STAND MANAGEMENT COOPERATIVE

ANNUAL REPORT

JANUARY – DECEMBER 2008

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MISSION AND ORGANIZATION

Mission

To provide a continuing source of high-quality information on the long-term effects of silvicultural treatments and treatment regimes on stand and tree growth and development and on wood and product quality.

Organization

The SMC is composed of forest industry, state, provincial, and federal agencies, suppliers, and universities and other institutions who commit resources and expertise to the mission. The voting Policy Committee, composed of dues-paying members, controls policy with the goal of establishing the highest possible technical standards in carrying out its mission. Technical Advisory Committees (TACs) in Silviculture, Nutrition, Wood Quality, and Modeling, comprised of leading scientists, have been created to develop plans for research projects that are approved by the Policy Committee. The SMC is headquartered at the School of Forest Resources, University of Washington, which provides administration and staffing.
2008 HIGHLIGHTS

New Members

- Roseburg Resources, Dillard, OR
- Renewable Resources, LLC, Amherst, MA
- Cortex Consultants, Victoria, BC.

Budget

- Cumulative SMC funding from all sources since 1985 reached $18.2 million of which 62% was member dues, 2% contracts, 16% external grants, and 20% institutional contributions.
- In 2008 total funding was $1,064,178, of which $605,770 was member dues, $12,483 contracts, $224,571 external grants and student support, and $221,354 institutional contributions. Included in the institutional contributions is $70,652 from the BC Ministry of Forests Research Branch for installation field work in BC. Operating funds were $628,421, net of a $11,555 balance from 2007 and in-kind credits to landowners for maintenance of the GGTIV installations. The largest component of expenses supports the staff for fieldwork and the database. Graduate students were supported on new and continuing external grants and by University of Washington funds.

Grants

- $40,000. Supplement to LTSP studies at Fall River, Matlock, & Molalla. NCASI. Rob Harrison
- $75,000 ($25,000/yr for 3 yrs). Agenda 2020 for paired tree fertilization study. Proposal: Management of PNW forest plantations: Additional site characterization and instrumentation for SMC/CIPS Paired-Tree Fertilization Projects. Rob Harrison1, Doug Maguire2, Eini Lowell3, Dave Briggs1, Doug Mainwaring2, Eric Turnblom1 and Kim Littke1. 1SMC-Univ. of Washington, 2CIPS-Oregon State University, 3USFS-Portland. USFS AGENDA 2020 (request: $150,000 FY08-FY10).
- A proposal “Proposal for the University of Washington to Join the I/UCRC Center for Advanced Forest Systems (CAFS)” was submitted to the National Science Foundation by David Briggs, Rob Harrison, Monika Moskal, Sandor Toth, and Eric Turnblom. This proposal is for $75,000/year for 5 years ($350,000 total) and would enable the Precision Forestry and Stand Management Cooperatives to collaborate with CAFS industry and university members.

UW College of Forest Resources Student support

- Corkery Family Chair, $70,000 for summer field crew students and RA support
- Gessel Scholarship Fund, $25,000
- UW Teaching Assistantships in support of SMC students, $24,571
Field Work

- **Genetic Gain Trial – Type IV (GGTIV) Installations:** First growth measurements of the three installations planted in 2006 were obtained during the 07/08 field season. Site characterization of these installations was completed by the summer 2008 field crew.

- **Paired-tree Fertilization (Type V) Installations:** A proposal to AGENDA 2020 to support instrumentation of these installations was successful. 28 Type V’s, each with 20 tree pairs, were installed, measured, fertilized, and instrumented in the 08/09 field season.

- **2008/2009:** 89 installations (355 plots) were visited for full measurements, to conduct treatment trigger checks, or to conduct thinning, fertilization, or pruning treatments.

- **2009/2010:** Full measurements on 7 type I’s, 0 type II’s, 7 type III’s, 3 Type IV-GGT’s, 6 Type V’s, and 6 contract installations. Anticipate creating 28 additional Type V installations.

- **Summer Field Crew:** The summer field crew Paul Footen, Kim Littke, Natalie Schmidt, & Gonzalo Thiene, funded by grants, the Precision Forestry Cooperative, Corkery Family Chair, and the SMC visited installations for
  - Site characterization of the three GGTIV’s (66 plots) planted in 2006.
  - Acoustic velocity tests on 600 trees (2 type I installations, 6 plots/installation, 50 trees/plot).
  - Understory vegetation surveys and soil sampling.

Database

- The database was updated and sent to members who had requested it in June. It currently contains data from 479 installations of which 119 are currently active SMC installations. Version 1 of the Long Term Site Productivity (LTSP) database was completed and delivered. An integrated database of the AGENDA 2020 tree and log acoustic velocity lumber and veneer recovery study is nearing completion.

Graduate Students: The SMC had 10 graduate students in residence during 2008:

- **Kevin Ceder** began his PhD in 2007 with Eric Turnblom. He is working on the “Vegetation Composition, Succession and Understory Diversity in Managed Ecosystems” project funded by NCASI.

- **Paul Footen** began his Masters with Rob Harrison in Spring 2007. He has been working on the carry-over-effects study and the Fall River and Matlock long-term site productivity projects.

- **Andrew Hill** began his PhD in 2002 with Eric Turnblom and completed his dissertation. His research was funded by the USFS FIA program.

- **Rapeepan Kantavichai** began her PhD in Fall 2004 with David Briggs. She is funded through UW sources and has been working on branch and wood density models to fulfill an intermediate MS expected in 2009. Her PhD interest is focusing on how to incorporate wood quality measures into forest planning models.

- **Kim Littke** began her PhD in Fall 2007 with Rob Harrison. She is funded by UW sources and is working on the paired-tree fertilization study.

- **Maria Petrova** began her Masters with Eric Turnblom in 2008. She is working on a specific part of a large project examining the controls on conifer regeneration patterns and implications for future stand development in southwestern forests and is funded by the USFS. She is currently working on validating the Central Rockies variant of the Forest Vegetation Simulator using a long-term data set spanning the years 1909 to 2004 covering parts of Arizona and New Mexico. Jon Bakker is co-advising.
• Carol Shilling, began her PhD with Rob Harrison in 2008. She is developing estimates of 5-year nutrient pools and biomass on the Fall River, Matlock and Molalla LTSP sites and is funded by NCASI and UW sources.

• Ben Shyrick began his Masters in Fall 2007 with Rob Harrison. He is working on the effects of urea fertilization on carbon sequestration in soil, understory vegetation and trees in Type I installations and is funded by the Gessel Scholarship.

• Gonzalo Thienel began his Masters in Summer 2005 with David Briggs which was completed in 2008. He was funded through the Corkery Family Foundation Chair and the AGENDA 2020 Project “Non-destructive evaluation of wood quality in standing Douglas-fir trees and logs”. He is continuing toward a PhD.

• Nick Vaughn who completed his MS on the young stand model in 2007 is continuing as a Ph.D. student with Eric Turnblom. His PhD topic is “Extracting Tree Species Information From Small-footprint Waveform Lidar”.

Technology Transfer

• During 2008, one Masters and one PhD Thesis were completed, 4 publications appeared in journals and proceedings with 3 others accepted, 3 technical reports/working papers were published, and 8 presentations/posters were given at various professional meetings.

• The CONIFERS young stand model, by Martin Ritchie, David Marshall, Eric Turnblom and Nick Vaughn, funded by AGENDA 2020 and the SMC, was completed and a workshop on its use was held following the SMC Spring meeting. The latest version can be found at

### SMC Members and Policy Committee Representatives

#### Land Managing Organizations

<table>
<thead>
<tr>
<th>Organization</th>
<th>Representative</th>
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<tbody>
<tr>
<td>Bureau of Land Management</td>
<td>George McFadden</td>
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<tr>
<td>The Campbell Group</td>
<td>Dave Rumker</td>
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<tr>
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<td>Bill Marshall</td>
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<tr>
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<td>Dan Stransky</td>
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<td>Randall Greggs</td>
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<td>Dennis Creel</td>
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<td>Hancock Forest Management</td>
<td>Dean Stuck</td>
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<td>Jake Gibbs</td>
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<tr>
<td>Longview Timberlands, LLC.</td>
<td>Chris Lipton</td>
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<td>Scott Holmen</td>
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<td>Doug Robin</td>
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<td>Pacific Denkman</td>
<td>Allen Staringer</td>
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<td>Connor Fristoe/Steve Wickham</td>
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<td>Mike Mosman/Jeff Madsen</td>
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<td>Jim Plampin</td>
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<td>Rayonier Forest Resources</td>
<td>Candace Cahill</td>
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<td>Harry Bell</td>
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<td>David Walters</td>
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<td>TimberWest - Coast Timberlands</td>
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<td>Gene McCaul/Scott Swanson</td>
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<td>Greg Johnson</td>
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#### Analytic Organizations

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<td>FORSight Resources, LLC</td>
<td>Karl Walters</td>
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<tr>
<td>ImageTree Coorporation</td>
<td>Mark Hanus</td>
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<tr>
<td>Jim Flewelling Biometrics Consultant</td>
<td>Jim Flewelling</td>
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<td>Mason, Bruce &amp; Girard</td>
<td>Steve Fairweather</td>
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#### Suppliers

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<td>Alan Levy</td>
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<tr>
<td>Dyno Nobel</td>
<td>Robert Handford</td>
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<td>J.R. Simplot</td>
<td>Terry Kendall</td>
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<tr>
<td>King County Department of Natural Resources</td>
<td>Roberta King/Peggy Leonard</td>
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#### Institutions

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<tr>
<td>B.C. Ministry of Forests, Research Branch</td>
<td>Louise de Montigny</td>
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<tr>
<td>FP Innovations-Forinteck Canada</td>
<td>Gerry Middleton</td>
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<tr>
<td>Oregon State University</td>
<td>Doug Maguire</td>
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<td>University of British Columbia</td>
<td>Bruce Larson</td>
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<tr>
<td>University of Washington</td>
<td>David Briggs</td>
</tr>
<tr>
<td>U.S. Forest Service PNW Research Station</td>
<td>Charley Peterson</td>
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</table>
TECHNICAL ADVISORY COMMITTEES

Modeling Project

Project Leader, David Marshall,
Weyerhaeuser Company

David Briggs, University of Washington
Burt Dial, Hancock Forest Management
Jim Flewelling, Biometric Consultant
Dave Hamlin, Campbell Group
Greg Johnson, Weyerhaeuser Company
Dave Lortz, Campbell Group
Fred Martin, Washington Dept. of Nat. Res.
Mark McKelvie, Weyerhaeuser Company
Bob Monserud, USFS PNW Research Station
Eini Lowell, USFS PNW Research Station
Larry Wiechelman, Quinault Dept. of Nat. Res.

Nutrition Project

Project Leader, Rob Harrison,
University of Washington

David Briggs, University of Washington
Louise de Montigny, B.C. Ministry of Forests
Bob Edmonds, University of Washington
Barbara Gartner, Oregon State University
Jake Gibbs, Lone Rock Timber Co.
Randall Greggs, Green Diamond Resource Co.
David Hann, Oregon State University
Andy Hiegel, Hancock Forest Management
Denny Hill, The Campbell Group
Scott Holub, Weyerhaeuser Company
Greg Johnson, Weyerhaeuser Company
Stephen H. Schoenholtz, Oregon State University
William Scott, Weyerhaeuser Company
Brian Sharer, Hancock Forest Management
Tom Terry, Weyerhaeuser Company

Wood Quality Project

Project Leader, Eini Lowell, USFS PNW Research Station

Jamie Barbour, USFS PNW Research Station
David Briggs, University of Washington
Jeff DeBell, Washington Dept. of Nat. Res.
Burt Dial, Hancock Forest Management
Barbara Lachenbruch, Oregon State University
Jake Gibbs, Lone Rock Timber Co.
David Hann, Oregon State University
Denny Hill, The Campbell Group
Doug Maguire, NWTIC, Oregon State Univ.
Greg Johnson, Weyerhaeuser Company
Bob Megraw, Weyerhaeuser Company, retired
Gerry Middleton, Forintek Canada
Al Mitchell, FP Innovations -Forintek Canada
Bob Monserud, USFS PNW Research Station
Denny Hill, The Campbell Group
Brad Shelley, West Coast Lumber Inspection Bureau
Eric Turnblom, University of Washington
Tony Zhang, FP Innovations -Forintek Canada
The dues calculations for 2008 were based on the following formula, approved by the Policy Committee at the Fall 2004 meeting.

<table>
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<th>Approved Fall 2004; Started in 2006</th>
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<tr>
<td>If acres &gt; 100,000</td>
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<tr>
<td>dues = $12,274 + $0.035675 Acres</td>
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<tr>
<td>If acres ≤ 100,000</td>
</tr>
<tr>
<td>dues = $ 6,137 + $0.035675 Acres</td>
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<tr>
<td>Dues cap = $79,517</td>
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</table>

Member dues in 2008 were $605,770 (Table 1, Figure 1) compared to $570,699 in 2007. Special contracts were $12,483, up from $8,480 in 2007. The BC Ministry of Forests Research Branch contributed $70,652 to support measurement and treatment costs associated with SMC Installations in BC. Other institutional members provided the equivalent of about $150,702 in the form of salaries of scientists, facilities, and administrative support.

Figure 1: Sources of 2008 SMC Funds
Table 1. 2008 Financial Support

<table>
<thead>
<tr>
<th>Cooperator</th>
<th>Amount</th>
<th>%</th>
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<td><strong>Formula dues:</strong></td>
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<td>Bureau of Land Management</td>
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<td>Weyerhaeuser Co.</td>
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<tr>
<td><strong>Total</strong></td>
<td>$ 605,770</td>
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<tr>
<td>Member Contracts, Grants, etc.</td>
<td>$ 12,483</td>
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<tr>
<td><strong>Subtotal</strong></td>
<td>$ 618,253</td>
<td>58.1%</td>
</tr>
<tr>
<td>Less in-kind credits</td>
<td>$(1,387)</td>
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<tr>
<td><strong>Net Cash Contributions</strong></td>
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<td><strong>Institutional Contributions</strong></td>
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<td>B.C. Ministry of Forests</td>
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<td>University of Washington</td>
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<td>USFS PNW Research Station</td>
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<td><strong>Subtotal</strong></td>
<td>$ 221,354</td>
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<td><strong>External Research Grants</strong></td>
<td>$ 224,571</td>
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<td><strong>TOTAL</strong></td>
<td>$ 1,064,178</td>
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Funding from external sources (Table 2) totaled $224,571; $115,000 from external grants and $109,571 of student funding from the UW.

Table 2. 2008 SMC External Grants and UW Student Support

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<tr>
<th>Source</th>
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<th>Period</th>
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<td>NCASI (Fall River)</td>
<td>$40,000</td>
<td>2008</td>
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<tr>
<td>UW Gessel Fund</td>
<td>$25,000</td>
<td>2008</td>
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<tr>
<td>UW Corkery Family Chair</td>
<td>$60,000</td>
<td>2008</td>
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<tr>
<td>AGENDA 2020: 25k/yr for 3 yrs</td>
<td>$75,000</td>
<td>2008/10</td>
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<tr>
<td>UW Teaching Assistantships</td>
<td>$24,571</td>
<td>2008</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$224,571</strong></td>
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</table>

External grants support graduate students and some SMC staff time thereby producing savings in the SMC budget. Total funding from all sources was $1,064,178 and increased the cumulative total since 1985 to $18.2 million (Figure 2). This does not include substantial in-kind time contributed by members participating on SMC committees nor donations of expertise and materials by supplier members.

