Overview of the Western Washington Forest Headwater Stream Riparian Ecosystem Management Studies (REMS): Testing Alternative Headwater Stream Management Options

Riparian Ecosystem Management Study

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Responding to Management Information Needs

In 2001, the Washington State Department of Natural Resources and the USFS Pacific Northwest Research Station initiated a project to determine the possible influence of different riparian buffer configurations on 1st order (headwater) streams in western Washington. Three buffer configurations are being compared: **variable width buffers**, **fixed width buffers**, and **no buffers**. An unmanaged basin is used as a control.

The design and implementation of treatments encompass entire headwater basins in an operational setting. Treatments were replicated in 8 locations, on both sandstone and basalt lithologies, on a total of 34 streams.

A highly collaborative approach to this research was taken to provide a broad context for resource managers to weigh the management alternatives. Concurrent research studies are examining the effects of the different buffer configurations on:

- ❑Litter fall input
- ❑Suspended organics
- ❑Aquatic invertebrates
- ❑N and C export & water chemistry
- ❑Hyporheic zone soil process
- ❑Stream discharge
- ❑Channel head migrations
- ❑Modeled tropic connection to down stream systems

- ❑Stream associated and terrestrial amphibians
- ❑Small mammals
- ❑Mollusk abundance and biodiversity
- ❑Stream temperature
- ❑Down woody debris inventory
- ❑Fish distribution and occurrence
- ❑Understory vegetation
- ❑Stand composition and dynamics

Current cooperators include the Washington State Department of Natural Resources, USDA Forest Service, the University of Washington, and the Washington State Department of Ecology.

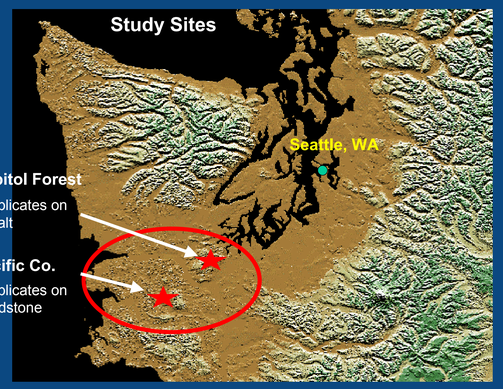


Fig. 1 General locations of the 8 REMS experimental replicates.

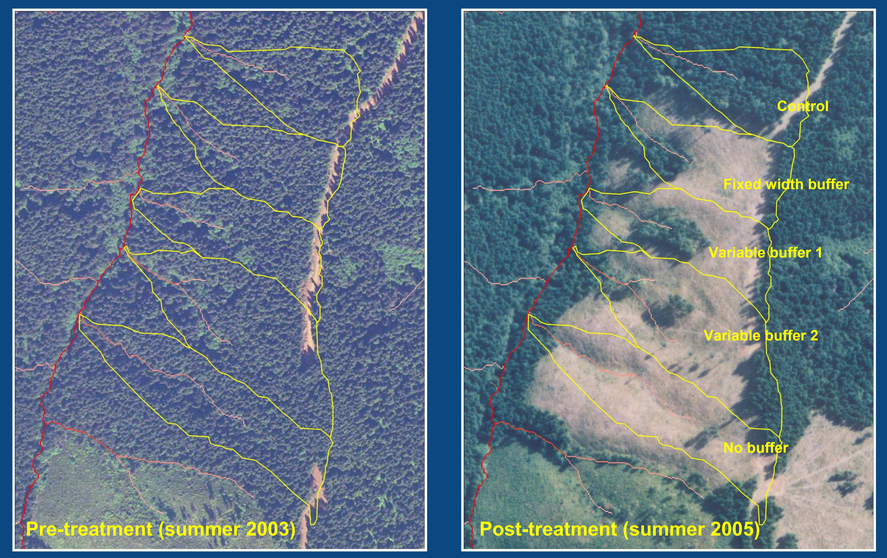


Fig. 2 Pre- and post-treatment aerial photographs of one of 8 replicate sites testing alternative headwater buffer configurations. Treatments were conducted in 2004 after 2 to 3 years of pre-treatment data collection

