

SMC Quarterly News

Stand Management Cooperative
School of Forest Resources, University of Washington

2nd Quarter 2011



Dave Briggs, SMC Director

From the Director

In the past I have occasionally mentioned that I was planning to retire in June 2013. Earlier this year it became apparent to me that a number of factors were converging in such a way that it made sense to re-examine this. These factors include the pace at which my graduate students would be finishing, grants that were winding down and the typical timetable to obtain new ones, completion of publications and so forth. As I re-examined these trends, the effects the economy is having on grant and salary prospects, and the short timeline that would remain after this year and my original retirement target, I decided to change my retirement to the end of 2011 and have officially sent notice. Considering retirement has been made difficult by the fact that I have greatly enjoyed all aspects of what I have been doing but there are also many things that my wife Anne and I want to do and this is just the right timing to move on. Consequently, this has created a number of discussions concerning how the various things that I have been doing, especially teaching and being Director of the SMC, Precision Forestry Cooperative, and the UW site of the NSF Center for Advanced Forestry Systems, will be accomplished in the future. I have indicated that I will be available to assist with these transitions.

Back to this issue, there are announcements concerning ORGANON, meetings, the database and field work; summary minutes of the Spring Policy Committee meeting, and an article by Paul Footen summarizing his recently completed Masters thesis on the carryover effects study. Paul's research is finding some interesting divergences between the plots where

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the prior stand had been fertilized and the plots where the prior stand was not fertilized. It sets the stage for thinking about a potential follow-up on the nine Type I installations that include a thinning x fertilization experiment.

Announcements

ORGANON

You may have received the following two announcements from David Hann but in case you did not they are reproduced here

- I. I would like to announce that a new edition of ORGANON (Edition 9.0) has been loaded onto the ORGANON website, including a new console version of the model with an associated revised manual, and a new set of DLLs with revised manuals. This new edition includes the red alder plantation (RAP) version of ORGANON. The equations in RAP-ORGANON, including the new red alder plantation site index equation, are described in Hann et al. (2011) which can be downloaded from the updated ORGANON web site. The new red alder plantation equation has also been incorporated into the SITECAL.EXE routine which is included in the set of files that can be downloaded from the ORGANON web site.

For DLL users, the call statement of the ORGRUN.DLL has changed substantially from that found in the Edition 8.4 DLL. An additional planting density variable used in RAP-ORGANON has been added to the RVARs array and ending tree arrays were added back to the call statement in order to allow the tripling option to work correctly. Finally, a wood quality DLL has also been included when the other DLLs are downloaded. All of these DLLs have been compiled to be compatible with Microsoft Visual Basic. However, I have also compiled DLLs that are compatible with Microsoft Visual C++ and with Lahey FORTRAN 95 which I can send you if you prefer (I am currently debating upon putting all “flavors” of the DLLs on the ORGANON web site).

Please let me know if you have problems with any of these!

Literature Cited

Hann, D.W., A. Bluhm, and D.E. Hibbs. 2011. **Development and evaluation of the tree-level equations and their combined stand-level behavior in the red alder plantation version of ORGANON.** Department of Forest Engineering, Resources, and Management, Oregon State University, Corvallis, Oregon. 127p.

2. I would like to announce that the source code for the ORGANON DLLs has been added to the ORGANON website for downloading. This is the last major change that I am planning for the ORGANON website.

FALL SMC POLICY COMMITTEE MEETING

Please note that the Fall 2011 Policy Committee Meeting will be held on September 20-21. Discussion at the Spring meeting concerning location led to investigating holding it in northern Washington. Megan O'Shea is investigating possibilities along the I-5 corridor from Marysville to Bellingham that have adequate conference and accommodation capabilities for our needs. If you have experience or suggestions concerning possibilities please contact Megan (moshea@u.washington.edu)

NSF CENTER FOR ADVANCED FORESTRY SYSTEMS (CAFS) MEETING

The fourth annual CAFS meeting will be held in Seattle on June 14-16. Details are in the copy of the meeting announcement flier can be found on page 24. The field trip on the 16th will visit one of the SMC/NWTIC genetic gain/type IV installations, one of the paired-tree (Type V) fertilization installations and the Fall River long term site productivity installation. If your organization presently contributes to the SMC and is one of the few that has not yet joined the UW CAFS site, please contact me (dbriggs@u.washington.edu) if you would like to join. It is a simple, no cost process that involves writing a letter.

SMC DATABASE

Randy Collier wants you to know that the SMC database update will be completed on schedule around mid-June. If you would like a copy and/or would like a tutorial on its structure, accessing the data, and generating reports, contact Randy Collier, SMC database manager rcollier@u.washington.edu. Randy notes that some users may encounter problems if they use any version of Access that is post 2003. The functions that were programmed into the database do not work properly in newer versions so Randy will be rewriting the functions so they will run in the newer versions. The delay in addressing these issues is a result of the fact that the database programmer, John Haukaas, who would handle such issues was laid off in 2009 as part of the process of reducing expenditures to deal with the dues reductions associated with the economic downturn.

