U.S. Department of Agriculture, Forest Service
Pacific Northwest Research Station

Density Management and Riparian Buffer Study in Western Oregon

Phase 1 Results, Launch of Phase 2

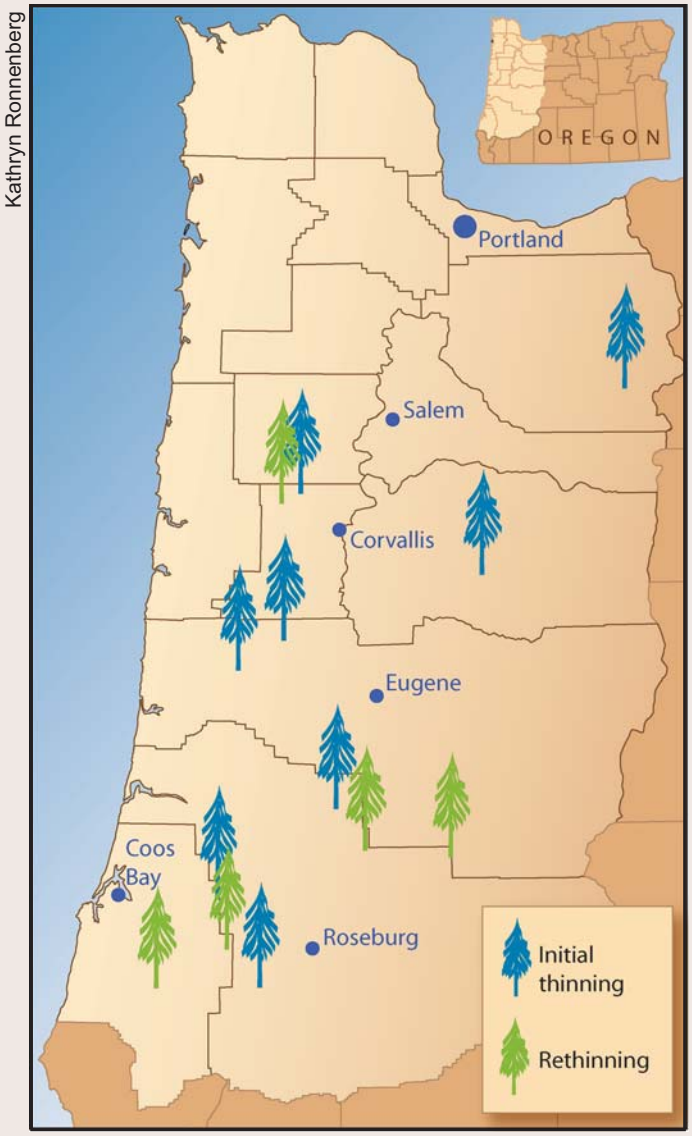
Paul Anderson

Can we expedite the development of late-successional forest conditions by applying thinning treatments to young forest stands? What effect will these thinning treatments have on headwater ecosystems? These broad questions lie at the foundation of the Density Management and Riparian Buffer Study (DMS) of western Oregon.