Figure 2. Cumulative SMC Funding: 1985-2008

Table 3 and Figure 3 provide a balance sheet for 2008, which began with a balance from 2007 of $11,555. In-kind credits to landowners associated with the GGTIV installations were $1,387. Therefore, funds available for operations were $628,421. Salaries include the permanent SMC staff, hourly helpers and occasional student support. Most of the salary expense along with a large share of travel and supplies supports field measurement activities and the associated database management. The salary shown is the net amount after charges to grants and the Precision Forestry Cooperative for work done by SMC staff. A summer field crew consisting of 4 persons was hired, with expenses split between the Corkery Family Foundation Chair, external grants, the Precision Forestry Cooperative and the SMC. The 2008 budget year ended with a surplus of $23,353.
# Table 3. 2008 Budget

## INCOME

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<td>Formula Funding</td>
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<td>Contracts</td>
<td>$12,483</td>
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<td>Subtotal</td>
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<tr>
<td>In-kind credits</td>
<td>($1,387)</td>
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<td>Net Cash Contributions</td>
<td>$616,866</td>
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<td>2007 Ending Balance Forward</td>
<td>$11,555</td>
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<td><strong>Total Funds Available</strong></td>
<td><strong>$628,421</strong></td>
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## EXPENSES

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<td>Travel</td>
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<td>Equipment &amp; supplies</td>
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<td>Contract Services</td>
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<td>Tuition</td>
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<td><strong>Subtotal</strong></td>
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<td>Indirect</td>
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<td><strong>Total Direct &amp; Indirect</strong></td>
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<td>Research Contracts</td>
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<td>0.0%</td>
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<td><strong>Total Expenditures</strong></td>
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<tr>
<td><strong>Total Funds Available</strong></td>
<td><strong>$628,421</strong></td>
<td>100.0%</td>
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**Figure 3: 2008 SMC Expenditures**

![Use of Member Dues](chart.png)
FIELD WORK AND DATABASE REPORTS

FIELD INSTALLATION DESCRIPTIONS

Stand Management Cooperative

TYPE I
Established between 1986 and 1994 in juvenile (age 7-15) Douglas-fir and western hemlock plantations with uniform stocking ranging from 300-680 stems per acre. Established before the onset of substantial inter-tree competition. At establishment, some plots were systematically thinned to 50% or 25% of the existing trees per acre. Seven plots constitute a common core on all installations and are following pre-defined thinning regimes based on Curtis’ relative density. At some installations counterparts to some of the core plots received best tree rather systematic thinning and others have either pruning or fertilization treatments. 38 installations, of which 30 are Douglas-fir, 322 plots, and 8 are western hemlock, 56 plots.

TYPE II
Established between 1986 and 1991 in Douglas-fir plantations that were approaching commercial thinning stage and considered to approximate the expected future condition of the Type I installations. Five plots, one unthinned control and four following thinning regimes based on Curtis’ relative density constitute the treatments. Originally 12 installations, 60 plots; currently 6 installations, 30 plots.

TYPE III
Planted between 1985 and 2001 with the best current regeneration practices at 100, 200, 300, 440, 680, and 1210 stems per acre. Plantings were at least 3 acres per spacing to provide experimental material for future research. A control measurement sample plot was established in each spacing. In the three widest spacings additional plots were established to create a matrix of density and pruning (pruned with unpruned “followers” with pruning to either 50% live crown removal or pruned to 2.5 inch top) treatments. In the three dense spacings a matrix of thinning treatments; early/light, early/heavy, late/light, late/heavy, and a late one time, was established based on relative spacing. 47 installations; of which 38 are Douglas-fir, 6 are western hemlock, and 3 with a 50/50 mix of Douglas-fir and western hemlock. Collectively they have 564 plots.

CARRYOVER
Planted in 1997-1999 on plots of the former Regional Forest Nutrition Research Program after harvesting to assess if fertilization of the previous stand affects development of its successor, 7 installations, 17 plots.

GENETIC GAIN TRIAL/TYPE IV (GGTIV)
“Genetic Gain/Type IV” Planted in 2005 and 2006. A Douglas-fir genetic gain and spacing trial collaboration with Northwest Tree Improvement Cooperative. Planting spacings are 7x7, 10x10, and 15x15. Genetic levels are elite, unimproved and intermediate stock. Vegetation control levels are current practice and complete until crown closure, 6 installations, 132 plots in the Grays Harbor breeding zone.

LTSP
“Long-term site productivity” Sites at Fall River, WA; Matlock, WA; Molalla, OR. Collaboration with USFS PNWRS, OSU, and companies.

TYPE V
Paired-tree study consisting of two treatments, 0 and 224 Kg N/ha to study effects on growth and yield, carbon, and wood quality. Stratified by parent material, vegetation zone, slope location. Detailed site characterization. Each installation has at least 12-15 tree pairs, 34 installations.
**Regional Forest Nutrition Research Project (RFNRP) 1969-2000**

<table>
<thead>
<tr>
<th>PHASE</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>I</td>
<td>Unthinned natural stands of Douglas-fir and western hemlock. Installations were established in 1969-70, received as many as 4 fertilization treatments, and were measured for 20 years. Completed in 1990, 117 installations, 702 plots.</td>
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<tr>
<td>II</td>
<td>Thinned natural stands of Douglas-fir and western hemlock. Installations were established in 1971-72, received as many as 4 fertilization treatments, and were measured for 20 years. Completed in 1992, 43 installations, 266 plots.</td>
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<td>III</td>
<td>Young thinned plantations of Douglas-fir and western hemlock, and low site quality stands of Douglas-fir. Installations were established in 1975, received as many as 4 fertilization treatments, and were measured for 20 years. Completed in 1996. 29 installations, 234 plots.</td>
</tr>
<tr>
<td>IV</td>
<td>Pre-commercially thinned (300 trees/acre) plantations of Douglas-fir and western hemlock, and Douglas-fir stands of naturally low stocking. Installations were established in 1980, received as many as 4 fertilization treatments, and were measured for 20 years. Completed in 2000, 34 installations, 306 plots.</td>
</tr>
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**FIELD WORK**

Bob Gonyea, Field Coordinator, Bert Hasselberg, Field Technician.

The following table indicates the number of times that SMC plots on the different types of installations have been measured.

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<tr>
<th># of Meas</th>
<th>Type I&lt;sup&gt;1&lt;/sup&gt;</th>
<th>Type II&lt;sup&gt;1&lt;/sup&gt;</th>
<th>Type III&lt;sup&gt;2&lt;/sup&gt;</th>
<th>Carryover&lt;sup&gt;3&lt;/sup&gt;</th>
<th>GGTIV&lt;sup&gt;2&lt;/sup&gt;</th>
<th>Type V&lt;sup&gt;1&lt;/sup&gt;</th>
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<td># plots %</td>
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<td>1123 100%</td>
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<td>309 100%</td>
<td>29 100%</td>
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1. Number of full measurements at establishment and every 4th year thereafter
2. Number of full measurements at establishment, every 2 years until 30 ft in height, & every 4 years thereafter
3. Number of full measurements at establishment and annually thereafter
The following table summarizes the number of field installations and plots visited during the past three field seasons along with the planned visits for the 09/10 season. This table does not indicate the multitude of activities performed on these installations. A fuller appreciation of the scope of the 08/09 workload is detailed in the summary following the table.

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<td>81</td>
<td>460</td>
<td>65</td>
<td>447</td>
<td>75</td>
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</tr>
</tbody>
</table>

Notes:

a = does not include paired tree plots on Type V installations
b = thinning to be determined based on RD checks
Type I

- Full re-measurement on 11 installations (111 plots). Complete re-measurement includes 100% dbh, 42 height and height to live crown measurements, branch measurements on all height trees, and comments and observations, all per plot.
- Partial measurement on 19 installations (30 plots). Partial measurement for RD check includes dbh only unless the plot reached the trigger; if so, then also obtain height on 42 trees per plot.
- Thinned 8 plots on 7 installations
- Fertilized 3 plots on 1 installation

Type II: No measurements

Type III

- Full measurement of 6 installations (78 plots). Complete re-measurement includes 100% dbh, 100% heights until average height exceeds 30 feet after which 42 heights are taken, 42 heights to live crown and crown width, branch measurements on all height trees, and comments and observations, all per plot.
- Thin check on 11 plots; thinned 5 plots on 4 installations
- Prune check on 12 plots on 2 installations; 11 plots on 2 installations pruned

Type IV (Genetic Gain Trial)

- Full measurement of 3 installations (66 plots)
- Site characterization of 3 installations (66 plots)

Type V (Paired Tree Fertilization)

- Installed 20 paired tree plots on each of 28 installations (40 trees/plot; 1120 trees total)
- Fertilized one tree in each paired tree plot on 28 installations (20 trees/plot; 560 trees total)
- Initial measurement of 20 paired tree plots on 28 installations (40 trees/plot; 1120 trees total)

Carryover

- Full measurement on 5 installations (14 plots)

Contracts

- Measurement of 1 installation (6 plots)
Summer Field Crew

- Site characterization (vegetation, habitat, soil disturbance, slash, red rot) of the three GGTIV installations (66 plots) planted in 2006.
- Acoustic velocity tests on 600 trees (2 type I installations, 6 plots/installation, 50 trees/plot).
- Understory vegetation surveys and soil sampling 66 plots, 3 installation.

DATABASE

Database Personnel: Randy Collier, Senior computer Specialist; John Haukaas, Research Consultant

The SMC database has 479 installations containing 5869 plots which have been measured 28,944 times. This represents a total of 277,432 individual trees which, in aggregate, have been measured a total of 1,563,067 times. Of this total 360 installations are either inactive RFNRP installations or installations associated with contract projects.

The remaining 119 installations are active Type I-Type V SMC installations containing 1954 plots which have been measured 5304 times. These plots contain 110,748 trees which have been measured a total of 520,046 times.
Progress to Date

The major SMC-related work on nutrition completed up to 2008 includes 1) the establishment of the bulk of the planned Type V Paired-Tree fertilization studies, with additional sites currently being installed and located, 2) additional work on the Fall River/ Matlock/ Molalla research studies including characterizing 5-year biomass at Matlock and Molalla and additional publications in journals from previous results, 3) further interesting progress and results on the carryover study, including presentations and publication of research results, 4) results and a publication from the Hood Canal N leaching vs. N fertilization study, and 5) additional work on effects of N fertilization on C sequestration in SMC stands and soils.

1) Type V Paired-Tree Fertilization Study Summary

Objectives: The primary objectives of this study are to evaluate the potential for response of 15-25 year-old stands to N fertilization within a given vegetation/geology type. Secondary objectives include being able to predict potential response from site and stand variables such that cooperators would be able to focus scarce fertilization resources into sites most likely to respond. A third objective would be to acquire outside funding to expand the scope and usefulness of the fertilization studies by providing a field laboratory for additional work. These studies have the potential to attract already-funded graduate students and visiting faculty (in fact, they previously have, and currently are) further amplifying the impact of the study.

Methods: The design for installing fertilizer treatments are copied almost exactly from the design utilized by Weyerhaeuser Company in similar research studies, as well as the CIPS fertilizer studies of Doug Maguire and Doug Mainwaring. A copy of the establishment report for the CIPS study is available at:


Copying their installation design not only allows this study to utilize the combined earlier thought that went into designing these studies, but also to greatly increase the coverage and “n” available when results of several studies are combined.

Stand and Site Selection: SMC Type V installations are located across the major geologic parent materials/soils and climate zones in the western Douglas-fir region of Oregon and Washington (Figure 1). Climate zone and parent materials were used to stratify the land for sampling.

A copy of the candidate area selection form is available from:

http://soilslab.cfr.washington.edu/publications/?100
With SMC cooperator input, we selected the strata with the most land coverage selected by each cooperator ensuring that each cooperator is included, but are also including minor strata that could provide meaningful information about response diagnostics. A portion of the stands were selected with attempts to include stands near the endpoints of the range of elevation, precipitation, site index, slope, etc. to allow interpolation of statistical models rather than extrapolation. Position on slope (ridge, sideslope, toeslope) were also considered when selecting sites, but it was difficult to find toeslopes. Priority was given those stands that have not received fertilization or thinning in the past 10 years. To date, all stands in the study meet these criteria. Existing SMC and Swiss Needle Cast co-op “Beyond Nitrogen” installations are also being considered as a secondary part of this study, and indeed, additional work in CIPS “Beyond Nitrogen” studies were funded as part of the Agenda 2020 study proposal along with the new SMC sites.

**Experimental Design:** The experimental design (at an “installation”) is a randomized complete block with two treatments and nominally 19-20 paired tree blocks at each location. The experimental unit consists of a 1/50th acre circular plot centered on a single subject tree. Each block consists of two experimental units selected to make the paired tree block as uniform as possible, primarily with respect to tree size, crown dimension, stocking in relation to surrounding trees, aspect, slope, soils, vegetation etc. Even though these “blocks” will not be physically contiguous, the matching of similar trees will reduce variation, thereby increasing the probability of detecting differences between treatments. The sampling unit is the single tree at the center of the plot. There are about 19-10 paired tree blocks per location with two treatments for a total of 38-40 single tree plots that are being established. One of the paired tree subplots is being randomly chosen to be fertilized.

Analysis is at the installation level and grouping by parent material types or other soil property choices for stratification as well as by position on slope within parent material types. A small difference in response should be detectable by this design.

A joint SMC/CIPS equipment proposal was selected for funding in the latest Agenda 2020 program, entitled “Agenda 2020 Management of PNW forest plantations: Additional site characterization and instrumentation for SMC/CIPS Paired-Tree Fertilization Projects”. Support for new research for the fertilization project is at $100K/year for 3 years. A copy of the proposal is available at:


Kim Littke, who is the full-time Ph.D. student working on the fertilization project, has managed to secure all of her personal support (stipend and tuition) from CFR scholarships and assistantships, which is a contribution of approximately $36,000 per year in terms of member dues plus overhead for 2008. We also received funding from the NSF CAFS (Center for Advanced Forest Systems) of $20,000 for 2009 to install and instrument additional sites. Such funding will help us greatly to multiply the impact of SMC member contributions to the overall project.
Thirty-four PairedTree Installations have been installed through spring 2009 (Figure 1). All sites have been sampled for soil down to one meter from one pit per site. Though we need further data for a full evaluation, the sites appear to represent a wide range of initial productivity as desired. For instance, Figure 2 shows the range in variability in total N concentrations in the soil profiles sampled. Soil moisture and temperature sensors are logging data at all sites (Figure 3), and fertilization made during the late winter/early spring time period when rainfall is predicted during or shortly after fertilization (Figure 4). Up to thirty more installations are being located now based on fitting into the sampling design, and are being installed in summer and fall 2009. Two year growth measurements and foliage sampling will be conducted this fall from the first six installations.

Kim is currently working on a publication on soil C and N variability across the range of sites in the study, to be submitted to a major forestry journal.

