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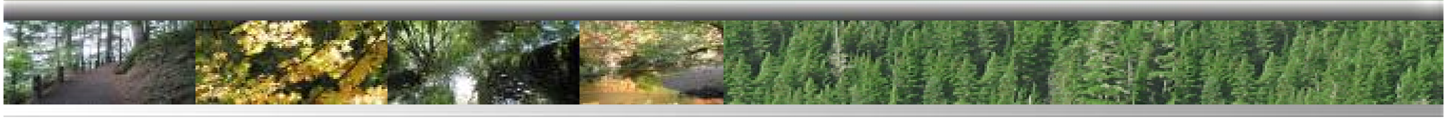


The FORSight Resource

Volume 4, Issue 2 Q2 2007

Upcoming Events...

Forest Growth and Timber Quality: Crown Models & Simulation Methods for Sustainable Forest Management
August 7-10, 2007
Portland, OR
http://www.westernforestry.org/crownmodels/crownmodels.htm

"Investing Globally in Forestland" Summit
A World Forest Institute Conference
September 10-12, 2007
Portland, Oregon
http://wfi.worldforestry.org/invest/

SAF National Convention
Oct 23-27
Portland, OR
http://www.safnet.org/natcon-07

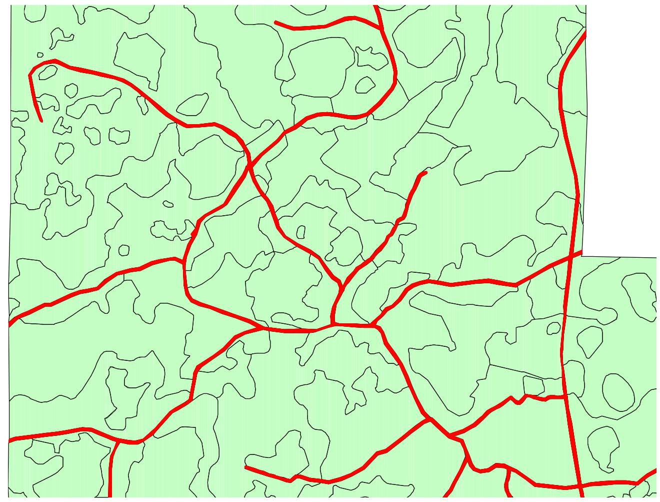
INFORMS Annual Meeting
WSU Convention Center
November 4-7, 2007
Seattle, WA
http://meetings.informs.org/Seattle07/

Inside this issue:

How to calculate net acres in a GIS stands layer

All forest landowners are interested in how many acres of land they own. To estimate productive capacity of the forest, foresters are interested in total acres net of unproductive areas and, typically, the largest component of unproductive areas is the area under roads.

A GIS manager generally can represent unproductive roads two ways: either as polygons that include road buffers directly, or as lines representing the center line of the road. While it is easy to calculate net area in the polygon approach, a more involved "net down" process is required for the line approach that calculates road acreage by stand, subtracts this acreage from the total stand acreage, and then store both gross and net acres in the stand layer as data fields. As we will demonstrate, there are many advantages to the "net down" process over storing road polygons in the stand layer.



First, let's look at storing the road buffers in the stand layer. In most forestry applications, stands are grouped by some administrative unit - typically a compartment or tract. When road buffers are stored in the stand layer it is common to generate one road polygon per administrative unit as show in the figure above.

This method of netting out road acreage has several disadvantages:

- A single stand can be broken into several parts by the road buffer and must be stored as a multi-part polygon. To edit any

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Research and development at FORSight Resources

Since inception FORSight staff members have regularly attended and presented at conferences throughout the US and Canada. You might be wondering why a small consulting firm like FORSight would spend the time and money to not only attend conferences, but take the time to prepare and deliver scientific papers. Here are just a few of the important reasons.