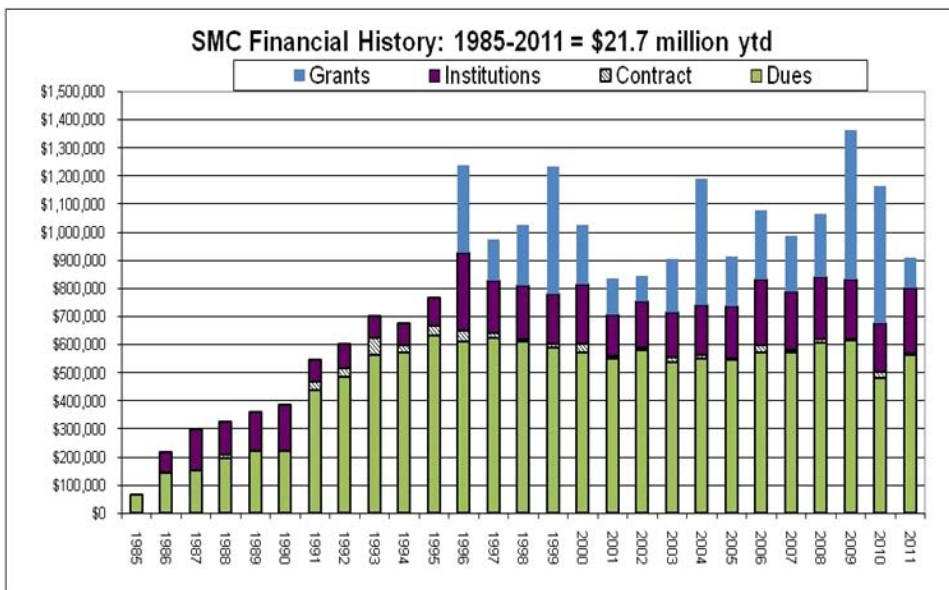
SMC Spring Policy Committee Meeting

The Spring meeting, was held at the Gifford Pinchot National Forest Headquarters in Vancouver, WA. with the agenda in [Appendix A](#); There were 59 attendees representing 29 organizations. Policy Committee Chair Dave Rumker opened the meeting, welcomed the attendees and commented on the importance of this meeting as the starting point of a search for a new Director given the announced retirement of David Briggs at the end of December 2011.

ACCOMPLISHMENTS

Dave Briggs reviewed 2010/11 accomplishments. A few highlights:

- Cumulative 1985-2011 funding of the SMC from landowner member dues, external grants, and institutional members has reached \$21.7 million.



- 13 articles in print, 1 accepted, 1 Masters thesis
- We now have 74 paired-tree fertilization installations
- We have 5 PhD and 4 Masters (1 graduated) students

NOMINATING COMMITTEE

According to the SMC by-laws a Policy Committee Chair is succeeded by the Vice

Chair at the Fall meeting every 2 years and when this transition occurs, the Nominating Committee, composed of the current Chair, Vice-Chair

and past Chairs nominates one or more individuals for Vice Chair for vote. In the past, the Nominating Committee is activated at the Spring meeting of the transition year. 2011 is the year when current Chair, Dave Rumker, would be succeeded by the Vice Chair, Jeff Madsen. When Director Briggs brought up this issue, two points were made. First, many felt that, given the Director's retirement and related succession activities being led by the current Chair, it would be unwise to change Chairs in the middle of this process. Second, Jeff Madsen indicated that he will retire in mid 2012. After some discussion Dave Rumker volunteered to remain Chair for another year to ensure continuity while the Director succession issue is being resolved. With Jeff stepping down, there is a need to nominate one or more individuals to replace him as Vice Chair and become Chair when Dave Rumker completes his extra year in 2012.

BUDGET

The 2010 budget, with dues set at 80% of full funding and 4 others at lower mandated levels, ended with a balance of \$65,159. This exceeded a target of \$20,000 set at the Fall 2009 meeting. This excess was achieved through a desire to keep the balance as large as possible as we did not know if the 20% reduction for 2010 would continue or change to some other amount and was accomplished primarily by the fact that our database programmer, John Haukaas, was laid off in mid-2009 and has not been replaced. At the Fall 2010 meeting the dues level was reset to 95% of full funding although state agencies remained at their lower mandated levels. The 2011 budget with dues set at 95% of full funding for 2010 is on track to meet the \$20,000 target set for the end of the year. The situation for 2012 was briefly discussed to provide guidance to the SMC Finance Committee. It was decided that we would develop 2012 budgets continuing the 2011 (95%) level and with a return to the 100% full funding level. It was noted that it is unlikely that the state agencies will be able to change from their current reduced levels.

STRATEGIC PLAN

The process that was developed in 2010 by the SMC Technology Transfer Committee to solicit proposed ideas for technology transfer projects, the set of proposals received, and the preference tally obtained at the Fall 2010 Policy Committee meeting were reviewed. It was noted that this resulted in focusing resources on the top project, to complete development of performance reports for the Type I, II, and III installations, which resulted in the workshop on Type III performance during the afternoon.

At this time, we need to repeat the process to solicit and flesh out new proposals, refine any on the list that were not selected as the top priority in 2010, and repeat the discussion and prioritization process at the Fall

tic velocity, Resistograph data and increment core sample collection has been completed. Increment cores were sent to USFS Southern Research Station for x-ray densitometry and near-infrared spectroscopy. We now have all data and some analyses are completed. Cosmin Filipescu and Ross Koppenal, scientists with the wood Fibre Centre, gave a presentation, available on the SMC website, on the acoustic velocity results.

TAC Meeting. Eini indicated that she would be scheduling a Wood Quality TAC Meeting and asked that those who are interested in being on the TAC contact her (elowell@fs.fed.us).

MODELING PROJECT REPORT: Dave Marshall, Modeling Project Leader

Model Updates: A collaboration to integrate ORGANON into the FVS interface is just getting underway. It will include SMC-ORGANON and the new red alder model with the expectation that testing will commence in late summer 2011. ORGANON 9.0 which includes the alder model has been released and was presented at the Growth Model User's Group meeting. ORGANON 9.1, with new taper equations, is now available. Dave Hann has retired, the dynamic link source code will be made available, and ORGANON will be maintained by CIPS in the future. Model contact information

- CONIFERS
 - Contact: Martin Ritchie (mritchie@fs.fed.us)
 - http://www.fs.fed.us/psw/programs/ecology_of_western_forests/projects/conifers/
- FVS
 - Contact: Erin Smith-Mateja (eesmith@fs.fed.us)
 - <http://www.fs.fed.us/fmsc/>
- ORGANON
 - Contact: David Hann (david.hann@oregonstate.edu)
 - <http://www.cof.orst.edu/cof/fr/research/organon/>

TAC Meeting: A TAC meeting will be scheduled in the summer of 2011 to define the Modeling TAC role under CAFS, biomass, biofuels, carbon and climate initiatives and to identify and prioritize potential needs and projects.

NUTRITION PROJECT REPORT: Rob Harrison, Nutrition Project Leader

David Briggs reported for Rob who was attending another meeting.

Carryover Study: Paul Footen has completed his Masters thesis “The effects of previous nitrogen fertilization on productivity and soil nitrogen and carbon pools of subsequent stands of Douglas-fir forests in the Pacific Northwest”. A few highlights of Paul’s thesis were presented and Paul is developing journal articles and a summary of his thesis will be in an upcoming SMC Newsletter.