Figure 2. Nitrogen content of soil in a range of SMC Type V paired-tree nutrition installations.
2) Fall River/Matlock/Molalla LTSP

For the first time this full year, we worked on the Fall River, Matlock and Molalla LTSP’s as a completely-integrated project, with decisions on what to do at each site aimed at maximizing the overall usefulness of the work. Work emphasis was actually shifted to Matlock and Molalla because of loss of funding and need for timely work there. Fall River itself is at a lower level of need due to the current stage of stand development. The full leaching study there was stopped because we couldn’t justify the expense of continued sampling and laboratory analysis when the nitrogen leaching below 1 m soil depth had dropped to extremely low levels. We shifted the costs of sample analysis at Matlock to the NCASI grant. We did, however, sample for dissolved carbon at Fall River to get data to position ourselves for getting additional grants and publishing papers related to C sequestration.

Graduate student Carol Shilling is currently building the 5-year nutrient pools for the Matlock and Molalla sites as part of work on her Ph.D. Visiting Chinese Professor Dr. Xiu Yi has also been working on the 5-year biomass work as well as other studies. Tim Harrington led the sampling of non-tree biomass during the summer of 2008 with the help of USFS crews, and many volunteers. Starting with her arrival in July, Carol has been working on the sampling of the tree biomass, including developing 5-year biomass equations at Matlock and Molalla as was done for Fall River. Carol has also sampled trees at Matlock for root biomass. All samples are now taken, and are being processed at UW. Results should be available by this summer. We published 7 papers directly from or including results from the LTSP’s during 2008 to March 31, 2009 and have submitted two additional (see list of publications at end of this document).

Brian Strahm, now a postdoc at Cornell, and soon to be a professor at Virginia Tech, published an article entitled “Controls on the Sorption, Desorption and Mineralization of Low-Molecular-Weight Organic Acids in Variable-Charge Soils” in the Soil Science Society of American Journal. This paper directly compares soils at Fall River, Matlock and Molalla, and covers some of the mechanisms that might be responsible for the high potential of PNW soils to retain organic matter, and also to be as productive as they are.

The entire article is available at:


Brian also submitted a related article he presented at the North American Forest Soils Conference to Forest Ecology and Management entitled “Postharvest organic matter retention as a potential mechanism for soil carbon sequestration” that has now been published. A copy of the entire article is available at:


We are currently developing a proposal to the National Council for Air and Stream Improvement for funding through the end of 2010 for the FR/Ma/Mo long-term site productivity studies. The difficulty in the current funding climate is to continue to meet the original plans of all three studies with reduced funding. We had earlier submitted a proposal to USDA Agenda 2020 after three earlier successful submissions, but our proposal wasn’t funded even though it ranked highly. We again plan to develop a proposal for the USDA AFRI (Agriculture and Food Research Initiative), but have been unsuccessful so far with several proposals. It appears that industrial forestry research may continue to be difficult to have ranked highly by the panel managers and members of this new program as it was with USDA-NRI.
3) Carryover Effects of N-fertilization

Paul Footen (Figure 5) continued to make progress on work on the carryover study, which should result in his completing his M.S. in Fall, 2009, but certainly not in his contributions to the SMC. Paul plans to continue on for a Ph.D. in forest soils at UW. He is publishing a journal article based on the growth of seedlings and young trees from the carryover study as follows: “Long-term Effects of Nitrogen Fertilization on the Productivity of Subsequent Stands of Douglas-fir in the Pacific Northwest” in Forest Ecology and Management. The entire article is available at:

http://soilslab.cfr.washington.edu/publications/Footen-et-al-NAFSC.doc

Paul has submitted an additional paper to the 2009 SSSA Annual meeting in Pittsburg, PA, and will be presenting further results there in November, 2009. He will also be submitting these findings in the form of a manuscript to the journal “Forest Science” for publication this fall. Here is an abstract of that work:

Abstract: Recent studies have shown past N fertilization of forestland soils, formed on glacial deposits, in the Pacific Northwest region has long-term effects on site productivity lasting up to 15-25 years after application. The phenomenon is called the “Carryover” effect. This study re-examines the Carryover effect on the same five study sites used in the previous study by re-measuring productivity of second rotation Douglas-fir trees (10-12 years old) and understory vegetation. In addition, above and belowground C and N pools were measured. The results show strong evidence that Carryover effects significantly impact above ground carbon (C) and nitrogen (N) pools of second rotation crop trees, understory vegetation and forest floor material, as well as below ground soil N and C pools. Total above ground biomass (tree, understory and forest floor) was significantly greater (p = 0.068) on the Carryover sites than on the paired controls (Table 1). Nitrogen content in the above ground component (understory and forest floor only) was significantly greater (352 kg N ha⁻¹; p = 0.027) on the Carryover sites. Soil C and N pools was examined by depth. Total N content of the soil, was 5% greater (290 kg N ha⁻¹; p = 0.39) on the Carryover sites. Concluding that 642 kg N ha⁻¹ of the original 884-1120 kg N⁻¹ that was applied to these five Carryover sites has remained in the ecosystem 15-25 years after application. Total soil C was 11% less (210 Mg ha⁻¹) on the Carryover sites. The results of the this study show that in general the long-term effects of N fertilization decrease below ground C pools while increasing above ground C and N. Because this study has a limited number of sites and studies like this are so few more investigation may be necessary.

This study has shown evidence that carryover effects of previous N fertilization (up to 20 years previously) significantly impact above ground carbon (C) and nitrogen (N) storage and content of second rotation crop trees, understory vegetation and forest floor material, as well as below ground soil N and carbon (C) storage, and cycling processes.

In general total (tree, understory and forest floor) above ground biomass was significantly greater (72 Mg ha⁻¹; p = 0.068) on the carryover sites than on the controls. Most of the biomass increase was accounted for in the understory vegetation component (48 Mg ha⁻¹) followed by the forest floor (20 Mg ha⁻¹) and then the tree component (4 Mg ha⁻¹). It should be noted that the trees in this study are 10-12 years old and thus have not had sufficient time to accumulate large amounts of biomass. Nitrogen content in the above ground component (understory and forest floor only) was significantly greater (352 kg N ha⁻¹; p = 0.027) on the carryover sites. This N content increase does not yet include N content of tree foliage, but these should be available soon.

Figure 5. Paul Footen assessed the impacts of previous N fertilization on the growth of new stands, the “Carryover” study
The story below ground is not so clear. Soil was examined both by depth and total amounts of N and carbon (C). In general total N content of the soil was 5% greater (290 kg N ha\(^{-1}\)) on the carryover sites when compared to controls. A total of 884-1120 kg N ha\(^{-1}\) was applied to these 5 carryover study sites 15-26 years ago and we can measure an average of 642 kg N ha\(^{-1}\) that remain in the ecosystem. It is possible the remainder could be found in the tree foliage once it is analyzed. We also analyzed carbon. Past studies have shown N fertilization can potentially increase C storage in the PNW. To our knowledge, no other studies have looked at the carryover effect of previous N fertilization on carbon sequestration in a new rotation. The results of the carryover study show that in general the long-term effects of N fertilization decrease C storage in soils of second rotation Douglas-fir plantations in glacial outwash and till parent materials. Because this study has a limited number of sites and there are no other studies like this one, and soils are highly variable in C distribution and content, more investigation may be necessary before we can make any solid conclusions.

**Table 1.** Summary table of results of carryover effects on above and below ground carbon storage on second rotation Douglas-fir plantations in the PNW.

<table>
<thead>
<tr>
<th>Tree</th>
<th>Mean Values</th>
<th>Mean Values</th>
<th>% Difference</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Fertilizer</td>
<td>Control</td>
<td>2008</td>
<td>Alpha = 0.1</td>
<td></td>
</tr>
<tr>
<td>Tree Height (m)</td>
<td>4.6</td>
<td>4.1</td>
<td>12%</td>
<td>0.100</td>
</tr>
<tr>
<td>DBH (cm)</td>
<td>6.2</td>
<td>5.1</td>
<td>21%</td>
<td>0.038</td>
</tr>
<tr>
<td>BA (m²)</td>
<td>12.8</td>
<td>9.7</td>
<td>32%</td>
<td>0.061</td>
</tr>
</tbody>
</table>

**ABOVE GROUND**

<table>
<thead>
<tr>
<th>Biomass kg/ha</th>
<th>Biomass kg/ha</th>
<th>% Difference</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tree</td>
<td>3960</td>
<td>2983</td>
<td>33%</td>
</tr>
<tr>
<td>Understory</td>
<td>47942</td>
<td>25835</td>
<td>86%</td>
</tr>
<tr>
<td>Forest Floor</td>
<td>19779</td>
<td>15648</td>
<td>26%</td>
</tr>
<tr>
<td>Total</td>
<td>71681</td>
<td>44466</td>
<td>61%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Carbon kg/ha</th>
<th>Carbon kg/ha</th>
<th>% Difference</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forest Floor</td>
<td>8086</td>
<td>6571</td>
<td>23%</td>
</tr>
</tbody>
</table>

**Nitrogen kg/ha**

<table>
<thead>
<tr>
<th>Nitrogen kg/ha</th>
<th>Nitrogen kg/ha</th>
<th>% Difference</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Understory</td>
<td>532</td>
<td>252</td>
<td>111%</td>
</tr>
<tr>
<td>Forest Floor</td>
<td>218</td>
<td>145</td>
<td>50%</td>
</tr>
<tr>
<td>Total</td>
<td>749</td>
<td>397</td>
<td>89%</td>
</tr>
</tbody>
</table>

**BELOW GROUND**

<table>
<thead>
<tr>
<th>Carbon kg/ha</th>
<th>Carbon kg/ha</th>
<th>% Difference</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil 0-10 cm</td>
<td>54597</td>
<td>58121</td>
<td>(-) 6%</td>
</tr>
<tr>
<td>Soil 10-50 cm</td>
<td>84738</td>
<td>112169</td>
<td>(-) 24%</td>
</tr>
<tr>
<td>Soil 50-100 cm</td>
<td>47685</td>
<td>40011</td>
<td>19%</td>
</tr>
<tr>
<td>Total Soil</td>
<td>187019</td>
<td>210301</td>
<td>(-) 11%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Nitrogen kg/ha</th>
<th>Nitrogen kg/ha</th>
<th>% Difference</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil 0-10 cm</td>
<td>1909</td>
<td>1789</td>
<td>6%</td>
</tr>
<tr>
<td>Soil 10-50 cm</td>
<td>2747</td>
<td>3200</td>
<td>(-) 14%</td>
</tr>
<tr>
<td>Soil 50-100 cm</td>
<td>1627</td>
<td>1004</td>
<td>62%</td>
</tr>
<tr>
<td>Total Soil</td>
<td>6283</td>
<td>5993</td>
<td>5%</td>
</tr>
</tbody>
</table>
4) Effects of N on Hood Canal Hypoxia

Initially, forest fertilization was considered to be a potential major source of N to Hood Canal. Nitrogen is the nutrient considered to be responsible for Hood Canal hypoxia problems. The assumptions (10% of N applied directly winds up in Hood Canal) seemed impossibly high for regular forest applications, but no research on similar soils with the same application techniques as is applied in the region by SMC members was available. Thanks to funding from Green Diamond, SMC, the Gessel Foundation and the Puget Region Integrated Research Model (PRISM), Cindy Flint carried out a study as part of her M.S. degree. Here is the abstract from Cindy’s article in the Journal of Environmental Quality, published in 2008:

“Leaching of nitrogen (N) after forest fertilization has the potential to pollute ground and surface water. The purpose of this study was to quantify N leaching through the primary rooting zone of N-limited Douglas-fir [Pseudotsuga menziesii (Mirb.) Franco] forests the year after fertilization (224 kg N ha\(^{-1}\) as urea) and to calculate changes in the N pools of the overstory trees, understory vegetation, and soil. At six sites on production forests in the Hood Canal watershed, Washington, tension lysimeters and estimates of the soil water flux were used to quantify the mobilization and leaching of NO\(_3^–\)N, NH\(_4^+\)N, and dissolved organic nitrogen below the observed rooting depth. Soil and vegetation samples were collected before fertilization and 1 and 6 mo after fertilization. In the year after fertilization, the total leaching beyond the primary rooting zone in excess of control plots was 4.2 kg N ha\(^{-1}\) (p = 0.03), which was equal to 2% of the total N applied. The peak NO\(_3^–\)N concentration that leached beyond the rooting zone of fertilized plots was 0.2 mg NO\(_3^–\)N L\(^{-1}\). Six months after fertilization, 26% of the applied N was accounted for in the overstory, and 27% was accounted for in the O+A horizon of the soil. The results of this study indicate that forest fertilization can lead to small N leaching fluxes out of the primary rooting zone during the first year after urea application.”

Cindy’s article in the Journal of Environmental Quality is available at:


5) Impacts of N on Carbon Sequestration.

Ben Shryock began sampling five of the Type I plantations in late 2008. The purpose of this study is to determine the effects of urea fertilization on carbon sequestration in the soil, understory vegetation and live trees, a followup to earlier work by Jana Canary (M.S. student) and Dr. AB Adams (postdoc) in naturally-regenerated Regional Forest Nutrition Research Project stands. We didn't have access to plantations in the earlier studies. The five sites were established on average 10 years after planting and had an average of 1149 initial stems per hectare (ISPH). The plots that were thinned to one quarter of their ISPH were selected for this study because they differ solely in the application of urea fertilizer and because they most closely resemble the stocking rate of coastal Douglas-fir plantations.

By the end of 2008 three out of five sites had been sampled. At each plot a one-meter soil pit was dug and each horizon was sampled for bulk density and chemical analysis. Three samples were taken from the forest floor and pooled for analysis. In addition, five understory samples were taken by clipping the vegetation to the forest floor and pooled for analysis. All samples were taken from randomly-located positions within each plot. Upon returning from the field, all soil, forest floor and vegetation were air-dried. After all five sites are sampled the laboratory analysis will begin.

Also at the end of the 2008 growing season, the amount of carbon stored in the trees was calculated. The diameters of each tree at 1.3 m (DBH) were taken at inception of each site and every four years thereafter.
for 16 years. The measurement of DBH coincided with the four-year fertilizer applications. Using the equations developed by Gholz, the biomass for each tree in the plot was calculated. The tree biomass was summed and converted into the mass of carbon by multiplying by 0.509 g C/g biomass. The amount of carbon sequestered in each plot was calculated by subtracting the difference between treatment and control plots at the first measurement (year 0) from the difference between treatment and control 16 years later (year 16). Results of Ben’s studies aren’t available yet, but should be available very soon.

Additional SMC-related Items

Rob Harrison is spending a month in Brazil this summer (indeed he is in Brazil as this report is written) and is initiating cooperative work as an adjunct faculty member at the State University of Sao Paulo at Botucatu, Sao Paulo State (UNESP-Botucatu). Rob is giving three courses at UNESP on general and specific impacts (with lots of examples from SMC studies) of forest management on C sequestration and soils. The adjunct faculty position, if approved, will likely require about a month in Brazil every 2 years on Rob’s part, but should greatly enhance the SMC’s ability to compete directly for funding from a variety of sources, as we can initiate coupled studies in Eucalyptus and PNW plantations (and possibly loblolly pine with the Forest Nutrition Cooperative), representing some of the most productive industrial forestry plantations in the world.

