SUMMARY

Objectives for 1999

Project objectives were to: (1) transport migratory salmonids around Elk Creek Dam, (2) determine the proportion of wild adult anadromous salmonids that return to Elk Creek, and (3) determine if transported coho salmon spawn in widely distributed areas upstream of Elk Creek Dam.

Accomplishments in 1999

All objectives were accomplished.

Findings in 1999

Trap catches of mature salmonids in the 1998-99 return year totaled 388 wild and 94 hatchery coho salmon (*Oncorhynchus kisutch*), 362 wild and 10 hatchery steelhead (*O. mykiss*), 17 unmarked and 3 marked chinook salmon (*O. tshawytscha*), and 81 wild cutthroat trout (*O. clarki*). A minimum of two adult salmonids died as a result of trap and transport. Fourteen adult salmonids were trapped twice because they moved downstream after transport upstream of Elk Creek dam. Samplers also transported 253 juvenile salmonids.

Wild adults that returned to Elk Creek in 1998-99 represented 19.4% of the wild coho salmon and 3.8% 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.

Coho salmon fry were observed at all sites near the upstream limits of areas that could be reached by spawners. These findings indicated that at least some of the transported coho salmon spawned in widely distributed areas of the Elk Creek Basin.

Recommendations

Snouts retained from adult coho salmon classified as hatchery fish should be sampled to determine the number of wild fish, if any, killed because a metal detector indicated that a coded wire tag was present.

INTRODUCTION

Elk Creek enters the Rogue River at River Kilometer (RK) 244. Elk Creek Dam is located 2.6 km upstream from the creek mouth. 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. Mean monthly flow in winter peaks between 1,000 and 1,800 cfs.

Coho salmon, steelhead, chinook salmon, and cutthroat trout spawn in the Elk Creek Basin. Coho salmon in southern Oregon and northern California have
been listed as threatened by the National Marine Fisheries Service (NMFS)
under the Endangered Species Act. Although NMFS decided not to list steelhead in the area, that decision is under judicial review. 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. A diversion tunnel through the dam was altered after construction in an attempt to provide upstream passage for 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 Oregon Department of Fish and Wildlife (ODFW) staff observed hundreds of adult salmonids 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 the spring of 1995. The project goal was 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. Findings from the first four years of work were reported by Satterthwaite et al. (1996a),

Satterthwaite et al. (1996b), Satterthwaite and Leffler (1997), and Satterthwaite (1998).

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 1998-99 were to: (1) transport migratory salmonids around Elk Creek Dam, (2) determine the proportion of wild adult anadromous salmonids that return to Elk Creek, and (3) determine if transported coho salmon spawn in widely distributed areas upstream of Elk Creek Dam.

METHODS

Collection and Transport of Salmonids

The fish collection facility operated continuously from 19 October 1998 through 18 May 1999 and was checked a minimum of once daily. Samplers recorded the species, fork length of salmonids to the nearest one cm, and any fin marks or tags. Salmonids longer than 30 cm received left opercle punches. Project staff transported and released all fish, except coho salmon of hatchery origin, in Elk Creek about one km upstream from the dam. Coho salmon of hatchery origin were killed in accordance with the National Marine Fisheries Service handling permit issued to ODFW. Coho salmon were classified as hatchery fish if (1) a fin clip was present, or (2) if a metal detector indicated that a coded-wire tag might have been present.

Proportion of Fish that Returned to Elk Creek

I 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 that returned to Elk Creek by the number of counterparts that passed the fish counting station at Gold Ray Dam on the Rogue River at RK 204. I assumed that trap catches and carcasses of non-transported fish found on the weir reflected the number of fish that attempted to return and spawn in the Elk Creek Basin.