Paired Tree Fertilization and N₁₅ Study: We presently have 74 paired tree sites. PhD student Kim Littke has submitted one manuscript and has another in preparation. Masters student Austin Himes is working on the NFS funded N₁₅ isotope aspects of this study. Fertilizer formulated with the isotope has been delivered and is being applied; it will permit accurate tracking of the applied N throughout the system. A new MS student, Sara Maher, will start in Fall 2011.

Fall River, Matlock, and Mollalla Long-term site productivity studies: The February 2011 Forest Science is a Special Issue entitled “Deep Soils” with Fall River Boistfort soil on cover and two papers use Fall River/Matlock/Mollalla LTSP results. <http://Soilslab.cfr.washington.edu/publications/DeepSoilsForestScience2011.pdf>. Warren Devine produced a manuscript submitted to Canadian Journal of Forest Research Predicting 5-year vegetation control effects on aboveground biomass and nitrogen distribution of planted Douglas-fir on three sites”. Paul Footen has just completed sampling at Fall river to develop new biomass equations for Fall River which will become a journal article submission. Future work will focus on determining soil C levels at Fall River.

“Maintaining Adequate Nutrient Supply — Principles, Decision-Support Tools, and Best Management Practices” by Robert B. Harrison, Douglas A. Maguire and Deborah Page-Dumroese, Chapter 6 in Sam D. Angima and Thomas A. Terry (eds) **Best Management Practices for Maintaining Soil Productivity in the Douglas-fir Region.** Oregon State University extension manuscript EM9023, April 2011.

SILVICULTURE PROJECT REPORT: Eric Turnblom, Silviculture Project Leader

2010/11 Field Season A total of 72 installations (301 plots) will have been visited which includes 5 Type I installations (40 plots) in B.C. measured by BCMOF. This includes GGTIV and Type V discussed below.

GGTIV Installations: Measurement of 601, 602, 603 (22 plots each, 66 plots total) planted in 2005 received 3rd measurement. Presently, almost 50% of the plots have 90% of trees over breast height. Included now is a new sinuosity measure developed by NWTIC. While we have discontinued competing vegetation control, fence maintenance we are continuing the following

Paired Tree (Type V) Installations. Presently 74 have been installed. Full measurement of 28 installations (1200+ trees); 6 measured by the SMC crew for BCMOF.

Summer 2011 Plan: A summer field crew has been hired and will visit all fully measured Type III installations and a subset of Type I installations that were measured in the 10/11 dormant season to obtain understory vegetation and habitat measurements.

Type I, II, III Performance Reports. Voted the highest priority Technology Transfer projects at the Fall 2010 Policy committee meeting, we have graduate students working on each; Masters student Nai Saetern on the Type I's, PhD student Jeff Cornick on the Type II's, and PhD student Kevin Ceder on the Type III's. Masters student Jed Bryce is assessing the branch diameter data collected on the Type III's with the SMC breast-height branch diameter protocol. The students are making great progress and the results of the Type III performance analyses are the basis for the afternoon workshop. We anticipate additional workshops in the future. Planned deliverables include streaming videos of workshops that will be posted on the SMC website, an on-line calculator tool that will allow users to generate tables, graphics, and EXCEL files that they can tailor to their needs, and SMC Technical Reports and Fact Sheets. Additional products will include articles for peer-reviewed journals.

Vegetation Composition and Succession in Managed, Coastal Douglas-fir Ecosystems. Sponsored by NCASI, Western Wildlife Program PhD student Kevin Ceder. The objectives of this study are: (1) To develop overstory / understory predictive relationships in young, managed Douglas-fir stands by major life form, eg., grass, fern, forb, shrub; by guild, eg., shade tolerance, leaf retention; and by species, nine most prevalent. The final draft of predictive models is nearly complete. (2) To develop dynamic models of vegetation change; a draft report nearing completion. (3) To benchmark the developed relationships against a small, independent vegetation data set. (4) To test extrapolative power of the models by comparing to observed data from differently treated stands (thinned and pruned) not used in model building.

Sun-Tree Identification in Tree Lists of Multi-Strata Stands.

Sponsored by USFS, cooperating with OESF / ONRC. Conjecture: top level or uppermost stratum may “drive” size / density relationships, hence stand dynamics. Algorithms for identification of this upper stratum have been compared.

Logging residue ratios A collaboration with the USFS and ONRC to develop updated ratios. Forestry residues are a potential significant source of biomass for energy production but the latest published residue ratios (tons / ha; tons / MBF) are based on old harvest methods in stands atypical of those being harvested today. This study is updating data and developing new ratios for Clallum, Grays Harbor, Jefferson, Kitsap, and Mason counties. A draft final report is near completion.

Workshop: Performance of the SMC Type III Installations

The Type III installations are designed planting density trials at 100, 200, 300, 440, 680, and 1210 stems per acre to study the effects of no further management and the use of thinning and pruning. They were planted between 1985 and 2001 with the regeneration practices used at that time. Plantings were in blocks of at least 3 acres per spacing. In each spacing block a control measurement sample plot was established that would receive no further treatment. In the three dense spacings an additional plot for a thinning regime based on relative spacing was established. In the three widest spacings an additional plot for a pruning regime was established. The purpose of the workshop was to present a summary of the performance of the Type III installations at their present stage of development to answer the questions “*What is the growth, yield, and quality of Douglas-fir stands planted at different spacings and what is the effect of thinning and pruning?*”. The entire program was captured on streaming video and we will announce its availability as soon as processing and editing is completed.

Feature Article

The Effects of Previous Nitrogen Fertilization on Productivity and Soil Nitrogen and Carbon Pools of Subsequent Stands of Douglas-fir Forests in the Pacific Northwest

This is a summary of Paul Footen's M.S. Thesis – see the PUBLICATIONS list at the end of this issue for full citation and access information.