If Rob’s application as an adjunct is accepted, which will take some time, it will also mean continued cooperation by UNESP faculty members. For instance, Dr. Irae Guerrini spent about a year at UW working on the Fall River and other studies, and has been a co-author of several papers. Also, as an adjunct faculty, UNESP will support a continuous student stipend that would normally “sandwich” their studies by working at least a year in the US, almost certainly on SMC studies. This, like the use of current stipend and TA sources, should result in faculty and students working on SMC projects without SMC paying for their personal support and tuition, which greatly enhances the impact of cooperator funding. Rob also recently spent a month in China at Chang’an University in Xian, China. The SMC is currently hosting a visiting professor, Dr. Xiu Yi, from Chang’an University. Dr. Yi has been working on the 5-year biomass results at Matlock and Molalla. Current plans include an additional professor, Dr. Xin Wu, working at the UW with Carol Shilling when Dr. Yi returns to Chang’an University this Fall.

Papers Published or Initiated in 2008


The Silviculture Project was quite active in calendar year 2008. In brief (more detail in section below), work pertaining to several long-term Silviculture Project studies continued. This included the SMC mission-driven gathering of high quality data on tree and stand growth and development and tree and product quality. A summary of field work accomplishments is in the Field Work Section on page 15.

In February 2008, Silviculture Project TAC (SPTAC) Leader Turnblom and SMC Director Briggs attended the Center for Advanced Forest Systems (CAFS) field tour and guided the group through Installation 712 Silver Creek, a Type I installation near Astoria, OR. This laid some important ground work so the SMC eventually could join CAFS. SPTAC Leader Turnblom also made significant contributions to three of seven projects identified in the proposal to NFS for joining CAFS. These were titled “Understanding response of plantations to combinations of planting density, thinning, fertilization, pruning on stand growth and development and wood quality,” “Understanding the interaction between genetics, stand density, and intensive plantation culture,” and “Modeling the effects of intensive plantation silviculture on stand growth and development.”

In summer of 2008, the second three GGTIV sites planted in 2006 were characterized using the newly developed site characterization protocol. The protocol is designed to capture attributes of the site that are not normally reported in a soil survey or a description of the soils. Attributes such as depth and coverage of red rot, depth and coverage of slash, depth of forest floor, and depth to red rot, as well as soil disturbance class are included in the measurements. Graduate student Paul Footen devised a browse severity index, vetted by SMC Research Forester Collier, SPTAC Leader Turnblom, and CFR Professor Charlie Halpern for the purposes of characterizing the relatively prevalent browse at the GGTIV Boxcar installation. The browse survey was implemented at Boxcar (installation 604) with results to be reported in the 3rd quarter of the 2009 SMC Quarterly newsletter.

The Silviculture Technical Advisory Committee (TAC) met jointly with the other TACs via “Webinar” on 26 Aug 2008 to discuss implementation of the SMC Strategic Plan. The major outcome was to develop two new priority projects. The first project will generate an initial plan to validate currently available growth & yield models, such as ORGANON, FVS, NW CONIFERS, TreeLab, and / or FPS, with the aim of revealing patterns among models in their performance which would point to knowledge gaps. Silviculture Project TAC Leader Turnblom discussed a pre-proposal with Modeling Project TAC leader Marshall, Greg Johnson, and Dave Hamlin. An estimated budget will be established and the basic project idea put before the entire Policy Committee for further discussion. The other project will develop a “LOGS-style” report on growth and yield in all Type I, II, and III installations to date. Silv. Project TAC Leader Turnblom will initiate a pre-proposal and will identify persons involved, a timeline, and a budget, and will be discussed at an upcoming TAC meeting, and brought before the Policy Committee for further discussion.

Work is progressing on calibrating relationships between the upper canopy or trees in young, intensively managed stands of Douglas-fir and lower canopy vegetation in SMC research plots. The objectives of the study include developing overstory / understory relationships in young, managed Douglas-fir stands at the species level, and to test their interpolative and extrapolative properties by comparing model forecasts to actual observations from a data set not used in the model building / fitting stage of the analyses. Progress was reported at the March 2008 AFPA Western Wildlife Program Technical meeting in Stevenson, WA.

Silviculture Project Leader Turnblom also worked closely with Olympic Natural Resources Center (ONRC)
forest researchers on the “Sun Tree Identification” project. Graduate student Nick Vaughn is currently assisting on this project and is developing some very promising techniques for identifying/separating distinct canopy layers in multi-layered canopy forests growing on the Olympic Peninsula.

**Age Three Analysis of the Genetic Gains / Type IV Joint Trial (GGTIV)**

These joint trials have their genesis in discussions between the Northwest Tree Improvement Cooperative (NTIC), the Stand Management Cooperative (SMC), the US Forest Service, and other interested parties on how best to study the interactions between genetic improvements and silvicultural treatments. The original SMC Type IV design actually attempted to tackle four experimental factors: genetic gain level, spacing, vegetation control, and fertilization regime. The original SMC design covers three coastal and three western Cascade Douglas-fir breeding zones, placing six installations within each breeding zone. Due to manifold logistical constraints and further discussions with NTIC, fertilization was dropped from the design and a single breeding zone was identified (Grays Harbor) to get things started.

The objectives of the GGTIV trials are to: 1) provide information to guide managers currently applying combinations of genetics, spacing and vegetation control; 2) provide linkages with other studies (such as Genetic Gains Trials, intensive vegetation management trials, and spacing trials like the SMC Type III), that will assist modeling efforts; 3) compare estimates of growth & yield parameters among genetic populations with different expected growth potential; and 4) develop a predictable relationship between expected genetic gain based on individual-tree growth characteristics and realized genetic gain on a per unit-area basis.

The trials, therefore, examine three factors: genetic gain level, spacing, and vegetation control level. The gain (G) factor is defined to have three levels: G1 – Unimproved, G2 – Intermediate gain (the SMC Type IV Trial portion does not use this level), and G3 – Elite gain. There are three spacing (S) factor levels chosen: S1 – 15 x 15’, nominally 200 Stems Per Acre (SPA), S2 – 10 x 10’, nominally 440 SPA (Genetic Gain Trial portion uses this single density only), and S3 – 7 x 7’, nominally 900 SPA. Finally, the vegetation control (V) factor has two levels defined: V1 – Current Practice (defined as a single site prep; used only in SMC Type IV Trial portion, which is consistent with SMC Type III protocols), V2 – Complete (defined as 80% or greater bare ground until crown closure; standard on all Genetic Gain Trial and on Type IV). A typical installation layout looks something that which appears in Figure 1. Results of the first measurement after two growing seasons (age 3) are provided in what follows.

Browse was minimal on installations 601 through 603 and on 605 and 606 (a few trees). The Boxcar Installation (604) was hit hard with browse from a local elk population due to many storm, wind, and animal events repeatedly knocking down the fence, providing easier access.
Strong evidence was observed ($p < 0.0001$) to indicate that site influences height of Douglas-fir seedlings at age three. These site influences include productivity, weather and climate, and other local effects. Solid evidence ($p = 0.016$) was also observed that genetic gain level affected average height of age 3 seedlings. Intermediate gain caused almost a 3% increase in height over woods-run stock, while the elite gain was observed to be about 6% taller than the woods-run stock. There was essentially no detectable effect of density on height after two growing seasons, neither was there a detectable effect of weed control on height.

No evidence was found for genetic gain level affecting basal diameter at age 3. Tree basal diameters averaged about 0.6 inches across all gain levels. There was marginal evidence ($p = 0.044$) that density affected basal diameter. Both the 7- and 15-foot spacings were about 1% smaller in diameter than the 10-foot spacing. These plantations are much too young at this point to surmise that the 10-foot spacing is somehow “optimal” for diameter growth. Evidence is beginning to emerge ($p = 0.049$) that continued (complete) weed control is affecting basal diameter. Plots with complete weed control are on average 2% larger than those plots with a single spraying during site preparation.

No significant difference in survival between genetic gain levels was found. On average, survival is a bit less than was hoped for, being estimated at 81 percent. Survival was about 4% higher on sites with complete weed control than without, but complete weed control appears to affect survival differently on widely spaced plots compared to plots having narrow spacing ($p = 0.027$). This result holds true regardless of whether survival proportion or absolute number of trees surviving is used as the dependent (response) variable. Survival is about 85% for both levels of weed control at the 7-foot spacing, is much lower (about 68%) on the limited weed control plots at the 10-foot spacing, but at the widest 15-foot spacing is actually higher on the limited weed control plots than on the repeated weed control plots. Here again, at such a young age, extreme caution is advised in the interpretation of this result.

With regard to crown width, only genetic gain level appears to have an effect ($p = 0.0382$). The elite gain plots have, on average, crown widths that are 4% narrower than either the woods-run or intermediate gain levels, which appear to have similar crown widths themselves.

In general, we expect the differences observed to date to increase as trees grow older and larger – time will tell.
Vegetation Composition and Succession in Managed, Coastal Douglas-fir Ecosystems (NCASI project)

The objectives of this study are to develop overstory/understory relationships at the species level in young managed Douglas-fir stands over time and forge links with silvicultural practices. The driving idea being that the impacts of cultural treatments on critical wildlife habitat requirements should be deduced from analyzing the vegetation that comprises habitat quality in general, rather than by analyzing habitat requirements of any particular species. More specifically, we seek to 1) develop overstory / understory relationships in young, managed Douglas-fir stands at the species level, 2) benchmark the developed relationships against a small, independent vegetation data set, and 3) test the extrapolative power of the models by comparing them to observed data from differently treated stands (thinned and pruned) not used in model building. Graduate student Kevin Ceder has begun work on this project with Silviculture Project Leader Turnblom.

Building a theoretical model relating the overstory and the understory follows basic principles outlined by Major (1951) in that plant occurrence and vigor are known to be a function of climatic, edaphic, and biotic factors. The input variables should define “growing space,” i.e., the intersection of life requisites of the vegetation: light, water, nutrients, and physical space. This growing space should then be related to, or impacted by, the trees in the form of tree summary, stand, and site variables.

Preliminary plotting and exploratory analyses of Type III data indicate the general pattern that shortly after harvest the new stands have little if any shrub cover as do shorter stands (stature measured by top height). As stands age, cover increases. Then, in older stands (larger top height) less shrub cover is found. Taken together, these observations point to a unimodal function between shrub cover and top height. However, with a paucity of data beyond a top height of 60 feet in the Type III set, we found it difficult to fit unimodal functions to these data. Figure 2 shows the quality of fit for two unimodal functions, the exponential power function and the Weibull function, under different assumptions about shrub cover at very tall (at least 100 ft) top heights in plot 2, installation 903.

As the project progresses, we will be expanding these models to include other tree summary information, site quality, and location and topographic parameters. We will be examining the strength of cover change relationships as well as models for cover accumulation just described. We will then be looking into how graminoids, forbs, and ferns behave, finally decomposing these life forms possibly into vegetation “guilds” (such as forest interior or edge species) and/or into individual species’ behavior.

Figure 2. Comparison of fitted exponential power function (black lines) and Weibull function (red lines) under different assumptions for behavior at taller top heights (solid, dashed, and dotted lines).
Sun-Tree Identification in Tree Lists of Multi-Strata Stands (ONRC project)

Stand Density Management Diagrams (SDMDs) were developed for single canopy (single stratum, and by implication single cohort) stands. However, the limiting size-density relationships upon which they are based apply equally well to mixed species stands, which may possess multiple strata, perhaps even multiple cohorts. In a light-limited environment such as the Olympic Experimental State Forest (OESF), there is reason to believe that the top (or uppermost) level stratum (cohort) still drives size/density dynamics. The objective of this study is to test and/or modify existing stratum-identification algorithms or develop new ones to identify objectively the individual strata in multi-strata (multi-cohort) stands. By direct imputation, the tallest or top level stratum should be composed of so-called sun-trees (sensu Yoda 1963), identifiable by their shade intolerance, rapid growth rates, high light compensation points, etc. Graduate Student Assistant Nick Vaughn is working on this project.

Work is now well underway comparing existing algorithms, principally those of Baker and Wilson (2000) and Latham, et al. (1998), with some newly developed ones. All the algorithms are based somewhat on tree height, height to crown base, and crown ratio. We are also exploring the usefulness of weighting any or all of these attributes by DBH or tree volume. One new idea showing promise is to base the canopy layer to which a tree belongs on the cumulative distribution of crown area profiles from the ground to the tallest tree, dubbed the “canopy closure” algorithm. Another promising algorithm bases the canopy layers on the differences in height between a neighboring tree and the subject tree, dubbed the “crown point” algorithm. The most promising algorithm to date involves the calculation of individual tree Crown Integration Value (CIV), which is the integral of tree height from crown base height to total height. Distances between trees are computed in the DBH – CIV plane, with significantly different distances defining the differentiation between crown layers.

Student Research and Activity

After successfully completing his Master of Science thesis, graduate student Nick Vaughn is continuing with graduate work at CFR, UW pursuing a Ph.D.

Andrew Hill successfully defended his Ph.D. dissertation on relating weather and long-term climate to the growth of Douglas-fir occurring in pure and mixed conifer stands growing in eastern Washington. Andrew has submitted two manuscripts for publication consideration, one to Forest Science; the other to Canadian Journal of Forest Research. During 2008, Dr. Hill held a post-doctoral position on the faculty in CFR assisting with a project led by Turnblom and sponsored by WA DNR to examine simpler alternatives to the complicated Forest & Fish rules regarding Riparian Management Zone buffer widths.

Silviculture Project Leader Turnblom also worked closely with graduate student Rapeepan Kantavichai, supervised by SMC Director Dave Briggs, on modeling ring specific gravity and wood density pre- and post-treatment on the Highway Thinning site; with graduate student Paul Footen, supervised by Rob Harrison, on the Carryover study; and with graduate student Ben Shryock, also supervised by Rob Harrison, on carbon content and cycling in the soil at several Type I installations.

NEW Publications / Theses / Reports in 2008


TAC Report

A Wood Quality TAC meeting was held August 26, 2008 via teleconference. The discussion revolved around what type of wood quality data we should routinely collect on the SMC installations. The consensus seemed to be that we should look at this from the final product perspective. What properties do we need to measure to maximize product option at harvest?

Potential measurements include:

- Density
- Tree crowns (and relation to wood density)
- Crown length
- Crown diameter (look at crown volume using a simplistic method)
- Take cores (x-ray densitometry and NIR)

Data from the entire tree, not just the butt log, should be collected. The basic properties of interest are Modulus of Elasticity (stiffness), specific gravity, and microfibril angle. One objective of collecting this data is to be able to map wood density within a stand and across a landscape with the goal to sort the resource while it is still standing.

Non-destructive techniques are one way to get some of this information. Working with University of Washington and their terrestrial LIDAR system may provide some measurement opportunities. For example, leaf area index measurements could be made on fertilization trials to examine crown volume and form response.

There are buffer zones in existing installations that are available for destructive sampling. Both SMC and LOGS installations provide latitudinal transects that could be used to measure site and stand variables. Work in this area would cross country borders.

A separate Wood Quality TAC meeting should be held to discuss which wood quality measurements are most important, how can we best obtain them using existing installations (both SMC and LOGS), is there a need to develop a new installation type focused on wood quality, and how this work might be funded.

New Projects Funded

The Wood Quality TAC was involved in the submittal of three proposals to Agenda 2020. In conjunction with the Nutrition TAC, the proposal “Management of PNW forest plantations: additional site characterization and instrumentation for SMC/CIPS paired-tree fertilization projects” was funded. Wood quality measurements, such as nondestructive testing on the stems of the plot center trees will be conducted. The objective for the Wood Quality TAC is to determine how key measures of wood quality are affected by site factors, stand conditions, management practices, and genetics. See the Nutrition Project Report for additional information on this funded proposal.
Discussions of New Projects for 2009

Means for performing non-destructive acoustic testing and collection of specific gravity core samples from the LOGS (Level of Growing Stock) installations were discussed with a formal plan for data collection and field work proposed for 2009.

