Minimum	Maximum
Width (m)	1.0	1.4
Length (m)	1.1	2.0
Area (m2)	1.0	3.0
Sill depth (m)	0.1	1.0
Mean substrate size (cm)	2	10
Water velocity (m/sec)	0.1	1.0

RESULTS AND DISCUSSION

Collection and Transport of Salmonids

Trap catches of mature salmonids at the collection facility in the 1995-96 return year totaled 349 wild and 70 hatchery coho salmon, 292 wild and 18 hatchery steelhead, 77 unmarked and 5 marked chinook salmon, and 68 wild cutthroat trout. Three wild coho salmon and one wild steelhead died either in the trap or prior to release above Elk Creek Dam. Trap catches of mature salmonids are summarized in Tables 2 and 3. We also trapped and transported 189 adult Klamath smallscale suckers.

Table 2. Number of mature coho salmon, steelhead, and cutthroat trapped at the fish collection facility on Elk Creek, 1995-96 return year. Coho salmon jacks were smaller than 50 cm and half-pounders were smaller than 41 cm. All cutthroat trout were longer than 30 cm and none exhibited hatchery marks. Data does not include fish transported multiple times.

Week of capture	Coho salmon				Steelhead				Cutthroat trout
	Jacks		Adults		Half-pounders		Adults		
	Wild	Hatchery	Wild	Hatchery	Wild	Hatchery	Wild	Hatchery	
11/05-11/11	0	0	0	0	0	1	0	0	0
11/12-11/18	1	0	15	0	0	0	2	0	7
11/19-11/25	0	0	10	0	0	0	0	0	0
11/26-12/02	9	6	240	17	4	0	98	1	29
12/03-12/09	2	3	37	11	2	0	39	2	8
12/10-12/16	1	0	12	7	1	0	6	2	16
12/17-12/23	0	0	8	14	1	0	3	0	0
12/24-12/31	0	0	8	6	0	0	3	1	0
01/01-01/07	0	0	1	3	0	0	4	2	0
01/08-01/14	0	0	4	2	0	0	6	1	0
01/15-01/21	0	0	1	1	0	0	5	0	1
01/22-01/28	0	0	0	0	0	0	3	0	0
01/29-02/04	0	0	0	0	0	0	4	1	0
02/05-02/11	0	0	0	0	0	0	17	3	1
02/12-02/18	0	0	0	0	1	0	6	0	1
02/19-02/25	0	0	0	0	0	0	4	0	0
02/26-03/04	0	0	0	0	0	0	5	1	0
03/05-03/11	0	0	0	0	0	0	15	0	0
03/12-03/18	0	0	0	0	0	0	14	0	0
03/19-03/25	0	0	0	0	0	0	10	0	0
03/26-04/01	0	0	0	0	0	0	6	1	0
04/02-04/08	0	0	0	0	0	0	20	0	3
04/09-04/15	0	0	0	0	0	0	4	0	1
04/16-04/22	0	0	0	0	0	0	2	1	0
04/23-04/29	0	0	0	0	0	0	7	0	1
04/30-05/06	0	0	0	0	0	0	0	0	0
05/07-05/13	0	0	0	0	0	0	0	1	0
Annual total	13	9	336	61	9	1	283	17	68

We observed six mature chinook salmon spawning upstream of the weir. These fish passed upstream prior to installation of the weir on 11 October. None were recovered as spawned carcasses.

Table 3. Number of mature chinook salmon trapped at the fish collection facility on Elk Creek, 1995-96 return year. Jacks were smaller than 60 cm. Data does not include fish transported multiple times.

Week of capture	Jacks		Adults	
	Marked	Unmarked	Marked	Unmarked
10/08-10/14	0	2	0	5
10/15-10/21	0	5	1	8
10/22-10/28	0	6	0	14
10/29-11/04	0	3	0	9
11/05-11/11	0	2	0	6
11/12-11/18	2	1	0	7
11/19-11/25	0	1	0	3
11/26-12/02	0	0	1	4
12/03-12/09	0	0	1	1
Annual total	2	20	3	57

We did not observe any immediate mortality among adult salmonids transported upstream of Elk Creek Dam. However, some transported fish migrated downstream through the dam and over the weir prior to spawning. We trapped five wild adult fish (one coho salmon and four steelhead) that had been previously transported upstream of the dam. This finding suggested that some adult fish may be stressed by factors associated with trap, transport, and handling of the fish while sampling to obtain life history information. The number of transported fish that migrated downstream prior to spawning and failed to return to the trap is not known.