Introduction

Forestland in the Pacific Northwest region of The United States is shrinking due to land conversion and resource managers are faced with the challenge of growing more trees on less land and within less time to meet current and projected needs (Alig *et al.*, 2003; Briggs 2006). Application of nitrogen (N) fertilizer (as urea) has long been a common practice by forest managers in the Pacific Northwest to increase the productivity of Douglas-fir stands. Relatively young, glacially formed, nutrient poor soils are common in the region; especially where managed stands of Douglas-fir are found, and tree growth is commonly limited by the supply of plant-available N (Gessel *et al.*, 1973; Chappell *et al.*, 1991). More than 65,000 ha of managed forestland are fertilized per year in the region to increase tree growth and reduce the amount of time it takes a stand to reach harvest age (Briggs, 2006). Past studies have shown the observable effects of fertilization on tree growth in a given stand lasting eight to ten years (Binkley and Reid, 1985; Smolander *et al.*, 1998; Nohrstedt *et al.*, 2000). Studies of similar forest and soil types in the region have shown there can be a greater potential of N fertilized soils to sequester C (Johnson, 1992; Canary *et al.*, 2001; Harrison *et al.*, 2003; Adams *et al.*, 2005). However, it is not well known if the effects of N fertilization can continue to impact above- and belowground C and N pools of a subsequent stand for more than one commercial rotation.

A study by Wagoner (2002) assessing growth of Douglas-fir stands measured in (2000) in the Pacific Northwest found the effects of N fertilization applied to an initial stand showed no significant changes during the first two years of seedling growth, but did show significant increases the C and N pools of understory vegetation of the subsequent stand (replacement stand) 9-20 years after the last application of N fertilizer (Figure 1). These stands were first established as N fertilization trials in the late 1960's and early 1970's to study the effects of repeated N fertilization on stand growth with the goal of determining whether fertilization could increase forest productivity (Figure 1). Following harvesting at economic maturity, these stands were re-established as "carryover" studies to monitor the impacts of previous N fertilization on the growth of the new

Figure 1. Timeline of the history of the carryover study highlighting the year (or range of years) when important events occurred such as: stand establishments, fertilization applications, harvest of stands, dates studies were conducted.

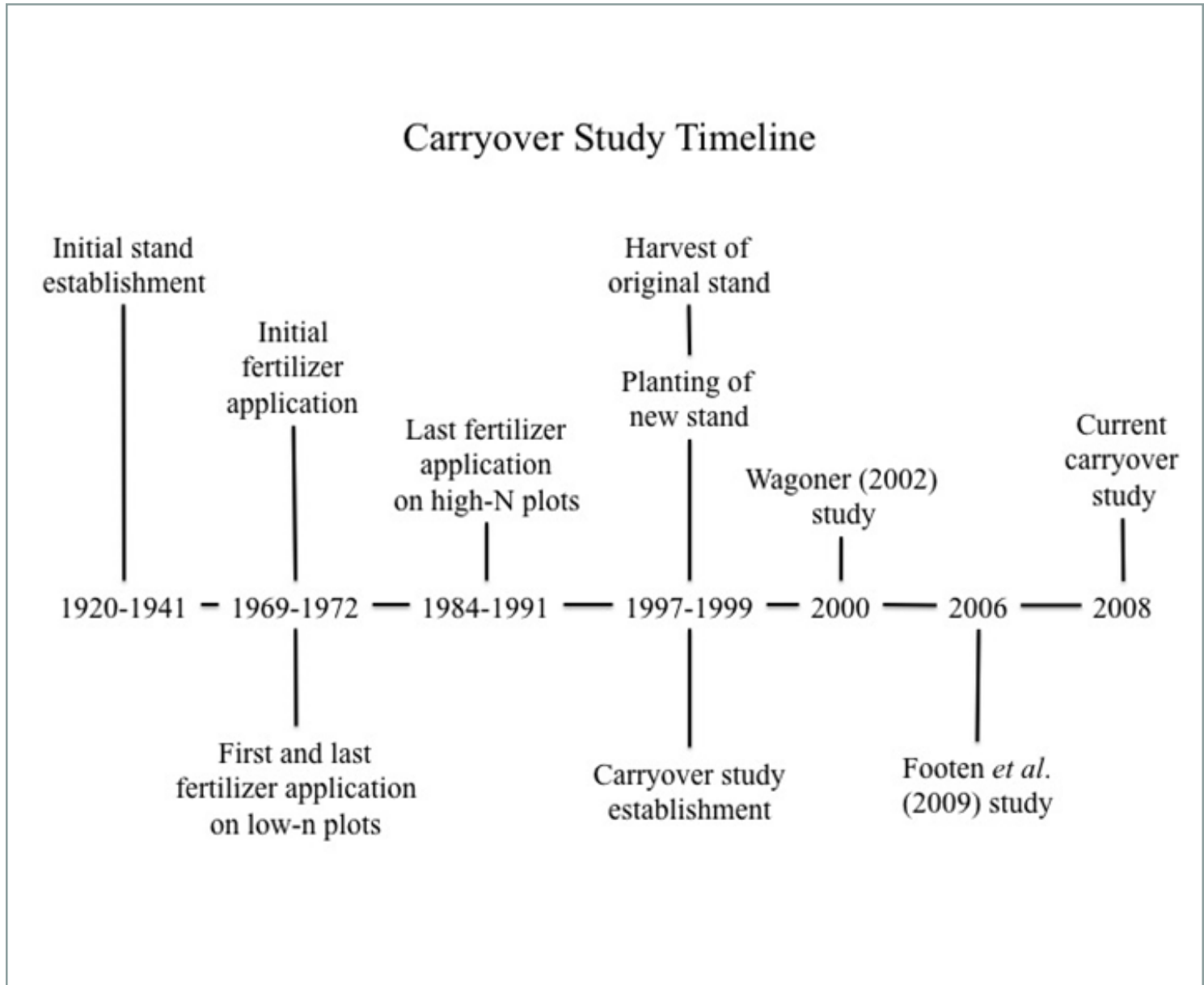


Table 1. Carryover study site descriptions, soil descriptions and fertilization regimes.

