



**STAND MANAGEMENT COOPERATIVE
ANNUAL REPORT
JANUARY-DECEMBER 2009**

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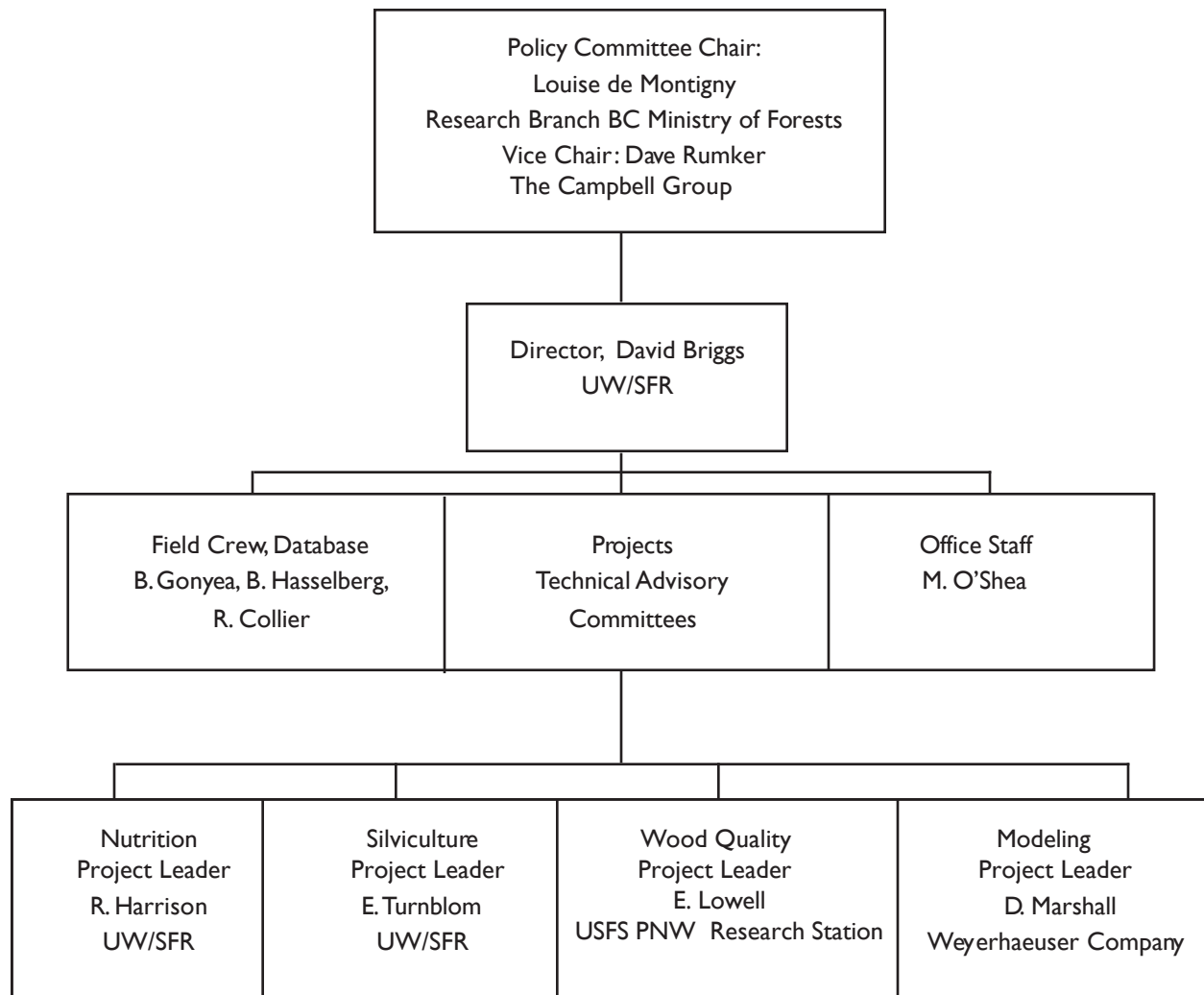
MISSION AND ORGANIZATION

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.



2009 HIGHLIGHTS

New Members

- Stimson Lumber Company, Forest Grove, OR.

Budget

- Cumulative SMC funding from all sources since 1985 reached \$19.6 million of which 60% was member dues, 18% external grants, and 20% institutional contributions.
- In 2009 total funding was \$1,363,559, of which \$613,759 was member dues, \$2.983 contracts, \$535.600 external grants and student support, and \$211,216 institutional contributions. Included in the institutional contributions is \$70,652 from the BC Ministry of Forests Research Branch for installation fieldwork in BC. Operating funds were \$624,889, net of a \$23,353 balance from 2008 and \$15,207 in-kind credits to landowners for maintenance of the GGTIV installations. The largest component of expenses supports the staff for field work and the database. Graduate students were supported on new and continuing external grants and by University of Washington funds.

Grants (\$397,600)

- \$40,000. Supplement to LTSP studies at Fall River, Matlock, & Molalla. NCASI. PI: Rob Harrison.
- \$350,000 (\$70,000/yr for 2009-2013) for University of Washington membership in the NSF I/UCRC Center for Advanced Forest Systems (CAFS). PI's: David Briggs, Rob Harrison, Monika Moskal, Sandor Toth, and Eric Turnblom.
- \$7600 from NSF Research Experience of Undergraduates supplement to the CAFS grant. PI's David Briggs and Monika Moskal.

UW College of Forest Resources Student support (\$138,000)

- Corkery Family Chair, \$73,000 for summer field crew students and RA support
- Gessel Scholarship Fund, \$25,000
- UW Teaching Assistantships \$40,000

Field Work

- **Genetic Gain Trial – Type IV (GGTIV) Installations:** Second growth measurements of the three installations planted in 2005 were obtained during the 08/09 field season. Second measurements for the three installations planted in 2006 was done in the 09/10 field season.
 - **2009/2010:** 45 installations (Type I, II, III, IV) were visited for full measurements, to conduct treatment trigger checks, or to conduct thinning, fertilization, or pruning treatments.
 - 3 contract installations were also measured and 28 Type V installations were located, measured and fertilized.
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- **Summer Field Crew: Summer Field Crew:** The summer field crew Paul Footen, Kim Littke, Ryan Reith, Carol Schilling, & Gonzalo Thienel, funded by grants, the Precision Forestry Cooperative, Corkery Family Chair, and the SMC visited installations to for
 - ✓ Paired-tree fertilization (Type V) installations: Kim, Bob and Bert established 26 new installations, bringing the total to 56. They have soil pits, lysimeters, and temperature and precipitation gauges. Additional installations are being sought to fill gaps in coverage. Kim was assisted by the following undergraduate volunteers; Afton Grider, Jennifer Perkins, Mallore Weinheimer, and Patrick McGuire.
 - ✓ GGTIV installations: The remainder of the summer crew collected competing vegetation and habitat data on the three installations planted in 2005. These three installations now have tree and competing vegetation data after the 2nd and 4th growing seasons. All GGTIV installations now have the same environmental sensors that are in the Type V installations.
 - ✓ The summer field crew also completed vegetation and habitat assessments on 3 installations (21 plots), soil sampling (3 installations), and pitch moth surveys (11 plots).

Database

- The database was updated and sent to members who had requested it in June. It currently contains data from 513 installations of which 133 are currently active SMC installations.
- Developing database design for the Intermountain Nutrition Cooperative.

