Bureau of Land Management's Density Management Study

Forest management on federal lands in western Oregon and Washington changed dramatically with the listing of the Northern Spotted Owl as a threatened species under the Endangered Species Act in 1990. In 1993, federal scientists and land managers were directed to produce a regional plan to protect and restore late-successional forest habitat and species, while simultaneously providing for a sustainable level of timber production. The resulting Northwest Forest Plan (1994) also called for the development of new silvicultural systems to meet these multiple objectives. The Bureau of Land Management (BLM) established the Density Management Study (DMS) in 1994 to develop and test options for young stand management to meet Northwest Forest Plan objectives in western Oregon.

The DMS was initiated by a partnership between the BLM and the U.S. Geological Survey (USGS), which quickly grew to include Oregon State University (OSU), the U.S. Forest Service Pacific Northwest Research Station (PNW), and Region Six of the U.S. Forest Service. The CFER program provides administrative and outreach support for the DMS and promotes new research opportunities on DMS sites. Each of these partners is represented on the DMS Steering Committee, a group that provides strategic and funding advice to the DMS.

Forest Service U.S. Department of Agriculture

OSU Oregon State University

USGS science for a changing world

CFER Cooperative Forest Ecosystem Research

The DMS demonstrates and evaluates different approaches to managing 40–70-year-old forest stands on low elevation sites in western Oregon to produce and maintain late-successional characteristics. Scientific and management objectives include:

- Evaluate effects of alternative forest density management treatments on important stand and habitat attributes (large trees; standing and down dead wood; understory trees, shrubs, and herbs; vertical distribution of tree canopy; and spatial distribution of trees, shrubs, herbs, and dead wood)
- Determine treatment effects on selected plant and animal taxa (amphibians, arthropods, mollusks, nonvascular plants, and fungi)
- Assess the combined effects of density management and alternative riparian buffer widths on aquatic and riparian resources
- Use DMS sites to develop operational approaches to implementation of new prescriptions, and improve methods for effectiveness monitoring of plant and animal taxa
- Use DMS sites to share results of on-the-ground practices and study findings with land managers, regulatory agencies, and policy-makers
- Use results from DMS to conduct a long-term adaptive management process where management implications and policy changes are regularly evaluated and changed as needed

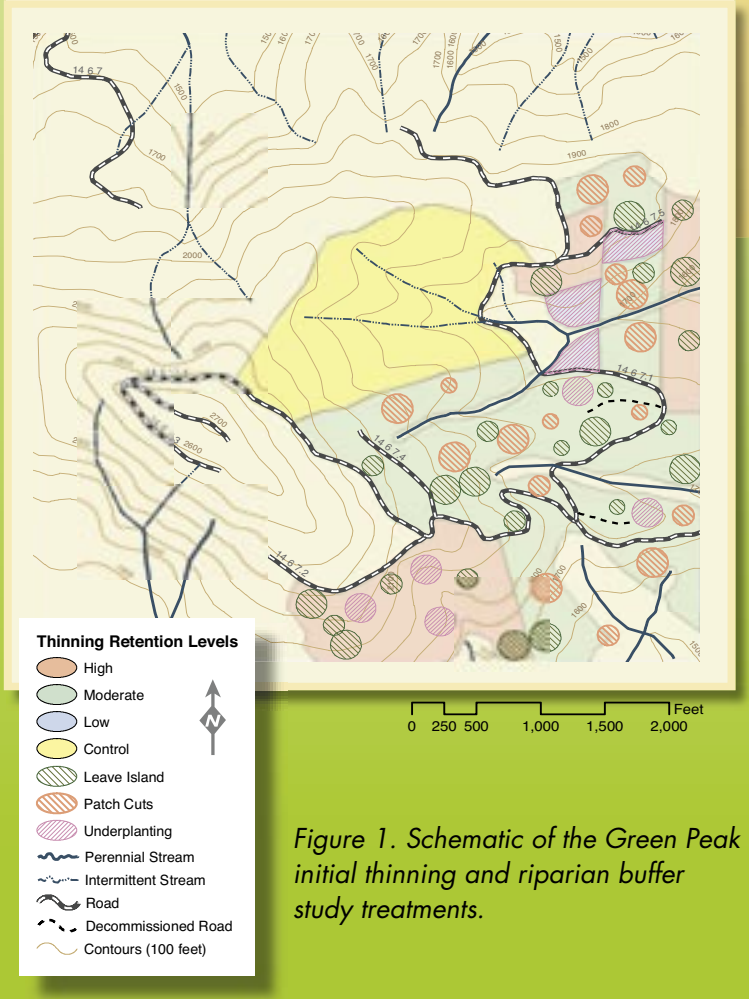

Figure 1. Schematic of the Green Peak initial thinning and riparian buffer study treatments.

Methods

Study Treatments

The DMS consists of three sets of treatments: initial thinning, riparian buffer widths, and rethinning.