| | Camp Grizdale | Pack Forest | Coyle | Simpson Log Yard | Hank's Lake |
|--|------------------------------------|----------------------------------|--|--|--|
| Latitude | 47°15'4"N | 46°50'2"N | 47°50'56"N | 47°14'25"N | 47°18'34"N |
| Longitude | 123°35'31"W | 122°17'38"W | 122°45'25"W | 123°15'50"W | 123°16'54"W |
| Elevation (m) | 420 | 548 | 189 | 152 | 177 |
| Precipitation (mm) | 2900 | 1000 | 1000 | 1800 | 2000 |
| Slope, aspect | 15%, W | 40%, S | 20%, SE | Flat | Flat |
| Parent Material | Old alluvium, glacial drift | Colluvial andesite | Glacial outwash | Glacial outwash + tephra | Glacial outwash |
| Soil type, texture | Umbric Dystrichrept, fine-loamy | Ultic Haploxeralf, fine-loamy | Dystric Xerochrept, sandy, skeletal | Dystric Xerochrept, sandy, skeletal | Dystric Xerochrept, sandy, skeletal |
| Installation establishment (year) | 1969 | 1972 | 1972 | 1975 | 1975 |
| Stand Establishment | 1941 | 1930 | 1937 | 1923 | 1920 |
| SI 50 (m) | 38 | 30 | 33 | 29 | 20 |
| High Fertilization dates | 1969-1977-1981-1985 | 1972-1980-1984 | 1972-1980-1984-1988 | 1975-1983-1987-1991 | 1975-1983-1987-1991 |
| High Fertilization regime (kg N ha ⁻¹) | 448-224-224-224 | 448-224-224 | 448-224-224-224 | 448-224-224-224 | 448-224-224-224 |
| Low Fertilization dates | 1969 | | | 1975 | 1975 |
| Low Fertilization regime (kg N ha ⁻¹) | 448 | | | 224 | 448 |
| Date of logging (month/year) | Jul-99 | Mar-97 | Dec-98 | Jan-99 | Mar-99 |
| Stand age at harvest (years) | 58 | 67 | 61 | 76 | 79 |
| Date of planting (month/year) | Jul-99 | Mar-97 | Jan-99 | Jun-99 | Jun-99 |

stands of Douglas-fir trees. A more recent study by Footen *et al.* (2009) of many of the same stands as the Wagoner (2000) study found significant increases in both tree growth and understory C and N pools 15-26 years after the last fertilizer application (Figure 1). The results of these studies were compelling enough to require another examination.

The objective of 2008 study was to measure the C and N pools of five previously fertilized stands and paired controls to determine whether carryover effects stand productivity, C sequestration and N retention. This study examines the same five Douglas-fir stands that were measured in 2006 by Footen *et al.* (2009) and four of the five stands assessed by Wagoner (2002). The addition of a low fertilized treatment on three of the five stands, assessment of tree foliage N content and forest floor and mineral soil C and N pools were added to the 2008 study to gain a better understanding of the carryover effect. The stands measure in this study received their last application of fertilizer 17-39 years ago (depending on fertilization regime) (Table 1 and Figure 1). The working hypotheses of this study are that the previously fertilized stands will have greater above and belowground C and N pools than the controls, and the increases will be proportional to the amount of fertilizer applied.

Materials and Methods

Study sites, sampling methods for trees and understory vegetation were the same as the Footen *et al.* (2009) study. Tree foliage nutrient content was measured by taking the current-year's (2008) foliar samples from each plot at the end of the growing season in the fall. Soil pits were dug at plot center leaving one undisturbed face about one meter wide and to at least one meter in depth of mineral soil. Horizons were identified and bulk density samples were collected by horizon using the core method (Hartage and Blake, 1986). Mineral soil was further sampled by horizon for nutrient analysis, texture and other soil properties. Soils were air-dried for two days and sieved to <2 mm. The coarse fraction (>2 mm) was not analyzed for nutrient content. The fine fraction (<2 mm) soil samples were oven-dried at 105°C to estimate total dry weight. Samples were then ground to <1 mm and total C and N concentration was determined by dry combustion (Perkin-Elmer CHN Analyzer Model 2400, Norwalk, CT). Forest floor samples were collected from the same locations as the soil pits using a 0.25 m² (0.5 x 0.5 m) sample frame. Material was bulked to include all fresh and decomposed litter in proportion to its ratio in the field.

Statistical analyses were performed on data at the treatment-level for each of the five sites using ANOVA (ANCOVA) with R statistical software (version 2.6.2). Two of the five sites did not have replication for the low-N treatments causing this study to have an incomplete randomized block design (high-N plots n = 5; low-N plots n = 3; control plots n = 5). There

was no replication of treatments at individual sites so discussion is limited to descriptive statistics. Tree mortality was higher than normal on one site and therefore used as a covariate during all statistical analyses.

Results

Mean tree height on high-N plots was significantly ($p < 0.1$) greater than the unfertilized controls from 2001 to 2006 (Figure 2). In 2008, the year of this study the high-N plots and the controls were not significantly different ($p = 0.2$), though tree growth was 14% greater. The low-N plots showed no significant differences from the first measurement year to the 2008 measurement when compared to the controls. However, mean tree height on the low-N plots was 6% greater than the controls in 2008, and showing an increasing trend when compared historically to the control (Figure 2).

Mean DBH was significantly greater on the high-N plots than on the unfertilized controls in 2005, 2006 and 2008 (Figure 3). In 2008 mean DBH was 22% greater ($p = 0.07$) on the high-N plots. During the time of this study, no significant differences were found between the low-N plots and the controls. Note that mean DBH was measurable on the high-N plots two years prior to the low-N plots and the controls (Figure 3). This early jump in growth could potentially increase seedling survival by reducing competition for nutrients and water. These results demonstrate the ability of a subsequent stand of trees to benefit from a fertilization application to the previous stand applied over 17-25 years ago (Figure 1), which challenges the conventional wisdom of past studies.