First, technology changes rapidly. Twenty years ago when some of us started working on LP-based harvest scheduling, the only computers capable of solving even modest-sized problems were mainframes. Virtually all of the forest planning analysts were US Forest Service personnel, and conferences were dominated with papers based on National Forest Planning and FORPLAN. Within a few years, personal computers were powerful enough to replace mainframes for forest planning. About 10 years ago, Remsoft had released

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Growth Model Review–RP2005

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Authors	Robert E. Buckman, Professor (retired), Badege Bishaw, Research Associate, College of Forestry, Oregon State University; T.J. Hanson, FEC Consulting, LLC, Beaverton, OR; and Frank A. Benford, Benford Applied Mathematics, Salem, OR
Species	Red Pine Natural Stands and Plantations
Region	Lakes States (Michigan, Minnesota, and Wisconsin)
Silviculture	Commercial Thinning
Model Type	Microsoft Excel spreadsheet
Add'l Info	http://nrs.fs.fed.us/pubs/9031

Red pine (Pinus resinosa) has been an important component of timber production in the Lake States region since the mid-nineteenth century, at one time occupying over 7 million acres. Today, red pine is limited to nearly 2 million acres, the majority of which is in plantations (Buckman et al 2006).

Since the early 1900s red pine has been intensively studied by the USDA Forest Service North Central Research Station and its cooperators because of high volume growth rates, low natural mortality rates, low susceptibility to insect and disease damage, and a wide variety of commercial products. During the last 45 years the following studies have made significant contributions and advancements in red pine growth and yield research, providing much of the basis for current red pine growth and yield:

Buckman (1962) used simple quadratic equations to predict periodic basal area increment in red pine stands 25 years of age and older. These equations, still in use today, led to the development of the first BA and stand volume output tables for a range of ages, sites, and stand densities. This was among the earliest efforts to develop compatible growth and yield models for even-aged species.

Wambach (1967) developed models to predict future basal area in stands up to ages 25-30, starting with a specified number of established trees/acre. This work used plots on different site qualities and tree spacings across the Lake States, and was one of the first to look at the effect of spacing on wood quality. The results had an immediate and significant impact on reducing red pine plantation densities in the Lake States.

Lundgren (1981) was instrumental in furthering the work being done on red pine, including merging the earlier work of Buckman and Wambach. In 1985 he published one of the first red pine growth and yield models, REDPINE (Lundgren 1985). This new model, which could simulate a wide range of management alternatives, provided a foundation for others to explore management options available for red pine in a way not previously possible.

In addition to REDPINE, RP**2, RPA, and RPPLUS were all based on equations or data from Buckman's original study (Ramm and Miner 1986). RPAL (Ramm 1989, 1990) is a QuickBasic program also based on basal area growth models from Wambach (1967), Buckman (1962), and Lundgren (1981). This was followed by RPGrow$, a model written in Microsoft Excel. RPGrow$ is based on RPAL, but expanded to include financial analysis (Hydahl and Grossman 1993). The financial analysis is based on a discounted cash flow. In 1998 RPSIM (Rose 1998a) was released. RPSIM was a major revision of Lundgren's REDPINE model with a number of new features not previously available in red pine models including flexible data entry, storage and retrieval, viewing and printing of output, and a graphing tool for graphically examining output. Rose also produced REDPTHIN (Rose 1998b), a menu-driven model for the derivation of optimal thinning schedules for even-aged red pine stands. Resinosa (Mack and Burk 2002), another Excel-based growth model with financial analysis, came next. Resinosa is described as an interactive Density Management Diagram (DMD) that is meant to be used to evaluate red pine management alternatives. Thinning options include standard thinning to a residual basal area or trees per acre at a particular age as well as relative density-based thinning using upper and lower density management lines.

The latest growth and yield forecasting model for even-aged red pine stands in the Lake States is RP2005. Like its more recent predecessors, RP2005 provides a computer-based means to estimate growth and yield. It allows the user to compare the consequences of various silvicultural and financial alternatives through time. Based on newly developed growth equations, RP2005 simulates growth, yield, and mortality for a variety of products and tree sizes in both natural and planted stands.

While earlier models were generally based upon the work of Buckman, Wambach, and Lundgren, the equations in RP2005 were built from a much larger database containing the set of research data used previously. Prior to the model's development, the authors examined the entire set of active and inactive red pine growth and yield studies. The oldest studies dated back as far as the mid-1920s. Available for their analysis were 31 experiments and sets of monitoring plots in both planted and natural forests containing 3,671 individual growth estimates. This dataset was ten times larger than had been available previously for model development (Buckman et al 2006).