The initial thinning treatments were installed in 40–60-year-old stands that had never been commercially thinned. Four stand treatments of 30–60 acres each were established at seven study sites: 1) unthinned control (200–350 trees per acre [TPA]), 2) high density retention (70%–75% of the stand thinned to 120 TPA, 20%–30% left unthinned in riparian reserves or leave islands of three sizes [0.25, 0.5, and 1.0 acres]), 3) moderate density retention (60%–65% of the stand thinned to 80 TPA, 10% of the stand cut in circular patch openings [0.25, 0.5, and 1.0 acres], 10% left in circular leave islands [0.25, 0.5, and 1.0 acres], 15%–20% left unthinned in riparian buffers), and 4) variable density retention (10% thinned to 40 TPA, 25%–30% thinned to 80 trees per acre, 25%–30% thinned to 120 TPA, 10% left in leave islands [0.25, 0.5, and 1.0 acres], 10% cut in circular patch openings [0.25, 0.5, and 1.0 acres], and 15%–20% left unthinned in riparian buffers). Figure 1 displays the layout of the treatments in the Green Peak study site in the Oregon Coast Range.

Within the control, high density, and moderate density treatments, nine 1-acre areas were underplanted with western hemlock (*Tsuga heterophylla*) and western redcedar (*Thuja plicata*). Western hemlock, Douglas-fir (*Pseudotsuga menziesii*), western redcedar, and grand fir (*Abies grandis*) were planted in all patch openings and in the 40 TPA areas of the variable density retention treatment.

The high density retention treatment most closely resembles a traditional commercial thinning for timber production. Whereas the effects on accelerating the development of forest structure may be short-lived, this treatment retains many options for later stand entries. The moderate density retention treatment allows more growing space for understory trees, shrubs, and herbs, and reduces competition among overstory trees for a longer period of time. Within stand complexity is created by openings and leave islands. The variable density retention unit results in a highly diverse mix of conditions over a small spatial scale, providing the highest level of spatial heterogeneity among the treatments.

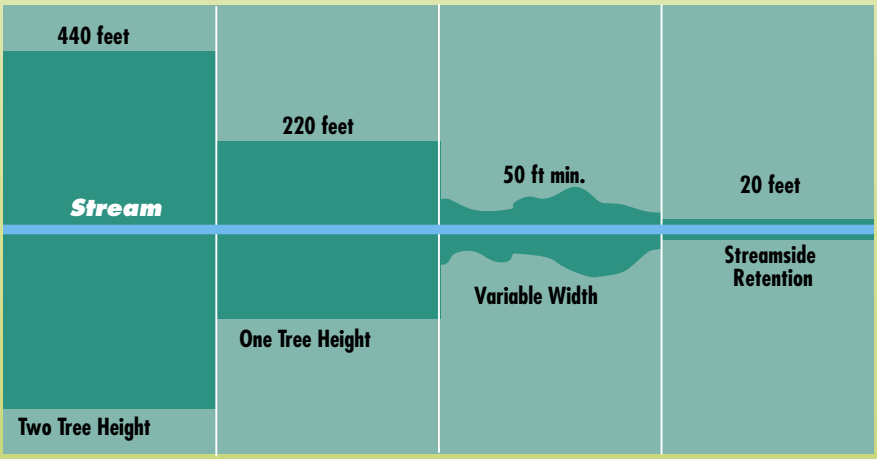

Figure 2. Schematic of the riparian buffer treatments.

The riparian buffer treatments were nested within the moderate density retention treatment of the initial thinnings at each of the seven study sites. Alternative riparian buffer width treatments included: 1) streamside retention (effectively equal to one tree canopy width, or 20–25 ft), 2) variable width (buffer follows topographic and vegetative breaks, approximately 50 ft), 3) one full tree height (approximately 220 ft), and 4) two full tree heights (approximately 440 ft). Physical limitations at each site usually prevented installation of all four treatments, and the two tree height treatment fit the ground only at one site. Figure 2 shows a schematic layout of the riparian buffer treatments.

Riparian buffers primarily protect aquatic dependent habitats, species, and ecological processes such as stream shading and input of large wood to streams. Streamside retention is expected to retain bank stability and control erosion, whereas wider buffers are thought to protect riparian habitat and microclimate. These treatments are implemented in small headwater streams where the aquatic and riparian values and buffer effects are least known.

The rethinning studies were installed in 60–70-year-old stands that had been previously thinned. Each study stand was split into two parts: one part as an untreated control (~100 TPA), and the other part designated as a rethinning (30–60 TPA). Rethinning treatments were installed to create horizontal variability in overstory tree density, but there were no specific leave island or patch cut objectives. Understory trees were generally abundant on these sites, and none of the sites were underplanted. The rethinning treatment was intended to represent a potential future option for a second entry thinning 15–25 years after an initial thinning.