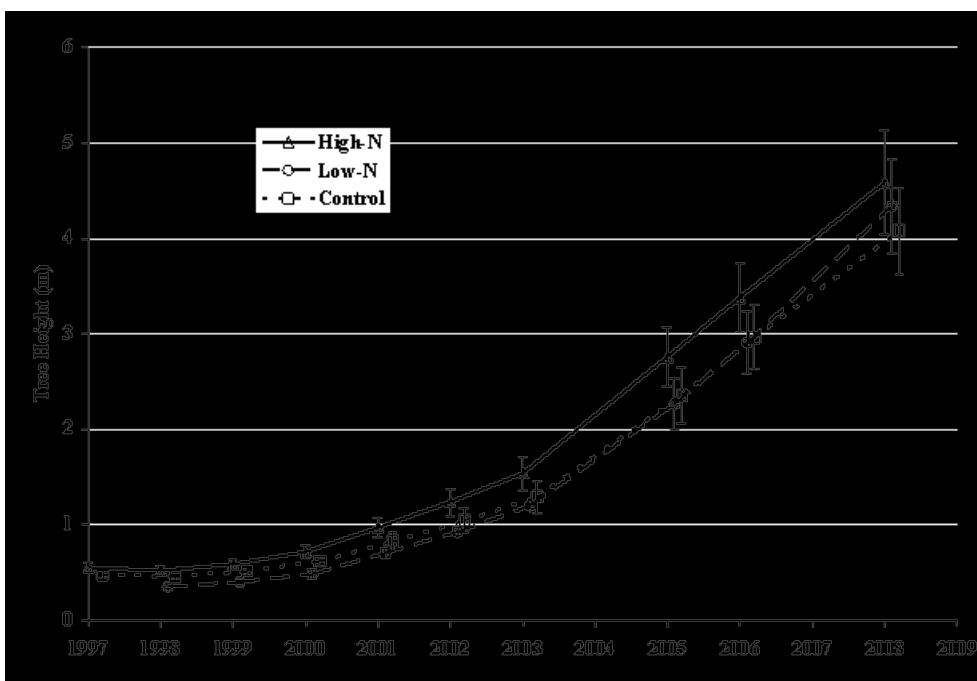
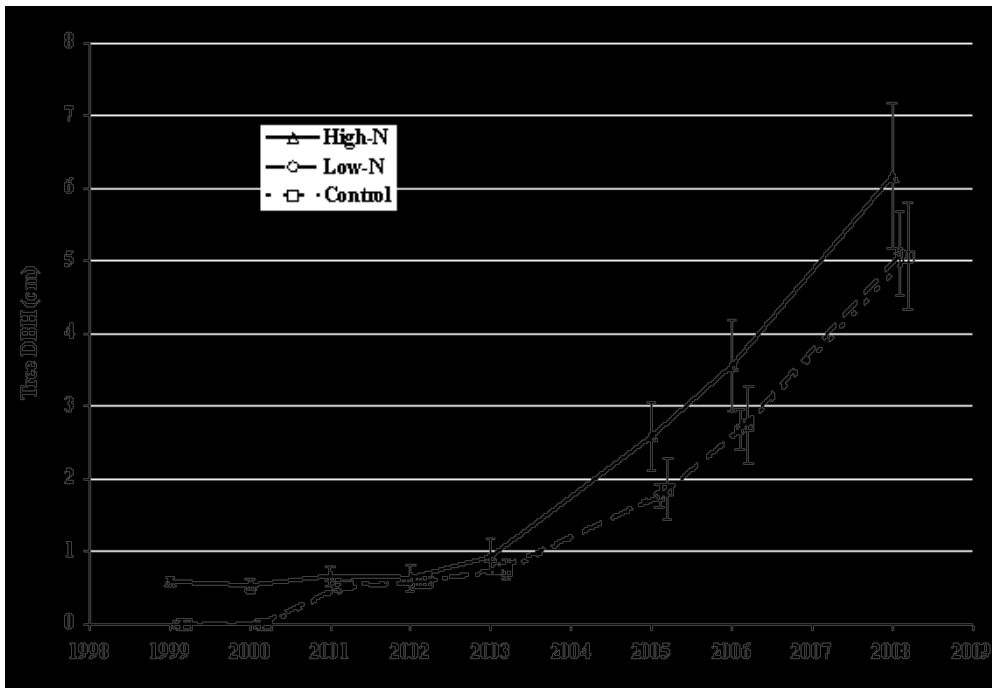


Figure 2. Mean tree height (m) of Douglas-fir on five carryover stands with three fertilization treatment levels from beginning of the study to 2008. Tree heights on high-N plots were significantly greater ($p < 0.1$) than the controls from 2001 to 2006. In 2008 mean height on high-N plots was 14% ($p = 0.1$) greater than the controls, and low-N plots were not significantly greater ($p = 0.2$) than controls. Note that the X-axis is offset slightly to allow differentiation of treatment mean data points

Figure 3. Mean diameter (cm) at breast height (DBH) of Douglas-fir trees on five carryover stands with three treatment levels from beginning of the study to 2008. DBH on high-N plots was significantly greater ($p < 0.1$) than controls in 2005, 2006 and 2008. DBH was (22%)($p = 0.07$) greater than controls in 2008, however, no significant differences were found between low-N plots and controls at anytime during the study. Note that the X-axis is offset slightly to allow differentiation of treatment mean data points.



In 2008, tree foliage N content was significantly greater than the unfertilized control plots on both the high-N and low-N fertilized plots by 80% and 20% respectively (Table 2). Both mean understory biomass and N content were significantly greater on the high- and low-N plots than on the unfertilized controls (Tables 2 and 3). Mean understory biomass was 86% ($p = 0.05$) and 91% ($p = 0.02$) greater on the high-N and low-N plots (respectively) when compared to the controls. Carbon content of the understory was similar to biomass results and significantly greater on both high-N and low-N plots than on the controls (Table 3). Mean understory N content, when compared to controls was also greater on the high-N and low-N plots 111% ($p = 0.04$) and 99% ($p = 0.04$), respectively (Table 2). These current understory vegetation results reflect those of the 2006 Footen *et al.* (2009) and Wagoner (2002) studies, strongly demonstrating long-term effects of N carryover on understory vegetation growing in subsequent stands.

Mean soil N content (including O horizon) on the low-N plots was 59% ($p = 0.03$) and 57% ($p = 0.04$) greater than on both the high-N and unfertilized controls, respectively (Table 2). Results of mean soil C content were similar to the results found with soil N. The low-N plots had 27% (48 Mg C ha^{-1}) more soil C than the controls and 50% (74 Mg C ha^{-1}) more than the high-N plots (Table 3).

Nearly all forest C and N pools were measured in this study. However, due to time and budget constraints C and N pools for roots and N content of bolewood and tree branches were not measured. Douglas-fir trees and understory vegetation comprise the total aboveground C pool and were 80% ($11.8 \text{ Mg C ha}^{-1}$) and 79% ($11.7 \text{ Mg C ha}^{-1}$) greater in the high-N and low-N plots (respectively) than the unfertilized controls (Table 3). Nitrogen content of Douglas-fir foliage and understory vegetation were measured to determine the total aboveground N pool, which were 87% ($352.5 \text{ kg N ha}^{-1}$) and 94% ($381.6 \text{ kg N ha}^{-1}$) greater on the high-N and low-N plots (respectively) than the controls (Table 2).

