Watershed Restoration Technical Bulletin
Streamline
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SPECIAL EDITION FIVE YEARS OF WATERSHED RESTORATION

A Message from the Editor:

This special anniversary issue of Streamline reflects upon accomplishments and lessons learned in watershed restoration. It is now five years since the Watershed Restoration Program was established in British Columbia. Five years is not a long time to evaluate processes, and there remain some pockets of skepticism about the success of rehabilitation projects and their contribution to resource recovery. To extend the time frame for evaluation it is important also to examine other jurisdictions that have been monitoring for longer periods of time. Therefore, we include some examples from integrated, hillslope, and instream projects that have been evaluated for substantially longer than five years. We also have provided updates on some of the projects that were covered in earlier issues of Streamline.

This issue is based on the *Annotated Bibliography of Watershed Restoration Responses and Lessons Learned*, being compiled by Megan Sterling for Forest Renewal BC. This document provides details of approximately 100 projects that have undergone research on effectiveness evaluation. Streamline thanks Ms. Sterling and Forest Renewal BC for assisting with the preparation of this special anniversary issue, which follows the format used in the bibliography. Each evaluation process begins with a brief project description, the criteria that were applied to justify restoration, the restoration responses (results) and the lessons learned throughout the process. When Ms. Sterling's bibliography is completed, we will advise readers about accessing the document. Note that this issue of Streamline will not have the usual Features and Technical Tips sections. We will return to our usual format in the next issue.

This Quarter
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BRITISH COLUMBIA
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Integrated Watershed Restoration Projects

Watershed Restoration in Deer Creek, Washington – A Ten Year Review

J.E. Doyle, G. Movassaghi, M.Fisher, and R. Nichols.

Project Description

Deer Creek is a major tributary of the North Fork Stillaguamish River located in the western Cascade Mountains of Washington State. According to historical records, the steelhead run in Deer Creek was once one of the largest native runs of summer-run steelhead in Puget Sound, perhaps in the whole State of Washington. Deer Creek is 38 km in length with 26 km accessible to steelhead and coho salmon. Average channel width (bankfull) is 11 meters, with a substrate dominated by boulder- and rubble-sized materials. Average channel gradient is 2.5%. Although logging began in the watershed in the early 1920's, the scale of this activity was small during the next 3 decades: before 1950, most of the watershed was well vegetated by a mature conifer forest. In the 1940's to early 1960's, erosion, flooding, riparian logging, and channel widening and aggradation diminished the quality and quantity of salmonid habitat. The riparian area along the main channel in the lower watershed was, for the most part, entirely logged off by the mid-1970's. After harvesting, the landowner aerial-sprayed these riparian corridors for alder and willow control through the 1970's and early 1980's. Accelerated erosion accompanied and followed the logging, and in 1984 a large landslide of glacial sediments (known as the DeForest Creek slide) entered Deer Creek. By 1992, the landslide had contributed more than 1.5 million tons of silt, sand and gravel to Deer Creek. In the late 1980's, the summer steelhead run declined to very low levels.

From 1920 to 1990, the three landowners in Deer Creek had harvested a total of 25,730 acres of forest. Over this 70-year period, 48% of the mature forest in this watershed had been harvested: on Washington State land 91% had been cut, on private land 88% was cut, and on National Forest land 37% had been harvested.

Figure 2. Looking upstream at this tributary, showing the initial upslope treatment which included sediment storage.

Figure 1. As shown in this pre-project photo, a Deer Creek tributary was chosen for large woody debris placement, sediment storage and bank stabilization.

Figure 3. Deer Creek four years after the photo in figure 1. This stream has benefitted from LWD placement and bank stabilization.