We recovered nine carcasses of coho salmon that washed downstream onto the weir. The only female in the group appeared to have completely spawned. We also recovered four steelhead carcasses from the upstream side of the weir. Two were females that appeared to have completely spawned. All carcasses, except one steelhead, exhibited opercle punches that indicated these fish had been trapped and transported upstream of Elk Creek Dam.

Trap catches of wild juvenile salmonids in the collection facility included 1 chinook salmon, 2 coho salmon, 308 steelhead, and 14 cutthroat trout. We concluded that all were wild fish because the salmon were small as compared to counterparts released from Cole M. Rivers Hatchery and because none of the trout exhibited fin clips or eroded dorsal fins.

Juvenile salmonids were captured from October through April with peak catches in November (Table 4). A large proportion of cutthroat trout were 23-30 cm long (Table 5) and many may have matured in the spring of 1996. Lengths of juvenile steelhead ranged between 15 cm and 25 cm (Table 5) and averaged 17.0 cm (95% CI = $\pm$ 0.5 cm). Six juvenile steelhead died in the trap or during transport upstream of Elk Creek Dam.

Table 4. Number of juvenile salmonids trapped at the fish collection facility on Elk Creek, 1995-96

Month of capture	Coho salmon	Steelhead	Cutthroat trout	Chinook salmon
October	0	35	2	0
November	1	71	4	1
December	1	182	8	0
January	0	9	0	0
February	0	4	0	0
March	0	3	0	0
April	0	4	0	0
Annual total	2	308	14	1

Table 5. Length-frequency distribution of juvenile salmonids trapped at the collection facility downstream of Elk Creek Dam in 1995-96. All were judged to be wild fish.

	Mid-point for interval of fork length (cm)											
Species	8	10	12	14	16	18	20	22	24	26	28	30
Chinook salmon	1	0	0	0	0	0	0	0	0	0	0	0
Coho salmon	1	1	0	0	0	0	0	0	0	0	0	0
Steelhead	0	10	49	46	47	52	56	32	7	2	6	1
Cutthroat trout	0	0	0	0	0	3	0	1	4	2	2	2

Proportion of Fish that Returned to Elk Creek

Returns of wild adult coho salmon to the collection facility on Elk Creek accounted for 10.4% of the wild adult coho salmon that passed the fish counting station at Gold Ray Dam in 1995-96 (Table 6). Returns of wild adult steelhead to the collection facility on Elk Creek accounted for 2.3% of the wild adult steelhead that passed Gold Ray Dam in 1995-96 (Table 6).

In comparison to steelhead, greater proportions of coho salmon have returned to Elk Creek in each of the four years that fish have been transported upstream of Elk Creek Dam. We estimate that returns to Elk Creek annually accounted for 7.1-10.4% of the wild coho salmon that passed Gold Ray Dam (Table 6). In contrast, only 1.3-2.3% of the wild steelhead that annually passed Gold Ray Dam returned to Elk Creek (Table 6).

The area upstream of Elk Creek Dam accounts for about 9.5% of the area accessible to anadromous salmonids that pass Gold Ray Dam. We believe that the basin should produce at least a comparable percentage of coho salmon and

steelhead because both species spawn in tributaries rather than in the Rogue River (Rivers 1964, Everest 1973). Historic passage problems at Elk Creek Dam may be responsible for the low returns of adult steelhead in recent years. In 1995, we found that production rates (fish/km) of subyearling trout (includes steelhead and cutthroat trout) were significantly lower in large streams of the Elk Creek Basin as compared to production rates of subyearling trout in large streams of a nearby basin (Satterthwaite et al. 1996).

