SUMMARY

Objectives for 1998

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 1998

All objectives were accomplished.

Findings in 1998

Trap catches of mature salmonids in the 1997-98 return year totaled 982 wild and 71 hatchery coho salmon (*Oncorhynchus kisutch*), 232 wild and 7 hatchery steelhead (*O. mykiss*), 30 unmarked and 3 marked chinook salmon (*O. tshawytscha*), and 60 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. Samplers also trapped and transported 79 juvenile salmonids and 54 adult Klamath smallscale suckers (*Catostomus rimiculus*).

Wild adults that returned to Elk Creek in 1997-98 represented 21.5% of the wild coho salmon and 4.4% 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.

Samplers observed trout fry in West Branch at two sites downstream of the culvert than spans Elk Creek Road, but observed no trout fry at 12 sites surveyed upstream of the culvert. In contrast, samplers found subyearling coho salmon 3 km upstream of the culvert. These findings suggested that adult steelhead and cutthroat trout did not pass upstream through the culvert in the 1997-98 return year.

Recommendations

1. The proportion of wild adult steelhead and coho salmon that return to Elk Creek should be estimated annually and the upstream

limits of spawning by coho salmon should be estimated with surveys in at least two more years.

2. Areas upstream and downstream of culverts installed in the Elk Creek Dam project area should be surveyed annually for a minimum of three years to determine if migratory adult salmonids pass upstream through the culverts. Appropriate steps should be taken to provide upstream passage or to mitigate for the loss of spawning and rearing habitat if surveys indicate that the culverts act as partial or complete migration barriers.

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 and steelhead in southern Oregon and northern California have been listed as threatened by the National Marine Fisheries Service under the Endangered Species Act and chinook salmon in the same area have been provisionally listed as threatened. 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 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 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 three years of work were reported by Satterthwaite et al. (1996a), Satterthwaite et al. (1996b), and Satterthwaite and Leffler (1997).

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 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

Samplers operated the fish collection facility in Elk Creek from 16 October 1997 through 5 May 1998. The fish trap was checked a minimum of once daily and operated continuously, except for holidays, when adult coho salmon migrated in Elk Creek (27 October through 16 January). During other periods of time, the fish trap operated continuously except between 1000 hours on Saturday and 1500 hours on Sunday.

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.

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.

I 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. 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. I did not estimate the proportion of wild chinook salmon that returned to Elk Creek because few juvenile spring chinook salmon released from Cole M. Rivers Hatchery in 1992-96 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 30 June and 1 July, samplers snorkeled the larger streams where fry were found in 1996 and 1997. 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 1997-98 return year totaled 982 wild and 71 hatchery coho salmon, 232 wild and 7 hatchery steelhead, 30 unmarked and 3 marked chinook salmon, and 60 wild cutthroat trout. One of the seven 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. Samplers also trapped and transported 54 adult Klamath smallscale suckers.

Project staff observed that a minimum of two wild coho salmon died as a result of trap and transport. One fish died while being trapped and the other died immediately after transport. On 31 October and 1 November samplers were forced to move 216 wild coho salmon without appropriate transportation equipment, and

these fish were subjected to greater stress as compared with fish transported on other dates.

Some of the adult salmonids that returned to Elk Creek were not trapped. Samplers found, on the upstream side of the weir, three carcasses of adult salmonids that had not been transported upstream of Elk Creek Dam. Two of the six chinook salmon, none of the 44 coho salmon, and one of the three steelhead, recovered as carcasses on the upstream side of the weir, had not been transported. None of the non-transported fish exhibited fin clips.

Some chinook salmon passed upstream prior to installation of the weir. Project staff observed six chinook salmon spawning in the area between the weir and the stilling basin.

Project staff observed one 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. Samplers trapped 14 adult fish (nine coho salmon and five 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 24 carcasses of female salmonids on the weir and judged that only one of these fish retained more than 10% of her eggs.

Trap catches of juvenile salmonids at the collection facility included one chinook salmon, 77 steelhead, and one cutthroat trout. All were of wild origin, except for two steelhead. Juvenile salmonids were captured from October through March with peak catches in November (Table 3).

Table 1. Number of mature coho salmon, steelhead, and cutthroat trout trapped at the fish collection facility on Elk Creek, 1997-98 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 origin were killed rather than released.

