Built for the Future: New Directions in Silviculture Research and Demonstration at Montana's Lubrecht Experimental Forest

Christopher R. Keyes[1] and Thomas E. Perry[1]

Abstract—Manipulative experiments at the University of Montana's Lubrecht Experimental Forest have long been set aside as permanent research and demonstration areas (RDA's) to communicate the tradeoffs among different stand management strategies. However, most of these have either degraded over time or have diminished relevance to contemporary forest management issues. An evaluation and rehabilitation of Lubrecht Forest's research and demonstration infrastructure is currently underway. Examples are presented of existing RDA's that are being refurbished, replaced, revised, or retired. New demonstration areas that exemplify the central theme of this rehabilitation effort—stand complexity and regeneration—are also described.

Keywords: silvicultural systems, stand structure, complexity, regeneration, reforestation.

Introduction

From its inception, the University of Montana's Lubrecht Experimental Forest (LEF) has included in its mission the study and demonstration of silvicultural practices and systems. At this 28,000-acre forest laboratory, manipulative experiments have been set aside as permanent reserves, or research/demonstration areas (RDA's), to communicate the tradeoffs among varying stand management strategies for ubiquitous forest types of the northern Rocky Mountains. Lubrecht Forest's RDA's have been widely utilized by many agencies, organizations, and landowner groups over the years, as well as legions of University of Montana students. But few new RDA's have been created since the 1980s. Many existing areas have suffered degradation, declined in their interpretative value, and lost much of their relevancy to contemporary issues.

An evaluation and rehabilitation of Lubrecht Forest's research and demonstration infrastructure is currently underway. Stand complexity and regeneration are the central themes that underlie this forest-wide rehabilitation effort. It is an effort that is designed to equip Lubrecht with a deliberately prepared suite of relevant RDA's, and a plan for their use and maintenance that will sustain this experimental forest's relevance into the future.

Lubrecht Forest Management

Lubrecht Forest was established in 1937, a gift from the Anaconda Company to the State of Montana under the auspices of the Montana Forest & Conservation Experiment Station (MFCES). Through subsequent additions, LEF now totals

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[1] Applied Forest Management Program, Montana Forest & Conservation Experiment Station, University of Montana, Missoula, MT.

28,000 acres of forest and range. Permanent study areas date back to 1948, but most RDA's were established after 1981 when the state legislature established the Mission-Oriented Research Program, an MFCES program that would continue to 2007 and provide much of the impetus for research and demonstration occurring at LEF. Today the MFCES's Applied Forest Management Program, initiated in 2007, oversees the long-term studies and demonstration areas at Lubrecht and leads the development of new research and demonstration opportunities.

Lacking a full management plan, Lubrecht Forest's management framework is summarized in a 1996 brief, titled "LEF Management Guidelines." LEF's stated mission (according to that document) is, "Natural resource study, demonstration, and learning, and public use in a forest setting." This goal is to be met via five stated management goals (underlining and italics added for emphasis):

1) Serve Montana citizens through research, demonstration, instruction, and public use.
2) Be available for a wide variety of research studies, demonstrations, and learning opportunities.
3) Demonstrate management which leads to healthy, sustainable ecosystems
4) Demonstrate a variety of forest management techniques applicable to ecosystems in the northern Rocky Mountains.
5) Generate revenue to support MFCES activities through the sale of goods and services *in a manner consistent with other goals* for the forest.

Operational management at LEF is best described as a conservative custodial model, with origins as a young regrowth forest with limited economic value. Much of the forest consists of same-aged thinned or unthinned forests. Over time, this custodial management model has changed little, but the forest itself has changed dramatically through growth and succession. Young stands on the forest are rare, the result of infrequent regeneration harvests or occasional stand-replacing disturbance events. The limited emphasis on strategic regeneration harvesting has limited structural diversity across LEF and has fostered the development of unmanaged understory cohorts that are uniformly dominated by Douglas-fir. These unfortunate consequences demand an innovative silvicultural approach to their remediation. Recently, substantial and widespread bark beetle mortality is forcing a more deliberate management focus on the next generation forest. A dynamic approach to promoting resilience and adaptability in that forest is a top priority.

Lubrecht's Silviculture RDA's

Lubrecht has a notable collection of long-term installations for research and demonstration of silvicultural practices. Although Lubrecht has been the site of numerous studies, relatively few of these have been established as permanent installations. Some of Lubrecht's RDA highlights are frequently used by diverse users, and hence they are considered among the most important for protection and maintenance. Two examples are the Fire & Fire Surrogates study area and the Uneven-aged Silviculture study areas. Part of a national network, LEF's large Fire & Fire Surrogates study, established in 2002, is used to evaluate the long-term effects and tradeoffs of fire and thinning to reduce forest fuels and restore ponderosa pine (*Pinus ponderosa* C. Lawson) forests. A smaller example is the Uneven-aged Silviculture study, established in 1984 with the objective of demonstrating the potential of uneven-aged silvicultural methods to achieve forest health and restoration goals. With regular data collection on a 5-year basis since 1984, and located immediately adjacent to Highway 200, it lends itself well to frequent use.

