RTI News

Newsletter of the Rural Technology Initiative

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Using LMS to Help With Stewardship Planning at the Monastery of St. Gertrude

The application of knowledge and theories learned in undergraduate education culminates with the development of a senior project. This experience is vital for independent work in the forest sector and helps build excitement and experience in resource management. The Monastery of St. Gertrude in Cottonwood, Idaho was the focus of our senior project, which was an exploration into multi-use management and stand projection/prediction models.

The Sisters of St. Gertrude depend on sustainable and ecologically sound timber harvests to monetarily support their community, preserve wildlife, encourage life long learning, and create an atmosphere of peace for the many visitors and retreats that are held on their property. In 1994, Sister Carol Ann Wassmuth developed a Forest Stewardship Plan for the 120 acres of forested land surrounding the monastery. The objectives of this plan were to maximize aesthetic value, provide a peaceful retreat for visitors, maintain and create wildlife habitat, practice ecologically sound and sustainable management, improve forest health, and, whenever possible, generate income from grazing allotments and timber harvests.

Through further education and training to hone her management skills, Sr. Carol Ann began to realize that over the past 100 years of management, most of the superior quality trees had been removed through the process of high-grading that leaves only the low value or deformed trees. She developed a new plan that focused on returning the ecosystem and tree composition to one more indicative of a healthy forest in that area, which is widely spaced Ponderosa pine and Douglas-fir. The first stage of this plan is now complete, and she looks forward to developing the next appropriate action to improve forest health, composition, and serenity within the monastery's forest.

Sr. Carol Ann was very excited to learn about the availability of the Landscape Management System (LMS) and other technology tools that can help her visualize her objectives and assess their economic viability. The LMS program and its various add-ons provide a comprehensive platform from which management decisions can be made. LMS can demystify the effects of active management by providing the manager with projection and visualization tools to supplement knowledge and intuition about the appropriate management pathway. Various charts, tables, and analysis tools are available within LMS and work in conjunction with personalized treatment scenarios to provide the support and confidence in any chosen alternative.

Sister Carol Ann Wassmuth discusses management options for the St. Gertrude Monastery with forest management student Brian Spradlin.

To get the monastery started with LMS, we gathered and entered the necessary forest inventory information using the LMS Inventory Wizard. We then developed and simulated three different management pathways to demonstrate how different management options can be assessed relative to the goals of the monastery. The specific

continued on page two

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RTI Director's Notes

As the university's academic year comes to a close, many of our affiliated students have either finished or reached significant milestones toward their degrees. The diversity and rigor of the research done by RTI affiliated students is impressive. We feature these students and their work in this edition of RTI News.

Our cover story features an LMS case study of an Idaho Monastery done by undergraduates Daisuke Sakuma and Brian Spradlin. Daisuke and Brian were introduced to LMS in the forest economics course taught by RTI staff member Kevin Zobrist, and they decided to explore the use of LMS on a non-industrial ownership for their senior project. Brian has graduated with a BS in forest management and will be returning in the fall to begin the Peace Corps Master's program. Daisuke is almost finished with his BS degree and is considering his post-graduation options.

Derek Churchill presents the results of his Master's project, which was an investigation of uneven-aged management in the dry Douglas-fir forests at Fort Lewis, WA. Derek graduated this year with an MS in Silviculture. Also graduating this year was Michael Andreu, who completed his Ph.D. in Silviculture and has accepted a position as an assistant professor at the University of Florida. Michael reports on his dissertation study, which was an investigation of the use of small diameter wood as a source of bio-energy.

Ph.D. student Elaine Oneil recently passed her preliminary exam. She is now working on her general exam, at which point she will become a Ph.D. candidate and proceed with her dissertation. Elaine reports on her proposed research topic, which is an investigation of the site factors that influence mountain pine beetle outbreaks in Eastside pine forests.

As we recognize the achievements of these students and wish them well in their future endeavors, we are also pleased to welcome two new graduate students this fall: Justina Harris and Hiroo Imaki. Justina Harris finished her BS this year with a double major in conservation forestry/wildlife science and a double minor in urban forestry/quantitative science. Mrs. Harris is skilled in the use of GIS and forestry software programs such as LMS. She will begin a Research Assistantship with RTI by working this summer on land use trend analysis. This fall she will begin working on her MS in Forest Engineering and Hydrology.