Table 6. Returns of wild adult anadromous salmonids to Elk Creek as compared to those that passed Gold Ray Dam, 1992-93 through 1995-96. Steelhead less than 41 cm (half-pounders) are not included. Passage estimates at Gold Ray Dam were received from Michael Evenson, ODFW, Central Point.

Return year	Coho salmon			Steelhead		
	Elk Creek	Gold Ray Dam	% return	Elk Creek	Gold Ray Dam	% return
1992-93	40	--	--	112	5,541	2.0
1993-94	76	756	10.1	105	8,022	1.3
1994-95	232	3,265	7.1	201	12,515	1.6
1995-96	349	3,345	10.4	283	12,344	2.3

Spawning Habitat for Coho Salmon

We located only four redds excavated by coho salmon. An unusually large freshet in the middle of December may have made it difficult to observe redds excavated prior to the freshet. Measurements of redd parameters (Table 7) suggested that the criteria developed to identify potential spawning sites were appropriate for use in tributaries of Elk Creek. None of the measurements for coho salmon redds found in the Elk Creek Basin were outside of the boundaries of the selection criteria listed in Table 1. Although four redds constitute a very small sample, we decided that the selection criteria could be used to identify potential spawning sites for coho salmon in tributaries of Elk Creek.

Table 7. Characteristics of four spawning sites of coho salmon found in tributaries of Elk Creek during 1995-96.

Redd parameter	Mean	Minimum	Maximum
Width (m)	1.1	0.9	1.4
Length (m)	1.7	0.9	2.6
Area (m2)	2.0	0.9	3.6
Sill depth (m)	0.5	0.2	0.9
Mean substrate size (cm)	2.6	2.0	3.4
Water velocity (m/sec)	0.3	0.1	0.4

Surveyors found potential spawning sites for coho salmon in each tributary of Elk Creek. Estimates of the number of potential spawning sites

in the tributaries ranged between 83 and 126 (Table 8). Estimates of the number of potential spawning sites varied between the two surveyors by 6% for West Branch, 22% for Flat Creek, 8% for Sugarpine Creek, and 2% for Bitterlick Creek. Based on these findings, we concluded that the lack of production of juvenile coho salmon in Flat Creek and Bitterlick Creek in 1995 (Satterthwaite et al. 1996) could not be explained by a lack of spawning habitat for adult coho salmon.

Potential spawning sites for coho salmon were clustered rather than randomly distributed (Table 8). We selected those areas with the greatest densities of spawning sites as priority areas to survey coho salmon that will spawn in 1996-97. Chosen areas include RK 3.0-4.6 in West Branch, RK 0.8-2.4 in Flat Creek, RK 4.6-6.0 in Sugarpine Creek, and RK 0.6-1.4 in Bitterlick Creek. From data in Table 8, we estimated that the spawning survey areas will cover 34-36% of the spawning sites in West Branch, 46-64% of the spawning sites in Flat Creek, 30-40% of the spawning sites in Sugarpine Creek, and 34-39% of the spawning sites in Bitterlick Creek. We believe that these areas are sufficiently large enough to determine if adult coho salmon transported upstream of Elk Creek Dam are spawning in widely distributed areas of the Elk Creek Basin.

Length of Coho Salmon Fry

Fork lengths of coho salmon fry at Cole M. Rivers Hatchery ranged between 2.9 cm and 3.6 cm among the 308 fish measured while at the “button up” stage of development (Table 9). We found that 18% of the fry were smaller than 3.2 cm and that their mean length was 3.3 cm (95% confidence interval = ± 0.1 cm). We also observed that almost all fry exhibited a dark band along the posterior edge of the anal fin, a preliminary characteristic that we used in 1995 to differentiate coho salmon fry and trout fry.

In 1995, we trapped fish in 12 streams and classified fry smaller than 3.2 cm as “unknown” salmonids because we were unsure as to whether they were coho salmon or trout. Mean lengths of fish classified as unknown salmonids were usually less than 3.0 cm with 95% confidence intervals of ± 0.1 cm. In contrast, the smallest mean length of the first coho salmon fry caught in streams was 3.5 cm. Lengths of newly emergent coho salmon fry also averaged about 3.5 cm in Carnation Creek, British Columbia (Hartman et al. 1982), but the size of coho salmon fry can vary between different populations (Beacham et al. 1985).