Graduate Students: The SMC had 10 graduate students in residence during 2009:

- 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.
- Rapeepan Kantavichai began her PhD in Fall 2005 with David Briggs. She is funded through UW sources, completed an MS and PhD research is focusing on modeling inter-annual biomass and wood density patterns of individual trees as affected by tree, stand, and growing environment (climate, soil) variables.
- 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.
- 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 2009, two Masters students completed their degrees, 4 peer-reviewed journal articles were published and 3 have been accepted. In addition, 2 articles were published in non-peer reviewed journals. SMC faculty, staff and students also participated in 15 conferences, symposia, workshops, etc.
- 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 2009 meeting. The latest version can be found at

http://www.fs.fed.us/psw/programs/ecology_of_western_forests/projects/conifers

SMC MEMBERS AND POLICY COMMITTEE REPRESENTATIVES

Land Managing Organizations

Bureau of Land Management	George McFadden
The Campbell Group	Dave Rumker
Cascade Timber Consulting	Bill Marshall
Forest Capital Partners	Scott Ketchum, Bruce Ripley
Green Diamond Resource Co.	Randall Greggs
Hampton Affiliates	Dennis Creel
Hancock Forest Management	Dean Stuck
Lone Rock Timber Company	Jake Gibbs
Longview Timberlands, LLC.	Rich Brooker
Olympic Resource Management	Scott Holmen
Oregon State Department of Forestry	Jeff Brandt
Pacific Denkman	Allen Staringer
Plum Creek Timber Company	Connor Fristoe/Steve Wickham
Port Blakely Tree Farms L.P.	Mike Mosman/Jeff Madsen
Quinault Department of Natural Resources	Jim Plampin
Rayonier Forest Resources	Candace Cahill
Renewable Resources, LLC	Harry Bell
Roseburg Resources	David Walters
Stimson Lumber Company	Margaret Banks
TimberWest - Coast Timberlands	John Mitchell
Washington State Department of Natural Resources	Scott McLeod
West Fork Timber Company	Gene McCaul/Scott Swanson
Weyerhaeuser NR Company	Greg Johnson

Analytic Organizations

Cortex Consultants	Andrew Howard
FORSight Resources, LLC	Karl Walters
ImageTree Cooperation	Mark Hanus
Jim Flewelling Biometrics Consultant	Jim Flewelling
Mason, Bruce & Girard	Ellen Voth

Suppliers

AGROTAIN	Ben Thompson
Dyno Nobel	Greg Godfrey
J.R. Simplot	Terry Kendall
King County Department of Natural Resources	Roberta King/Peggy Leonard

Institutions

B.C. Ministry of Forests, Research Branch	Louise de Montigny
BC Wood Fibre Center	Al Mitchell
FP Innovations-Forintek Canada	Gerry Middleton
Oregon State University	Doug Maguire
University of British Columbia	Bruce Larson
University of Washington	David Briggs
U.S. Forest Service PNW Research Station	Charley Peterson

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
Sean Garber, Roseburg Resources
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
Eric Turnblom, University of Washington
Larry Wiechelmann, Quinalt 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
Sean Garber, Roseburg Resources
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, Campbell Group
Scott Holub, Weyerhaeuser Company
Greg Johnson, Weyerhaeuser Company
Brian Sharer, Hancock Forest Management
John Shumway, USFS PNW Research Station
Eric Turnblom, University of Washington
Gordon Weetman, University of British Columbia
Steve Wickham, Plum Creek Timber Co.

Silviculture Project

Project Leader, Eric Turnblom,
University of Washington
Norm Andersen, Washington Dept. of Nat. Res., retired
David Briggs, University of Washington
Robert Curtis, USFS PNW Research Station, retired
Louise de Montigny, B.C. Ministry of Forests
Burt Dial, Hancock Forest Management
Alex Dobkowski, Weyerhaeuser Company
Candance Cahill, Rayonier Forest Resources
Sean Garber, Roseburg Resources
Randall Greggs, Green Diamond Resource Co.
David Hann, Oregon State University
Connie Harrington, USFS PNW Research Station
Rob Harrison, University of Washington
Denny Hill, The Campbell Group
David Hyink, Weyerhaeuser Company, retired
Keith Jayawickrama, NWTIC, Oregon State Univ.
Greg Johnson, Weyerhaeuser Company
Scott Ketchum, Forest Capital partners, LLC
Eini Lowell, USFS PNW Research Station
Steve Loy, Hancock Forest Management
Jeff Madsen, Port Blakely Tree Farms
Gene McCaul, West Fork Timber Co.
Dave Marshall, USFS PNW Research Station
Peter Marshall, University of British Columbia
Mike Mosman, Port Blakely Tree Farms
Jim Plampin, Quinalt Dept. of Nat. Res.
Jim Vander Ploeg, Hancock Forest Management
Jeff Brandt, Oregon Department of Forestry
Nick Smith, Weyerhaeuser Company
Allen Staringer, Pilchuck Tree Farm

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.
Sean Garber, Roseburg Resources
Jake Gibbs, Lone Rock Timber Co.
Burt Dial, Hancock Forest Management
Barbara Lachenbruch, Oregon State University
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, FP Inoculations -Forintek Canada
Al Mitchell, FP Innovations -Forintek Canada
Dave Rumker, Campbell Group
Brad Shelley, West Coast Lumber Inspection Bureau
Eric Turnblom, University of Washington
Tony Zhang, FP Innovations -Forintek Canada

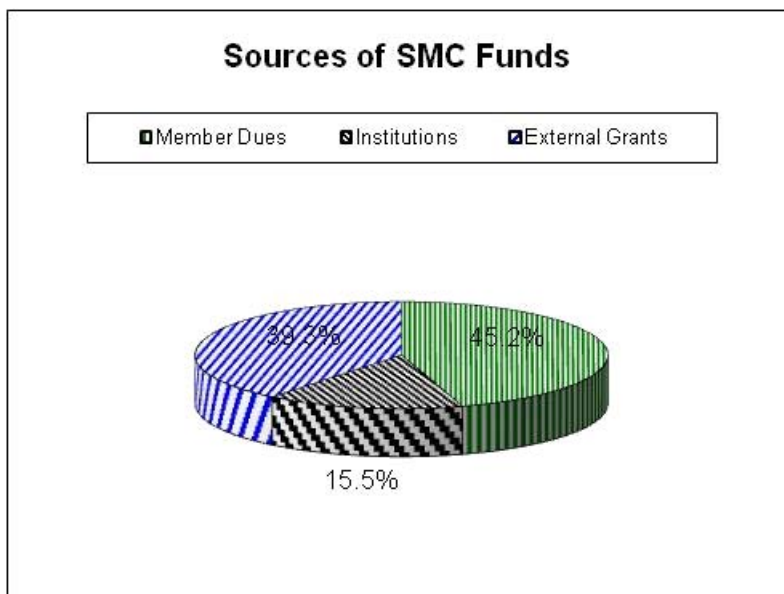
2009 BUDGET

2009 dues were calculated from the following formula, approved by the Policy Committee at the Fall 2004 Policy Committee meeting and implemented in 2006.

If acres > 100,000 dues = \$12,274 + \$0.035675 Acres
If acres ≤ 100,000 dues = \$ 6,137 + \$0.035675 Acres
Dues cap = \$79,517

Member dues in 2009 were \$613,759 (Table I, Figure I) compared to \$605,770 in 2008. Special contracts were \$2,983 compared with \$12,483 in 2008. Credits to owners of the six GGTIV installations for vegetation control and fence maintenance was \$15,207. 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 \$140,564 in the form of salaries of scientists, facilities, and administrative support.

Figure I: Sources of 2009 SMC Funds



Funding from external sources (Table 2) totaled \$535,600 of which \$397,600 was from external grants and \$138,000 was from the UW for support of SMC students. This is more than double the external funding received in 2008, and is primarily due to the NSF I/UCRC CAFS grant of \$70,000/yr over 2009-2013.