Hiroo Imaki is a graduate of Tokyo University of Agriculture and Technology where he earned his Ph.D. in Wildlife Conservation studying Japanese Monkeys and their interaction with people. Since being in the US he has attended the Green River Community College Forestry Program and worked on various GIS and remote sensing based conservation projects. Dr. Imaki will pursue an MS in Silviculture as an RTI Research Assistant. His goal is to combine his extensive expertise in wildlife sciences with a knowledge of forestry towards integrating management and biodiversity goals.

Working with undergraduate and graduate students is an important part of our mission, and the students make tremendous contributions to our work. We congratulate the students who have graduated this year and we look forward to working with our new arrivals this fall.

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"St. Gertrude" continued from page 1

management goals at St. Gertrude's are to provide aesthetic, recreational, and wildlife amenities to the community while providing the income required to remain self-sufficient. The three options that we demonstrated were 1) no action, 2) thinning all stands together, and 3) staggered thinnings to even out cash flow.

The Economatic program within LMS was used to analyze cash flows over time for each of our three management alternatives. We also tracked basal area over time relative to beetle outbreak risk thresholds (*Figure 1*), and we created visualizations showing the aesthetic outcomes of each alternative (*Figure 2*). These results demonstrate that carefully planned thinnings can provide steady income, maintain forest health, and also maintain aesthetics.

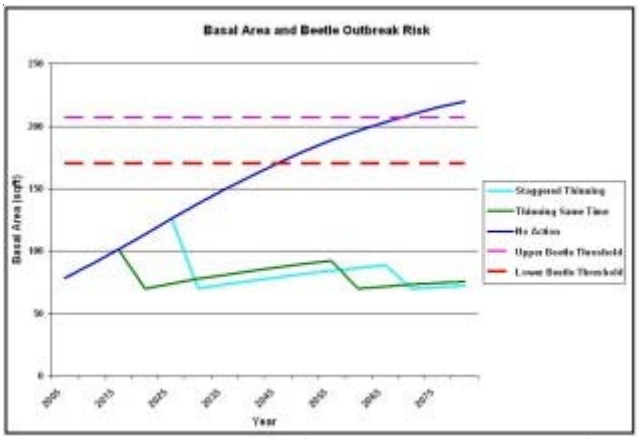

Figure 1: Basal area relative to beetle outbreak risk for three management alternatives.

The management alternatives that we demonstrated will serve as a baseline from which Sr. Carol Ann Wassmuth of St. Gertrude's can begin to explore the possibilities and uses of LMS and other technology tools. Our next step is to hold a one day "workshop" for the Sisters so they can better understand how these programs can be utilized for developing sound economic and ecologic management decisions.

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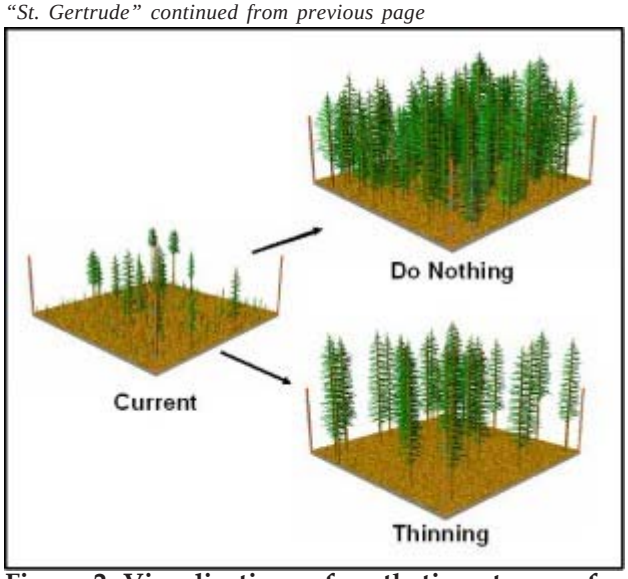

Figure 2: Visualizations of aesthetic outcomes for different management alternatives.