Project Updates

**Project Title:** “Non-destructive evaluation of wood quality in standing Douglas-fir trees and logs”

**Principal Investigators:** David Briggs¹, Eini Lowell², Eric Turnblom¹, Bruce Lippke³, Peter Carter⁴

¹ Stand Management Cooperative (SMC) University of Washington, Seattle, WA, ² USFS PNW Research Station, Portland, OR, ³ Rural Technology Initiative (RTI), University of Washington, Seattle, WA, ⁴ Manager Resource Technology & Commercialization, CHH Fibre-Gen, New Zealand

**Collaborators:** Robert J. Ross, Xiping Wang, USDA Forest Service Forest Products Laboratory, One Gifford Pinchot Drive, Madison, WI. Dennis Dykstra, USDA Forest Service Pacific Northwest Research Station, Portland, OR. Glenn Howe, Marilyn Cherry, Vikas Vikram; Pacific Northwest Tree Improvement Research Cooperative, Oregon State University, Department of Forest Science, 321 Richardson Hall, Corvallis, OR, 97330-5752. The following members of the SMC provided support for the Objective 1 portion of the study; Green Diamond Resource Company (timber, harvesting, transportation), Port Blakely Tree Farms (timber, harvesting, transportation), Washington Department of Natural Resources (timber, harvesting, transportation), Weyerhaeuser Company (timber, harvesting, transportation, milling, x-ray densitometry). Olympic Resource Management, a member of both PNWTRC and SMC provided support (seed orchard, progeny trials, harvesting) for the Objective 2 portion of the study.

**Funding:** This project combined an $87,500 grant from the USFS AGENDA 2020 FY 05/07, $80,000 industry funds, and $95,000 UW (Stand Management & Precision Forestry Cooperative) with $139,150 USFS PNWRS and, $74,941 industry in-kind support into a total effort of $476,591.

**Project Description:** Douglas-fir (Pseudotsuga menziesii var. menziesii [Mirb.] Franco) is renowned as a building construction material due to its abundance and high strength and stiffness. Non-destructive testing technology, based on the velocity of acoustic waves propagated through wood, provides a method for indirectly measuring wood stiffness, an important property in structural and other applications. Within the past decade, technology has been developed that permits rapid, convenient measurement of acoustic velocity of wood in logs, and studies have found excellent relationships between the acoustic velocity of a log and the resultant stiffness of lumber or veneer recovered from the log. More recently, technology has been developed for measuring acoustic velocity of wood in the lower bole of standing trees, enabling the use of acoustic methods for assessing wood quality and sorting raw material along the chain of custody. The overall purpose of this study was to determine these relationships for Douglas-fir and to understand how genetics and silvicultural treatments may be used to influence the stiffness; hence quality, of Douglas-fir.

**Research Objectives:** (1) What are the relationships between the average stiffness of lumber or veneer in a log, stiffness of the log, and stiffness of the parent tree and to what extent are these relationships influenced by stand, tree, or log variables? **Hypothesis:** We hypothesize that relationships between average stiffness of product in a log, the HM 200 log stiffness measure, and the ST 300 stiffness measure of the parent tree are all linear and that these relationships are unaffected by tree and stand variables. (2) What are the effects of cultural treatments and genetics on these stiffness relationships? **Hypothesis:** Silvicultural treatments (planting spacing, thinning, fertilization, pruning) and genetics do not alter the basic relationships found by Objective # 1. That is,
treatment or genetic effects would simply have the same slope and intercept as the baseline relationship between tree and log stiffness values. (3) How can the natural variability of stiffness among trees within a stand be monitored and incorporated into decision support tools that assist managers in assessing if stands and stand treatments are within desired specifications and in making improved marketing decisions?

**Progress and Results**

To accomplish objective 1, tree-to-product (lumber and veneer) milling studies were conducted in 2006-2007. Approximately 50 trees from the 5 treatment plots on four Type II installations were measured for acoustic velocity in August/September 2006; one of the 20 total plots was not usable due to storm damage. A stratified random sample of 12 trees was chosen from the 19 remaining plots for harvesting (228 trees total); one-half were converted to veneer, and the other half to lumber. Sample trees were harvested and re-measured for acoustic velocity in November 2006; veneer and lumber conversion studies were respectively conducted in December 2006 and March/April 2007. Detailed tree and log measurements, including acoustic velocity, were recorded and all full and half-sheet veneer and all 2x4 and 2x6 lumber was tested for stiffness at the US Forest Products Laboratory. Cross-section disks from each log end were measured for moisture content, green and oven-dry density, age, percent heartwood, percent wood 10 years and younger and percent wood 20 years and younger. Strips from the disks were removed for x-ray densitometry by Weyerhaeuser Company and completed in 2008.

Analyses and publications are being completed to (1) predict log acoustic velocity from tree acoustic velocity, (2) predict veneer (lumber) stiffness from log acoustic velocity, and (3) investigate effects of log height position, log diameter, knots, and percent juvenile wood as further explanatory variables. These results will be useful to those who market timber to manufacturers of engineered wood products where stiffness is a critical criterion and to forest managers who may be able to improve stiffness through silviculture.

Object 2, gain an understanding of the potential use of genetics to improve stiffness (acoustic velocity), was accomplished in collaboration with the Pacific Northwest Tree Improvement Research Cooperative (PNWTIRC). In 2005, wood stiffness (MOE), density, moisture content, and growth in a coastal Douglas-fir progeny test (50-130 families per trait; 1-3 sites) and clonal seed orchard (66-82 parental clones per trait) were measured and trees thinned from the progeny test were converted into lumber. MOE of lumber was measured directly using bending tests on recovered 2x4s from butt logs, and indirectly using tools that measure acoustic velocity in logs and standing trees. “Acoustic” MOEs were also obtained from the tree and log velocities and wood density. We examined the genetic relationships (heritabilities, genetic gains, and genetic correlations between traits) of wood stiffness and growth measures. This research found that seed orchard and progeny tests can be used to measure wood properties and select genotypes with superior wood stiffness. Gains can be made in bending stiffness by selecting on acoustic velocity measures. Acoustic velocity from the log and standing tree tools offer rapid inexpensive assessments of wood quality in breeding program but the log tool is more efficient than the standing tree tool for improving lumber stiffness. Furthermore, wood density was found to be inferior to using acoustic velocity and supplementing acoustic velocity with wood density did not provide justifiable improvements. These results are important to tree breeders who are seeking to improve wood properties of intensively managed planted forests. Work is underway to determine the most efficient way to incorporate stiffness measures into operational breeding programs.

Accomplishment of objective 3 includes the analyses and resulting statistical models associated with Objectives 1 and 2. However, Objective 3 goes further in that we wish to use the information from this study to demonstrate how statistical process control methods could be used to assist in marketing timber
through improved and more flexible quantitative linkages between a customer’s requirements for stiffness in raw material purchases and the distribution of stiffness (acoustic velocity) in the resource. The same technique could also be used by silviculturists in monitoring acoustic velocity as stands develop and respond to treatments. By quantifying stiffness along the chain of custody and understanding the effect of tree, stand, and site, it may be possible to improve and augment growth models and harvest planning models.

Publications


**Project Title:** Effect of Thinning and Fertilization on Diameter of the Largest BH Region Branch in Douglas-fir Plantations

**Principle Investigators:** David Briggs, Rapeepan Kantavichai, Eric Turnblom

**Funding:** UW Corkery Family Chair $30,000 (2005), $30,000 (2006), $30,000 (2007)

**Project Description:** Nine SMC Type I Installations contain a fertilization/density management experiment where 3 plots at the ISPA, ISPA/2, and ISPA/4 densities have counterparts that received 200 lb/a N at plot establishment and every 4 years thereafter until 1000 lb/a have been applied. The SMC has been collecting data on the diameter of the largest branch in the breast-height region (DLLBH) of the approximately 40 height sample trees on each plot. Thus there are 54 total plots with 2254 trees measured for DLLBH.

**Research Objectives:** (1) What are the relationships between the tree and growing condition variables and DLLBH at (1) the plot mean level and (2) the individual tree level?

**Progress and Results**

To accomplish objective 1, regression models were developed to predict the mean DLLBH of the trees on the 54 treatment plots from other mean tree and growing condition variables. Models were developed from the following perspectives (a) using tree variables only, (b) using growing condition variables only, (c) using a combination of tree and growing condition variables, and (d) using only variables that could be measured with remote sensing (LIDAR) combined with variables that would be known from management records (e.g. stand age). The mean treatment plot models would be useful for linking with stand-level growth and yield models and for estimating and mapping stand-average DLLBH across landscapes. It was found that the best model used a combination of mean tree and growing condition variables to predict mean DLLBH. We also succeeded in finding a model that used only data that would be obtained from LIDAR in combination with information that managers would know from stand history. This phase was completed and an article has been accepted in the Canadian Journal of Forest Research.

To accomplish objective 2, regression models were developed to predict the DLLBH of individual trees on the 54 treatment plots \( n = 2254 \) trees) from other individual tree and growing condition variables. Models were developed from the same perspectives as for Objective 1: (a) using tree variables only, (b) using growing condition variables only, (c) using a combination of tree and growing condition variables, and (d) using only variables that could be measured with remote sensing (LIDAR) combined with variables that would be known from management records (e.g. stand age). The individual tree models would be useful for linking with individual tree-level growth and yield models and for providing estimates of individual tree DLLHB within stands across landscapes.

The rationale for DLLBH models is based on prior research that established relationships between DLLBH of trees and the largest limb average diameter (LLAD), also known as branch index (BIX) of logs milled from those trees. LLAD is a common log quality variable used to predict product grade mix in product recovery studies. Knowledge of how DLLBH is affected by tree and growing condition variables establishes an important linkage between stand development, silvicultural treatments, log quality and product grade mix.
Publications


Project Title: Modeling Specific Gravity Patterns in a drought-prone, low site, 55 year old Douglas-fir Stand as Affected by Treatment, Soil, and Local Climate

Principal Investigators: David Briggs, Rapeepan Kantavichai, Eric Turnblom

Funding: UW Corkery Family Chair, $30,000 (2008)

Project Description: A previous study examined the effect of thinning and biosolids implemented in 1977 in a drought-prone, low site, 55 year old Douglas-fir stand. In 1998, 48 trees were felled for a product recovery study and cross-section disks from the top of the first 16.5 foot (5m) log provided samples for x-ray densitometer scans for width and specific gravity (SG) of whole rings earlywood and latewood. X-ray scans were performed by Weyerhaeuser Company. Soil data and local monthly temperature and precipitation data from PRISM were available and used to calculate monthly water balance.

Objectives: (1) What are the post-treatment relationships between ring SG and treatment, tree, stand, precipitation, temperature and water balance variables? (2) What are the pith-to-bark relationships? (3) What are the implications for estimating dry weight and carbon storage?

Progress and Results:

Thinning increased latewood width but ring SG was unchanged. Biosolids decreased SG by 7.8%, and thinning with biosolids decreased SG by 8.3%, not different than biosolids alone. The SG decrease due to biosolids resulted from decreased earlywood SG, latwood SG, and latewood percent. SG decreased with increased July soil moisture deficit; alternatively, SG increased with increased July total precipitation. Warmer mean March-May or August-November temperature also increased SG.

A four-parameter logistic mixed model was used to model SG from near the pith to about ring sixty. Individual ring SG was modeled using local temperature, precipitation, and soil moisture deficit as growing environment variables and ring number, ring area increment, ring width and radius to the ring as tree characteristic variables. The average cross-section SG to any ring within each tree was also modeled using these variables. Results showed that ring age, ring area increment, fertilization with biosolids, average temperature in Mar to May, and July soil moisture deficit were important predictors of SG on this site.
Post-treatment volume growth of thinning, biosolids, and thinning/biosolids respectively were 6% lower, 2% higher, and the 23% higher than the control. However, considering SG effects of treatments, dry weight and carbon growth respectively were 2% lower, 6% lower, and 12% higher than the control. Dry weight/carbon storage estimates using the average SG in the Wood Handbook and stem wood biomass equations were inconsistent between treatments with errors as large as 50%. Since SG on this site exceeded the average for Douglas-fir, impacts on related wood quality properties may not be critical; however, failure to consider local SG on dry weight and carbon storage calculations produced substantial errors. The Objective 2 equations for SG can be easily converted to equations for carbon or energy content since dry wood contains about 49% C and 8600 btu/lb (20.4mj/kg).

**Publications**


**Project Title:** Modeling Specific Gravity Patterns in Four SMC Type II Douglas-fir Installations as Affected by Treatment, Soil, and Local Climate

**Principal Investigators:** David Briggs, Rapeepan Kantavichai, Eric Turnblom

**Funding:** UW Corkery Family Chair, $30,000 (2008)

**Project Description:** Four Type II installations, each with 5 thinning trial plots, were used for veneer and lumber recovery studies to evaluate tree and log acoustic tools to predict product stiffness. A stratified random sample of 12 trees per plot was chosen for harvesting (228 trees total); 19 of 20 plots were sampled with one plot unusable due to storm damage. Cross-section disks from the ends of 16-foot sawlogs and each 17-foot veneer logs from each tree provided samples for x-ray densitometer measurement of the width and specific gravity (SG) of whole rings and earlywood and latewood components. X-ray scans were performed by Weyerhaeuser Company. Soil data and local monthly temperature and precipitation data from PRISM permit water balance calculations.

**Objectives:** What are the relationships between ring SG and ring age, treatment, tree, stand, precipitation, temperature and water balance variables from pith to bark?

**Progress and Results:** x-ray scans were completed in 2008 and the database delivered in late 2008. Monthly temperature and precipitation data from PRISM has been obtained and water balance was calculated by month for each year with a modified Thornthwaite-type water balance equation that considers latitude, precipitation, temperature, soil water capacity, slope and aspect (Lutz 2008). Analyses using three- and four-parameter logistic functions are underway. The equations for SG can be easily converted to equations for carbon or energy density since dry wood contains about 49% C and 8600 btu/lb (20.4mj/kg).


**Publications:** one manuscript being drafted
MODELING PROJECT PROGRESS REPORT

Project Leader: Dave Marshall, Weyerhaeuser Company

The SMC Modeling TAC did not meet officially this year, but members participated in other TAC meetings and graduate committee meetings during the year and have supported a number of modeling projects.

For example, members of the Modelling TAC contributed to Eric Turnblom’s (University of Washington and the Silviculture TAC) to develop a proposed framework for model validation.

Young Stand Model

The Pacific Northwest version of Conifers was completed and released in the spring of 2008 by Martin Ritchie (PSW Research Station). The project was funded through the USFS Pacific Southwest Research Station Agenda 2020 program and the SMC. Martin has continued to make updates and cooperators are encouraged to test the model and get feedback to Martin. A workshop on the use of the model was held on April 23rd following the SMC Spring Meeting. In addition, Doug Maguire, Oregon State University, CIPS Cooperative) has been testing the model and working with Martin to explore potential improvements.