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Net area calculation...

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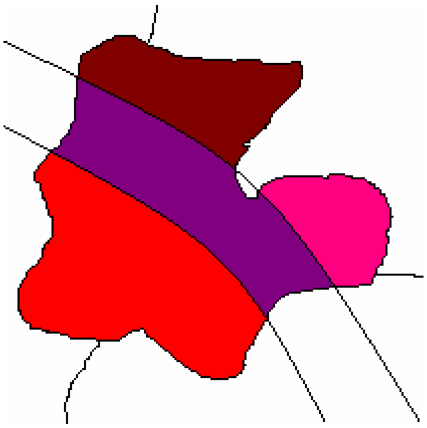
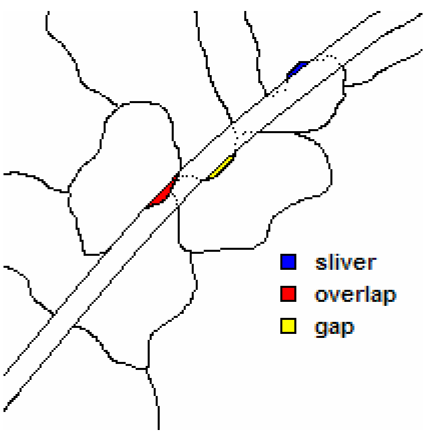
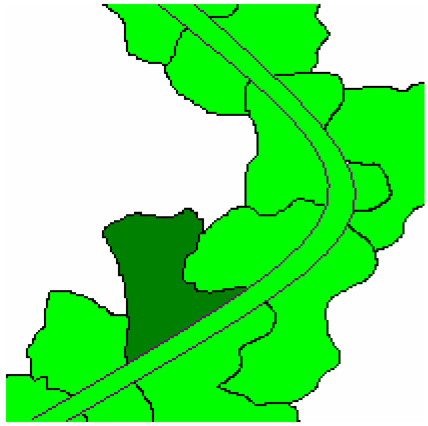
single part of the multipart polygon it must be separated from the group, edited, and rejoined to the original group.



- Moving a road buffer to correct spatial inaccuracies becomes a difficult process that can generate sliver stands, small gaps in the stand layer, or areas of overlap between a stand and road polygon.



- Increased editing time.
- In web based systems or systems that work by checking out the stands to be edited, all stands adjacent to the target stand are also checked out. In this instance, a stand that borders the road buffer causes the road buffer to be checked out, as well as all stands touching the buffer. Instead of checking out a minimal number of surrounding stands, the system must check out all stands touched by the road buffer. This can significantly reduce system performance.



- If the road buffer width needs to be increased or decreased due to environmental, administrative, political or other constraints, this becomes a costly procedure. Whether buffers are manually edited or an automated process is used that removes, recreates and reintegrates the buffer back into the stand layer, this is a costly process that can also generate errors in the stand layer.
- Road acreage is only available by administrative unit, not at the stand level.

The alternative process of netting down road acreage may be achieved as follows:

1. Road buffer widths are stored on each road segment as an attribute or in a lookup table by road type.
2. Buffers are generated around the roads using the buffer distances described above.
3. The buffers are then processed to eliminate areas of overlapping roads such as intersections or areas where two parallel road buffers overlap.
4. This layer is then intersected with the stand layer and the resulting layer summarized for road acres by stand.
5. The roads summary data is then joined back to the stands layer and net acres are calculated by simply subtracting road acreage from stand acreage and storing the result in the net acres field.

This process can be done as part of the editing process (during check in) or in a batch process after editing has been completed. By using this method the disadvantages associated with storing road buffers in the stand layer can be eliminated.

Some foresters like to display road buffers on maps. This can be easily handled with the net down procedure by building and storing the buffer layer for map display. Taking the net down process one step further you could net out stream buffers or other sensitive areas with the same process. Separate acreage fields could be kept for each net acreage class or combined into a single net acreage calculation.