Sr. Carol Ann Wassmuth is excited about this technology and its implications in building and maintaining economic and ecologic sustainability. Equipped with these new management tools, Sr. Carol Ann will unquestionably remain an exemplary forest steward as awarded by the Idaho State Department of Lands. Her hope is to affect real change in the management goals and priorities of individual land owners and show that preserving forest values does not necessarily mean relinquishing economic viability.

- Daisuke Sakuma and Brian Spardlin, Seniors in Forest Management, University of Washington -

Editor's Note: *Streaming video of Daisuke and Brian's project presentation can be found at* ***http://www.ruraltech.org/video/topics/lms/index.asp***

Developing Density Thresholds to manage Mountain Pine Beetle Attack

Eastern Washington forests are increasingly impacted by insect outbreaks that are thought to be beyond their historic range of variability. One of the more destructive insects in eastern Washington is the Mountain Pine Beetle (MPB) (*Dendroctonus ponderosae* Hopkins). According to the 2004 Department of Natural Resources aerial survey, this tiny insect is responsible for upwards of 430,000 acres of mortality in pine species out of the approximately 2.8 million acres of pine dominated forests found across the state. Typically the largest trees and those in more densely stocked forests are attacked and killed by MPB. These trees are often under moisture stress which predisposes them to MPB attack - but not all sites demonstrate the same degree of stress at the same stocking levels. In looking for ways to reduce MPB caused mortality, we need to combine knowledge of plant physiology, stand dynamics, climate, and site specific ecological metrics to determine when a forest is too dense relative to its site and thus vulnerable to MPB infestation. Only then can we determine optimal treatments and effectively design density reductions to maintain healthy forest conditions.

There has been much research conducted on the processes related to outbreaks of MPB in the pine forests of western North America. At the stand level, studies have described the links between successful bark beetle attacks and stand parameters such as density, basal area, age, species composition, and crown competition. Risk rating systems have been developed using stand parameters, beetle population metrics, or some combination of the two to arrive at a broad, generalized categorization of risk, hazard, and susceptibility. The studies have greatly advanced knowledge of how the MPB interacts with its host tree, but not the underlying mechanisms that result in equally high mortality under stand conditions that are not similar. Researchers documenting MPB attacks have found a range of threshold values after which stands become susceptible. Those thresholds are based on stand parameters, but stand parameters are only one side of the equation. One linkage that requires more research in our efforts to understand thresholds is the role of site carrying capacity, which typically has not been incorporated into susceptibility assessments.

Defining relationships between carrying capacity, stand parameters, and climate is a useful conceptual approach to refine estimates of stand susceptibility to MPB. In order to visualize the relationships between stand carrying capacity and stand metrics, consider the familiar elements of the fire triangle as shown on the left hand side of *Figure 1*. The fire triangle consists of three equally important legs: fuel loading, topography, and weather. In fire management it is recognized that only the fuel leg of the triangle can be managed, but the other two legs are integral in estimations of risk and impacts during a fire event. On the right hand side of *Figure 1* is a similar model outlining the key elements of the MPB susceptibility triangle: stand parameters, carrying capacity, and weather/climate. In *Figure 1* note that the role of site carrying capacity in MPB infestation is analogous to the topography leg of the fire effects triangle. As is the case with topographic limitations during a fire event, management does not generally change site carrying capacity. However, by understanding the limitations imposed by carrying capacity and the weather/climate duo during a 'MPB event', more accurate prediction and mitigation activities can ensue.

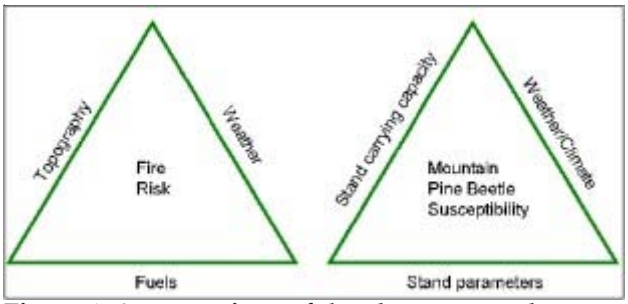

Figure 1: A comparison of the elements used in fire risk rating and mountain pine beetle susceptibility rating.