Location

Study sites were selected to be broadly representative of mesic, low-elevation forests in western Oregon. Sites are located in both the Coast Range and the Cascade Range. Coastal wet forests and dry forests of southwest Oregon are not included in the study.

Seven sites host a full set of initial thinning treatments (three on the BLM Salem District, two on the BLM Eugene District, and one each on the BLM Roseburg and BLM Coos Bay Districts; Figure 3). Three similar sites on the Siuslaw National Forest expand the scope of the riparian buffer study in the Coast Range. Rethinning treatments are located on five sites (two on the Salem District, and one each on Eugene, Roseburg, and Coos Bay Districts; Figure 3.)

Figure 3. Location of the Density Management Study sites.

Component Studies

Several component studies are currently underway addressing DMS objectives. Measurement, remeasurement, data management, and analysis were ongoing for each of these components in 2003. Publications summarizing initial findings are planned for 2004.

Vegetation

Vegetation response to study treatments is a primary DMS objective being addressed through a network of permanent plots. Randomly allocated plots are scattered across all treatment areas to characterize treatment implementation and whole-treatment response. These plots also provide information about the influence of overstory conditions on understory vegetation diversity and development. Transects across patch cut and leave area boundaries are being used to measure island and patch dynamics as affected by island and patch size and neighbor-

hood. A full suite of overstory and understory tree, shrub, herb, and dead wood variables are being monitored. Klaus Puettmann (OSU) is the lead investigator for this component.

Aquatic Vertebrates

DMS sites are being used to assess potentially unique aquatic resources in managed headwaters and evaluate the effects of thinning in riparian reserves. Pre- and post-treatment surveys along streams with alternative riparian buffer widths and moderate retention thinning measure fish and amphibian abundances and their habitats. Terrestrial salamanders and mollusks are being monitored on two sites. Deanna Olson (PNW) is the lead investigator for this component.

SL Collins

Riparian microclimate and Microhabitats

Edge effects in riparian areas generated from nearby density management practices have not been well described to date. Microhabitat and microclimate gradients indicate changes in the physical environment due to density management practices and alternative riparian buffer widths. At seven DMS sites transects oriented perpendicular to the same streams being monitored for aquatic vertebrates extend from stream center to approximately 240 ft past the end of the riparian buffer. Microhabitat and microclimate measurement points are distributed along these transects. Available light, air and soil temperature, streambed temperature, relative humidity, vegetation, and overstory trees are measured at each point. Samuel Chan (PNW) is the lead investigator and Paul Anderson (PNW) is a co-investigator for this component.

Arthropods

Aquatic and terrestrial arthropods add significantly to the beauty and biodiversity of forest and stream ecosystems, are significant links in many food chains, and are important regulators of nutrient cycling processes. The biodiversity and biomass responses of aquatic and terrestrial arthropods to thinning and to alternative riparian buffer widths are being evaluated on three DMS sites through pitfall and emergence traps. Andrew Moldenke (OSU) and Robert Progar (PNW) lead this component.

Leave Islands

Green tree retention has emerged as an important silvicultural strategy designed to maintain plant and animal diversity within managed forest stands. The objective of this component is to evaluate the relative effective-

ness of various sizes of green tree aggregates (leave islands) in providing refugia for low mobility species including vascular plants, amphibians, mollusks, and arthropods. Species abundance and diversity in leave islands of different sizes are being compared to thinned areas and to unthinned controls. Stephanie Wessell (OSU), working under Deanna Olson's and Richard Schmitz's (OSU) direction, is leading this component of the study.

Preliminary Research Results and Management Implications

Since its inception, interest in the DMS has been high. Numerous field tours and workshops have enabled researchers and forest managers to visualize the effects of various silvicultural prescriptions on forest structure and composition and discuss the potential effects of different management practices on future stand conditions. For example, in 2003 approximately 1,125 individuals were exposed to the DMS through 10 field tours and 10 presentations at workshops and symposia. In addition, numerous publications sharing initial findings are in preparation or have been published.

Preliminary results are providing a basis for monitoring and adaptive management in young forests of the Pacific Northwest. Young stand management decisions must proceed on an ongoing basis, and DMS outreach activities are helping inform these decisions. Interaction and dialog among resource managers, scientists, and citizens increase the awareness and flow of new ideas to all concerned. Although these activities and outcomes are important, final results will be demonstrated on the ground as treated stands develop over the coming decades.

Study Timeline

Thinning treatments were implemented on the 12 study sites between 1997 and 2002. Permanent vegetation plots were established in each stand soon thereafter. Remeasurement of permanent plots is scheduled to occur periodically thereafter on a 5-year cycle. Each component study follows a similar timeline. Major analyses and reports are expected on a 5-year cycle.

For more information on the current status of these studies, please contact John Cissel, DMS Coordinator (jcissel@or.blm.gov, 541.683.6410).