Simply put, the net down process is by far the most flexible method of calculating net area. It reduces the complexity of the stand layer, minimizes check out time for editing, and eliminates the need to edit buffers. This results in less time spent editing and less money spent maintaining the GIS stand layer.

Foggy morning, Olympic National Forest. Photo courtesy K. Walters.

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Red pine stand in Michigan. Photo courtesy, S. Canavan.

RP2005 projects red pine plantations and natural stands based on stand age, site quality (site index), and stand density (trees/acre and/or basal area/acre). Growth in young stands (0-25 years) is predicted using trees/acre as a measure of stand density, while growth in older stands (30+ years) is predicted using BA/acre. The two models overlap in the 20-30 year range where either measure of stand density can be used.

Required inputs to the model include:

1. Stand age (range: 0-100+ years from seed)
2. Site index (range: 40 to 80 feet, base age 50)
3. Number of established trees/acre (range: 200-2500)
4. Minimum dbh for calculation of board-foot/acre volume (range: 7+ inches)
5. Rotation age (<= 200 years suggested)

Optional inputs include:

1. Basal area/acre of trees 1"+ in Dbh at starting age
2. Yield reduction factor for adjusting predicted yields for local conditions (±5%)
3. Maximum basal area/acre for constraining stand basal area growth
4. Up to 20 thinning treatments – requires stand age of thin(s) (years from seed), residual basal area/acre (30-200 ft2/acre), and d/D ratio (0.8-1.2).

Total cubic foot volume/acre is calculated using Buckman's (1961) equation based on basal area/acre and average dominant stand height. Board-foot sawtimber volume is estimated using the red pine sawtimber utilization standards employed by the Forest Inventory and Analysis (FIA) group of the North Central Research Station. This involves a three-step process: (1) estimating the total cubic volume of each stem by 1-inch dbh classes; (2) empirically determining the proportion of the total stem that is merchantable; and (3) determining a board-foot/cubic-foot ratio by 1-inch dbh classes.

RP2005 simulates commercial row thinning, thinning from above, thinning from below, and a combination of above and below using stand age, residual basal area/acre, and the d/D ratio. The "d/D ratio" is defined as the ratio of QMD for removed trees to the QMD for residual trees remaining after the thinning. Up to 20 thinning types and timings can be specified. The model reports growth and yield information for before and after thinning along with removal volumes. Reporting is done on several different worksheets under different formats. Annual growth, yield, and stand parameter information as well as information for years coinciding with management actions are given.

Net present values, benefit cost ratios, and return on investment are calculated for projected stands for evaluating alternative treatment regimes. These economic analyses are based on user-assigned operational costs (fall/buck, yard/load, haul, harvest tax), administrative costs (roads, administration, site preparation, planting, and taxes), percent real cost and price increases by

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R&D at FORSight...

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Woodstock with linear programming extensions, and these days, forest planning models easily dwarf the monster models discussed in the early literature. Heuristics came to the fore with spatial forest planning, but more recently, advances in formulations allow true optimization to be applied to far larger problem instances than just a few years ago. Only by attending conferences can we continue to stay abreast of technologies and advancements.

But it is not enough to just attend conferences and take notes. Many of the projects we undertake for clients result in new ideas and methodologies that can be applied elsewhere. Since we have benefited from presentations given by our peers, it is only fair to give back in kind. Often, the feedback from presentation leads to improved processes, or application beyond what we initially conceived. Had we kept our findings as a proprietary secret, the benefits accrued would have been far less.

So why do research at all? Forest companies such as Weyerhaeuser and MeadWestvaco invested heavily in forest research that resulted in a great deal of the current knowledge about forest nutrition and silvicultural best practices. To date, most of the investment community has not shown interest in making that kind of investment. As time goes by, the existing literature becomes out of date so somebody has to undertake research. Here at FORSight, we see it as part of a shared responsibility to take up some of the slack. Thus, we participate in research, present papers at technical conferences, publish the results of our research in peer-reviewed journals and other outlets. In addition, we are active members in several research cooperatives, contributing both our ideas and finances to support these important organizations. We will continue to do our part in supporting and participating in forest research, and we encourage those of you who have not done so to join us.

