

Fish Habitat Restoration in Tenmile Creek  
Life-cycle Monitoring Project Summary Report

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## INTRODUCTION

Over the last 30 years, the general use of stream habitat “improvement” or “restoration” techniques by land and fisheries agencies have become common and are now an accepted management technique in the Pacific Northwest (Hall and Baker 1982; Reeves and Roelofs 1982). Various types of habitat restoration techniques aimed at increasing rearing density of salmonids have been tried in Oregon coastal streams. These techniques have included placing wood and boulders of various types and configurations into small coastal streams, or excavating off-channel alcoves (Nickelson et al. 1992b). Recently, restoration activities have also included reestablishing conifer in hardwood dominated riparian areas and stabilizing upslope areas to decrease sediment loads into coastal streams. Unfortunately, there are few long-term intensive studies to determine how these restoration activities influence salmonid production in Pacific Northwest streams. The Tenmile Watershed Restoration Study was initiated in 1991 to examine the effects of watershed restoration activities in Tenmile Creek (including the addition of large wood into the stream channel) on the production of downstream migrant salmonids, particularly steelhead and cutthroat trout. This study combines a treatment (Tenmile Creek) and control (Cummins Creek) stream approach with a pre- and post-project evaluation. Tenmile Creek and Cummins Creek are both ocean tributary streams on the central Oregon coast. Pre treatment sampling of fish populations and habitat in Tenmile and Cummins creeks began in 1991. Most of the restoration activities in the Tenmile Creek study took place in 1996, and the post-restoration sampling of fish populations and habitat is ongoing in Tenmile Creek and the control stream, Cummins Creek.

## BACKGROUND STUDY AREA DESCRIPTION

The Tenmile Creek watershed encompasses approximately 15 thousand acres on the central Oregon Coast. The watershed is unique in its location, placed between the Cummins and Rock Creek wilderness areas. Together, this area is part of the largest contiguous coastal temperate forest left in the Pacific Northwest. It is also unique in its geology, as the stream runs through both the Yachats basalt formation (characteristic of the small coastal streams in the vicinity of Cape Perpetua), as well as Tyee sandstone in the upper watershed (characteristic of most coastal streams on the central Oregon coast). Because of their location and relative isolation from the larger river basins to the north and south (the Alsea and Siuslaw Rivers), ODFW has recognized and managed Tenmile Creek and surrounding streams (Cummins, Rock, Bob, and Cape Creeks) as an important haven for production of wild salmonids. Steelhead and cutthroat trout, coho and chinook salmon, pacific lamprey, eulachon (smelt), and four species of cottids are known to live in the Tenmile basin. The ODFW Research personnel have monitored the fish populations in the basin since 1991, estimating both the summer rearing populations in the basin, and the migrating smolt populations as they enter the ocean in the spring.

While Tenmile Creek still produces significant numbers of juvenile salmonids each year, changes in the habitat within the watershed have reduced these numbers from historic levels. Homesteading, logging, and road building activities have reduced the quantity and quality of fish habitat throughout the basin. Over 70% of the riparian area is in an early seral condition, which will prolong the unnaturally low levels of large wood in the channel. Priorities for watershed restoration of the Tenmile Creek basin were identified by the USFS in their Cummins/Tenmile Watershed Analysis in 1994. These include road removal and stabilization, modifying riparian vegetation, placement of large wood in the instream channel, and replacement of culverts that affect fish passage. A group of private landowners (Tenmile Creek Association, National Audubon

Society), ODFW, and USFS agreed to implement these restoration efforts throughout the watershed and monitor the affect on fish populations.

## **DESCRIPTION OF HABITAT MODIFICATIONS**

Watershed restoration work in the Tenmile basin began in the summer of 1996 as a cooperative project with the US Forest Service (Siuslaw Forest) and local landowners. The U.S. Forest Service decommissioned approximately 12 miles of roads in the watershed, removing culverts and fill to decrease future landslides. Riparian areas were planted with approximately two thousand young conifer trees along approximately 1.6 km of stream. Other streamside riparian areas dominated by hardwood were thinned to increase the growth of existing conifers in the understory. In October of 1996, 240 large conifer trees (length of 30 – 35 m, 75 cm butt diameter) were transported to the stream channel by helicopter. About 200 of the trees were felled on adjacent ridges and placed within the stream channel with limbs attached. The remaining trees were removed from 2 debris torrent deposits on the road running adjacent to Tenmile Creek. These trees often had rootwads attached, but were generally shorter in length (15 – 20 m) than the felled trees. Two aluminum tags were attached to each of the placed trees. The trees were placed at 35 different sites throughout the upper half of the mainstem of Tenmile Creek. Most sites consisted of 3 to 8 large trees placed together to produce accumulations of large wood. Most sites were located in areas near the upper or lower entrances of old side channels, or in natural bends in the stream where large debris would logically accumulate. Trees were not cabled or attached, although the ends of some trees were wedged between existing live trees standing near the stream bank when available to increase stability.