Density Management and Riparian Buffer Study in Western Oregon

Study Objectives

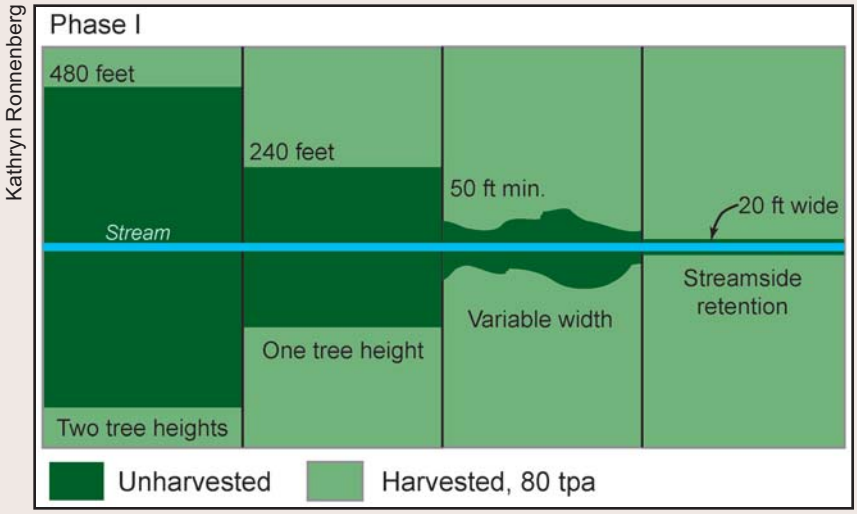
The DMS is a partnership among the Bureau of Land Management (BLM), USDA Forest Service Pacific Northwest Research Station, Oregon State University and the U.S. Geological Survey. It was initiated in 1994 to advance active management strategies to restore late-successional forest habitats, a key objective of the federal Northwest Forest Plan. The 12 DMS study sites are in mesic, low-elevation forests of Oregon's Coast and Cascade Ranges. The thinning treatments under evaluation leave stands with a high degree of spatial variation. DMS is one of several operational-scale management experiments in the region, but it is the only such study addressing the influences of thinning and buffers on riparian function and habitat.



The Density Management Study sites.

Key Management Objectives

- Develop stand-level density management treatments that accelerate late-successional habitat development while producing timber.
- Create stands with the following components in 120 to 150 years:
  - Large trees (30 to 50 inches in diameter)
  - Diverse species and forest structure
  - Multiple vegetation layers and diverse understory vegetation
  - Snags and downed logs of various sizes and stages of decay
- Integrate riparian and upland stand management prescriptions to provide habitat and timber.



Phase 1 of the Density Management and Riparian Buffer study was designed to test the effectiveness of different stream buffer widths for protecting animal assemblages and microclimate around headwater streams where thinning harvests were conducted upslope.

Study Treatments

Phase 1 and 2 treatments for DMS Initial Thinning and Riparian Buffer study

Treatment	Trees per acre* Phase 1 1997-2002	Trees per acre* Phase 2 2009-2011	Thinning pattern
Unthinned control	200-350	200-350	None
High-density retention	120	60	20-30% left unthinned in riparian reserves or leave islands up to 1 acre
Moderate-density retention	80	30	• 10% of stand cut in circular patch openings up to 1 acre • 10% left in circular leave islands • 15–20% left unthinned in riparian buffers
Variable-density retention	40 80 120	20 30 60	• 10% left in leave islands • 10% cut in circular patch openings • 15-20% left unthinned in riparian buffers

Phase 1 and 2 treatments for DMS Rethinning study

Treatment	Trees per acre* Phase 1	Trees per acre* Phase 2
Control—commercial thinned ~1970	100+	100+
Rethin	30-60	30

*All treatments except for the unthinned control include an additional 5 residual trees per acre for snags and 2 trees per acre left for downed wood.

To determine which silvicultural treatments can be used to meet these objectives, scientists designed three component studies to be conducted in two phases:

Phase 1

- An initial thinning study on young conifer stands 50 to 80 years old
- A riparian buffer study nested within the initial thinning study
- A rethinning study on previously thinned forests 70 to 100 years old

Matt Kluber

Phase 2

- A second thinning in the “initial thinning” study area and within the riparian buffer zones
- Further thinning in the rethinning study areas

Findings from Phase 1 and Phase 2 studies are helping scientists:

- Determine if density management treatments lead to differences in stand structure
- Evaluate the responses of various plant and animal taxa and their habitat conditions to density management

Phase 1 Findings

Vegetation Responses to Thinning Treatments

Late-successional forests in the DMS study region are characterized by multilayered tree canopies, high spatial heterogeneity of trees and understory vegetation, and large snags and downed wood that support a variety of flora and fauna. The alternative density management treatments were conceived to enhance the development of these characteristics, previously lacking in even-aged conifer stands. Klaus Puettmann and Adrian Ares with Oregon State University are the lead investigators for the DMS vegetation component.