Table 1. 2009 Financial Support		
Cooperator	Amount	%
Formula dues:		
Bureau of Land Management	\$ 79,517	
Campbell Group	\$ 19,139	
Cascade Timber Consulting	\$ 17,411	
Forest Capital Partners	\$ 17,423	
Green Diamond.Resource Co.	\$ 21,086	
Hampton Affiliates	\$ 9,562	
Hancock Forest Management	\$ 32,791	
Lone Rock Timber Company	\$ 16,375	
Longview Timberlands LLC	\$ 35,620	
Olympic Res. Mgt/Pope Res.	\$ 17,289	
Oregon Dept. Forestry	\$ 37,545	
Pacific Denkman	\$ 6,672	
Plum Creek Timber Co.	\$ 28,619	
Port Blakely Tree Farms	\$ 17,365	
Quinault Dept. Nat. Res	\$ 8,387	
Rayonier Forest Resources	\$ 24,582	
Renewable Resources, LLC	\$ 8,792	
Roseburg Resources.	\$ 22,869	
TimberWest-Coast Timberlands	\$ 37,291	
Stimson Lumber Company	\$ 18,738	
Washington Dept. Nat. Res.	\$ 49,162	
West Fork Timber Co. LLC	\$ 8,006	
Weyerhaeuser NR Co.	\$ 79,517	
Total	\$ 613,759	
Member Contracts, Grants, Adjustments.	\$ 2,983	
Subtotal	\$ 616,742	45.2%
Less in-kind credits (GGTIV)	\$ (15,207)	
Net Cash Contributions	\$ 601,536	
Institutional Contributions		
B.C. Ministry of Forests	\$ 70,652	
Oregon State University	\$ 10,000	
University of Washington	\$ 110,564	
USFS PNW Research Station	\$ 20,000	
Subtotal	\$ 211,216	15.5%
External Research Grants	\$ 535,600	39.3%
TOTAL	\$ 1,363,559	100.0%

Table 2. 2009 SMC External Grants and UW Student Support

External Grants: \$ Received in 2009			
Source	Amount	period	PI
Non_UW			
NCASI (Fall River)	\$ 40,000		Harrison
NSF U/ICRCCAFS	\$ 350,000	2009-14	Briggs, Harrison, Moskal, Toth,
NSF U/ICRCCAFS Undergrad Supplement	\$ 7,600	2009-10	Moskal, Briggs
Subtotal	\$ 397,600		
UW			
Gessel Fund	\$ 25,000	2009	Harrison
Corkery Family Chair	\$ 73,000	2009	Briggs
UWTA	\$ 40,000	2009	
Subtotal	\$ 138,000		
Total	\$ 535,600		

External grants support graduate students and some SMC staff time thereby producing savings in the SMC budget.

Total funding from all sources was \$1,363,158 and increased the cumulative total since 1985 to \$19.6 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: 1985-2009

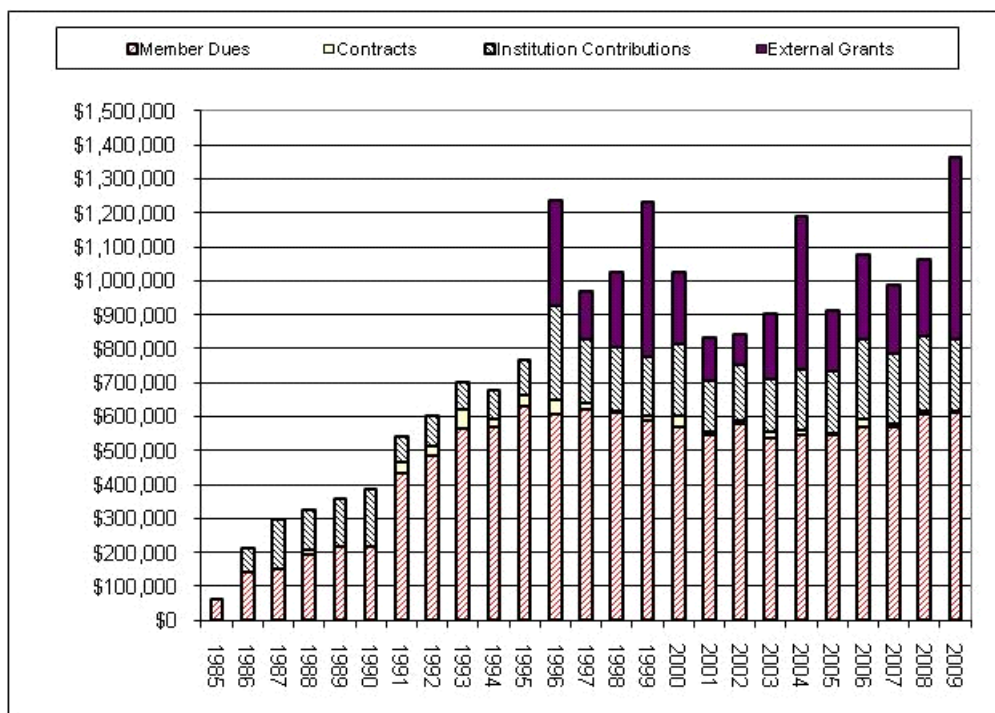
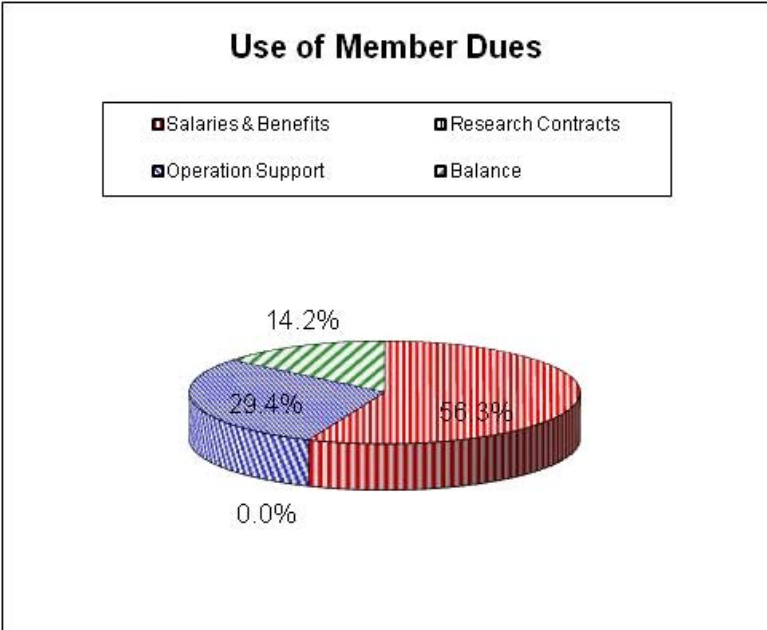


Table 3 and Figure 3 provide a balance sheet for 2009, which began with a balance from 2008 of \$23,353. In-kind credits to landowners associated with the GGTIV installations were \$15,207. Therefore, funds available for operations were \$624,889 compared to \$628,421 in 2008. Salaries include the permanent 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 was hired, with expenses split between the Corkery Family Foundation Chair, external grants, the Precision Forestry Cooperative and the SMC. The 2009 budget year ended with a surplus of \$89,029. This surplus was created by taking actions at mid-year in anticipation of a serious budget shortfall in 2010 due to the depressed economy. These actions were

1. We laid off one of our two database management staff.
2. Summer salary for the Director was cut from 1.5 to 0.5 months and summer salaries for the Nutrition and Silviculture Project Leaders were cut from 2.5 to 2.0 months.
3. Salaries for the remaining staff were reduced by 7.7%.
4. We curtailed all other expenditures as much as possible.

Table 3. 2009 BUDGET		
INCOME	Amount	%
Formula Funding	\$ 613,759	98.2%
<u>Contracts</u>	\$ 2,983	0.5%
Subtotal	\$ 616,742	98.7%
<u>In-kind credits</u>	\$ (15,207)	-2.4%
<u>Net Cash Contributions</u>	\$ 601,536	96.3%
<u>2008 Ending Balance Forward</u>	\$ 23,353	3.7%
Total Funds Available	\$ 624,889	100.0%
EXPENSES	Amount	%
Salaries	\$ 284,441	45.5%
Benefits	\$ 67,462	10.8%
Travel	\$ 50,657	8.1%
Equipment & supplies	\$ 8,918	1.4%
Contract Services	\$ 13,798	2.2%
Tuition	\$ 0	0.0%
Subtotal	\$ 425,275	68.1%
<u>Indirect</u>	110,585	17.7%
Total Direct & Indirect	\$ 535,860	85.8%
<u>Research Contracts</u>	\$ -	0.0%
Total Expenditures	\$ 535,860	85.8%
2009 Ending Balance	\$ 89,029	14.2%
Total Funds Available	\$ 624,889	100.0%

Figure 3: 2008 SMC Expenditures



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 treatment. 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.
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. . Temperature and precipitation gages and lysimeters at each installation. 6 installations, 132 plots in the Grays Harbor breeding zone.
LTSP	"Long-term site productivity" Sites at Fall River, WA; Matlock, WA; Mollalla, 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. Each installation has 20 tree pairs. Temperature and precipitation gages and lysimeters at each installation. 60 installations

Regional Forest Nutrition Research Project (RFNRP) 1969-2000

PHASE I	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.
PHASE II	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
PHASE III	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
PHASE IV	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
PHASE V	Single-tree screening trials in young noble fir and Pacific silver fir stands; established 1986-1988. One fertilizer application. Completed in 1991. 22 installations.