Estimates of the number of wild adult coho salmon and wild adult steelhead that passed Gold Ray Dam were obtained from Michael Evenson, ODFW, Central Point. I assumed that coho salmon and steelhead of hatchery origin were all marked with fin clips. This assumption seemed reasonable because cohorts were all marked before release from Cole M. Rivers Hatchery. The proportion of wild chinook salmon that returned to Elk Creek was not estimated because few juvenile spring chinook salmon released from Cole M. Rivers Hatchery in 1993-97 were marked with fin clips.

Spawning Distribution of Coho Salmon

Upstream limits of coho salmon spawning were estimated from the distribution of subyearling coho salmon. On 11 August, samplers snorkeled the larger streams where fry were found in 1996-98. Surveys began at the upstream limits where coho salmon fry were observed in previous years. Samplers attempted to determine the upstream limits of fry to the nearest 0.1 km and sampled at least 0.2 km upstream of sites that appeared to be the upstream limit of fry distribution. Samplers identified juvenile fish as coho salmon if the distal rays of the anal fin were elongated and if the spaces between the parr marks were wider than the parr marks.

RESULTS AND DISCUSSION

Collection and Transport of Salmonids

Trap catches of adult salmonids at the collection facility in the
1998-99 return year totaled 388 wild and 94 hatchery coho salmon, 362 wild and 10 hatchery steelhead, 17 unmarked and 3 marked chinook salmon, and 81 wild cutthroat trout. Five of the ten steelhead of hatchery origin entered Elk Creek after being trapped at Cole M. Rivers Hatchery and released in the Rogue River downstream of Elk Creek. Trap catches of adult salmonids are summarized in Table 1 and in Table 2.

Table 1. Number of mature coho salmon, steelhead, and cutthroat trout trapped at the fish collection facility on Elk Creek, 1998-99 return year. Coho salmon jacks were less than 50 cm long and half-pounders were less than 41 cm long. All cutthroat trout were longer than 30 cm and none exhibited hatchery marks. Data do not include fish transported multiple times. All fish were released upstream of Elk Creek Dam except that coho salmon of hatchery were killed rather than released.

	Coho salmon				Steelhead		
	Jacks		Adults		Half-pounders		Adults
Week of capture	Wild	Hatchery	Wild	Hatchery	Wild	Cutthroat trout Hatchery	Wild Hatchery[a]
10/22-10/28	0	0	0	1	0	0	0 0 0
10/29-11/04	0	0	0	0	0	0	0 0 0
11/05-11/11	0	2	0	0	0	0	0 0 0

11/12-11/18	9	4	23	5	0	0	0
0	1						
11/19-11/25	21	10	197	19	7	0	62
0	51						
11/26-12/02	2	4	48	12	0	0	43
0	7						
12/03-12/09	0	0	23	10	0	0	6
0	2						
12/10-12/16	0	1	22	11	0	0	3
0	0						
12/17-12/23	0	0	1	1	0	0	0
0	0						
12/24-12/31	0	0	26	7	0	0	8
0	1						
01/01-01/07	0	0	1	3	0	0	0
0	0						
01/08-01/14	0	0	4	0	0	0	1
0	0						
01/15-01/21	0	0	5	2	1	0	11
0	4						
01/22-01/28	0	0	4	1	0	0	12
4	0						
01/29-02/04	0	0	1	1	0	0	2
0	0						
02/05-02/11	0	0	1	0	0	0	8
0	0						
02/12-02/18	0	0	0	0	1	0	19
0	6						
02/19-02/25	0	0	0	0	0	0	27
0	0						
02/26-03/04	0	0	0	0	0	0	35
2	4						
03/05-03/11	0	0	0	0	1	0	8
2	1						
03/12-03/18	0	0	0	0	0	0	15
0	0						
03/19-03/25	0	0	0	0	0	0	36
0	0						
03/26-04/01	0	0	0	0	0	0	15
0	0						
04/02-04/08	0	0	0	0	0	0	13
0	0						
04/09-04/15	0	0	0	0	0	0	8
1	2						
04/16-04/22	0	0	0	0	1	0	10
1	0						
04/23-04/29	0	0	0	0	0	0	4
0	1						
04/30-05/06	0	0	0	0	0	0	3
0	0						
05/07-05/13	0	0	0	0	0	0	2
0	1						
05/14-05/20	0	0	0	0	0	0	0
0	0						