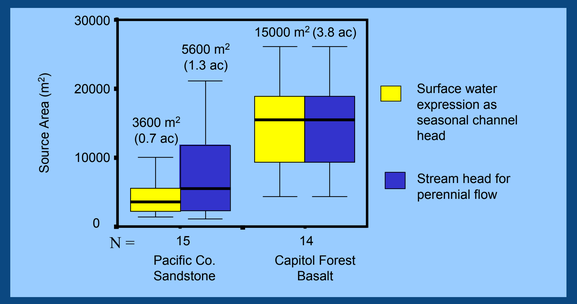
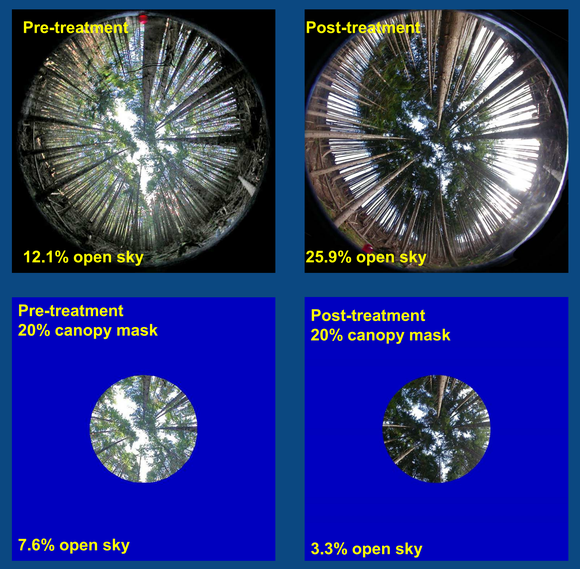


Fig. 3 Source area that support perennial flow (stream head) differs by bedrock on REMS sites; sandstone sites had a mean source size of 1.4 acres (0.57 ha), basalt sites 3.8 acres (1.54 ha). Also, surface water expression of streams on sandstone migrated downstream an average of 16 m during the dry season. There was no seasonal change in channel head location on basalt bedrock steams (adapted from Jeager 2004).

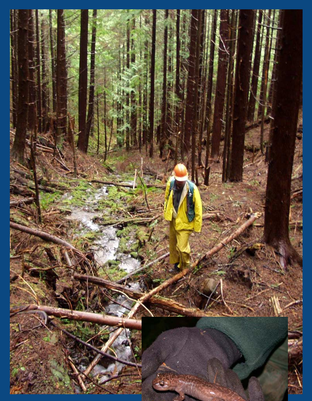
Fig. 4 Hemispherical photographs of the forest canopy were taken at permanent photo points before and after treatment. Photographs were analyzed using Gap Light Analysis 2.0 (GLA). A topographic mask was applied to each photograph prior to analysis.

Topographic masks can be used to model the terrain as viewed from a given photo point to compensate for shading caused by topographic vs. canopy effects. Topographic masks can also be used to control the extent of the analysis area. A small analysis area can be used to focus on the upper canopy by masking out mid-story branches, boles, and understory vegetation appearing at lower angles in hemispherical photographs.



Establishing the treatments

Coordination with local managers to determine the location of project sites began nearly two years before pre-treatment sampling was initiated. Treatments encompassed entire headwater basins. The design goal of random treatment assignment was precluded in some cases by the added cost of road building and additional environmental impacts. Further difficulties arose in implementation of the basin-wide clear-cut treatment as a result of communication lapses with foresters and last minute operator substitutions. Constant compliance is an expensive but necessary requirement for operations scale experiments.



Need for Active Adaptive Management

A recent literature review (http://www.dnr.wa.gov/hcp/type5/default.html) of forest management impacts on coastal PNW headwater streams showed the vast majority (approx. 85%) of hypotheses were based primarily on factual observation and case studies; few hypotheses were developed from designed experiments (see Table1 for definitions). Modern adaptive management requires increased confidence that current and future management options are effective.

Table 1. Classification Criteria.

	Quantitative	Use of Untreated Controls	Replication	Statistical Analysis	Before / After Comparison	Geographic Scope
Observational	(x)		(x)			x
Case Study	x		(x)	(x)	x	x
Experimental	x	x	x	x	x	x

Key: Blank = N/A, (x) = conditional, x = required

WADNR State Lands HCP Conservation Strategy Development

The Washington Department of Natural Resources has prepared a long-term multi-species Habitat Conservation Plan covering approximately 1.6 million acres (650,000 ha) of upland and riparian areas in western Washington. The riparian ecosystem conservation strategy has the objective to maintain or restore salmonid freshwater habitat, and contribute to the conservation of other aquatic and riparian obligate species. The strategy created continuous 150-foot (45.7 m) buffers on fish-bearing streams and 100-foot (30.5 m) on larger non-fish bearing streams.

When the DNR HCP was written in 1997, there was insufficient information to complete a long-term headwater stream conservation strategy. The REMS project is designed as an empirical test of the range of future headwater management options and will provide information for the development and future effectiveness monitoring of a long-term conservation strategy for the WADNR HCP.

The Role of Our Research Partners

Partners are essential to successfully implementing large, replicated, operational-scale active management. Traditional stereotypes of operations managers who focus only on the "bottom line" and researches who are unduly independent need to change. In active adaptive management commercial operations can yield rigorous information.