Forest Vegetation Simulator (FVS)

New extensions and tools for FVS variants include a the Economics Extension (created by Fred Martin of the WA DNR) and a carbon accounting tool that allows users to get estimates of tons of carbon per acre. Nick Crookston is continuing work on making a climate sensitive FVS. Current work will be to include new Oregon white oak equations into many of the R6 variants and to increase the species list for the Blue Mountains variant (Erin Smith-Mateja, USFS Forest Management Service Center). Documentation for all the variants has been updated into a much more “user friendly” uniform format.

http://www.fs.fed.us/fmsc/

SMC-ORGANON

Progress is being made in the development of the RAP (Red Alder Plantation) version of ORGANON project by David Hann (Oregon State University). Most of the component equations have been developed or are nearing completion. Validation of the ORGANON Douglas-fir volume and taper equations found that the equations predict well for trees with DBH’s under 30” but have an over prediction bias for trees with DBH’s over 30”. As a result, new volume and taper equations are being developed for Douglas-fir. Work continues the Windows variant of ORGANON as time permits.

http://www.cof.orst.edu/cof/fr/research/organon/
TECHNOLOGY TRANSFER

A. MEETINGS, WORKSHOPS & FIELD TOURS, AND CONFERENCES

Meetings, Workshops, Field Tours

1. February 14, 2008 (Meeting) BC Ministry of Forests Research Branch, Victoria, BC. Discuss fertilization research and collaboration opportunities. (R. Harrison).

2. February 21, 2008. (Field Tour) Center for Advanced Forest Systems (CAFS) Field Tour (25 attendees). Longview, WA - Astoria, OR. Overview of SMC and visit Gnat Creek Type I Installation.

3. February 28, 2008. (Seminar) Terrestrial LIDAR for Stem Measurements on Forest Growth Plots. Dr. Glen Murphy, Forest Engineering Dept, OSU. College of Forest Resources, U of W.


5. April 8, 2008 (Meeting) Inland Forest Nutrition Cooperative Meeting, Moscow, ID. (2 presentations, R. Harrison).


10. Sept 12. SMC Strategic Planning Committee Meeting via GoToMeeting video-conference.

11. Sept 16-17, SMC Fall Meeting, Little Creek Casino, Kamilche, WA.

Presentations and Posters


B. PUBLICATIONS and REPORTS 2005-2008

Listed are all fact sheets, reports, proceedings, and journal articles produced over the last years associated with SMC projects and resources (data, plots, wood samples, etc.). Many can be copied from the SMC website; for others contact the authors.

2005

Theses


Publications


2006

Theses


Publications


2007

**Theses**


**Publications**


7. Footen, P.W. and R.B. Harrison. **King County METRO Biosolids 5 year Report for 2007.**


2008

Theses


Publications


Accepted


Journal & Proceedings Articles: In review


Technical Reports, Working Papers, etc.


SOFTWARE

   http://depts.washington.edu/nitrogen/.

   http://depts.washington.edu/silvproj/tlghome_[download requires password available from Silviculture Project Leader Eric C. Turnblom].


5. SMC ORGANON and associated DLL’s are available on the ORGANON web site:
   http://www.cof.orst.edu/cof/fr/research/organon/.

6. Conifers Version 4.01 is available from the USFS web site:

   http://depts.washington.edu/silvproj/tlghome/.
CD’s

(Contact the SMC for copies 206-543-5355)

• 2004 RFNRP Publications
• Alder Symposium “Red Alder: A state of knowledge” streaming video
• SMC 20th Anniversary streaming video
BY-LAWS OF THE STAND MANAGEMENT COOPERATIVE

First Adopted: April 22, 2003
Most recent amendment: Sept. 23, 2004

ARTICLE I: Name

The name of this organization shall be the Stand Management Cooperative (SMC).

ARTICLE II: Mission

The Mission of the SMC is “To provide a continuing source of high-quality data and information on the long-term effects of silvicultural treatments and treatment regimes on stand and tree growth and development and on wood and product quality.”

ARTICLE III: Scope and Limitations

The territorial coverage of the programs and activities of the SMC consists of forested lands west of the Cascades in Oregon and Washington, northern California, and coastal British Columbia.

ARTICLE IV: Location and Contact

1. The SMC headquarters are located in the College of Forest Resources, University of Washington, Seattle, WA.
2. Contact with the SMC headquarters can be made via
   a. Web site http://www.standmgt.org
   b. Telephone 206-543-9744 or 206-543-1581
   c. FAX 206-685-3091
   d. Email Director: David Briggs dbriggs@u.washington.edu
      Staff: Megan O’Shea moshea@u.washington.edu

ARTICLE V: Membership Categories

1. Land Managing Organizations
   a. Public agencies and private companies that manage forest land provide funds to support the mission and provide land and operational support for field research sites.
   b. A Memorandum of Agreement governs the relationship between the Land Managing Organization members and the SMC. Each member agrees to terms presented in the renewable annual Memorandum of Agreement. An example is presented in ANNEX A.
   c. Organizations wishing to join the SMC as a Land Managing Organization member do so through a written request to the Director. The application is presented to the Policy Committee at its next meeting for approval.
2. Analytic Organizations
a. Organizations that utilize information gathered through SMC research and stored in its database for the purpose of producing and marketing information, products and service.

b. A Memorandum of Agreement governs the relationship between the Analytic Organization members and the SMC. Each member agrees to terms presented in the renewable annual Memorandum of Agreement. An example is presented in ANNEX B.

c. Organizations wishing to join the SMC as an Analytic Organization member do so through a written request to the Director. The application is presented to the Policy Committee at its next meeting for approval.

3. Institutional Organizations

a. Universities, research laboratories, and trade associations are Institutional members that provide scientist time, laboratory and office space and other services to the SMC. Also research grants from external sources leveraging SMC investments in field sites may be received by these institutions or provided by them.

b. Organizations wishing to join the SMC as an Institutional member do so through a written request to the Director. The application is presented to the Policy Committee at its next meeting for approval.

4. Supplier Organizations

a. Organizations that provide materials and supplies to the SMC or its members may become a Supplier member.

b. Organizations wishing to join the SMC as a Supplier member do so through a written request to the Director. The application is presented to the Policy Committee at its next meeting for approval.

ARTICLE VI: Fees & Continuing Membership

Dues and fees are established by the Policy Committee.

1. Land Managing Organizations
   Annual dues are calculated by a funding formula established by the Policy Committee. Membership is retained through payment of assessed dues.

2. Analytic, Institutional, and Supplier Organizations
   Annual dues are not assessed. Continuing membership is maintained through an annual vote by the Policy Committee based on active participation and contribution to the SMC mission.

ARTICLE VII: Voting and Representation

1. Organizations under ARTICLE V, paragraphs 1, 2 and 3, are voting members of the SMC Policy Committee.

2. Each such voting organization designates one individual as its representative on the Policy Committee and has a single vote.

ARTICLE VIII: Receipt of SMC Database, Research Tools and Services

1. Each Land Managing Organization member receives
   a. an annual updated version of the complete SMC database.
   b. copies of the SMC Annual Report and Quarterly Newsletter.
   c. one free printed copy of research papers and technical reports with a discount for additional printed copies (electronic copies are free from the SMC website).
   d. unlimited access to SMC staff for questions and technical support “as available” in consideration of their institutional obligations.

2. Each Analytical Organization member receives
a. An annual updated version of the complete SMC database.

b. copies of the SMC Annual Report and Quarterly Newsletter.

c. one free printed copy of research papers and technical reports with a discount for additional printed copies (electronic copies are free from the SMC website).

d. unlimited access to SMC staff for questions and technical support “as available” in consideration of their institutional obligations.

3. Each Institutional and Supplier Organization member receives

a. copies of the SMC Annual Report and Quarterly Newsletter.

b. one free printed copy of research papers and technical reports with a discount for additional printed copies (electronic copies are free from the SMC website).

4. All recipients of any portion of the SMC database must comply with the SMC Database Policy (ANNEX C).

**ARTICLE IX: Management**

1. The management policies and operations of the SMC shall be vested in a Policy Committee as defined in Article VII.

2. A Director, appointed by the Dean of the College of Forest Resources, University of Washington, and approved by the Policy Committee, will be responsible for operational management of the SMC. A review of the Director’s performance may be initiated by the Dean every 5 years per University of Washington policy or at any time per request from the Chair of the Policy Committee. Enactment of a review and appointment of the review committee membership are at the discretion of the Dean.

**ARTICLE X: Election**

1. The term of the Chair of the Policy Committee is 2 years. At the end of the term, which is a Fall Meeting, the current Vice-Chair will become Chair effective 30 days after the date of that meeting.

2. At this same Fall Policy Committee meeting, a new Vice-Chair is elected and will serve 2 years as Vice-Chair followed by 2 years as Chair.

3. All elections and resolutions, unless specifically provided for, shall require a majority vote of the members in attendance.

4. Fifty percent of the members shall constitute a quorum at any annual or special meeting of the SMC for the transaction of business. Proxy votes submitted to the Director or Chair of the Policy Committee shall be included in achieving a quorum.

**ARTICLE XI: Powers and Duties of the Policy Committee**

1. The Policy Committee defines the dues structure of the SMC and approves annual budgets prepared by the Director.

2. The Policy Committee approves all research activities utilizing funds obtained through the dues assessments.

3. The Policy Committee elects a Chair and Vice-Chair.

4. The Policy Committee consults with the Dean of the College of Forest Resources in appointing the Director and any subsequent reviews and consults with the Dean and Director in appointing Technical Advisory Committee leaders and hiring staff.

**ARTICLE XII: Meetings**

1. The SMC shall have two meetings of the Policy Committee each year; one in April (Spring Meeting) and one in September (Fall Meeting) at a specific date and location determined by the Policy Committee. Special meetings may be called at the discretion of the Policy Committee. Notices of
meetings shall be sent to all members at least 2 weeks prior to the meeting. Such notice will be sent to the last known address of the member as it appears in the membership database.

2. Technical Advisory Committees. TAC’s shall meet on dates and places as determined by the appropriate TAC Project Leader. Notices of meetings shall be sent to all members at least 2 weeks prior to the meeting. Such notice will be sent to the last known address of the member as it appears in the membership database.

ARTICLE XIII: Technical Advisory Committees

Each Technical Advisory Committee (TAC) is headed by a Project Leader approved by the Policy Committee. TAC’s provide technical review and advice to the Policy Committee on field activities and research projects being conducted by SMC staff or affiliated scientists. The need for, definition of, and effectiveness of TAC’s will be reviewed by the Policy Committee every 2 years.

ARTICLE XIV: Duties of Officers

1. The duties of the Chair of the Policy Committee shall be to preside at the regular and special meetings of the SMC.
2. The Vice-Chair shall perform the duties of the Chair in the absence of the Chair and such other duties as may be delegated by the Policy Committee.
3. The Director shall be responsible for all operations of the SMC, supervision of employees and students. He/she reports to both the Chair of the Policy Committee and to the Dean, College of Forest Resources, University of Washington.

ARTICLE XV: Property

The real property of the SMC shall be in the custody and at the disposal of the Dean of the College of Forest Resources, University of Washington for reallocation to other uses at the College. Each member of the SMC owns the data collected from its land holdings. The University of Washington acts as an agent for SMC member data for the purposes of collecting and storing said data. The University of Washington shall be the sole licensor for SMC databases, research tools and other SMC services.

ARTICLE XVI: Conduct of Meetings

The meetings shall be conducted under the rules of procedure contained in M.A. DeVries (1998) *The New Robert’s Rules of Order, 2nd Ed.* Signet, NY. When a conflict of interest arises, the member will be recused from voting.

ARTICLE XVII: Vacancies

1. Any vacancy in the Office of Chair of the Policy Committee shall be filled immediately by the Vice-Chair.
2. Any vacancy in the Office of Vice-Chair shall be filled by nominations and vote at the next regular Policy Committee meeting.

ARTICLE XVIII: Amendments

The By-laws of the SMC may be amended by a two-thirds vote of the full membership at any regular or special meeting provided notice of such amendment shall have been sent to all members by the Director at least two weeks prior to such meeting.
ANNEX A
MEMORANDUM OF AGREEMENT BETWEEN LAND MANAGING ORGANIZATION COOPERATORS AND THE UNIVERSITY OF WASHINGTON IN THE STAND MANAGEMENT COOPERATIVE
(copy available upon request)

ANNEX B
MEMORANDUM OF AGREEMENT BETWEEN ANALYTIC ORGANIZATION COOPERATORS AND THE UNIVERSITY OF WASHINGTON IN THE STAND MANAGEMENT COOPERATIVE (copy available upon request)

ANNEX C
STAND MANAGEMENT COOPERATIVE DATA & PUBLICATION POLICY

I. Data & Database

A. Definition

Data are defined as any measurements of stands, trees, or products (a) developed by the SMC research program or (b) shared with the SMC and another organization and for which the SMC has direct responsibility. The Database is defined as all data resulting from efforts of the integrated program, the Regional Forest Nutrition Research Project (RFNRP), and the Stand Management Cooperative; for policy matters no distinction will be made among these three sources of data.

B. Data & Database Rules

1. All organizations, member or non-member, have access to data from installations on their own land at any time.

2. Upon request, each SMC member receives a CD copy of the annually updated database. Updates are generally available at mid-year. Costs of special requests to SMC staff for retrieving, analyzing, reporting, and/or transmitting data will be borne by the Cooperator requesting the data.

3. SMC members have access to all data collected from SMC-supported studies under the condition that the data will not be released to non-member organizations with the exception that a member may temporarily share data with confidentially bound assigns for the sole purpose of having analyses performed for the benefit of the SMC member with the assign allowed to make no further use of the data or analyses.

4. It is recognized that certain individuals and organizations who are not SMC members may desire access to the SMC database for research or other purposes without joining. Requests for data in these situations will be treated on a case-by-case basis. The individual or organization will submit to the SMC Director a written proposal request outlining the analysis planned, plans for use and/or publication of results, and the specific data requested. The proposer must agree to (a) share results of their analyses with the SMC and (b) to provide a review draft of any related publication. The Director will present the request to the Policy Committee for approval. Upon approval, a formal agreement, including a Licensing Agreement and appropriate fees, will be negotiated by the SMC and the proposing entity through the University of Washington Office of Software and Copyright Ventures.

5. Data shared with the SMC by other organizations will not be available to any other member or non-
member organization without the express permission of the sharing organization. Data shared with the SMC are to be used for accomplishment of SMC goals, and only results and summaries from analyses are to be published. Shared data will be considered as proprietary information and the designated analyst(s) will take every precaution to ensure confidentiality.

II. Publications, Software, Models and Other Works

1. SMC members are encouraged to share results from their analyses involving use of SMC data. Any publications or products resulting from the use of SMC data must credit that fact.

2. Analyses and software derived in whole or in part on SMC data may not be shared with non-SMC members except when placed in the public domain.

3. Results of analyses, software, or models based on the SMC database produced by UW faculty, staff, students, and designated analysts appearing in peer-reviewed journals, theses, symposium proceedings, and other media are owned by the University of Washington and administered by the Cooperative Director. SMC members will receive copies of these works. These works may be copyrighted by the UW, the authors, or the publishing entity.

4. Non-UW members may also develop and publish analyses, software, or models based on the SMC database. Copyright, if any, established on any such works remains under the ownership and control of their respective authors (or assignees).

5. SMC members and non-members wishing to use or distribute copyrighted materials must obtain appropriate permissions from the copyright owner(s).

6. The SMC data used in the development of any copyrighted or un-copyrighted works remains the property of the University of Washington and subject to the distribution rules in Section I.