Annual total	32	21[b]	356	73[b]	11	0	351
10	81						

[a] *Includes five fish released downstream in the Rogue River after capture at Cole M. Rivers Hatchery.*

[b] *Includes 20 fish (7 jacks and 13 adults) without fin clips. A metal detector indicated that coded-wire tags may have been present.*

Table 2. Number of mature chinook salmon trapped at the fish collection facility on Elk Creek, 1998-99 return year. Jacks were less than 60 cm long. Data do not include fish transported multiple times.

Week of capture	Jacks		Adults	
	Marked	Unmarked	Marked	Unmarked
10/15-10/21	0	0	1	0
10/22-10/28	0	1	0	1
10/29-11/04	0	1	0	2
11/05-11/11	0	2	0	1
11/12-11/18	0	1	1	5
11/19-11/25	0	0	1	3
Annual total	0	5	3	12

Project staff observed that a minimum of two wild coho salmon died as a result of trap and transport. One fish died, for unknown reasons, in the trap on 23 November. The other fish was a female that died in the trap during late January. An absence of eggs in the body cavity indicated that this fish had spawned before entering the trap.

In addition, some wild coho salmon may have been killed because they were classified as hatchery fish at the time of capture. The metal detector indicated that seven unmarked jacks, and 13 unmarked adults, contained coded wire tags. Trap catches of marked coho salmon totaled 14 jacks and 60 adults. These data suggest that 33% of the jacks, and 18% of the adults, classified as hatchery fish had only coded wire tags. In contrast, fish tagged with coded wires composed only the 12% and 14% of the respective broods at the time of release from Cole M. Rivers Hatchery. Snouts were retained from fish thought to have

coded wire tags so it should be possible to estimate how many wild coho salmon, if any, were killed because the metal detector indicated that they were hatchery fish.

The trap did not capture all of the adult salmonids that returned to Elk Creek. Samplers found, on the upstream side of the weir, one carcass of an adult coho salmon that had not been transported upstream of Elk Creek Dam. Ten other carcasses (Six coho salmon, two steelhead, and two cutthroat trout) were recovered and opercle punches indicated that these fish had been transported upstream of Elk Creek Dam.

Some transported fish migrated downstream through the dam and over the weir prior to spawning. Samplers trapped three adult 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 sampling to obtain life history information. The number of transported fish that migrated downstream and failed to return to the trap before spawning is not known.

Almost all of the fish that passed upstream of the trap appeared to have spawned. Samplers found five carcasses of female salmonids on the weir and judged that one of these fish retained 15% of her eggs.

Trap catches of juvenile salmonids included 250 steelhead and three cutthroat trout. All were of wild origin, except for three steelhead. Almost all of the juvenile salmonids were captured in October and November (Table 3).

Table 3. Number of juvenile salmonids trapped at Elk Creek, 1998-99.

capture	Steelhead	Cutthroat
October	129	0
November	111	3
December	8	0
January	0	0
February	2	0
Total catch	250[a]	3

[a] *Includes three marked fish of hatchery origin.*

Proportion of Fish that Returned to Elk Creek

Returns of wild adult coho salmon to the collection facility on Elk Creek accounted for 19.4% of the wild adult coho salmon that passed the fish counting station at Gold Ray Dam in 1997-98 (Table 4). Returns of wild adult steelhead to the collection facility on Elk Creek accounted for 3.8% of the wild adult steelhead that passed Gold Ray Dam in 1997-98 (Table 4).

Table 4. Returns of wild adult anadromous salmonids to Elk Creek as compared to those that passed Gold Ray Dam, 1992-93 through 1997-98. Steelhead less than 41 cm (half-pounders) are not included. Passage estimates at Gold Ray Dam were received from Michael Evenson, ODFW, Central Point.