Integrated Watershed Restoration Projects

The U.S. Forest Service began to conduct stream and fish habitat surveys in Deer Creek in 1979 and early in the 1980's. Beginning in 1984, the Mt. Baker Snoqualmie National Forest took the lead in conducting watershed-wide resource inventories and assessments. Figure 1 demonstrates upslope and stream conditions prior to the restoration projects. Based on the findings from these early inventories and assessments, the restoration strategy in the Deer Creek Watershed focused on modifying or altering the sedimentation process. The strategy was to reduce the coarse sediment delivery to the stream channel network and to mechanically stabilize the riparian sideslopes and streambanks. This was intended to lead eventually to riparian revegetation, stream channel recovery, and fish habitat improvement.

Figures 2 and 3 show the conditions following the restoration projects. This strategy employed two tactical operations: 1) restoration efforts that involved road, upland, and in-channel projects; and 2) restoration efforts that would be carried out over a multi-year period and would cover the entire watershed.

The specific restoration objectives for each treatment were:

Road and upslope

A. Reduce coarse sediment transport from roads and gullies into the larger, lower gradient stream channels through the use of sediment fences; and
B. Reduce the risk of major landslide failure at as many sites as possible.

Instream

C. Reduce the erosion of channel banks and thereby reduce sediment delivery to the channel; and
D. Promote stream channel downcutting to encourage formation of deeper and greater numbers of pools for fish habitat.

Prioritization for restoration treatment for each project site was based on factors of accessibility, achievability, cost, and risk of failure.

From 1984 to 1994, integrated watershed restoration in Deer Creek on National Forest lands involved:

I. 24 km of road decommissioning;
II. 93 km of road upgrading/ storm proofing;
III. 12.1 ha of hillslope and gully stabilization; and
IV large woody debris placement in channels.

Criteria for Restoration Evaluation: Fish population and migration.

The treatment results are general in nature because the Deer Creek restoration program did not have sufficient funding to implement monitoring for long enough to obtain quantitative results. This program restricted monitoring to the identification of observable trends including changes in watershed condition. The following table summarizes the monitoring accomplished in Deer Creek basin:

Type of Monitoring	Year(s)
Aerial Photos, low elevation	1982, 83, 84, 87, 88, 93
Aerial Photos, 1:12 000 (*=1:24 000)	1942, 56, 64, 72, 79*, 83, 89, 92
Channel Morphology	1984
Cross Sections	1984, 86-87, 88, 89, 91, 92
Fish Habitat Surveys/ Channel Stability Ratings	1979, 82, 84, 87, 91, 92
Fish Population Census	1955-61, 1970-73, 1981, 1983-94
Helicopter Video	1987, 89, 90, 91, 95
Landslide Inventory	1984-85
Stream Discharge	1917-30
Sediment Budget	1990
Temperature Study	1979, 84
Temperature Record	1984-89

Juvenile Fish

Since 1984, the Washington Department of Fish and Wildlife has been independently conducting juvenile salmonid population estimates at seven sites in the watershed. With the use of a 3-pass electrofishing method at each site, juvenile fish of all species were captured. The population of each species and age class were estimated and rearing densities were calculated for each species and age class.

Adult Steelhead

Monitoring has included adult summer-run steelhead abundance spawning surveys and estimating the number of adult fish returning to spawn. Helicopter survey is the preferred method.

Restoration Responses

Juvenile Fish

From 1984 to 1992, steelhead parr densities declined at the rate of 30-50% per generation. For the first time since the annual juvenile population estimates have been monitored, the juvenile densities for 1993 and 1994 had increased over those estimated in their parent year (Figure 4).

Adult Steelhead

An increase in the number of steelhead summer-run adults, from less than 100 in 1989 to more than 460 in 1994, represented a significant increase in the population.