When C and N pools of the forest floor and mineral soil pits were added to the aboveground pools, total forest pools could be estimated. Total forest C pools were 31% ($59.5 \text{ Mg C ha}^{-1}$) greater than the controls, which were 8% ($14.7 \text{ Mg C ha}^{-1}$) greater than the high-N plots (Table 3). Total forest N pools were 5% (271 kg N ha^{-1}) and 60% ($3231 \text{ kg N kg}^{-1}$) greater on the high-N and low-N plots than on the controls (Table 2). The amount of total N on the low-N plots was much greater than expected and could, again, be influenced by the small number of sites ($n = 3$). The fact that the high-N plots had 271 kg N ha^{-1} more N than the controls demonstrates the possible ability of previously applied fertilizer to remain on site for 17 to 24 years after application (Table 2 and Figure 1).

Table 2. Total above- and belowground nitrogen pools (kg N ha^{-1}) of five carryover study sites with three fertilization treatment levels. The first row of numbers in each column is the mean. Different letters across rows represent significant differences ($p < 0.1$), ANOVA, (Tukey's HSD) between treatment observations for carbon pools. Standard errors of the means are in parentheses.

| Nitrogen Pools | High-N | Low-N | Control |
|-----------------------------------|---------------------|----------------------|---------------------|
| Tree Foliage | 228 a {57} | 271 a {55} | 155 a {40} |
| Understory | 532 a {74} | 517 a {149} | 252 b {49} |
| Total Nitrogen aboveground | 759 a {17} | 788 a {94} | 407 b {89} |
| O horizon | 218 a {57} | 261 a {65} | 145 a {40} |
| 0 - 10 cm | 2155 a {577} | 2714 b {652} | 1845 a {312} |
| 10 - 30 cm | 1527 a {128} | 2788 b {565} | 1839 a {190} |
| 30 - 50 cm | 1028 a {143} | 2095 a {113} | 1180 a {300} |
| Total Nitrogen belowground | 4927 a {905} | 7858 b {1395} | 5009 a {842} |
| Total Nitrogen | 5687 a {922} | 8647 b {1489} | 5416 a {931} |

Table 3. Total above- and belowground carbon pools (Mg C ha⁻¹) of five carryover study sites with three fertilization treatment levels. The first row of numbers in each column is the mean. Different letters across rows represent significant differences ($p < 0.1$), ANOVA, (Tukey's HSD) between treatment observations for carbon pools. Standard errors of the means are in parentheses.

| Carbon Pools | High-N | | Low-N | | Control | |
|---------------------------------|---------------|---------------|--------------|---------------|----------------|---------------|
| Tree | 2.03 | a {0.5} | 1.37 | a {0.4} | 1.53 | a {0.5} |
| Understory | 25 | a {4} | 25 | a {8} | 13 | b {4} |
| Total Carbon aboveground | 27 | a {4} | 26 | a {8} | 15 | b {4} |
| O horizon | 10 | a {2} | 11 | a {3} | 8 | a {2} |
| 0 - 10 cm | 62 | a {13} | 69 | a {8} | 62 | a {8} |
| 10 - 30 cm | 46 | a {3} | 81 | b {12} | 61 | a {4} |
| 30 - 50 cm | 30 | a {3} | 61 | b {9} | 43 | a {8} |
| Total Carbon belowground | 148 | a {21} | 222 | b {32} | 174 | a {22} |
| Total Carbon | 174 | a {25} | 248 | b {40} | 189 | a {26} |

Conclusions

- The long-term effect of previous fertilization on subsequent stands Douglas-fir and understory vegetation was significant on the high- and low-N plots when compared to unfertilized controls and similarly matched results of the 2006 study of the same sites.
- The effect of previous fertilization on C and N pools in soils showed low-N plots had greater N retention and C storage than on both the high-N and unfertilized control plots.
- This study is limited by the number of low-N fertilized plots (n=3), comparable depth of the soil profile and pre-treatment plot level soil nutrient data.
- There are continued effects of previous fertilization on the productivity and C and N pools of subsequent stands of Douglas-fir. However, continued monitoring of this study and ones like it are needed to properly assess the overall impacts of this recently discovered phenomenon.

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Publications

Cedar Extension Note: Louise deMontigny sent notice of a new Extension Note on cedar which can be accessed at <http://www.for.gov.bc.ca/hfd/pubs/Docs/En/En101.htm>

Footen, P.W. 2011. **The effects of previous nitrogen fertilization on productivity and soil nitrogen and carbon pools of subsequent stands of Douglas-fir forests in the Pacific Northwest.** MS Thesis. School of forest Resources, University of Washington, Seattle, WA. 54pp. <http://soilslab.cfr.washington.edu/publications/FootenPaul-t>

Hann, D.W., A. Bluhm, and D.E. Hibbs. 2011. **Development and evaluation of the tree-level equations and their combined stand-level behavior in the red alder plantation version of ORGANON.** Department of Forest Engineering, Resources, and Management, Oregon State University, Corvallis, Oregon. 127p.

Harrison, Robert A., Douglas A. Maguire and Deborah Page-Dumroese. 2011. **“Maintaining Adequate Nutrient Supply — Principles, Decision-Support Tools, and Best Management Practices”**, Chapter 6 in Sam D. Angima and Thomas A. Terry (eds) **Best Management Practices for Maintaining Soil Productivity in the Douglas-fir Region.** Oregon State University extension manuscript EM9023.