These and a few other gems notwithstanding, examples also exist at Lubrecht of RDA's that are essentially demonstrating decay. Missing, outdated, and damaged signs minimize the interpretive value of otherwise useful sites. In other areas, normal growth and decay have put RDA's beyond their original shelf lives. Examples include the group selection cutting unit of the Silvicultural Systems area, where growth has made the group selection gaps indistinguishable from the forested matrix; in another RDA designed to illustrate thinning and slash management techniques, piles and twitches have deteriorated to indistinguishable mounds covered in needles. Most recently, major levels of mortality from a landscape scale bark beetle outbreak has substantially altered many RDA's, forcing rapid assessments of their usefulness and creative responses to their treatment.

Evaluation of Existing RDA's

To address these situations, a complete evaluation of Lubrecht's RDA's is underway. The effort began with an inventory and compilation of relevant data, and is now progressing in a continuous screening and sorting of RDA's into condition classes that will help dictate their future management. These categories are:

- Refurbish—useful and relevant, but requiring service; continue the original management strategy with periodic treatment updates consistent with the original intent of the RDA.
- Replace—still conceptually useful, but has outlived its research and/or demonstration shelf-life due to mortality or decay; conduct fresh treatments to revitalize lost elements, or else identify new location where original conditions can be re-established.
- Revise—useful stand structure but treatments reflect outdated strategies or are lacking in contemporary value; enhance the site with new hypotheses and/or treatments that best exploit the treatment histories and longitudinal data.
- Retire—beyond salvage; site is so deteriorated that its usefulness is minimal; return to operational landbase.

The most challenging of these is the "Revise" category. An example is provided by the Levels-of-Growing-Stock study areas. One-time low thinnings were conducted in 1982 (three pure stands, three mixtures) to demonstrate the effect of thinning on stand structure and tree growth. Unmanaged since 1982, they adequately exhibit the effects of a one-time thinning, but they are not representative of a silvicultural strategy for continued density management. For these RDA's, strategies of density management based on stand density index (SDI) are being developed to demonstrate the potential of long-rotation thinning regimes and to evaluate tradeoffs in growth, value, and stand structure among them. Alternatively, where understory development has been substantial, treatment options to address advanced regeneration may also be desirable, for example, overlaying a precommercial thinning of the understory cohort to promote vigor, or else conducting understory burn treatments to retard ladder fuels development.

New Directions

Even as existing studies are being evaluated and modified, new studies are being developed and installed. These are designed to address topical voids in the Lubrecht RDA infrastructure and to meet contemporary and projected needs. They mainly focus on structural complexity and regeneration. Examples include managing for spatially irregular stands using the experimental 'irregular selection' technique that has been applied in Idaho (Graham and Jain 2005, Graham and others 2007), and by an adaptation of the experimental 'Acadian Femelschlag'

method being tested in Maine (Seymour 2005). Others include the establishment of Nelder spacing wheels with pure and mixed species plantings; analysis of regeneration dynamics in salvaged and unsalvaged beetle-kill stands; spatially irregular planting to promote stand differentiation; and the transitional silviculture of aging, even-aged regrowth stands to develop pure and mixed two-age stands. Consistent with this focus on fostering resilience during the regeneration phase, Lubrecht Forest's operational capacity for reforestation will be enhanced with the addition of a micro-nursery over the next several years. This new infrastructure will provide the forest with the ability to better link reforestation to harvesting activities, and will also provide LEF with new opportunities for studying and demonstrating aspects of small-scale seedling production.

Conclusions

Understanding and forecasting Lubrecht Forest's current and potential future users is helping to guide this planning effort. In the past, Lubrecht's silviculture RDA's were used by many agencies, organizations, and landowner groups, as well as legions of University of Montana students. In the future, public participation in natural resource decision-making is expected to grow as it has during past decades. By providing effective, accessible research and demonstration areas with relevance to contemporary and anticipated forest management issues, by creating an array of stand structures and compositions for yet unknowable future uses, and by developing new and innovative opportunities for their utilization in public outreach and learning, a refreshed and revitalized Lubrecht Forest will be positioned for continued relevance and leadership in the study and promotion of sustainable silvicultural management.

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