Integrated Watershed Restoration Projects

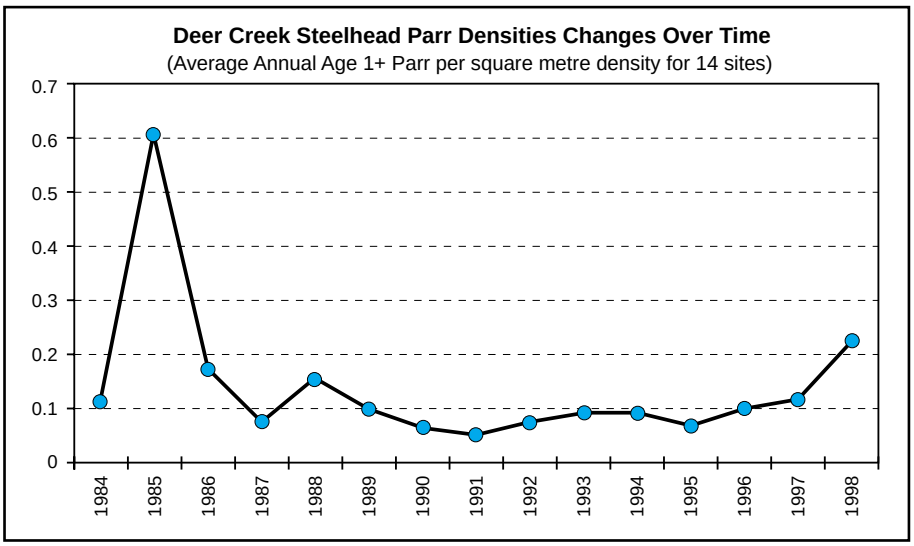

Figure 4. Deer Creek steelhead parr densities.

This increase was mainly due to the increase in freshwater survival of 1-year-old steelhead juveniles (parr). By the late 1990s it was estimated that stocks had recovered to 50 – 70% of historical abundance (J.Doyle, Jan. 2000).

Lessons Learned

The increase in steelhead production from essentially the same parr densities can only be explained by the combination of two factors: increased overwintering survival from parr to smolt and increased survival from smolt to adult. In view of the general poor smolt-to-adult survival of steelhead in the Puget Sound area for the past few years, and the apparent improvement in the freshwater habitat, it seems likely that the improved capability of the habitat in Deer Creek to produce juveniles accounts for most of the increase in adult production.

Fish populations in Deer Creek have increased significantly in the last two years. The observed increase in juvenile fish densities is a reversal of a decade-long decline. In part, this is attributable to the improvement of habitat during the past five years.

Stabilization efforts on the hillslopes, together with the large floods in 1990, were effective in removing sediment deposits from coarse boulder substrates, thus restoring the fish habitat. The reductions in sediment inputs from roads, gullies, and channels are inferred as the primary causes of coho and steelhead stock recoveries. ▲

Based on two documents: 1) Doyle, J.E., G. Movassaghi, M.Fisher, and R. Nichols. 1999. Watershed Restoration in Deer Creek – A Ten Year Review. *Sustainable Fisheries Management – Pacific Salmon.* 1999. E.E. Knudson, C.R. Steward, D.D. MacDonald, J.E. Williams, and D.W. Reiser (eds.). Lewis Publishers, New York and on: 2) Kraemer, C. 1999. Management Brief: 1999 Update on the Status of the Deer Creek Summer Steelhead. Draft. Washington Dept. of Fish and Wildlife.

Upper Willow Watershed Effectiveness Evaluation Strategy

Shannon Sterling

Project Description

The upper portion of the Willow River Watershed covers approximately 880 km^2 in the Quesnel Forest District (Cariboo Forest Region) and is located 55 km northeast of Quesnel, B.C. An Effectiveness Monitoring Strategy (EMS) – also referred to as an Effectiveness Evaluation Strategy – was designed and implemented to allow evaluation of rehabilitative works that were, or will be, prescribed and constructed. An EMS is designed to detect changes in the early stages following rehabilitation activities, as well as longer-term changes as a result of periodic events (e.g., large rainstorm). Monitoring continues until an apparent state of equilibrium has been reached.

The EMS was designed to monitor the large area economically (for less than 5% of the construction