Klaus Puettmann

Understory vegetation and tree regeneration in a gap and interior forest at a study site.

Key Question

Does thinning affect overstory growth and development of late-successional characteristics?

- Average tree growth increased, but stand-level growth was similar to unthinned control plots.
- Tree regeneration was highly variable, but more prevalent after thinnings.
- Richness of herbs and shrubs increased.
- Exotic species remained a minor understory component.

Key Question

What effects do gaps have on vegetation?

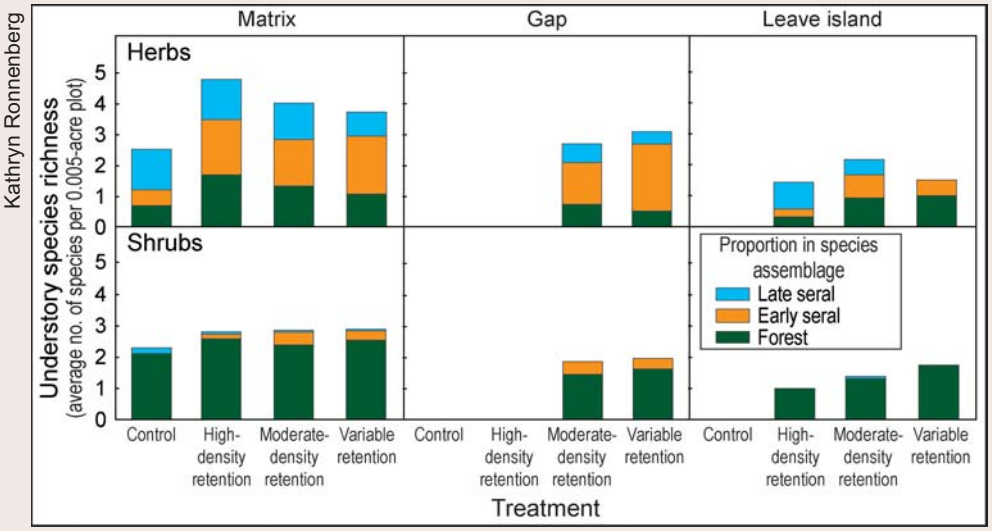
- Gaps allowed establishment of early-successional species.
- Larger gaps were more effective at creating species heterogeneity.
- Gap influence on understory vegetation did not penetrate the neighboring forest.

Key Question

What is the relative contribution of the forest interior, gaps, and leave islands to species richness?

- Understory vegetation richness was similar in leave islands and the unthinned controls.
- Treatments, such as gaps and leave islands, make important contributions to heterogeneity of understory vegetation.

Kathryn Ronnenberg



Thinning treatments increased the number and variety of understory species (O.M. Hubbard site).

Habitats and Vertebrates Associated with Headwater Streams

Headwater streams differ from larger fish-bearing streams within a watershed. They support distinct assemblages of species and transport important nutrients and woody structure downstream. In the Oregon Coast Range, headwater streams compose up to 70 percent of some watersheds, so decisions regarding their protection affect use on a significant amount of land. Deanna Olson, a research ecologist with the PNW Research Station, leads the investigation on the physical characteristics of headwater drainages and the habitats of the amphibians and fish species that live there.

Key Question

How are headwater streams distinct?

- Many are spatially intermittent—they dry up or flow underground before resurfacing.
- They are the primary habitat for some species. Torrent salamanders (e.g., *Rhyacotriton variegatus*), for example, were frequently found in these areas, making them species to consider for headwater management.
- Different animal assemblages occur in different parts of the headwater.

Key Question

Did riparian buffers protect headwater vertebrates and their habitat from the effects of upslope thinning treatments?