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 through the 09/10 field season.

Update through 09/10
distribution of plots by number of times measured

# of Meas	Type I ¹		Type II ¹		Type III ²		Carryover ³		GGTIV ²		Type V ³ Individual Trees	
	# plots	%	# plots	%	# plots	%	# plots	%	# plots	%	# inst.	%
0	0	0%	0	0%	0	0%	0	0%	0	0%		
1	2	1%	0	0%	3	1%	0	0%	66	50%	56	90%
2	0	0%	0	0%	16	5%	0	0%	66	50%	6	10%
3	0	0%	0	0%	20	6%	0	0%	0	0%		
4	7	2%	6	10%	38	12%	0	0%	0	0%		
5	88	23%	12	20%	53	17%	2	11%	0	0%		
6	159	42%	28	47%	120	39%	0	0%	0	0%		
7	60	16%	12	20%	38	12%	6	32%	0	0%		
8	54	14%	1	2%	4	1%	9	47%	0	0%		
9	5	1%	0	0%	17	6%	2	11%				
10	3	1%	1	2%								
11												
12												
Total	378	100%	60	100%	309	100%	19	100%	132	100%		

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 four field seasons along with the planned visits for the 10/11 season. This table does not indicate the multitude of activities performed on these installations. A fuller appreciation of the scope of the 09/10 workload is detailed in the summary following the table

FIELD WORK UPDATE

Installation	Activity	2006/2007		2007/2008		2008/2009		2009/2010		2010/2011 Plan	
		No. Inst.	No. Plots	No. Inst.	No. Plots	No. Inst.	No. Plots	No. Inst.	No. Plots	No. Inst.	No. Plots
Type I	Full Measurement	12	109	7	70	11	111	8	75	12	163
	Thin check	8	9	11	16	19	30	12	21	17	32
	Thinned	7	7	2	2	7	8	7	9		
	Fertilized	2	6			1	3				
	Pruned										
	Stem analysis										
	Foliage samples	2	12	2	12			1	6		
Type II	Full Measurement	6	25	2	10					3	15
	Thin check	1	1	1	1						
	Thinned	1	1								
	Stem analysis										
Type III	Full Measurement	7	54	9	90	6	78	8	72	5	45
	Thin check	6	9	3	3		11	2	4	2	2
	Thinned	5	7	1	1	4	5	2	4		
	Pruned measured	2	12	2	15	2	12	2	12	3	24
	Pruned	3	9	2	9	2	11				
	Stem analysis										
Carryover	Full Measurement	5	14	0	0	5	14			5	14
Type IV GGT	Plot installation										
	Seedling Assessment	3	66								
	Full Measurement	3	66	3	66	3	66	3	66	3	66
Type V	Plot installation			6	tree pairs	28	tree pairs	28	tree pairs	12	tree pairs
	Fertilized			6	120 trees	28	560 trees	28	560 trees	12	240
	Initial Meas.			6	240 trees	28	1120 trees	28	1120 trees	12	480
	Remeasurement							6	240 trees	28	1120
Contracts	Full Measurement	2	56	6	43	1	6	3	31		
	New										
Total		75	463	57	338	89	355a	138b	300a,b	114	2201
Notes:											

Notes:

a = does not include paired tree plots on TypeV installations

b = thinning to be determined based on RD checks

Type I

- Full re-measurement on 12 installations 163 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 17 installations 32 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.

Type II:

- Full measurement of 3 installations 15 plots.

Type III

- Full measurement of 5 installations 45 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 2 plots on 2 installations
- Prune check on 24 plots on 3 installations.

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 12 paired tree plots on each of 28 installations (56 trees/plot; 2130 trees total)
- Fertilized one tree in each paired tree plot on 12 installations (20 trees/plot; 240 trees total)
- Initial measurement of 20 paired tree plots on 12 installations (40 trees/plot; 480 trees total)
- Re-measurement of 1120 plots on 28 installations

Carryover

- Full measurement on 5 installations (14 plots)

Contracts

- Measurement of 3 installation (27) plots

Summer Field Crew

Graduate students Paul Footen, Kim Littke, Carol Shilling, and Gonzalo Thienel and undergraduate Ryan Reith accomplished the following

- Paired-tree fertilization (Type V) installations: Kim, Bob and Bert established 26 new installations, bringing the total to 56. These all have soil pits, lysimeters, and temperature and precipitation gauges. Additional installations are being sought to fill gaps in coverage. Kim was assisted by the following undergraduate volunteers; Afton Grider, Jennifer Perkins, Mallore Weinheimer, and Patrick McGuire.
- GGTIV installations: The remainder of the summer crew collected competing vegetation and habitat data on the three GGTIV installations planted in 2005. These three installations now have tree and competing vegetation data after the 2nd and 4th growing seasons. All GGTIV installations now have the same environmental sensors that are in the Type V installations.
- The summer field crew also completed vegetation and habitat assessments on 3 installations (21 plots), soil sampling (3 installations), and pitch moth surveys (11 plots).

Salaries and expenses for the summer field crew students were paid by UW funds, primarily the Corkery Family Chair, some of the staff time was paid through the NSF CAFS grant, and expenses for instrumentation were paid by AGENDA 2020 and CAFS funds.

DATABASE UPDATE

Database Personnel: Randy Collier, Senior computer Specialist

At the end of the 09/10 field season, the database contained data from 513 installations which contain 7,139 plots which have been measured 30,727 times. This translates into 278,723 trees which have been measured a total of 1,592,888 times.

Presently there are 133 active installations of Types I through V. These installations hold 3,072 plots, which in aggregate have been measured 6,679 times. These plots contain 94,846 trees which have in total been measured 507,293 times.

The remaining balance of installations are either inactive installations of the old Regional Forest Nutrition Research Program (RFNRP) or active/inactive special contract installations with SMC members.

National Science Foundation Industry-University Cooperative Research Centers (I/UCRC) Center for Advanced Forest Systems (CAFS)

The UW proposal to join CAFS was approved in February 2009. We received \$70,000 NSF funding since the UW industry supporters who wrote letters of support and intent to join CAFS exceeded \$300,000. Because of the timing of the award, we did not participate in the February 10-12 CAFS annual meeting where we would have presented projects for prioritization. Instead, we were instructed to select our own priority projects for 2009. After discussions at the UW and with the SMC Policy Committee and the Precision Forestry Cooperative Executive Board, we selected the following three projects for allocation of the 2009 funding. These projects were chosen due to their high priority in strategic planning and the fact that they were in early stages where an infusion of CAFS funding would provide substantial leverage and progress.

A. PROJECT TITLE: Understanding Site-Specific Factors Affecting the Nutrient Demands and Response to Fertilizer by Douglas-fir

INVESTIGATOR(S): UW Faculty (Rob Harrison, David Briggs, and Eric Turnblom) OSU faculty (Doug Maguire, Doug Mainwaring)

PROJECT DESCRIPTION: This project is a paired-tree fertilization study designed to measure general response to N fertilization and identify specific site characteristics that may predict productivity and response. The primary objectives of the proposed 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 provide a field laboratory for additional work. Studies of forest fertilization in the Pacific Northwest, which is a major timber-producing region for the United States, are now relatively rare and these studies have the potential to answer some extremely important questions about forest fertilization impacts.