Abstracts and Publications

Chris J.K. MacQuarrie, Barry J. Cooke. Density-dependent population dynamics of mountain pine beetle in thinned and unthinned stands. Canadian Journal of Forest Research, 2011, 41:1031-1046, 10.1139/x11-007

Abstract

Thinning, the selective removal of some trees from a forest, is one way forest managers can reduce the probability that a forest will be susceptible to attack by bark beetles. Although this method has been shown to be effective, it is not clear whether the effect arises when pre-outbreak populations are small or during the epidemic phase when outbreaks are growing. We adopted a population dynamics approach to determine if the effect of limit or basal area thinning could be observed in the form of differential beetle recruitment using lodgepole pine (*Pinus contorta* Dougl. ex Loud.) and ponderosa pine (*Pinus ponderosa* Dougl. ex P. & C. Laws.) mortality data from previously published studies as a proxy measure of mountain pine beetle (*Dendroctonus ponderosae* Hopkins) population size. We found that mountain pine beetle populations exhibit density-dependent population dynamics that are influenced by the silvicultural history of their host's stand. Thinning did not change the epidemic equilibrium but instead caused a shift in dynamics from linear to nonlinear. In a validation test, the models developed for thinned and unthinned stands predicted reproductive rates in independent locations. These data also suggest the epidemic dynamics of mountain pine beetle may be sensitive to perturbations and to systematic trends associated with climate variability and climate change.

Abstracts and Publications cont.

Joshua Clark, a Glen Murphy. Estimating forest biomass components with hemispherical photography for Douglas-fir stands in northwest Oregon. Canadian Journal of Forest Research, 2011, 41:1060-1074, 10.1139/x11-013

Abstract

Accurately and quickly identifying inventories of forest biomass has become increasingly important for a variety of reasons. Current allometric equations require time-consuming tree-level measurements, but ground-based remote sensing could lead to faster estimates of forest biomass. Hemispherical photography (HP) is one potential technology that could estimate forest biomass quickly and efficiently. This analysis is based on a study in northwest Oregon where 15 Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco) plots were destructively sampled, and 60 HPs (four per plot) were taken. One photograph was taken after removing each quartile of a plot (by basal area). Two subsets of bone-dry biomass were measured and estimated: (i) crown and branch biomass (CBB) and (ii) total aboveground biomass (AGB). AGB ranged from 136 to 423 Mg/ha, and CBB ranged from 26 to 68 Mg/ha. A regression analysis between actual and HP estimated biomass showed that the average of the top two and top three 18° zenith angles resulted in the highest correlation and lowest RMSE for both CBB and AGB, while an estimate of plant area index over the top three zenith angles had the lowest correlation. HP estimates are compared with two allometric equations: one based on a regional study and one based on a national compilation of studies.

2011 meeting. Director Briggs will send the proposal form and the current list of proposals to solicit new technology transfer ideas and needs of members.

WOOD QUALITY PROJECT REPORT: Eini Lowell, Project Leader

NDT Study. In 2004, the SMC collaborated with PNWTIRC to obtain an AGENDA 2020 grant that would develop models on use of acoustic tools to evaluate wood stiffness along the tree to log to product (lumber or veneer) chain. In 2005, we collaborated with the Pacific Northwest Tree Improvement Research Cooperative at OSU to perform this evaluation in a Douglas-fir progeny trial. Analyses for this phase of the study have been completed and publications are now in print. In 2006/7, the second phase of the study focused on four SMC Type II installations which are thinning trials with 5 plots each. On each plot all trees were measured with a TreeSonic acoustic tool and based on the distribution of acoustic values a stratified sample of 12 trees were selected with 6 to be processed into veneer and 6 into lumber. This recovery study produced many data components from which analyses and publications are emerging. One aspect of analysis is those trees chosen for veneer conversion for which each log has a high level of veneer recovery. This has allowed Christine Todoroki, with SCION to rewind the veneer into its original position within the log and product radial maps and models of veneer properties such as stiffness and density by bolt location in the trees. At this time, one publication is in print, a second in review, and a third in preparation. Work is also underway on the trees chosen for lumber conversion. C.L. Huang, now an Affiliate Associate Professor at the UW is analyzing the properties of lumber by installation, plot, and log position. He gave a presentation, available on the SMC website, summarizing findings to date. Disks obtained at the stump and top of each 16 ft sawlog and 17 ft peeler from all of the sample trees. Both whole disk and x-ray densitometer, done by Weyerhaeuser, data was collected from each disk. UW PhD student Rapeepan Kantavichai is using disk data to model wood density and biomass increment as affected by ring age, treatment (thinning), and local climate and soil information.

LOGS Study. This study is a collaboration of the USFS PNW Research Station, Canadian Forest Service Wood Fibre Centre, the Precision Forestry Cooperative and the SMC. The objective is to determine the effect of thinning, site quality and stand density on wood quality using non-destructive testing to develop predictive models of stiffness, density and other wood properties. The Sample consists of five LOGS Installations (135 trees/installation); three treatments (light thinning, heavy thinning and unthinned); three plots per treatment and 15 trees per plot. ST300 acous-



Center for
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Center for Advanced Forestry Systems 2011 Industrial Advisory Board Annual Meeting

**JUNE 14-16, 2011
Seattle, Washington**

The Center for Advanced Forestry Systems (CAFS), a National Science Foundation (NSF) Industry/University Cooperative Research Center (I/UCRC), will hold its Fourth Annual Industrial Advisory Board Meeting June 14-16, 2011, at the Red Lion Hotel on Fifth Avenue, Seattle, Washington.

Tentative Agenda

| | |
|---|--|
| Day 1 – Tuesday, June 14, 2011 | |
| 7:00-8:00am | Continental Breakfast and Meeting Check-in |
| 8:00am-12:00pm | Morning Technical Session (presentations & posters) |
| 12:00-1:00pm | Working Lunch |
| 1:00-5:00pm | Afternoon Technical Session (presentations & posters) |
| 5:30-7:00pm | Reception with cocktails & substantial hors d'oeuvres |
| Day 2 – Wednesday, June 15, 2011 | |
| 7:00-8:00am | Continental Breakfast |
| 8:00am-12:00pm | Morning Technical Session (presentations & posters) |
| 12:00-1:00pm | Working Lunch |
| 1:00-5:30pm | Afternoon Technical Session (presentations & posters), and IAB Business Meeting |
| | Dinner on your own |
| Day 3 – Thursday, June 16, 2011 - Optional Field Trip | |
| 6:30am | Boxed breakfast at hotel |
| 7:00am-5:00pm | Field trip hosted by the University of Washington, School of Forest Resources - there is no additional fee for this field trip, which will include transportation and lunch. The field tour will conclude at 5:00pm back at the hotel. |

Project proposal summaries will be sent by email to IAB members in advance of the meeting.

Go to www.cnr.ncsu.edu/fer/cafs/meetings.html for registration, meeting and hotel details!



Don't miss it! We need your participation!