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Relationships between site carrying capacity and mortality from insect attack have been hinted at as early as 1987 when Fred Hall used data from Sartwell and Stevens 1975 work on bark beetles in the Black Hills as part of a site carrying capacity metric called Growth Basal Area or GBA. GBA is the basal area a stand can carry at 100 years of age and still maintain a growth rate of 1" per decade in radial increment on the dominant trees. GBA is a useful measure for assessing site carrying capacity relative to MPB attack because trees allocate photosynthate to survival and root and shoot growth first and only then to diameter growth and insect resistance in approximately equal ranking. Because of this equivalence in allocation, diameter growth provides a useable estimator for tree vigor and stand health relative to insect resistance. The question remains: How do we specify the links between a growth index like GBA and the forest health benefits we might obtain from managing stands to keep them within the carrying capacity of the site?

In order to arrive at estimates of site specific MPB thresholds as a function of variables influencing site carrying capacity it is necessary to analyze current stand growth patterns relative to site qualities such as slope, aspect, and elevation as well as historic and current weather patterns which influence moisture status on these sites. By linking site carrying capacity and climate/weather to current stand parameters, we believe we can develop better predictors of thresholds that would support a MPB outbreak. Analyzing density thresholds for MPB in this manner incorporates changes in risk and susceptibility associated with current and future weather and climate variables. As such the analytic methods may provide a useful context for assessing how thresholds for any given site will change as we move into altered climatic conditions.

- Elaine Oneil, Ph.D. Student, University of Washington -

Uneven-Age Management in Dry-Site Douglas-fir Stands at Ft Lewis, Washington

In the Westside forests of the Pacific Northwest, there is growing interest in uneven-aged management for ownerships with a mix of financial, wildlife habitat, aesthetic, and other objectives. Forest stands on Ft. Lewis, Washington are being managed for such a mix of objectives under an uneven-age silvicultural system that relies on natural regeneration. Under a partnership between Ft. Lewis, RTI, and the U.S.F.S. Pacific Northwest Research Station in Olympia, RTI graduate student Derek Churchill recently completed an assessment of uneven-aged management in dry-site Douglas-fir stands at Ft. Lewis.

Approximately 25% of the forestland (15,000 ac) at Ft. Lewis is dry-site Douglas-fir forest that established over the last 150 years on former prairies with coarse textured, droughty outwash soils. These stands have been managed for the past several decades with light thinning entries that remove 15-20% of standing volume at roughly 10-year intervals. In the understory, Douglas-fir is well established and is the only conifer species present. Ft. Lewis managers are relying on this naturally regenerated Douglas-fir to become overstory trees in the future as they continue the 10-year cycle of thinning entries. Managers wanted to assess the vigor of the existing Douglas-fir regeneration to determine whether it is a viable source of replacement trees and what management strategies are needed to ensure that the current silvicultural system is sustainable.

Factors influencing the vigor of Douglas-fir regeneration were investigated in thirteen stands at both the individual tree and stand levels. Indices of understory vigor (live crown ratio, height-to-diameter ratio, and crown density) were combined to produce two methods of quantifying vigor: a regression model that predicts volume growth as a percent of maximum site potential (relative volume growth) and a simple 4 class vigor classification system. The management implications of different levels of vigor were then defined by linking each of the 4 vigor classes with estimates of release potential and the likelihood of recruitment into the overstory without further release.

At the individual tree level, a strong relationship was observed between the relative volume growth vigor metric, overstory density, and competition from neighboring understory trees and shrubs. Regeneration with low levels of understory competition was shown to require an average of >35% full sunlight (<25% full site occupancy) to achieve levels of vigor where recruitment into the overstory without further thinning begins to be possible. If released, these high vigor trees will quickly attain growth rates comparable with trees that were never suppressed. Between 15-35% full sunlight (25-55% full site occupancy), regeneration was found to be growing too slowly to recruit into the overstory without release. However, understory trees did appear to have sufficient live crown and stem stability to be able to adequately respond to release. Below 15% full sunlight (>55% full site occupancy), regeneration was scarce and of poor vigor. For all vigor classes, regeneration with high levels of understory competition was found to require more light to achieve the same growth rates, and this effect increased in higher light environments.