EXPERIMENTAL PLAN: Research installations will be located across the major geologic parent materials/soils and climate zones in the western Douglas-fir region of Oregon and Washington. Stands will be 15-25 yr-old Douglas-fir plantations not previously fertilized. The experimental design (at an "installation") is a randomized complete block with two treatments and nominally 12-15 paired tree blocks at each location. The experimental unit consists of a 1/50th acre circular plot centered on a single subject tree (Figure 1). Each block will consist of two experimental units selected to make the paired tree block as uniform as possible. Even though these 'blocks' will not be physically contiguous, the matching of similar trees will reduce variation, thereby increasing the probability of detecting differences. A small difference in response should be detectable by this design. At each location up to 36, but not less than 24, 1/50th acre circular plots will be established on a 50 foot square grid starting from a well defined and marked reference point (Figure 1). Trees will be paired based on similarity of DBH, height to live crown, height, competition (basal area), and known environmental gradients. Treatments consist of N applied as urea at two levels: 0 lbs N/acre and 200 lbs N/acre broadcast as urea. The following site properties/ parameters will be sampled for each installation, where possible and/or available: 1) site index, 2) LAI, 3) slope, aspect, slope shape, 4) age, 5) elevation: 6) precipitation.

HOW THIS PROJECT IS UNIQUE: This project is different from current SMC projects in that similar fertilization studies have not been carried out in the region. By cooperating and installing a large number of research studies, the hope of being able to predict site-specific response to fertilization, may be realized.

POTENTIAL MEMBER COMPANY BENEFITS: Forest products companies are funding most of the costs of this study. The SMC has not conducted major field studies specifically on forest fertilization for over a decade, primarily because of the costs of the studies involved and a focus on other study priorities, but also from a lack of consensus on what designs would provide the best information for cooperators. Shifting actual forest fertilization to the highest-responding sites in the region could give a much bigger “bang-for-the-buck”, including an estimated 50% increase in productivity with the same amount of fertilizer currently applied by selecting highly responsive stands and avoiding unresponsive ones.

EXPECTED DELIVERABLES: The primary deliverables of this study are the creation of a network of studies as proposed above. This matrix of studies will cover the major range of company-owned production lands, as each site is selected based on company preference as well as fitting into the overall study plan.

PROJECT TIMELINE: Year 1 & 2 (field sampling, laboratory analyses, preliminary summary statistics); Years 3-5 (modeling, RA).

PROJECT BUDGET: 2009 allocation: \$24k allocated used for costs of field personnel and instrumentation to set up installations.

PROGRESS: By combining CAFS funding with \$25k/yr from AGENDA 2020, sixty paired tree fertilization trial installations (Type V) have been created with soil samples collected, temperature and precipitation gages and lysimeters at 10cm and 50cm depth have been installed).

B. PROJECT TITLE: Remote Sensing for Measuring and Monitoring the Response of Plantations to Intensive Management

INVESTIGATOR(S): L. Monika Moskal

PROJECT DESCRIPTION: This project will contribute to CAFS’ mission by introducing spatially explicit dynamic change monitoring techniques capable of assessing the effectiveness of intensive plantation silviculture and management techniques at scales from individual tree level to stand and ecosystem levels. Laser scanning methods such as aerial lidar have been effectively demonstrated by many, for example: in forest height inventory assessment (Andersen et al 2006), multiple resource inventory (Reutebuch et al 2005), precision forestry (Moskal et al. 2008) and ecosystem studies (Lefsky et al 2002). The improvements in density, quality and foremost availability of aerial and terrestrial lidar technology have supplemented the inventory research and facilitated research focusing on leaf area and productivity parameterization necessary for assessment of ecosystem services (Zheng and Moskal, 2008; Richardson et al 2008). Previously, Vose and Allen (1988) have demonstrated the relationship between leaf area and nutrient through ground sampling, however, non-destructive testing methods facilitated by terrestrial laser scanning allow for revisitation and multitemporal assessment of above ground biomass accumulation; a critical characteristic of productivity that can be related to carbon sequestration or water interception. The relationship between nutrient treatments and plantation response has not been explored through the laser scanner remote sensing perspective. Such an approach, combined with three-dimensional crown reconstruction (Moskal and Kato, 2008; Kato et al. 2008) and point cloud slicing (Zheng and Moskal 2008), will benefit from the systematic ability of aerial and satellite lidar to capture spatially explicit coverages and the fine structural and temporal resolutions provided by the terrestrial lidar instrument.

EXPERIMENTAL PLAN: We propose to assess multi-scale, from tree-level to stand and greater, forest inventory characteristics and leaf area index of plantation and intensive management experimental sites. The assessment will require multitemporal monitoring at the ground level, with a terrestrial laser scanner (Leica Scan Station 2), through the growing season, as well as fusion of the terrestrial scanning observation with

available aerial and satellite based (IceSAT/GLAS) lidar data. The analysis will utilize point cloud slicing approach (Zheng and Moskal 2008) and three dimensional crown reconstruction (Kato et al. 2008), to determine dynamic changes in the forest inventory parameters and crown formation, including leaf area index. The assessments will be validated using field data; were available.

HOW THIS PROJECT IS UNIQUE: Our approach develops methods that synergize data from multiple scans and fuse that information with additional sensor observations. Our techniques are evolving to utilize the three dimensional structure inherent in the lidar data and promise to deliver finally resolved parameters of forest structure that can compliment field observations and other methods of sampling.

POTENTIAL MEMBER COMPANY BENEFITS: As the aerial and terrestrial laser scanning technologies mature adaptation and mobilization of these tools in precision forestry and environmental monitoring sectors will be facilitated by the techniques developed and demonstrated under CAFS.

EXPECTED DELIVERABLES: The deliverables of the remote sensing module will be spatially explicit models characterizing change in forest inventory and leaf area index parameters.

PROJECT TIMELINE: The project will take one year to complete. Site identification maximizing the availability of data (aerial and satellite lidar and field inventory) and a range of management practices or experimental contrails will occur in the 1st month. Terrestrial lidar data will be acquired at bi-weekly intervals commencing at pre-greenup and ending with of the growth cycle. Aerial and satellite lidar data analysis will occur simultaneously with the terrestrial lidar data acquisition. Deliverables will be assessed for accuracy during months 10, and final reports and publications will be developed during months 11 and 12.

PROJECT BUDGET: 2009 \$24k allocated: RA and associated field travel.

PROGRESS: SMC Type IV, newly planted in 2005 and 2006, and Type V installations, created in 2008 and 2009 are being visited monthly for terrestrial lidar scanning. Analysis methods for assessing leaf-area index and other parameters are under development and testing.

C. Modeling the Effects of Intensive Plantation Silviculture on Wood Density, Stiffness, Knots, and Other Properties

INVESTIGATOR(S): David Briggs UW, Eric Turnblom UW, Eini Lowell USFS PNW Research Station, Al Mitchell, Canadian Wood Fibre Center

PROJECT DESCRIPTION: Presently, information concerning the effect of intensive plantation silviculture and genetics on wood properties (wood density, carbon and energy content, stiffness, knots) of PNW conifers is sparse and piecemeal precluding integration of wood quality with growth and yield models to improve understanding and predictions. Integrated models would permit estimation of how these wood properties change as stands develop, are subjected to silvicultural treatments, and are replaced following harvests. Knowledge of spatially explicit patterns of wood properties as well as timber volume and size through time would improve decision support systems assisting with silvicultural planning and marketing decisions with respect to traditional timber products, carbon credits and bio-energy. This project will focus on wood specific gravity (SG) since it is strongly linked to quality of traditional wood products as well as to carbon sequestration and energy content.

EXPERIMENTAL PLAN: The SMC has more than 100 active long-term field research sites, each with multiple treatment plots, spanning western Oregon and Washington and coastal British Columbia that provide a rich resource of experimental material with known treatment history. Plots were designed with

extra-wide treated buffers in anticipation of destructive sampling for wood quality studies. We propose a sample of 25 Douglas-fir Type I installations (5 Coastal BC, 5 Coastal WA, 5 Cascade WA, 5 Coastal OR, 5 Cascade OR) to cover a broad range of bio-geo-climatic zones. Four trees from each of seven treatment plots common to all installations will be sampled. Acoustic velocity and increment cores at breast height will be obtained. Depending on funding, SG will be obtained from either whole core or x-ray densitometry scans (~700 cores); the latter being preferable since one could model inter-annual SG to any age within each tree. A more expensive, but more informative alternative would be to obtain multiple disks per stem by felling. Latitude, longitude, elevation, and soil of these installations is known. PRISM weather and climate data is available for the installations from Climate Source, Inc. Analysis will focus on modeling SG as a function of tree, treatment, geographic location and weather/climate variables and assessing the utility of non-destructive (NDT) field tools (ex. Resistograph) for estimating SG. Future work would extend this study to western hemlock, and east-side Douglas-fir, ponderosa pine and lodgepole pine.