	Coho salmon			Steelhead		
Return year	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
1996-97	319	3,516	9.1	493	14,144	3.4
1997-98	982	4,566	21.5	224	5,018	4.4
1998-99	408[a]	2,104[a]	19.4	351	9,232	3.8

[a] *Includes all fish without fin clips. About 13% of the hatchery fish did not have fin chips.*

In comparison to steelhead, greater proportions of coho salmon have returned to Elk Creek in each year of trapping. I estimated that returns to Elk Creek accounted for 7-22% of the wild coho salmon that annually passed Gold Ray Dam (Table 4). In contrast, only 1-4% of the wild steelhead that annually passed Gold Ray Dam returned to Elk Creek (Table 4). Steelhead production in Elk Creek may be on the increase. The percentage of wild fish that returned to Elk Creek in 1998-99 (3.8%) was more than two-fold greater than the percentage return in 1994-95 (1.6%).

The area upstream of Elk Creek Dam accounts for about 9.5% of the area accessible to anadromous salmonids that pass Gold Ray

Dam. I 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). Given that the return to Elk Creek accounted for about 19% of the wild coho salmon that passed Gold Ray Dam in 1997-98, the Elk Creek Basin appears to have the capability of producing a large proportion of the wild migratory salmonids produced in the upper portion of the Rogue River Basin.

I also believe that steelhead production should be greater in the Elk Creek Basin because (1) densities of juveniles were very low in 1995 (Satterthwaite et al. 1996a), (2) annual returns have accounted for less than 5% of the wild adults that passed Gold Ray Dam, and (3) annual returns have never come close to reaching mitigation levels identified in planning documents (USACE 1980). Consequently, I recommend continued sampling to enumerate wild fish in order to monitor the success of fish transportation as a method to restore the natural production of migratory salmonids.

Spawning Distribution of Coho Salmon

Coho salmon spawned in widely distributed areas of the Elk Creek basin during 1996-99. Fry in the West Branch of Elk Creek were distributed farther upstream in 1999 as compared to 1996-98 (Table 5). The upper distribution of fry in the other three streams was intermediate to that observed in earlier years (Table 5). Waterfalls located at RK 3.2 on Flat Creek and at RK 20.9 on Elk Creek appeared to be barriers to adult coho salmon that returned to freshwater in 1998.

Table 5. Upstream limits (RK) of coho salmon fry in five creeks within the the Elk Creek Basin, 1996-99.

Year	West Branch	Flat	Sugarpine	Bitterlick	Elk
1996	3.5	3.2	8.9	4.0	23.0
1997	3.8	4.1	6.6	2.0	20.9
1998	4.1	5.5	9.2	3.1	20.9
1999	4.4	3.2	7.2	4.0	20.9
Mean	4.0	4.0	8.0	3.3	20.9

±95% CI	0.6	1.7	2.0	1.5	1.7

Data from 1996-99 suggested that fry surveys would be an effective method to determine whether adult coho salmon continue to spawn in widely distributed areas of the Elk Creek Basin. With only four years of data, the 95% confidence intervals associated with the means of spawning limits ranged between 0.6 and 2.0 km (Table 5). Assuming no changes in the standard deviations associated with the means, I estimate that the 95% confidence intervals should range between 0.5 and 1.8 km if fry distributions are estimated for a total of five years.

Future changes to methods of fish transportation, or construction to modify or remove a portion of Elk Creek Dam, may result in some type of fisheries evaluation. Baseline data on the spawning distribution of coho salmon in the Elk Creek Basin is a low-cost method of evaluating the effects changed conditions for fish passage. Consequently, I recommend that sampling continue for at least one more year to increase the precision of the estimated mean km of upstream spawning by coho salmon in each stream.

ACKNOWLEDGMENTS

Bryan DeBerry, Ronald Leffler, and Michael Masonheimer assisted with sampling. Ronald Leffler assisted with data entry and data summary.

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