Growth Model Review...

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year, delivered mill revenue and other income, and other financial parameters (land area, discount rate, initial land cost, entrepreneurial profit, and re-investment and reversion rates).

The development of RP2005 and its predecessors was possible because of the dedicated technicians who installed and maintained long-term growth and yield studies. Model building requires re-measurement data, a sadly dwindling commodity. It is this information that, while sometimes appearing of lower priority than more immediate concerns, becomes worth its weight in gold as time goes on and re-measurements are done. Growth models evolve over time, and their evolution is dependent upon continued data collection. Many thanks are owed to those who have maintained permanent plots and collected forest re-measurement data.

Photo courtesy S. Canavan.

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Headquarters has moved... across the hall

Effective immediately, the new address for FORSight's North Charleston office is:

FORSight Resources, LLC
8761 Dorchester Rd, Suite 102
North Charleston, SC 29420

Please update your records with the new address. NOTE: All phone numbers will remain the same as before.

FORSight Resources adds two new staff members

FORSight Resources is pleased to announce the addition of two new staff members. In April, Dr. Charles T. Stiff became FORSight's newest Biometrician, and this week, Steven D. Mills joined the firm as Forest Planning Analyst.

Chuck comes to FORSight with over 30 years of experience, including 19 years in academia (Louisiana State University, University of Idaho), 6 years in forest industry (Temple-Inland) and 5 years as a private consultant.

Chuck grew up in Stoughton, WI and after 30 years away, he and his wife Carol recently bought a home in Milton, about 20 miles from his hometown. Along with daughter Jennica, they share their home with their 3 dogs. Chuck and Carol have a son Jonathon who resides in Moscow, ID with wife Kama and daughter Klarissa.

In a continuing effort to serve all forested regions in the U.S., Chuck will manage the company's new office in Milton, WI and will have responsibilities for inventory and biometrics as well as business development in the Lake States.

Steve recently graduated from Penn State University with a Master of Science degree in Forest Management and Operations Research, under the direction of Dr. Marc McDill. In addition to his thesis research, Steve worked to develop and maintain planning tools used by the Pennsylvania Bureau of Forestry for their long-term forest management planning.

Prior to graduate studies, Steve worked for a small consulting firm providing management planning and inventory services to private land owners. Steve and his fiancée Laura plan to marry in September, and recently they purchased a home that they will share with their dog Daisy. Steve will work out of FORSight's company headquarters in North Charleston, SC.

All of us at FORSight Resources are excited to have Chuck and Steve on-board as we continue to expand our business and serve new clients. Their range of talent and experience will complement and expand FORSight's core competencies and offerings.

FORSight Resources provides world-class expertise to companies and agencies facing critical natural resource decisions. The company's offerings include forest planning, acquisition due diligence, forest inventory & biometrics, GIS & data services, custom system/application development and hardware/software sales.

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Short Term Harvest Schedule Sensitivity To Future Stumpage Price Assumptions

Eric S. Cox. 2003

Abstract– Forest planning models have long been used as an analytical tool for providing information to facilitate effective decision making and planning. Inherent to the financial analyses conducted with these models are assumptions concerning key financial parameters contained in the model such as discount rates, future costs, and future stumpage prices. While projecting timber prices into the future with any accuracy is an extremely difficult exercise, price forecasting is nonetheless a critical part of forest planning analyses.

The ramifications of these assumptions over a long planning horizon can be significantly different product flows, activity levels, and cash flows. The purpose of this study is to investigate the impact of different future stumpage price assumptions on the short-term (5-year) timber harvest schedule for a southern pine forest, and to examine how much of the schedule is financially driven. The findings indicate that the short-term harvest schedule is sensitive to different price projections. This result is significant especially with respect to the timing of short-term timber harvest decisions to take advantage of market prices.

KEYWORDS: Stumpage prices, harvest schedule, forest planning

For a copy of this paper, visit our website: http://FORSightResources.com/library

What is research but a blind date with knowledge?
- Will Harvey