Effectiveness Monitoring of Restoration Projects in the Shasta Basin

Shasta River at Yreka Ager Road 1951

Same site in 2007 after being fenced for 11 years

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ECOSYSTEMS NORTHWEST

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Executive Summary

Twenty-four sites were surveyed in the Shasta Basin along the Shasta and Little Shasta Rivers to document the effects of restoration efforts by the Shasta Valley Resource Conservation District and others. Restoration projects have included planting of trees, stream bank reinforcements, gated cattle access, fish screens, dam removals. But fencing the riparian zone to control cattle grazing has been the single largest category of restoration. Therefore, a major focus of the monitoring was an examination of the effectiveness of fencing. In addition to fencing, the survival of planted trees was also assessed. Additional sites that had not been restored were added in as controls (e.g., to compare fenced sites to unfenced sites). Six sites were measured for stream, channel and biological status using an intensive approach with paired controls. Twenty-four sites consisting of unfenced sites and sites fenced for varying lengths of time were surveyed using longitudinal transects in an extensive approach.

Fencing was associated with increased vegetation growth in the riparian zones and shifts from grass-dominated to mixtures of grass with trees and herbaceous vegetation. The increase in trees appeared to be due mainly to colonization and growth of naturally establishing sandbar willows and less to tree-planting activities. Fenced sites also showed trends of change to the channel. Channel changes included decreased bank erosion, increased cover for fish, increased shade, increased channel complexity, and channel narrowing. Macroinvertebrates diversity was higher in fenced sites compared to unfenced controls. Tests for fish and water chemistry were inconclusive. Most fencing appeared to be highly effective in excluding cattle. Two sites were more than ten years old, had met the terms of the exclusion contract, and were now being grazed in a managed rotation. Unfenced sites did not necessarily mean that grazing was occurring. At one unfenced control, the riparian zone was effectively protected by an irrigation ditch. At two other unfenced sites, grazing appeared to be managed to appropriate levels.

The effects of fencing are just now becoming evident, as the oldest sites have been fenced 14 years. It is expected that benefits to the river will continue and accumulate. As larger blocks of stream are fenced, it is expected that benefits will include more than just local streamside vegetation. Larger blocks should have a better chance of improving fish habitat and maintain riparian connectivity. Attempting to measure fencing effectiveness using paired unfenced controls worked for measures of riparian growth, but did not work as well to detect other variables such as channel habitat. One problem with finding properly matched control sites is confounding due to differing landownership and therefore management approaches. Once a landowner decided to fence streams, they typically had their entire property along the river fenced. Another issue with choosing sites for statistical tests of fencing is that many smaller holding do not cross the river and the two banks were often under different fencing and grazing regimes.

Copies of this report are available from the Shasta Valley RCD.

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Introduction

This report has been prepared for the California Department of Fish and Game (DFG) on behalf of the Shasta Valley Resources Conservation District (RCD) as part of California's Fisheries Restoration Grant program. This report describes data collected from field surveys in 2007 and 2008 on 24 sites in the Shasta Basin regarding status of riparian zone, stream channel, and biological status (presence/absence of fish) and indices of aquatic invertebrates. (Prior to 2007, monitoring consisted of aerial flights with videos taken of potential sites. These videos can be made available for those interested by contacting K Mattson.) Twenty-one of the sites were on private lands of cattle ranches and two sites were on public lands and one site was on a lands of a non-profit agency. Sites were either along the Shasta River below Dwinnell Dam or along the Little Shasta River (see maps in Appendix A). The sites were selected to be representative of riparian fencing projects that have been ongoing in the Shasta Basin for that past 15 years. Most sites were in a relatively homogenous, low- gradient reach of the Shasta Valley between the lower canyon and Highway A-12. The sites included a range of "years of fencing" plus sites that were not fenced (unfenced controls). Data collected were used to test effectiveness of fencing by pairing of fenced sites to unfenced controls and by plotting survey data as functions of years since fencing to search for patterns of change.

The purpose of the project was to provide quantitative data by which to assess the effectiveness of restoration projects in the Shasta Basin. A secondary purpose was to demonstrate to the private landowners the value of collecting quantitative monitoring data so to provide the proper framework by which to define, assess, and manage resource issues. The RCD, largely through funding by the DFG among other sources, funded $4 million dollars of fencing from 1986 through 2005 and built over 20 miles of fencing in the basin. Up to this study, there has been no formal study of the effectiveness of such restoration projects and there had been only limited studies of stream and riparian conditions over the Shasta Basin.

Background and problem statement

The Shasta River drains 795 square miles in Siskiyou County, in northern California. It is one of four large tributaries to the Lower Klamath River, (below Iron Gate Dam, the current upper extent of anadromous fish). The Shasta River has been considered to be historically one of the more important salmon producing tributaries to the Klamath River. The flow in the Shasta Basin is derived from snowmelt from the Klamath Range and snow and glacier melt from Mount Shasta. While precise empirical relationships between landscape properties and salmon production are not well established (Sharma and Hilborn 2001) we can hypothesize qualitatively how the historic conditions in the Shasta Basin may have contributed to high salmonid production. The unique combination of cold water, constant flow, nutrient enriched water, combined with the relatively large flat Shasta Valley likely produced the high quality spawning and rearing habitat that resulted in high adult returns. High natural nutrient contents of the underlying bedrock types have contributed to the highly productive waters as soils and mineral deposits originating off volcanic Mount Shasta can be high in phosphorus while those from the Klamath Range which include oceanic sedimentary deposits which can have high amounts of nitrogen. The relatively flat gradient of the Shasta Valley and the alluvial soils likely contributed to the creation of a complex river meandering system that is believed to increase habitat for salmonids.