Changes and exceptions to this Policy must be approved by the Policy Committee.
MINUTES OF MEETINGS
Stand Management Cooperative
Spring Meeting, April 22-23, 2008
Gifford Pinchot NF Headquarters, Vancouver, WA

Attendees: BC Ministry of Forests, Louise de Montigny; Cascade Timber Consulting, Bill Marshall; Consultant, Mel Scott; Consultant, Jim Flewelling; Forest Capital Partners, Scott Ketchum; Forest Informatics, Jeff Hamann; FORSight Resources, LLC, Karl Walters; Green Crow, Ryan Singleton; Green Diamond Resources, Randall Gregg; Hancock Forest Management, Dean Stuck; Lone Rock Timber Co, Jake Gibbs; Longview Timber Corporation, Richard Haight, Andrew Hopkins, Chris Lipton; Mason Bruce & Girard, Inc, Ellen Voth; Olympic Resource Management, Scott Holmen, David Stafford; Oregon State University, Terrance Ye, Doug Maguire, Glen Howe, Sean Garber, Keith Jayawickrama; Plum Creek, Steve Wickham; Port Blakely Tree Farms LP, Jeff Madsen; Quinault Indian Nation, Jim Plampin, Larry Wiechelman; Rayonier Forest Resources, Candace Cahill; Regenetics Forest Genetics Consulting, Dan Cress; Roseburg Forest Products, Dave Walters; The Campbell Group, Dave Hamlin, Dave Rumker; The Canadian Wood Fibre Centre, Al Mitchell; University of British Columbia, Craig Farnden; University of Washington, Megan O’Shea, Gonzalo Thienel, Keven Ceder, Paul Footen, Kim Littke, Ben Shyrock, Nick Vaughn, Eric Turnblom, Rob Harrison, Dave Briggs; USFS PNWRS, Eini Lowell, Tim Harrington; USFS PSWRS, Martin Ritchie; Washington DNR, Scott McLeod; West Fork Timber CO, Gene McCaul; Weyerhaeuser Company, Scott Holub, Greg Johnson, Bill Scott, Dave Marshall; WSU Extension, Ole Helgenson

Young Stand Workshop Attendees: Consultant, Mel Scott; Consultant, Jim Flewelling; Forest Informatics, Jeff Hamann; FORSight Resources, LLC, Karl Walters; Lone Rock Timber Co, Jake Gibbs; Longview Timberlands, LLC, Richard Haight, Andrew Hopkins, Chris Lipton; Olympic Resource Management, Scott Holmen, David Stafford; Oregon State University, Terrance Ye, Doug Maguire, Keith Jayawickrama; Port Blakely Tree Farms LP, Jeff Madsen; Quinault Indian Nation, Larry Wiechelman; Regenetics Forest Genetics Consulting, Dan Cress; Roseburg Forest Products, Dave Walters; The Campbell Group, Dave Hamlin; University of Washington, Nick Vaughn; USFS PSWRS, Martin Ritchie; Washington DNR, Scott McLeod; West Fork Timber CO, Gene McCaul; Weyerhaeuser Company, Dave Marshall; WSU Extension, Ole Helgenson.

The meeting at the Gifford Pinchot NF Headquarters, Vancouver, WA began at 9:30 with the agenda in Appendix A. This year’s program differed from past years in that the second day morning was devoted to a special workshop on the Young Stand Model that was developed by Martin Ritchie. There were 53 attendees (30 organizations) for the April 22 program and 24 attendees (19 organizations) at workshop on April 23.

Policy Committee Chair Louise de Montigny opened the meeting, welcomed the attendees, commented on the changes affecting forestry in BC and the US, and stressed the importance of, and opportunities for, international collaboration as part of our continued strategic planning efforts.

Accomplishments: Dave Briggs reviewed a handout summarizing accomplishments to date. A few highlights:

• Cumulative funding since the SMC began in 1985 has reached $18.1 million.
• Two new Landowner Organizations have joined: Roseburg Resources, Dillard, OR. and Renewable Resources, LLC, Amherst, MA.
• The 07/08 field program was completed on time in spite of access issues due to wind damage and heavy snow.

• Six new Type V paired tree fertilization installations have been established and fertilized and a related proposal to AGENDA 2020 for environmental instrumentation, measurement of quality (acoustics), and leaf area index is in review.

• Completion of the young stand model project.

• Hiring of a field crew for summer 2008; the priority is site characterization of the GGTIV installations planted in 2006.

• 14 publications plus a similar number of symposium and workshop presentations per year.

• 7 graduate students in residence per year with a completion rate of about 2 per year.

**Fall Meeting:** The Fall Meeting will be September 16-17 at the Little Creek Casino in Kamilche, WA, near Shelton. The 16th will be a business meeting followed by research reports and the 17th will be a field trip to visit one of the GGTIV installations, the Matlock long-term productivity site, and perhaps a Type III installation.

**Budget Review:** Operational funding in 2007 from member dues was $570,699 versus $568,248 in 2006. This is the net amount after deductions for in-kind credits associated with the GGTIV installations ($8,958) and special contract income ($8,480). Institutional Funding from the BC Ministry of Forests Research Branch was $70,652 from a competitive grant to support field work in BC. Other institutional members provided the equivalent of about $136,795 in the form of salaries of scientists, facilities, administrative support. External grants and research assistant funding from the University of Washington totaled $200,064. The salaries and benefits shown are net amounts after charging some SMC staff to other grants. The balance at the end of 2007 was $11,555, compared to a deficit of $16,809 at the end of 2006.

For 2008, operational funding from member dues increased to $618,235. The increase results from the combination of two new members plus a net gain of special contract income over expected in-kind credits for GGTIV maintenance. The BC Ministry of Forests Research Branch will continue to have grant funds ($70,500) to support measurement and treatment costs in BC. Other institutional members are anticipated to provide an amount similar to that of 2007. External grant and UW scholarship and other funds of approximately $120,000 have been received to date and may increase depending on the outcome of submitted proposals. Projections suggest that 2008 year end with a small surplus that will carry into 2009. Two factors that will weigh heavily on this are rising transportation costs and potential opportunities to charge some SMC staff time to external grants.

**Strategic Planning:** The Strategic Planning Committee did not meet since the last Policy Committee meeting. Over the summer we hope to have meetings of the TAC’s to discuss progress on the strategic plan and possible new activities and to have a Strategic Planning Committee meeting to summarize results for discussion at the fall meeting. SMC strategic planning also needs to consider integration with other efforts in the region including the Center for Intensive Planted-forest Silviculture (CIPS) at Oregon State University, the Center for Advanced Forest Systems (CAFS), and a proposal for a University of Washington Forest Centers (UWFC).

Doug Maguire summarized ongoing activities of CIPS and also gave Glen Howe’s presentation on CAFS, which was formed under the Industry/University Cooperative Research Centers Program (IIP) within the
Industrial Innovation Partnership Division of the National Science Foundation. The goal of IIP is to provide catalyst funding to foster industry/university cooperatives to enhance the intellectual capacity of the engineering and science workforce through integration of research and education. Four forestry Universities, North Carolina State, Oregon State, Purdue, and Virginal Tech were successful in creating CAFS, which held its inaugural meeting in early 2008. The SMC is taking the lead to develop a proposal for University of Washington membership. It is likely that CAFS membership, which will bring only a modest level of new funding, will provide new opportunities for more integrative, synthesized research.

David Briggs summarized the UWFC which is being discussed as a possible approach to improve the communication and planning at the UW to utilize the talents within the various discipline oriented forest-related centers and cooperatives to respond to broader forest policy issues such as climate change, carbon accounting, timber and water supply, etc. Presently, policy makers, agencies and other organizations find the array of discipline-oriented centers and cooperatives difficult to understand and relate to in the context of these larger issues and indicated that they would prefer a single point of contact. Unlike CIPS, which tends to focus on filling scientific gaps, UWFC would focus on integrating and using the best science available to address environmental, economic and social aspects of forest issues. Several mechanisms for creating UWFC are being explored. One likely option, would be re-charter, and possibly rename, the existing Institute of Forest Resources (IFR) in the College of Forest Resources. The IFR was originally created by the State Legislature which has periodically modernized its mission, name, and funding structure. It has been dormant since the 1990’s and revising it again may be the most appropriate approach to the issues being raised in the UWFC discussions.

**Silviculture Project Report:** Eric Turnblom reviewed the work for the field season on the installations. A total of 47 installations (357 plots) were visited during the 07/08 season, including 8 installations measured in BC by the BC Ministry of Forests Research Branch. This includes 7 Type I installations (70 plots) with full measurements and 13 installations (21 plots) with partial measurements. Two Type II installations (10 plots) received full measurements. Nine Type III installations (88 plots) received full measurements and one (9 plots) received partial measurement. The three 2006 GGTIV installations (66 plots) received their first measurement and the three 2006 GGTIV’s had survival surveys. The status of fence maintenance and vegetation control activities was reviewed and it was noted that site characterization of the 2006 planted GGTIV’s will be completed by the summer 2008 field crew. The first six paired-tree (24 pairs, 48 trees) fertilization installations, designated as Type V installations, have been established and fertilized. Finally, six contract installations (43 plots) were measured. Eric noted that Nick Vaughn finished his Masters and is continuing on a PhD and that Andrew Hill finished his PhD. He also noted progress on the NCASI-funded study "vegetation composition and succession in managed coastal Douglas-fir ecosystems." Kevin Ceder, who is working on this project for his PhD, gave a progress report during the afternoon session.

**Modeling Project Report:** Dave Marshall introduced Martin Ritchie who provided background and preview of the young stand model, which was the topic of the workshop on the next day. We will have a feature article on this model in the next issue of the newsletter.

**Nutrition Project Report:** Rob Harrison reviewed the status of past students, projects of current students that were presented later in the meeting, and the funding status of current and incoming graduate students. Rob then reviewed the status of current research proposals. These are (1) “Management of PNW forest plantations: additional site characterization and instrumentation for SMC/CIPS paired tree fertilization project”, in review with AGENDA 2020, (2) “Strategic linking of forest plantation productivity studies in the Pacific Northwest”, in review with AGENDA 2020, and (3) “Leveraging forest industry participation into fertilization research: a unique opportunity to investigate the controls on the short-term fate of applied nitrogen”, in review with the USDA National Research Initiative Managed Ecosystems.
Wood Quality Project Report: Eini Lowell summarized the TAC meeting held on November 28, 2007. The TAC reviewed strategic plan to identify potential areas where the wood quality project could contribute. These are briefly summarized as follows:

Goal 1: “Define and design research to understand the short and long term effects of silvicultural treatments on timber (growth and yield, wood quality, etc.) and environmental (habitat, carbon, water, etc.) values of forests”. The TAC discussed wood quality opportunities in the existing installations. While the new paired-tree fertilization installations could have a wood quality component designed into them, this would only be short term response. The longer term SMC installations, particularly Type III’s, and potentially the GGTIV’s could provide more information. Next steps will involve discussions to design appropriate field sampling and property measurement procedures for wood quality, including new technologies such as obtaining acoustic measurements and use of ground-based LIDAR.

Goal 3: “Analyze the high quality data to produce information that furthers global competitiveness of the forest products sector and improves environmental benefits to society”. Discussion focused on improvements to the current wood quality module in ORGANON. Improvements suggested were (1) to develop alternative output file formats, (2) to build more realistic tree descriptions, and (3) to develop a new WQ DLL.

Goal 4: “Conduct technology transfer to assist in the application of information gained from the research.” The SMC sponsored wood quality workshops in the early 1990’s and there is now both new information and a new audience. As a result, a 2-day wood quality workshop will be held in May 2008. A second topic was the idea of working with extension specialists to develop a web site on Douglas-fir wood quality. The website should have a technical focus but be written so that a broader audience would find it useful.

Goal 6: “Seek opportunities for collaboration with other organizations and individuals to leverage SMC research programs.” The TAC reviewed a number of upcoming research grant opportunities and possible collaborations with the Canadian Wood Fibre Centre. The WQ TAC is involved in the development of three pre-proposals for the next AGENDA 2020 funding cycle.

Eini also reviewed the status of the nondestructive testing study and a project with Scion, New Zealand, in which photographs of a subsample of the veneer sheets are being used in developing an automated image processing system as part of a glass-log model.

RESEARCH REPORT SESSION

The Research Report Session presentations during the afternoon of April 22 can be downloaded from the SMC website (www.standmgt.org)
Appendix A. STAND MANAGEMENT COOPERATIVE SPRING MEETING

<table>
<thead>
<tr>
<th>April 22</th>
<th>AGENDA</th>
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<tbody>
<tr>
<td>9:00</td>
<td>Coffee &amp; Rolls</td>
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<td>9:15</td>
<td>Meeting opening &amp; Introductions</td>
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<td>9:25</td>
<td>Welcoming Remarks</td>
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<td>9:40</td>
<td>Accomplishments &amp; Plans for 2008, Plans for the SMC Fall Meeting on Sept 16-17, Other Announcements</td>
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<td>9:50</td>
<td>Strategic Planning</td>
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<td>Center for Intensive Planted-forest Silviculture (CIPS)</td>
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<td>Center for Advanced Forest Systems (CAFS)</td>
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<td></td>
<td>Proposed UW Precision Forestry &amp; Technology Transfer Center</td>
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<td>10:35</td>
<td>Break</td>
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<tr>
<td>10:50</td>
<td>2007 Budget Review &amp; 2008 Budget Forecast</td>
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<tr>
<td>11:05</td>
<td>Silviculture Project Report</td>
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<td>11:30</td>
<td>Wood Quality Project Report</td>
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<td>11:55</td>
<td>Modeling Project Report</td>
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<tr>
<td>12:15</td>
<td>Lunch</td>
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<td>1:00</td>
<td>Nutrition TAC Report –</td>
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<td></td>
<td>Research Reports</td>
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<td>1:20</td>
<td>The Canadian Wood Fibre Centre</td>
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<td>2:05</td>
<td>Strategic linking of forest plantation productivity studies in the Pacific Northwest</td>
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<td>2:30</td>
<td>Effect of tree, stand and site on acoustic velocity in standing trees. Consistency of repeated measurements of tree acoustic velocity</td>
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<td>2:55</td>
<td>Break</td>
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<tr>
<td>3:10</td>
<td>Modeling the wood density profile in Douglas-fir: Influence of weather and treatments</td>
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<td>3:30</td>
<td>Vegetation Composition and Succession in Managed, Coastal Douglas-fir Ecosystems: Examining and modeling shrub – overstory relationships in young managed forests</td>
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<td>3:50</td>
<td>Long-term effects of nitrogen fertilization on productivity of subsequent stands of Douglas-fir in the Pacific Northwest</td>
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<td>4:10</td>
<td>Predicting Nitrogen Fertilizer Response in Douglas-fir Plantations</td>
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<td>4:30</td>
<td>Hood Canal Fertilization Study – Updated Leaching Budget</td>
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<td>4:50</td>
<td>Adjourn</td>
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<tr>
<th>April 23</th>
<th>AGENDA</th>
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<tbody>
<tr>
<td>8:30</td>
<td>Young Stand Model Workshop</td>
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Stand Management Cooperative

Fall Meeting, September 16-17, 2008
Little Creek Casino Resort, Kamilche, WA

Attendees: BC Ministry of Forests Louise de Montigny, Dave Goldie, Brian D’Anjou; Forest Capital Partners LLC, Scott Ketchum; Green Diamond Resource CO, Randall Greggs; Hancock Forest Management, Dean Stuck, Chris Eades, Dean Strunk; Lone Rock Timber CO, Jake Gibbs; Mason, Bruce & Girard, Inc., Ellen Voth; Olympic Resource Management, Scott Holmen, Patrick Raymon; Oregon Dept of Forestry, Doug Robin; Oregon State University, Doug Maguire, Doug Mainwaring; Plum Creek Timber, Greg Konchar; Port Blakely Tree Farms LP, Jeff Madsen, Mike Warjone, Chris Whitson; Quinault Indian Nation, Jim Plampin, John Mitchell; Rayonier, Western Forest Resource, Candace Cahill; Roseburg Forest Products, Mark Wall, Sean Garber; The Campbell Group, Dave Hamlin, Dave Rumker; USDA FS PNW Research Station, Tim Harrington, Eini Lowell; University of Washington, Eric Turnblom, David Briggs, Megan O’Shea, Bert Hasselberg, Rob Harrison, Randy Collier, John Haukaas, Monika Moskal, Guang Zheng, Kim Littke, Carol Shilling, Kevin Ceder; Washington DNR, Scott McLeod, Gill Wells, Brian Broznitsky, John Trobaugh, Norm Anderson (ret); West Fork Timber CO, Gene McCaul; Weyerhaeuser Company, Rod Mead, Dave Marshall, Scott Holub, Tom Terry, Bill Scott.