PROJECT UNIQUENESS: This project will be the first to develop regional SG models of managed coastal Douglas-fir for integration with growth and yield models. A second unique feature of this study will be to explore the utility of using geographic location, soil and climate to improve wood quality predictions. A third unique feature will be determining the ability of NDT as a field method for estimating SG.

POTENTIAL BENEFITS: Knowledge of how much volume (or biomass) inventory exists with a specific range of size and quality characteristics over space and time will be an important aspect of decision support models for assessing opportunities and trade-offs associated with silvicultural planning, harvest scheduling, and markets for traditional timber products, carbon credits and bio-fuels on a forest estate. Two common biomass estimation methods are (1) to multiply volume by the published average SG of a species and (2) to use biomass equations based on tree dbh (Gholz et al. 1979) or dbh and height (Jenkins et al. 2004). Applying the average SG assumes that all trees of a species have the same density regardless of age, size, management or growing environment. Biomass equations assume that all trees of the same physical size have the same weight regardless of age, treatment, or growing environment. Recent studies indicate that biomass equations produce locally inaccurate information. This project will develop the SG assessment tools/models that can be linked with growth models to assist and improve decision support systems with respect to biomass utilization. The patterns of SG change with physiological age across landscapes is generally known for a number of conifers (USFS 1965, Jordan et al. 2008). However predictive models that account for effects of silvicultural treatments and local as well as site to site growing environment (soil, temperature, and precipitation) effects are lacking. Furthermore, development of a rapid, reliable NDT method for estimating SG will be a significant augmentation of routine forest inventory practice.

FUNDING: 2009 \$22k for field sampling of levels of growing stock (LOGS) and SMC Type I installations.

PROGRESS: Resistograph unit has been ordered for direct field measurement of wood density. Sampling plan has been designed. Canadian Wood Fibre Center, Vancouver BC, is collecting acoustic data for measuring wood stiffness on the same sample trees. Method for modeling properties are being developed with datasets from other studies.

NUTRITION PROJECT PROGRESS REPORT

Project Leader: Rob Harrison, University of Washington

PROGRESS TO DATE

The major SMC-related work on nutrition completed up to 2009 includes, 1) continued establishment (to 62 total current) 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, 3) further progress and results on the carryover study, including presentations and publication of research results, and 4) A continuing project and an M.S. thesis on effects of N fertilization on carbon sequestration.

PROJECT TITLE: Douglas-fir paired tree fertilization trials

PRINCIPAL INVESTIGATOR: Rob Harrison (UW), Doug Maguire (OSU), Eini Lowell (USFS PNWRS), Dave Briggs (SMC), Doug Mainwaring (OSU), Eric Turnblom (UW), **Student:** Kim Littke (UW, PhD)

PROJECT SUMMARY: Several decades of research by the Regional Forest Nutrition Research Project (RFNRP), as well as other studies of N fertilization of Douglas-fir, have shown that coastal Douglas-fir will respond to 224 Kg N/ha applications about 2/3 of the time. If fertilization could be concentrated into the top half of responding stands, the average response could be increased to about 25-30%.

OBJECTIVES: 1) To evaluate the potential for response of 15-25 year-old stands to N fertilization within a given vegetation/geology type, 2) to predict potential response from site and stand variables such that landowners can focus fertilization on sites most likely to respond, 3) to assess effects on wood quality (wood density, stiffness), and 4) to assess the utility of Lidar to measure and monitor response.

APPROACH: Installations will be located in previously unthinned and unfertilized 15-20 yr-old Douglas fir plantations across the major geologic parent materials/soils and climate zones in western Oregon and Washington. Within these strata, position on slope (ridge, sideslope, toeslope) will also be considered when selecting sites. At each installation 20 matched tree pairs per installation of which one randomly chosen to receive 200lb/ac N as urea. Each tree is considered to be the center of a 1/50 th acre plot with a minimum distance between plots of 50 ft. A soil pit will be dug at each site, temperature and precipitation gages and lysimeters will be installed to monitor growing environment variables throughout the year. Foliage samples will be collected. Wood quality testing will be performed at the end of the study.

PROGRESS & PLANS: 56 installations completely set up and fertilized in 7/08, and 08/09. Additional installations being sought. Will measure after every 2 growing seasons for 6 years. The six installations set up in 2007 had their 1st measurements after the 2009 growing season.

FUNDING: Stand Management Cooperative (set up), Precision Forestry Cooperative (Lidar, wood quality) AGENDA 2020 \$25,000/yr for 3 years for instrumentation, soil pits CAFS \$20,000 (2009), \$ 20,000 (2010/2011) for set-up and instrumentation, soil pits, foliage CAFS \$20,000 (2009), \$ 20,000 (2010/2011) for Lidar

Type V Paired-Tree Fertilization Study Summary

PRINCIPAL INVESTIGATOR: Rob Harrison, (UW), **Students:** Paul Footen (UW, M.S.), Ben Shryock (UW, M.S.), Kim Littke (UW, Ph.D.), Carol Shilling (UW, Ph.D.)

A copy of this report is available at:

<http://soilslab.cfr.washington.edu/publications/SMC-Nutrition-2009.doc>

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:

<http://soilslab.cfr.washington.edu/publications/MaguireFertilizationProject2007.pdf>