	Coho salmon						Steelhead	
	Jacks		Adults		Half-pounders		Adults	
Week of capture	Wild	Hatchery	Wild	Hatchery	Wild	Hatchery	Cutthroat trout	Wild Hatchery

10/15-10/21	0	0	0	0	0	0	0	0	0
10/22-10/28	0	0	2	0	0	0	0	0	0
10/29-11/04	1	0	293	10	0	0	8	0	3
11/05-11/11	2	0	116	7	0	0	10	0	4
11/12-11/18	4	0	90	11	0	0	0	0	0
11/19-11/25	3	1	197	14	0	0	3	0	2
11/26-12/02	4	0	85	5	0	0	1	0	0
12/03-12/09	0	1	29	3	0	0	0	0	0
12/10-12/16	1	0	13	4	0	0	0	0	0
12/17-12/23	6	2	111	5	2	0	12	0	2
12/24-12/31	0	0	3	0	0	0	0	0	0
01/01-01/07	2	1	13	4	0	0	7	0	0
01/08-01/14	2	0	5	3	1	0	41	0	7
01/15-01/21	0	0	0	0	2	0	20	1	11
01/22-01/28	0	0	0	0	1	0	12	1[a]	12
01/29-02/04	0	0	0	0	0	0	6	0	13
02/05-02/11	0	0	0	0	0	0	0	0	0
02/12-02/18	0	0	0	0	0	0	2	0	0
02/19-02/25	0	0	0	0	0	0	11	0	3
02/26-03/04	0	0	0	0	2	0	3	1	1
03/05-03/11	0	0	0	0	0	0	3	0	1
03/12-03/18	0	0	0	0	0	0	14	1	1
03/19-03/25	0	0	0	0	0	0	13	0	0
03/26-04/01	0	0	0	0	0	0	18	0	0
04/02-04/08	0	0	0	0	0	0	11	2	0

04/09-04/15	0	0	0	0	0	0	4
0	0						
04/16-04/22	0	0	0	0	0	0	17
0	0						
04/23-04/29	0	0	0	0	0	0	8
1	0						
04/30-05/06	0	0	0	0	0	0	0
0	0						
Annual total	25	5	957	66	8	0	224
7	60						

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

Table 2. Number of mature chinook salmon trapped at the fish collection facility on Elk Creek, 1997-98 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	5
10/22-10/28	0	0	1	2
10/29-11/04	0	1	0	10
11/05-11/11	0	5	1	3
11/12-11/18	0	1	0	2
11/19-11/25	0	1	0	0
Annual total	0	8	3	22

Table 3. Number of juvenile salmonids trapped at the fish collection facility on Elk Creek, 1997-98.

Month of capture	Chinook salmon	Steelhead	Cutthroat trout

October	0	7	0
November	1	54	0
December	0	2	0
January	0	13	1
February	0	0	0
March	0	1	0
Annual total	1	77	1

Proportion of Fish that Returned to Elk Creek

Returns of wild adult coho salmon to the collection facility on Elk Creek accounted for 21.5% 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 4.4% of the wild adult steelhead that passed Gold Ray Dam in 1997-98 (Table 4).

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 appears to be on the increase. The percentage of wild fish that returned to Elk Creek in 1997-98 (4.4%) was almost three-fold greater than the percentage return in 1994-95 (1.6%).

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					

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 22% 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 1997-98. Fry in West Branch and in Flat Creek were distributed farther upstream in 1998 as compared to 1996 and 1997 (Table 5). The upper distribution of fry in the other three streams was intermediate to that observed in 1996 and 1997 (Table 5).

Data from 1996-98 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 three years of data, the 95% confidence intervals associated with the means of spawning limits ranged between 0.7 and 3.3 km (Table 5). Assuming no changes in the standard deviations associated with the means, I estimate that the 95% confidence intervals should range between 0.4 and 1.6 km if fry distribution is estimated for a total of five years.

Table 5. Upstream limits (RK) of coho salmon fry in five creeks within the Elk Creek Basin, 1996-98. Electrofishing gear was used to sample in 1996-97 and snorkel gear was used to sample in 1998.

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	6.6	3.1	20.9
Mean	3.8	4.3	7.4	3.0	21.6
±95% CI	0.7	2.9	3.3	2.5	1.2

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 two more years to increase the precision of the estimated mean km of upstream spawning by coho salmon in each stream.

While surveying coho salmon fry, samplers noted that subyearling trout were absent in West Branch upstream of the culvert that spans Elk Creek Road at RK 1.2. Samplers snorkeled 12 areas between RK 3.6 and RK 5.1 without observing subyearling trout. Samplers also surveyed two areas at RK 0.7 and RK 1.1 and observed subyearling trout in each area.

The lack of subyearling trout in the area upstream of the culvert indicates that few, if any, steelhead or cutthroat trout passed through the culvert to spawn in upstream areas during the 1997-98 return year. In contrast, results from electrofishing surveys completed in 1995 suggested that migratory trout spawned as far upstream as RK 4.4 in West Branch (Satterthwaite et al. 1996a).

The presence of juvenile coho salmon, coupled with the absence of subyearling trout, suggests that the culvert on West Branch may periodically block the upstream passage of adult salmonids. Consequently, I recommend that areas upstream and downstream of culverts be surveyed annually for a minimum of three years to determine if migratory adult salmonids pass

through the culverts to spawn in upstream areas. Appropriate steps should be taken to provide upstream passage or to mitigate for the loss of spawning and rearing habitat if surveys indicate that the culverts act as partial or complete migration barriers.

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