It is also thought that this high-quality habitat has been substantially impaired. In probably the first comprehensive review of salmon in the Klamath basin, Snyder (1931) cited an "old resident" who claimed the Shasta as the most productive tributary for chinook (*Onchorhynchus tshawytscha*) in the Klamath basin (p. 31). There are no estimates of these historic numbers, but Snyder, in his time, considered the runs as already decreased in the Shasta due to irrigation. His view is noteworthy considering during the year of his report, 1931, over 80,000 returning chinook were counted at the fish counting station at the mouth of the Shasta. This number at 1931 constitutes the start of the documented decline of returning salmon to the Shasta River (Figure 1). In the early 1990's, the counts of returning chinook dropped to as low as 500 fish before averting a complete collapse and climbing back up to as high as 5,000 in the last few years. The situation for coho salmon is thought to be similar to Chinook. While the data for coho salmon are less precise as coho spawn later in the year and often the weir was taken down before the completion of the coho run, it is generally presumed that coho runs are also significantly reduced. It is not known how many coho historically used the Shasta, but it is estimated that typically 1,000 fish returned to the Shasta during the 1960's (CDFG report 1965, cited by NRC 2004). More recently, weir counts estimate coho returns at 200-300 (CDGF 2002).

Salmon have been in a steady decline in numbers throughout their southern ranges along the west coast of North America. Indeed, this month (May 2008), the United States Secretary of Commerce declared the commercial salmon fishery to have "failed" on the west coast of the United States based on historically low returns of salmon, particularly the low returns of fall Chinook to the Sacramento River last year (NOAA 2008). The precise causes of the decline are unknown, but changes to the habitat, ocean conditions, harvests, and introduction of large numbers of hatchery fish have all been listed as likely contributing causes for the declines. Activities in the Shasta Basin thought to be contributing to salmon declines include construction of Dwinnell Dam in the 1920's located at river mile 40, irrigation diversions for agriculture, and low and now warming summer flows, and near-stream grazing of cattle and impairment of riparian shade, erosion of banks, and introduction of sediment.

The effects of livestock grazing, and the need for intact riparian vegetation to reduce nutrient and sediment inputs to stream have been well known for some time (McColl 1978, Platts and Nelson 1985, Armour and others 1991, reviewed by Belsky et al. 1999). Riparian restoration by establishing buffer strips has been recognized as one of the most important and perhaps easiest steps to take in restoring stream function in heavily grazed areas (Kauffman et al. 1997). Indeed, riparian restoration can often be the most cost-effective means for restoring water quality in streams impacted by non-point source pollution (U.S. EPA, 1996). Grazing exclusion fences represent passive restoration, which, due to natural revegetation, is often all that is necessary to reestablish riparian function. To this end, the largest component of restoration projects in the Shasta has been construction of riparian fencing. The Mid-Term Evaluation of the Klamath River Basin Fisheries Task Force noted that the Task Force's efforts to restore riparian areas in the Scott and Shasta River basins is the most successful aspect of the Restoration Program (Kier Associates 1999, pg. 3-12).

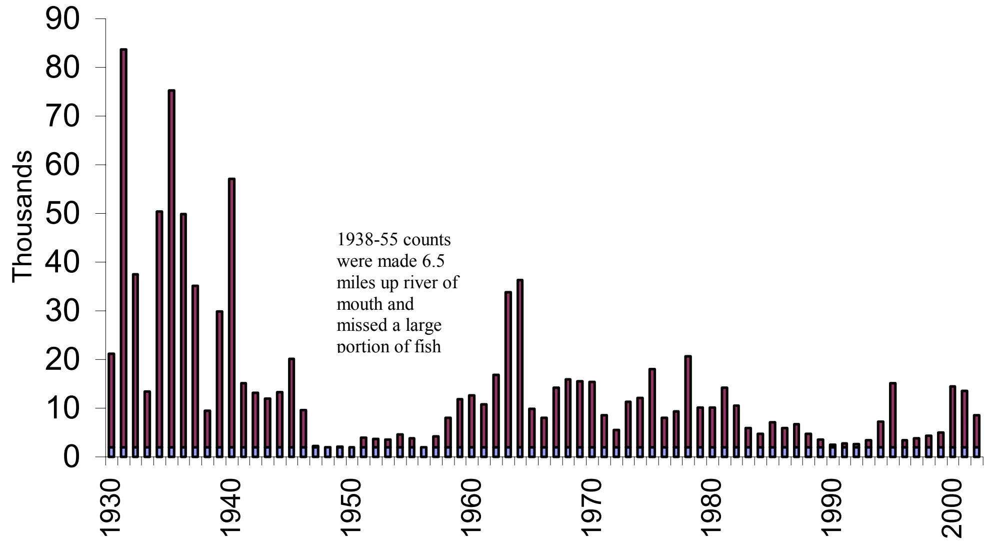

Figure 1: Total counts of returning Chinook salmon to the counting weir at the mouth of the Shasta River.