A stand level model was also developed and demonstrated that while overstory density is the dominant factor influencing understory vigor, understory stocking, shrub cover, and the spatial arrangement of the cohorts are also important. Guidelines were developed for managing both the overstory and understory to help managers achieve the desired balance of stand volume growth, structural and habitat goals, and understory vigor.

While maintaining the overstory below 25% full site occupancy is necessary to recruit Douglas-fir advanced regeneration into the overstory, entire stands do not need to be thinned to

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"Uneven-Age Management" continued from previous page
these low levels. Rather, to balance the tradeoff between total stand volume growth and vigor of regeneration, patchy stands can be created in which some areas are treated with light thinnings from below to maximize volume growth, other areas are thinned more intensively to establish regeneration and maintain its release potential, and other areas are opened up to provide enough light for regeneration to grow vigorously and recruit into the overstory. In this last case, group selection and clumped retention, rather than more uniform heavy thinnings, appear to use growing space more efficiently. In addition to overstory thinning, pre-commercial thinning and shrub control around crop trees where regeneration is clumped in thickets or dense throughout a stand has the potential to significantly increase vigor levels, especially in more open stands. This study suggests that uneven-age management is ecologically possible with Douglas-fir on dry sites using a mix of single tree and group selection systems and can yield both market and non-market benefits.

- Derek Churchill, MS in Silviculture, University of Washington -

Economic, Social and Silvicultural Analysis of Converting Residual Forest Biomass to Methanol

The sustainable management of western forests is becoming increasingly difficult in the face of intense summer forest fires, large insect outbreaks, and limited silvicultural options due to the loss of markets for lower quality, small diameter wood. The ability to utilize low-quality, small-diameter wood has diminished over the past two decades as a direct result of the closure of pulp and saw mills throughout the region. Frequently blame is laid for these closures on the increased regulatory environment associated with wildlife habitat protection policies and the subsequent loss of a steady supply of raw material. Other researchers claim that the phenomenon of western mill closures is a function of a glut of raw material available both domestically and abroad. This research has changed the focus from finding a cause for this shift in demand for western wood products to finding alternative uses for these resources. It is looking at integrating small-scale, mobile wood biomass chemical conversion to liquid fuel (methanol) systems with emerging technologies in the renewable-energy sector (hydrogen fuel cells).

The economic feasibility has traditionally not favored such chemical conversion systems, but the combination of technology improvements for the conversion processes and policy shifts associated with green credit markets and other incentive based programs can shift the market dynamics in favor of such a system. Such a system would potentially provide a needed economic boost to rural economies once dependent on timber revenues by providing jobs in the logging sector, as well as in the production of wood-based methanol. Such a system would likely not be subject to the market fluctuations associated with excess raw material on the market, because the harvested wood would be coming from silvicultural operations normally considered pre-commercial. The added value is both in the production of energy from a negatively valued product as well as a silvicultural option that promotes a fire safe and vigorous forest. For additional information on this study please visit **http://www.cfr.washington.edu/research.Forest_Energy/**.

- Michael Andreu, Ph.D. in Silviculture, University of Washington -

Upcoming Events

July 9, 2005
Thinning for forest health workshop
Tolt River Highlands, Carnation, WA
For information contact Amy Grotta, WSU King County Extension, at (206) 205-3132 or amy.grotta@metrokc.gov

July 16, 2005
"Measuring your forest" field day
Poulsbo, WA
For registration/information contact Andy Perleberg, WSU Extension, at (360) 428-4270 or andyp@wsu.edu

August 13, 2005
Estate planning for family forest owners seminar
Everett, WA
For registration/information contact Andy Perleberg, WSU Extension, at (360) 428-4270 or andyp@wsu.edu

September 14-16, 2005
LMS Training Workshop
Pack Forest, Eatonville, WA
Watch for details at http://www.ruraltech.org

September 24, 2005 (tentative)
North Central WA Forest Owner Field Day
Chelan, WA
More details will be available soon

Oct-Nov, 2005
Forest Stewardship Coached Planning Shortcourse
Arlington, WA
For registration/information contact Andy Perleberg, WSU Extension, at (360) 428-4270 or andyp@wsu.edu

December 4-6, 2005
ArcGIS Training Workshop
Pack Forest, Eatonville, WA
Watch for details at http://www.ruraltech.org

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