Plum Creek

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The Alsea Study Revisited

Comparative Response of Salmonids to Historical and Contemporary Commercial Timber Harvest Practices at the Watershed Scale

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Introduction

The original Alsea Watershed Study demonstrated the magnitude and short-term duration of timber harvest impacts on salmonid fish populations (principally coho salmon [*Oncorhynchus kisutch*] and coastal cutthroat trout [O. clarki]) when forest management activities were conducted without regard for aquatic resources (Moring and Lantz 1975). More recent studies by Gregory et al. (2008) established that coho have remained relatively unaffected by the extreme harvest practices in the clearcut watershed (Needlebranch Creek), whereas cutthroat populations show a persistent decrease in older age classes. A commonly hypothesized reason for the cutthroat response is that habitat quality (pool depth and complexity) was fundamentally reduced during the initial harvest and has not recovered (Connolly and Hall 1999, Gregory et al. [2008], Reeves et al. 1997). Competitive interactions between coho and cutthroat have also been suggested as a mechanism behind the response (Connolly 1997, Reeves et al. 1997, Schwartz 1990). We believe contemporary harvest practices will have little to no adverse effects on water quality, fish habitat, and fish populations in Needlebranch Creek. We further believe that the density of larger trout can be increased through large wood placement. The purpose of this study is to assess the fish response to current forest management activities and to compare the response with observations made forty years ago under radically different practices.

Objective

To determine if cutthroat trout growth, survival, and distribution are affected by contemporary logging practices in Needlebranch Creek.

Hypotheses

1. Fish distribution within catchments may shift in response to change in water quality, water quantity, food resources, or cover. Changes in fish distribution may result from movement of individuals or variation in survival.

2. Additions of large woody debris during logging will increase pool habitat volume and associated cover, resulting in one or more of the following responses in coastal cutthroat trout:
    a. increased survival;
    b. reduced emigration;
    c. increased length at age; or increased fraction of fish in older age classes.

Approach

A before-after, control-impact (BACI) design will be used to examine the fish and habitat response to logging. There will be a three year pre-harvest monitoring period before logging in the upper watershed, followed by a 4-year green-up interval, and then logging of the lower watershed at year seven. There will be at least a two-year post-harvest period after final logging (yr 7-9). The stream will be loaded with large woody debris at the time of final harvest to restore complexity to the stream channel. This practice is permitted as part of current harvest rules and regulations.

Methods

Fish Habitat and Channel Characteristics
Habitat inventories will be conducted for the fish-bearing portion of the channel prior to summer electrofishing surveys in both streams. Habitat measurements will be nested hierarchically into segments (Frissell et al. 1986, Moore et al. 1998), geomorphic reach types (Montgomery and Buffington 1997), and pool, riffle-rapid, cascade, and vertical step habitat-unit types (Bisson et al. 1982). For each habitat unit, estimates of wetted width, length, vegetative cover, active channel widths, and substrate will be recorded (Moore et al. 1998). Maximum depth will be collected for each wetted habitat unit along with thalweg depth at each pool-riffle crest. In addition, cover provided by wood, vegetation, boulders, and undercut bank will be summarized by zone of occurrence (Robison and Beschta 1990) for all pools. The geographic location of habitat features will be referenced to a network of tree tags. Tags will be placed at approximately 15 m intervals throughout the fish bearing channel in both watersheds. Counts of large woody debris (minimum qualifying dimensions of 10-cm diameter by 2-m length) in zones 1-3 (Robison and Beschta 1990) will be summarized by tree tag intervals and aggregations will be noted. In order to get a more precise and less biased estimate of stream substrate composition, a digital photograph of substrate (Whitman et al. 2003) will be collected in the thalweg adjacent to each tree tag.

Fish Distribution and Relative Abundance
All pools and cascades throughout the entire fish-bearing network of the paired basins will be surveyed once per year with single-pass electrofishing. Surveys will occur during summer low flow conditions (July-August). All sampled fish will be weighed to the nearest 0.1 g and measured to the nearest 1.0 mm fork length. Scale samples of a subset of the sampled fish will be taken for verification of age-size class distributions and for growth calibrations with PIT-tagged fish. Scales will be taken from all PIT-tagged fish and from a subset of fish in each size class. Density diagrams will be plotted and variograms or other statistics will be calculated to examine changes in distribution and abundance relative to harvest. Presence data will be collected on a habitat unit basis for additional aquatic vertebrates including lamprey, sculpin, pacific giant salamanders, and tailed frog tadpoles.

Population Estimates
Cutthroat and juvenile coho population sizes will be estimated using multiple-pass removal methods via electrofishing. Four (50-100 m) sites each in Flynn and Needlebranch creeks will be sampled at the same locations used during previous fish and habitat investigations.

Population estimates for these "index reaches" will be made once each year during the summer low flow season. These data will be used to compare results with previous studies.

Fish Movement

Half-duplex Passive Integrated Transponder (PIT) tags will be placed in all salmonids larger than 100-mm fork length that are captured during annual electrofishing surveys. One continuously-operated stationary antennae will be installed at the lowermost gaging station of each basin. This will be used to track fish that leave the watersheds and thereby improve survival estimates. Data will be downloaded weekly during battery changes. Whole-stream surveys will be conducted bi-monthly or after major flow events using mobile tracking antennae.

Fish Food

The influence of riparian forests on food for fish is another area of considerable interest (Wilzbach et al. 2005). This topic will be explored by sampling for benthic and drifting invertebrates and fish diet samples. Abundance and community composition of benthic invertebrates will be used to indicate pre-harvest stream conditions and help assess post-harvest changes. Drifting invertebrates and fish diet samples will assess if and how the invertebrate prey base and fish responses change under varying annual conditions and following forestry activities. Our general analytical approach will be to examine relative abundances, a variety of metrics that can be compiled for various indices, and multivariate analyses of taxa compositions over time and space. Macroinvertebrates and cutthroat stomach contents will be collected once a year in spring (May) at three locations in each basin.

Analysis

Standard statistical procedures will be used to compare pre- vs. post-harvest cutthroat distribution, density (number, spread, symmetry of 'hotspots'), growth, survival, length-at-age, or proportion of the population in older ageclasses. Because we anticipate large spatial and temporal autocorrelation within the data, statistical techniques for identifying and addressing this issue will be used (e.g., Ganio, Torgersen and Gresswell (2005).

Costs

Equipment is expected to cost ~ \$15,000 - \$20,000 for the duration of the project. Data collection and analysis will be completed by Doug Bateman and his crew through Oregon State University's Watershed Research Cooperative (or USGS-FRESC). Labor costs are expected to be \$70,000-90,000 per year.

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