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/TypeV_SingleTreeFert.doc

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 experi-

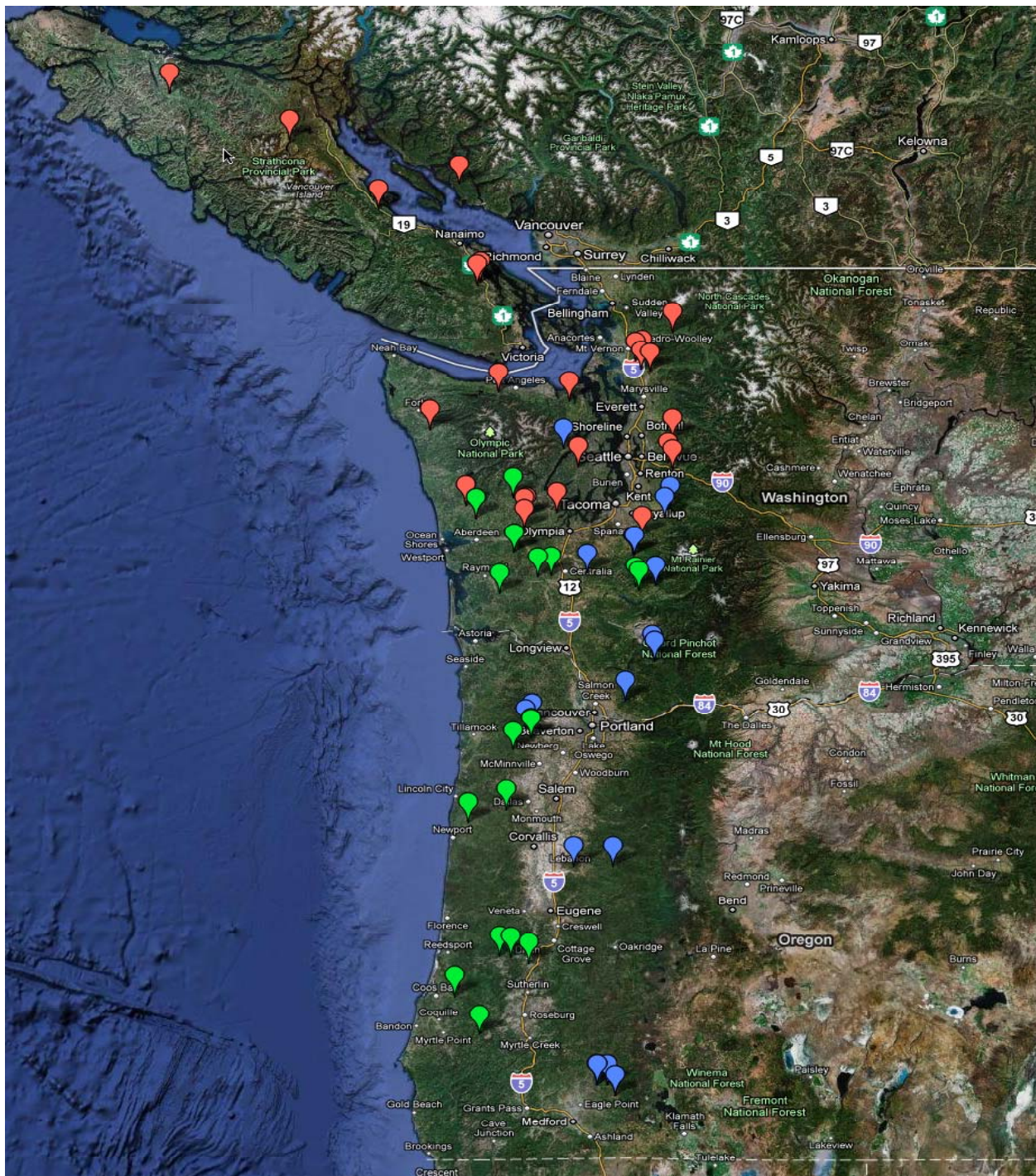


Figure I. Distribution of current and pending installations in the SMCType V Paired-tree fertilization study. Red indicators are for glacial origin sites, green for sedimentary, and blue for volcanic origin sites.

mental 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:

<http://soilslab.cfr.washington.edu/publications/Agenda2020ProposalFinal.doc>

Kim Littke, who is the full-time Ph.D. student working on the fertilization project, continues 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 (and 2010) to install and instrument additional sites. Such funding will help us greatly to multiply the impact of SMC member contributions to the overall project.

A total of 62 Paired Tree Installations have been installed through the end of 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. Figure 3 shows the range in variability in total C concentrations. As expected, there is a strong direct relationship between total C and N.

We are a bit hesitant to report growth results this early in a multi-year study, so please do not overstate the results reported below. There are small differences noted in average growth between the six sites from 2008 to 2009. For instance, Figure 4 shows differences in basal area growth (2008 to 2009) for the six sites installed in 2008. Only one site showed significant differences (0.1 level), the Cherry Grove 2 installation. Figure 5 shows differences in height growth (2008 to 2009) for the six sites installed in 2008. Again, only one site showed significant differences (0.1 level), the Adna I installation. Figure 6 shows differences in volume growth (2008 to 2009) for the six sites installed in 2008. Three sites showed higher volume growth in the fertilized compared to the control and three showed lower; however, only the Cherry Grove site was statistically significant (0.1 level). Again these data are presented to show the kinds of comparisons we can make on the larger dataset available in the future, and not a lot should be made out of this preliminary data.

Note that the six sites for which we have growth data are in the intermediate range of N contents. The Cherry Grove 2, which was the single site with the highest response, has the lowest total N content (Figure 2), but fairly high growth rates compared to the others (Figure 6) and the only statistically-significant volume response. We started this study acknowledging that there would likely be high variability, and there is in these six installations. In terms of predicting responses, we will eventually use a variety of tools; however, Kim did notice some interesting results from the six installations for which we have growth data. For

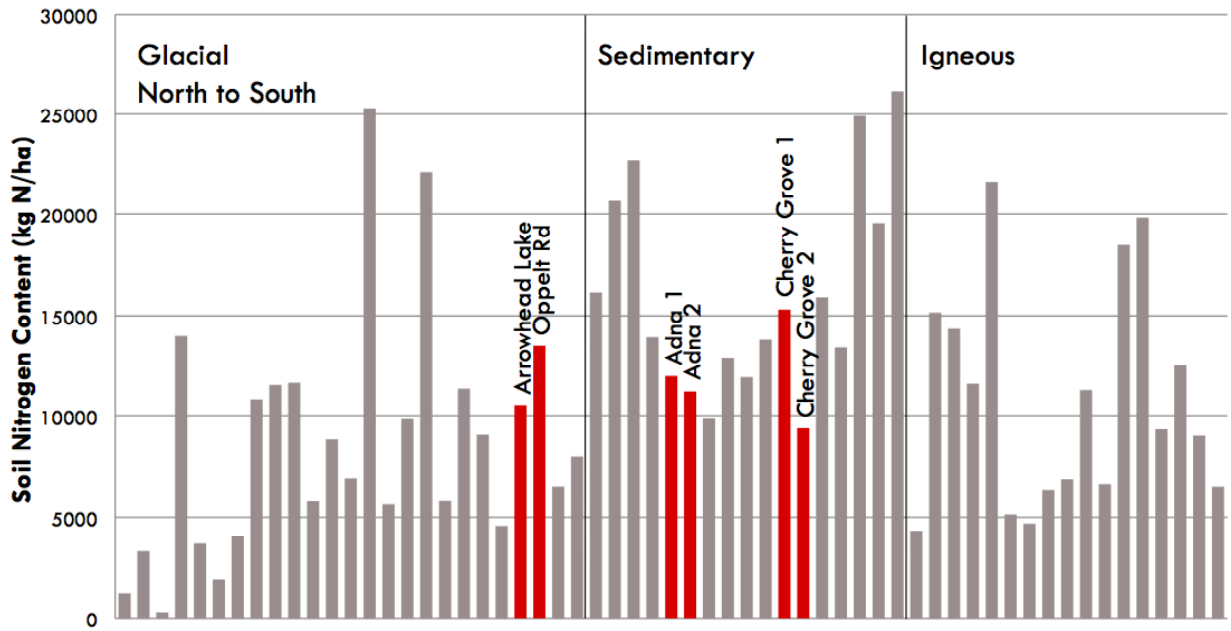


Figure 2. Nitrogen content of soil in a range of SMC Type V paired-tree nutrition installations.

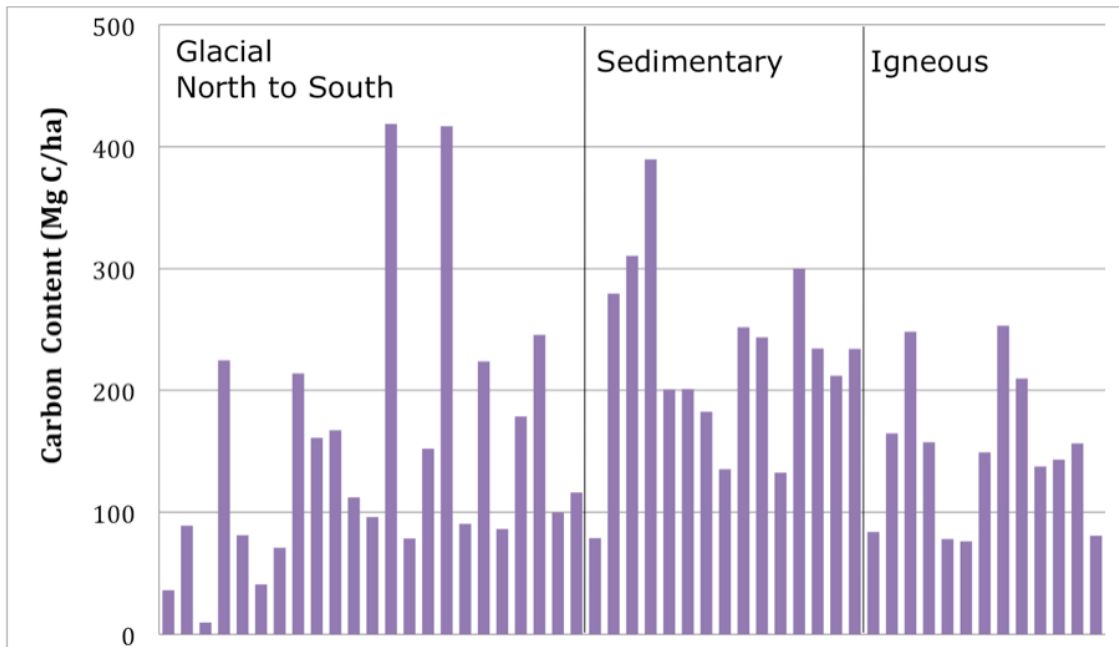


Figure 3. Carbon content of soil in a range of SMC Type V paired-tree nutrition installations.