## **METHODS**

### **Summer and Winter Habitat Surveys**

In August and September of each year, we complete physical habitat surveys in Tenmile and Cummins Creeks. We divided the Tenmile Creek basin into 6 stream reaches, and the Cummins Creek basin into 3 stream reaches. We used the methods described by Hankin and Reeves (1988) to estimate the amount of available habitat, as described by Nickelson et al. (1992a). Surface area for each habitat unit in each stream reach is visually estimated, and every tenth unit was measured to calibrate the visual estimates. In addition, we classified the substrate in each habitat unit by visually estimating the percentage of each category of substrate present. Substrate composition is separated into the following categories: clay (extremely fine sediment that is tightly packed), silt (fine sediment often containing a large proportion of organic material that when disturbed will become suspended in the water column); sand (<0.2 cm); gravel (particles between 0.2 and 6 cm. in diameter); cobble (6 to 25 cm.); small boulders (26 to 100 cm.); large boulders (>100 cm); and bedrock. We also measured the maximum depth of each pool, and estimated the surface area of undercut bank, the percent canopy, and the wood complexity for each habitat unit.

Twice during the pre-restoration period and once during the post-restoration period, we have completed winter habitat surveys to determine the amount of winter habitat available for rearing in Tenmile Creek and Cummins Creek. These surveys were completed in December and January during moderate winter flow conditions. Additional winter habitat surveys will be completed in the future.

### **Estimating Summer Fish Population Size**

In the Tenmile Watershed Restoration Study, we divided the Tenmile Creek basin into 6 stream reaches, and the Cummins Creek basin into 3 stream reaches. We

make separate estimates of the number of juvenile salmonids rearing in each reach during the summer. Estimates are made of the number of young-of-the-year coho salmon, young-of-the-year trout (steelhead and cutthroat combined), age 1+ steelhead trout, and age 1+ cutthroat trout rearing in each stream above the trap sites each year.

To estimate the number of fish rearing in the pools, we (1) estimate the mean number of fish per pool by snorkeling every third pool, (2) adjust the mean fish per pool estimate by a calibration factor derived from electrofishing population estimates in a subset of the snorkeled pools, and then (3) multiplied this adjusted mean by the total number of pools in the stream (Hankin and Reeves 1988). For each stream reach, we generally calibrate the diver counts in 6 to 8 of the snorkeled pools with electrofishing equipment, using either a pass-removal methodology (Seber and LeCren 1967) or a mark-recapture methodology (Chapman 1951). Mark-recapture estimates were generally used in pool habitat that was characterized by high levels of wood complexity or presented special sampling problems where removal estimation methods have been shown to be less accurate (Rodgers et al. 1992). Every habitat unit was blocked by seines on both ends and sampled for juvenile salmonids using 1000 volt D.C. backpack electrofishers. Specific criteria for sampling intensity were established to control the size of the confidence interval derived from the population estimate and to prevent exposing the fish to unnecessary repeated electrofishing. When using the removal method, we continued to sample until we achieved a 50% reduction in the number of fish captured on the previous pass, if the catch on the first pass was fewer than 10 fish. If the catch on the first pass was greater than or equal to 10 fish, then a 66% reduction was required before discontinuing the sampling effort. For the mark-recapture estimates, we attempted to retrieve 50% of the marked fish released.

Snorkel estimates are impractical in habitat with shallow depths. Therefore, to determine the number of fish rearing in glide, riffle, and rapid habitat, we estimate the mean density of fish for a subset of each of these habitat types by completing pass-removal population estimates with electrofishing equipment. We generally sample 10 glides, and 10 riffles in each stream reach. For each habitat type, we then multiplied this mean density by the total surface area of this habitat type in the entire stream reach. (Hankin 1984).

### **Estimating the Number of Downstream Migrants**

We estimate the number of downstream-migrating coho salmon, steelhead and cutthroat trout, and chinook salmon in Tenmile Creek and Cummins Creek each spring, based on numbers of juvenile salmonids captured in rotating screw traps located near the mouth of each stream. Estimates of steelhead trout migrants were made for the following size categories: 60-89mm, 90-119mm and  $\geq 120$ mm. Only steelhead migrants in the  $\geq 120$ mm size category showed physical characteristics associated with seaward migration (silvering, loss of condition) and were classified as steelhead smolts. Estimates of cutthroat trout migrants were made for the following size categories: 60-89mm, 90-119mm and 120-159mm, and  $\geq 160$ mm. Only cutthroat migrants in the  $\geq 160$ mm size category showed physical characteristics associated with seaward migration (silvering, loss of condition) and were classified as searun cutthroat smolts. Because Tenmile has a population of chinook salmon, we also estimate the number of downstream migrant chinook each spring and summer. Trapping begins in the first week of March in each stream. Trapping is discontinued in Cummins Creek in mid-June, when downstream migrants are no longer caught. Trapping continues in Tenmile Creek

until late July in order to estimate chinook migrants out of the basin. Traps generally operate 24 hours per day and are monitored daily.