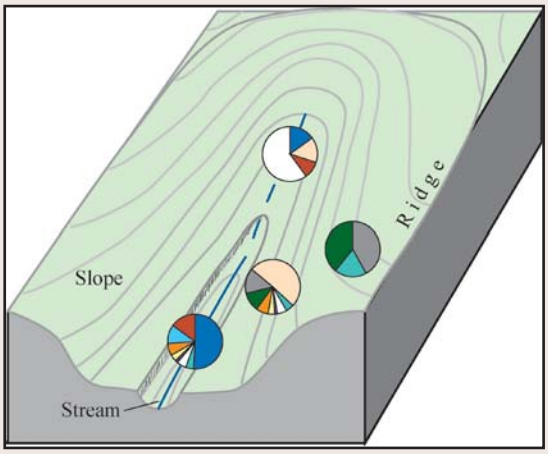
Treatments were a relatively benign disturbance to stream habitats and species 1 to 2 years after treatment.

- Upland salamanders sometimes were detected less after thinning.
- Combined buffers and thinning may provide connectivity for a suite of species across adjacent headwaters.

William P. Leonard

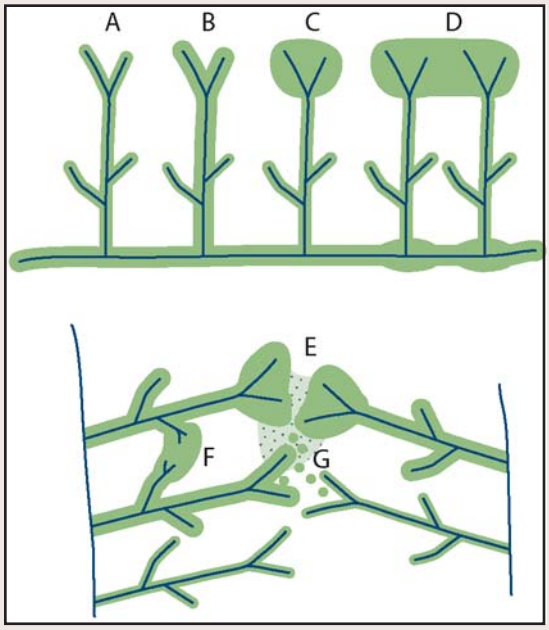
Torrent salamander, *Rhyacotriton variegatus*.

Kathryn Ronnenberg



Headwater forests have a rich amphibian fauna. The composition of amphibian species, denoted by the pie charts, differs throughout the headwater drainage. The torrent salamander, the white pie wedge, was found predominately in the upper reaches of headwater streams. This is a species of concern that may warrant headwater management consideration.