Based on the findings that almost all coho salmon fry at the hatchery exhibited a distinctive visual characteristic and that coho salmon fry at the hatchery were significantly larger than fry classified as unknown salmonids when trapped in 1995, we concluded that the treatment of unknown fry as trout fry was appropriate for the comparisons of fish production rates between streams in the Elk Creek and Trail Creek basins (Satterthwaite et al. 1996).

Table 8. Potential spawning sites of coho salmon in four large tributaries of Elk Creek as enumerated by two samplers in April 1996. Surveys began at sites where juvenile fish were trapped in 1995.

	West Branch		Flat Creek		Sugarpine Creek		Bitterlick Creek	
RK	Sampler 1	Sampler 2	Sampler 1	Sampler 2	Sampler 1	Sampler 2	Sampler 1	Sampler 2
0.0-0.2	--	--	--	--	--	--	2	2
0.2-0.4	--	--	--	--	--	--	0	4
0.4-0.6	1	5	--	--	--	--	0	1
0.6-0.8	5	5	--	--	--	--	7	5
0.8-1.0	0	2	12	13	--	--	12	8
1.0-1.2	4	7	7	16	--	--	12	11
1.2-1.4	9	7	5	10	--	--	2	4
1.4-1.6	5	5	2	1	--	--	0	1
1.6-1.8	0	0	8	6	--	--	0	2
1.8-2.0	2	2	2	4	--	--	0	0
2.0-2.2	7	6	4	7	--	--	0	0
2.2-2.4	0	0	7	13	--	--	0	1
2.4-2.6	5	3	2	1	--	--	4	11
2.6-2.8	2	2	0	3	--	--	1	1
2.8-3.0	0	0	0	0	--	--	5	5
3.0-3.2	9	5	3	3	--	--	4	2
3.2-3.4	5	14	1	0	--	--	1	2
3.4-3.6	7	10	4	2	2	2	5	1
3.6-3.8	4	4	6	6	11	10	14	7
3.8-4.0	6	6	6	7	2	1	11	13
4.0-4.2	1	1	5	6	0	0	2	1
4.2-4.4	8	6	2	0	2	2	0	0
4.4-4.6	2	2	5	3	4	0	1	0
4.6-4.8	3	0	1	0	6	4	1	1
4.8-5.0	6	3	6	4	6	7	1	0
5.0-5.2	13	10	1	1	8	11	0	0
5.2-5.4	4	6	0	1	0	2	--	--
5.4-5.6	0	0	4	3	5	8	--	--
5.6-5.8	0	0	--	--	2	5	--	--
5.8-6.0	6	6	--	--	4	8	--	--
6.0-6.2	2	2	--	--	2	3	--	--
6.2-6.4	0	1	--	--	0	0	--	--
6.4-6.6	0	3	--	--	2	2	--	--
6.6-6.8	0	1	--	--	10	6	--	--
6.8-7.0	2	2	--	--	4	4	--	--
7.0-7.2	--	--	--	--	9	5	--	--
7.2-7.4	--	--	--	--	3	2	--	--
7.4-7.6	--	--	--	--	7	7	--	--
7.6-7.8	--	--	--	--	5	3	--	--
7.8-8.0	--	--	--	--	4	7	--	--
8.0-8.2	--	--	--	--	10	13	--	--
8.2-8.4	--	--	--	--	2	7	--	--
Total	118	126	86	110	110	119	85	83

Table 9. Length-frequency distribution of coho salmon fry measured at the "button up" stage of development among cohorts incubated at Cole M. Rivers Hatchery on 4 April 1996.

Incubation tray	Fork length (cm)							
	2.9	3.0	3.1	3.2	3.3	3.4	3.5	3.6
#381	0	9	22	62	47	35	14	1
#382	1	8	16	36	23	20	14	0
Total	1	17	38	98	70	55	28	1

ACKNOWLEDGMENTS

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