The meeting held at the Little Creek Casino Resort, Kamilche, WA, began at 9:00 with the agenda in Appendix A; there were 51 attendees from 19 organizations. Policy Committee Chair Louise de Montigny opened the meeting, welcomed the attendees, and noted the importance of the discussions that have been taking place as part of the process of continuous review and updating of the strategic plan.

Accomplishments: Dave Briggs reviewed accomplishments to date. A few highlights:

- Three new members: Cortex Consultants, Victoria, BC; Renewable Resources, LLC, Amherst, MA.; Roseburg Resources, Dillard, OR.
- The database update with 07/08 field data was delivered to members in mid-summer.
- Six new Type V paired tree fertilization installations have been established and fertilized. The proposal to AGENDA 2020 ($50,000/year for 3 years) for instrumentation to monitor temperature and precipitation, measurement of quality (acoustics), and leaf area was funded at half the requested level ($25,000/year for 3 years). Priority use of the funding will be to obtain the temperature and precipitation instruments for all installations as they are installed.
- Summer field crew completed site characterization of the GGTIV installations planted in 2006. We have complete site characterization and first growth measurements (after 2 growing seasons) for all 6 GGTIV installations (132 plots). A summary of growth data was presented later in the program.
- Completion of the young stand model project.
- 2 graduate students completed and 8 graduate students in residence; all funded by external grants and UW.
- The proposal to join the NSF Center for Advanced Forest Systems has been completed ($70,000 per year for 5 years) and will be submitted by September 26.
**Budget Review:** Member dues in 2008 was $606,770. Including in-kind credits associated with the GGTIV installations ($1,387) and special contract income ($12,483) resulted in an operational budget of $616,866. Institutional Funding from the BC Ministry of Forests Research Branch was $70,652 from a competitive grant to support field work in BC. Other institutional members provided the equivalent of about $135,163 in the form of salaries of scientists, facilities, administrative support. External grants and research assistant funding from the University of Washington totaled $224,571 to date. The salaries and benefits shown are net amounts after charging some SMC staff to other grants. The projected balance at the end of 2008 is currently estimated to be a deficit of $1,645 but, considering some salary and equipment shifts to grants, the end of year is more likely to have a positive balance on the order of $10-20,000.

Based on responses from members regarding acreage changes, dues for 2009 are projected to be $605,248; some changes may occur given pending land transactions. A motion made by Gene McCaul and seconded by Jeff Madsen to accept the dues calculations for 2009 passed (20 in favor, 0 opposed, 0 abstain). Contract income is off-cycle this year and may be very low and a $15,000 estimate of in-kind credits for maintenance of the GGTIV installations is assumed. With these assumptions, operational funding would be $590,731. Expenses were projected under the pessimistic assumption of no expense buyouts on grants and assuming that travel costs will climb to $85,000 per year. Assuming a zero balance carried from 2008 into 2009, a deficit as high as $89,000 would occur at the end of 2009. This size of deficit is unlikely as a number of opportunities will occur to charge some expenses to grants. Steps are also being taken to use webinars and other approaches to cut travel and other expenses.

**Modeling Project Report:** Dave Marshall noted recent modeling accomplishments including the update of ORGANON completed in 2006, the release of the young stand model in 2008 and the new publication “Calibration and Modification for the Pacific Northwest of the New Zealand Douglas-fir Growth Model” by Jim Flewelling and Dave Marshall (full citation is in the Accomplishments in Appendix C). Dave then reviewed the strategic planning priorities that emerged from the Modeling TAC webinar on August 12:

- Priority 1: The following items related to existing growth models
  - Encourage implementation of genetic modifier in ORGANON
  - Encourage completion of red alder analysis
  - Collaborate with CIPS on process model proposal
    - what are data needs?
  - Develop a proposal for growth model evaluation
- Priority 2: Items related to future growth model updates
  - Work with wood quality TAC on wood quality modeling
    - what data is needed?
    - explore potential for updating ORGANON wood quality module
  - Update ORGANON with SMC thinning and fertilization data
- Priority 3 – Items related to future funding opportunities
  - Biofuel and biomass modeling
  - Climate and weather modeling

These were discussed during the afternoon strategic planning session.
**Nutrition Project Report:** Rob Harrison reviewed the status and plans for the long term site productivity studies (LTSP), Hood Canal, carryover, and paired tree fertilization studies. The LTSPs at Fall River, Matlock, and Molalla are continuing to provide important information; NCASI provided $40,000 for 2008 and may provide the same for 2009; Graduate students Paul Footen and Carol Schilling (both funded from UW sources) will continue work at these sites; Former PhD Brian Strahm has 2 articles published and 2 in review. At Hood Canal, Cindy Flint has one article recently published, Ben Shyrock (UW funding) is continuing sampling for his thesis, and there may be a future opportunity to shift this work from inputs associated with fertilization of Douglas-fir stands to inputs associated with red alder. Paul Footen is wrapping up a summary of the carryover study; we will continue to measure these but there is no funding at the moment. We did receive $25,000/year for 3 years (one-half of what was requested) from AGENDA 2020 for the paired-tree fertilization (Type V) installations; these funds allow purchase of temperature and precipitation instrumentation that will be placed on each installation. We are also placing this instrumentation on the six GGTIV installations. A collaborative proposal with VPI and NC State will be submitted.

**Wood Quality Project Report:** Eini Lowell noted that the wood quality TAC input into the strategic planning process was summarized at the Spring meeting and reviewed again at the wood quality TAC webinar on Aug 12. Eini noted the opportunity to obtain wood quality data from the paired-tree (Type V) that could include wood density and terrestrial LiDAR. A proposal to AGENDA 2020 for wood quality research on the Type I installations was not funded. The TAC will continue to seek funding opportunities. The NDT acoustic study is at the stage where all data has been reconciled and a database is being created that will permit more comprehensive analyses and associated publications. Each of the NDT study logs had cookies from each end from which X-ray densitometer data was collected by Weyerhaeuser; this forms a great dataset for modeling wood density profiles in trees. Christine Todoroki is working with about 1200 veneer sheets from the veneer phase of the NDT study; these sheets were photographed and are being used for glass log modeling. Because of the interest in developing a wood quality model, there will be a joint meeting of the wood quality, modeling, and silviculture TAC’s to discuss how to accomplish this.

**Silviculture Project Report:** Eric Turnblom reported on the status of the GGTIV installations. All have site characterization work completed and all have the first growth measurements obtained after 2 growing seasons. A summary of growth was presented during the afternoon technical session. Eric also mentioned that the 08/09 field plan will be sent soon. He summarized graduate student activity: Nick Vaughn is continuing on a PhD and is working on a “sun-tree” identification project funded by the USFS, Andrew Hill who finished his PhD is a post-doc and has papers in review, Kevin Ceder who is also working on a PhD is making rapid progress on the NCASI-funded study “vegetation composition and succession in managed coastal Douglas-fir ecosystems”, and a new student Maria Petrova is just starting on a Masters. With respect to the strategic plan, three priorities emerged from the silviculture TAC webinar on August 12:

- **Priority 1:** Develop criteria for retirement of installations
- **Priority 2:** Work with the modeling TAC on the model evaluation/validation study (see modeling TAC priority 1)
- **Priority 3:** Create a “LOGS” style summary report of the performance of the Type I, II, and III, installations

These were discussed during the afternoon strategic planning session.

**Strategic Planning:** David Briggs reviewed the history of the current strategic planning effort which began with the creation of a Strategic Planning Committee in 2004. Over the next 3 years Mission and Vision statements and a set of 6 goals were adopted and within each goal, a set of objectives, tasks and responsibilities were developed. For the strategic plan to remain current and relevant, it must be viewed as
a dynamic document that will be continuously reviewed for progress and updated. Dave suggested that it was time to begin this review of the plan that we have developed over 04/07 (referred to as Phase I) and continue to do this in the future on an annual basis. To initiate this process, the TAC’s held webinar meetings on August 26 to report on progress and suggestions for changes and new activities for the next 5 years. This information was reviewed and consolidated by the Strategic Planning Committee on September 12 for presentation at the Policy Committee meeting. Dave then briefly reviewed the Mission, Vision, and Goals as stated in the Phase I Strategic Plan. He then returned to these to include suggestions from the TAC/SPC meetings and to get additional discussion and feedback from the Policy Committee. Some key points were (1) re-wording of the Mission and Vision Statements, (2) Further modeling evaluations and improvements including more refinements of ORGANON (genetic multiplier, additional analysis of fertilization and thinning response with new SMC data, encouraging completion of the alder growth and yield component, improving the current wood quality aspect and working toward a new wood quality model, and performing a gap analysis of existing growth and yield models), (3) developing “LOGS-style” summary reports of the performance of the Type I-III suite of installations in a forest manager friendly format, and (4) pursue external funding for biomass/biofuel/carbon/nutrition assessments, understanding how LiDAR can be used to measure and monitor forest attributes, and establishing new UW foundation funding to support graduate students in the production forestry arena. These and other points will be used as the basis for additional webinar discussions with the objective of creating a draft Phase II strategic plan for the Spring 2009 Policy Committee meeting. In discussing this procedure, it was decided to disband the SPC since webinars can easily accommodate participation by the entire Policy Committee.

TECHNICAL SESSION

Tom Terry led off the Technical Session presentation with an excellent summary of lessons learned from the Fall River, Matlock, and Molalla long-term site productivity studies. This was followed by Eric Turnblom who summarized the initial growth measurements, obtained after 2 growing seasons, of the GGTIV installations. Monika Moskal summarized work at the UW with terrestrial LiDAR and links that are being established with SMC installations for ground truthing. These presentations can be downloaded from the SMC website (www.standmgt.org) and provided an excellent perspective for the field tour visits on the following day.
### APPENDIX A. STAND MANAGEMENT COOPERATIVE FALL MEETING

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<thead>
<tr>
<th>16 Sept</th>
<th>AGENDA</th>
<th>BUSINESS MEETING</th>
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<tbody>
<tr>
<td>8:30</td>
<td>Registration. Coffee &amp; rolls</td>
<td>Louise de Montigny, Policy Committee Chair &amp; David Briggs</td>
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<tr>
<td>9:00</td>
<td>Welcome &amp; Introductions:</td>
<td>David Briggs</td>
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<td>9:20</td>
<td>2008 Accomplishments, Announcements, etc.</td>
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<tr>
<td>9:45</td>
<td>Modeling Project Report:</td>
<td>David Marshall</td>
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<tr>
<td>10:05</td>
<td>Break</td>
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<tr>
<td>10:30</td>
<td>Nutrition Project Report</td>
<td>Rob Harrison</td>
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<tr>
<td>11:00</td>
<td>Wood Quality Project Report</td>
<td>Eini Lowell</td>
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<td>11:30</td>
<td>Silviculture Project Report:</td>
<td>Eric Turnblom</td>
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<tr>
<td>12:00</td>
<td>Lunch</td>
<td>Lunch</td>
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<tr>
<td>1:00</td>
<td>SMC STRATEGIC PLAN</td>
<td>David Briggs</td>
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<td>1:30</td>
<td>Strategic Plan: Review</td>
<td>David Briggs</td>
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<td>2:00</td>
<td>Strategic Plan: Proposed Future Directions</td>
<td>David Briggs</td>
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<td>2:30</td>
<td>Break</td>
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<td>2:45</td>
<td>Washington and Oregon Regional Long-term Soil Productivity Studies—Objectives and Findings to Date</td>
<td>Tom Terry, Tim Harrington</td>
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<td>3:15</td>
<td>Summary of 1st growth measurements and site characterization of the GGTIV Installations</td>
<td>Eric Turnblom, Keith Jayawickrama,Terrance Ye</td>
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<td>3:55</td>
<td>Ground-based Lidar Estimation of Changes in Biomass and Its Distribution Associated with Silvicultural Treatments</td>
<td>Guang Zheng, Monika Moskal</td>
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<td>4:25</td>
<td>David Briggs will give a slide show of his photo safari in Tanzania</td>
<td>David Briggs will give a slide show of his photo safari in Tanzania</td>
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<td>5:00</td>
<td>Adjourn</td>
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<tr>
<td>Dinner</td>
<td>Xinh’s Clam and Oyster House, Shelton, WA,</td>
<td>Speaker is Bill Dewey with Taylor Shellfish</td>
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</tbody>
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### Sept 17 | FIELD TRIP |
| 7:30 | Depart from Little Creek Casino for the Matlock LTSP site: Travel time 45 min | Tim Harrington |
| 8:15 | Stop # 1: Matlock LTSP | |
| 10:15 | Depart for Paired-tree fertilization Installation: Rabbit Creek: Travel time 15 min | |
| 11:30 | Depart for GGTIV Installation #605: Travel time 1 hr 30 min: Lunch as we drive | |
| 1:00 | Stop # 2: GGTIV Installation #605, “Left Court”; Port Blakely Tree Farms: | |
| 2:30 | Adjourn | Return to Little Creek Casino |
## STAND MANAGEMENT COOPERATIVE STAFF

**University of Washington, Seattle:**
- Dave Briggs, SMC Director
- Randy Collier, Senior Computer Specialist
- Bob Gonyea, Field Coordinator
- Rob Harrison, Nutrition Project Leader
- Bert Hasselberg, Field Technician
- John Haukaas, Research Consultant
- Megan O’Shea, Administrative Specialist
- Eric Turnblom, Silviculture Project Leader
- William Bizak, Hourly field assistant

**B.C. Ministry of Forests, Victoria:**
- Louise de Montigny, B.C. Research Forester

**PNW Research Station, Portland:**
- Eini Lowell, Wood Quality Project Leader

**Weyerhaeuser Company**
- Dave Marshall, Modeling Project Leader

**Graduate Students:**
- Kevin Ceder, PhD
- Paul Footen, MS
- Andrew Hill, PhD
- Rapeepan Kantavichai, PhD
- Kim Littke, PhD
- Maria Petrova, MS
- Carol Shilling, PhD
- Ben Shyrock, MS
- Gonzalo Thienel, MS, PhD
- Nick Vaughn, PhD

**Undergraduate Students:**
- Natalie Schmidt