Kathryn Ronnenberg

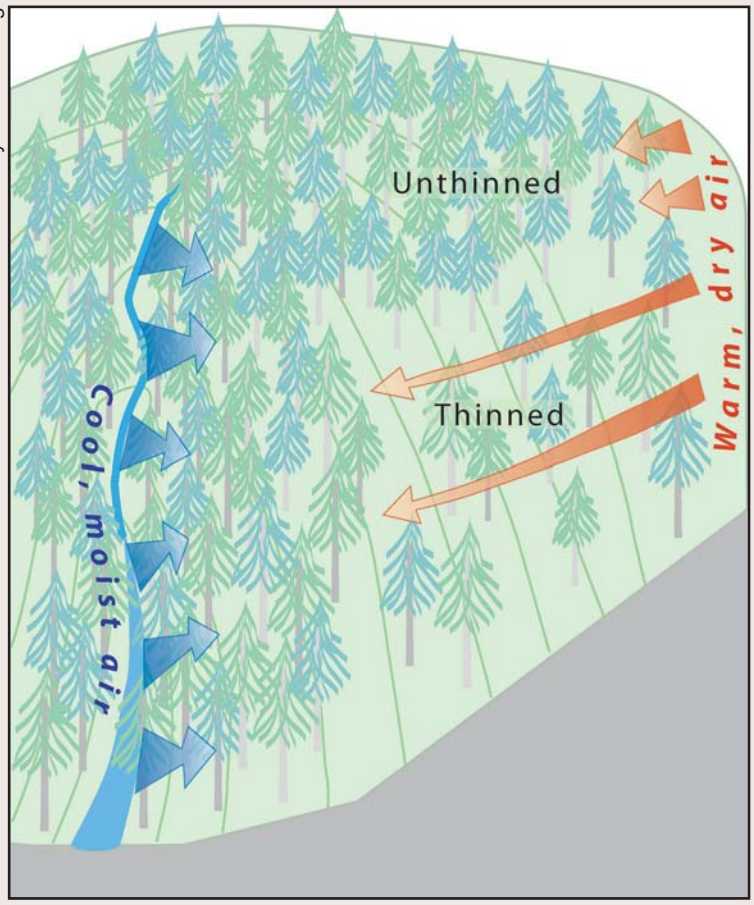


Some species within headwater areas may benefit from habitat corridors that connect riparian areas across ridgelines. Here, a "spaghetti and meatball" reserve design illustrates how stream buffers of different widths (the spaghetti) provide streamside habitat, and patch reserves (the meatballs) with or without thinning provide connectivity among streams over ridgelines.

Riparian Microclimate and Microhabitats

Riparian areas are integrally linked to upland forests through vegetation that regulates air and water temperatures, humidity, and the exchange of nutrients. Microclimate and microhabitat conditions were monitored along transects extending from headwater streams, up through the riparian zone and into the adjacent upslope forest where the various thinning treatments had been applied. Paul Anderson, a research forester with the PNW Research Station, leads this research.

Kathryn Ronnenberg



Researchers monitored humidity and air and soil temperatures to evaluate how thinning treatments affected the microclimate and microhabitats in headwater riparian areas and adjacent uplands.

Key Question

How do thinning treatments affect microclimates and microhabitats in headwater riparian areas and adjacent uplands?

- Microclimate varied with distance from stream: air and soil temperatures tended to increase and relative humidity decreased further from streams.
- With minimum buffer widths of 45 to 75 feet, air temperatures within 30 feet of the stream were little affected by upslope thinning.
- Microclimate differences among treatments occurred predominately during the warmest part of the day midsummer.

Paul Anderson

Additional Studies

Numerous other studies have been conducted in conjunction with the DMS. Assessments of arthropods, birds, lichens, and fungi, for example, provide valuable baseline information that contributes to a broader understanding of ecosystem response to thinning treatments. Many of these studies are available at the DMS Web site: http://ocid.nacse.org/nbii/density/index.html

Phase 2 Begins

Phase 2 of the Density Management and Riparian Buffer study seeks deeper understanding of the links between density management, forest response, plant successional patterns, and effects on headwater ecosystems. Building on phase 1 findings, phase 2 addresses the following questions:

- Does the overstory canopy need to be rethinned to maintain the enhancements of understory vegetation and tree regeneration arising from phase 1 thinnings?
- Will riparian buffers continue to effectively mitigate upslope thinning effects if stand densities are reduced below phase 1 levels, or if the buffer itself is thinned?

Habitat and species-specific surveys are underway in preparation for phase 2 treatments beginning in 2010. These survey data will enable an examination of responses approximately 10 years after the initial treatments.

Paul Anderson

Local Questions, Watershed Relevance

The response of a headwater stream to thinning treatments cascades throughout the watershed. Findings from the DMS study will help land managers and policymakers develop management plans to produce a sustainable level of timber production while maintaining:

- **Water quality**—Humans, fish, and many other species require clean water, and temperature is a critical issue for threatened fish species living lower in the drainage system. Headwaters also contribute important nutrients and woody structure to downstream habitats.
- **Biodiversity**—Late-successional forests and riparian areas are rich in flora and fauna.
- **Ecosystem services**—Clean air, recreational opportunities, and nontimber forest products are just a few of the many other benefits humans receive from healthy ecosystems.

Adrian Ares

Phase 1 thinning increased vegetative diversity, but it is unknown how long these thinning effects will last.

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Web Resource

Additional information, including reports and publications from the Density Management and Riparian Buffer study, can be found at: ***http://ocid.nacse.org/nbii/density/index.html***

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For Further Reading

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