Captured fish are removed daily from the trap and anesthetized with buffered MS-222. To determine the size of each species at the time of outmigration, we measure the length of up to 25 juvenile salmon and trout to the nearest mm fork length each week. We also collect scale samples from a portion of the population each spring to determine age at outmigration.

To determine the total number of downstream migrants that pass the traps each spring, we estimate the trapping efficiency for each trap each week throughout the spring for each species. Up to 25 fish of each species are removed from the trap each day, marked with a Panjet Marking Instrument, and released several hundred meters back upstream from the trap site. Weekly trap efficiency estimates are calculated by dividing the number of marked fish re-captured by the number of marked fish released each week. The total number of unmarked fish captured was divided by the estimated trap efficiency to estimate the number of fish passing the trap site each week. Weekly estimates were summed to estimate the total number of fish passing the trap site each spring. We use a bootstrap method (Efron and Tibshirani 1986) to estimate the variance for each weekly population estimate for coho salmon.

## **RESULTS AND DISCUSSION**

### **Habitat Modification**

In the Tenmile Creek Watershed Restoration Study, the number of key pieces of large wood increased from 21 pieces in reach 3 in pre-restoration surveys to over 150 in the initial post-restoration survey. As a result, the percent of summer pool surface area in reach 3 with high wood complexity increased from an average of 6% in pre-restoration

surveys to 12% and 18% in post-restoration surveys completed in the summer of summer of 1997 and 1998. To date, the total number of pools, the total stream surface area of pools, and the substrate composition have not changed significantly in Reach 3 as a whole. Observations of habitat immediately in the vicinity of selected sites does suggest substrate changes are occurring near the wood accumulations. More detailed analysis of physical habitat changes resulting from the restoration work will be completed as more years of post restoration data are collected.

While most of the large trees that were carried into the stream channel by helicopter during the restoration work in the summer of 1996 have remained near the site where they were placed, some trees were transported downstream during high water events in the winter of 1998-99. These trees were primarily from sites placed at sites in upper reach 2 where the active channel was quite wide. Most trees traveled less than 1 km before lodging in a new debris accumulation. All trees associated with the habitat restoration project are still in the upper half of the Tenmile Creek watershed. More detailed information on the movement of the trees associated with the restoration projects will be available after the 1999 summer habitat surveys are completed.

### **Fish Populations**

Estimates of fish populations in the post- restoration phase of this project are not complete. Results of summer population estimates and spring migrant estimates observed to date are given for both Tenmile and Cummins creeks in Tables 1 and 2. Estimates of steelhead trout smolts and searun cutthroat trout smolts were higher in the spring of 1998 than any estimates made during the pre-restoration years. Additional years of sampling are needed to see if this trend continues.

Table 1. Summer population estimates of juvenile salmonids in Tenmile and Cummins Creeks during the Tenmile Creek Restoration Study, 1991-98. Post-restoration sampling will continue in future years.

Stream	Year of Summer Sampling	Coho	Cutthroat	Steelhead	Trout
		Salmon	Trout	Trout	Fry
		Age 0+	≥ 90mm	≥ 90mm	Age 0+
Cummins Creek	1991	1292	1177	2306	6467
	1992	1316	1591	3010	8104
	1993	1079	1274	2946	4646
	1994	1015	1281	2255	7998
	1995	913	1502	3689	9383
	1996	1074	1545	5002	8625
	1997	1646	2417	4798	17927
	1998	863	2524	7171	11132
Tenmile Creek	1991	8003	4023	16613	79958
	1992	7799	3503	16324	66226
	1993	30663	3231	18417	70664
	1994	3294	2540	12180	54865
	1995	4369	2822	12818	69391
	1996	3783	4256	19784	63193
	1997	4410	2412	13491	59710
	1998	2105	2957	12204	60903

Table 2. Estimates of salmonid smolt production in Tenmile and Cummins Creeks during the Tenmile Creek Restoration Study, 1992-98. Post-restoration sampling will continue in future years.

Stream	Year of Spring Sampling	Coho Salmon	Searun	Steelhead	Chinook
		Smolts Age 1+	Cutthroat Trout Smolts => 160 mm	Trout Smolts => 120 mm	
Cummins Creek	1992	1023	50	786	0
	1993	738	56	1424	0
	1994	1435	106	1623	0
	1995	1076	40	1167	0
	1996	475	142	2303	0
	1997	674	223	2790	0
	1998	2215	110	1816	0
Tenmile Creek	1992	5442	429	6312	557 <sup>a</sup>
	1993	5260	350	7817	381 <sup>a</sup>
	1994	9234	259	5420	527 <sup>a</sup>
	1995	1729	324	2342	700 <sup>a</sup>
	1996	2230	215	4652	2773 <sup>b</sup>
	1997	2952	632	7334	4046 <sup>b</sup>

1998                      5462                      813                      11869                      4841<sup>b</sup>

(a) Trapping period March 1- June 30

(b) Trapping period March 1- August 15

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