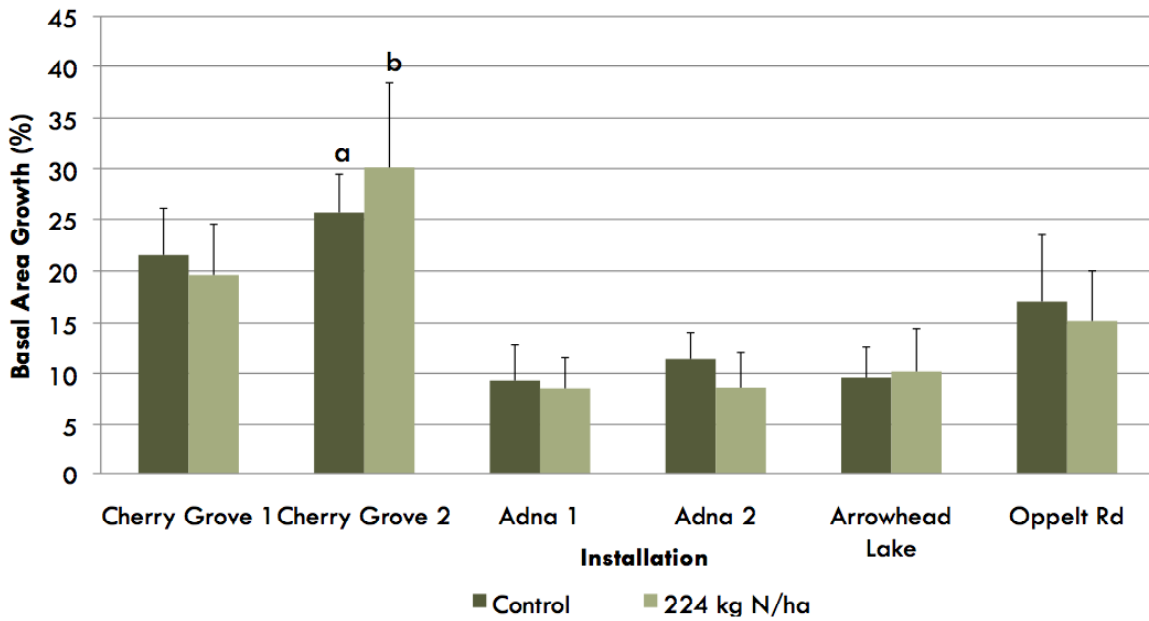


Figure 4. Average basal area growth comparisons (2008 to 2009) at the six sites installed in 2008.

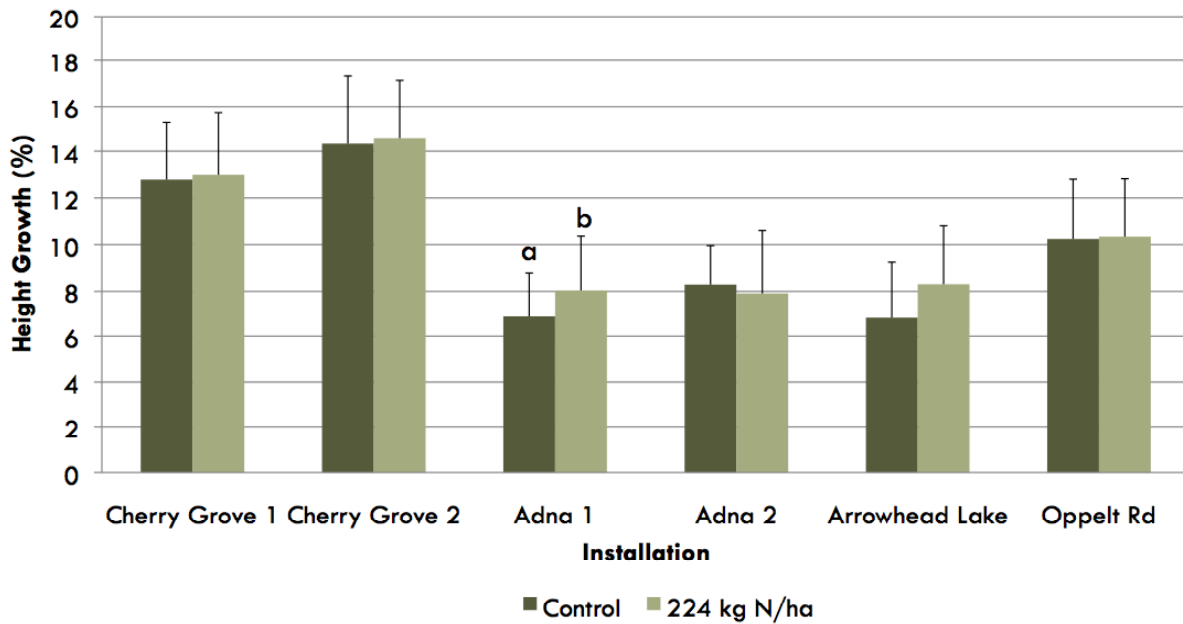


Figure 5. Average height growth comparisons (2008 to 2009) at the six sites installed in 2008.

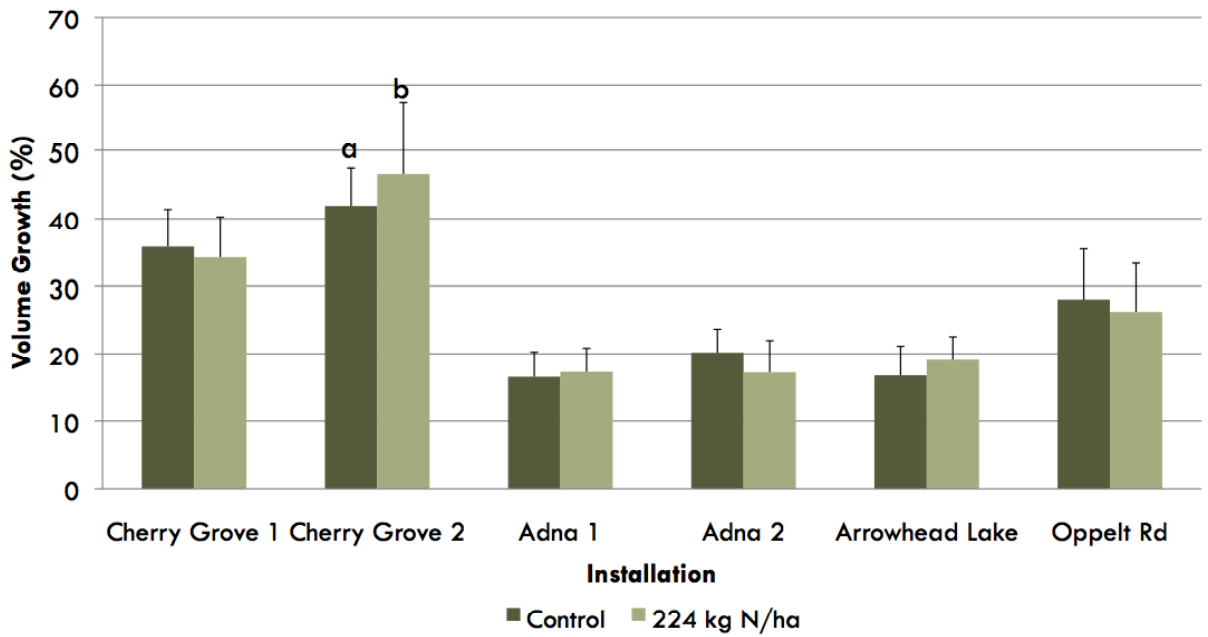


Figure 6. Volume growth (2008 to 2009) at the six sites installed in 2008.

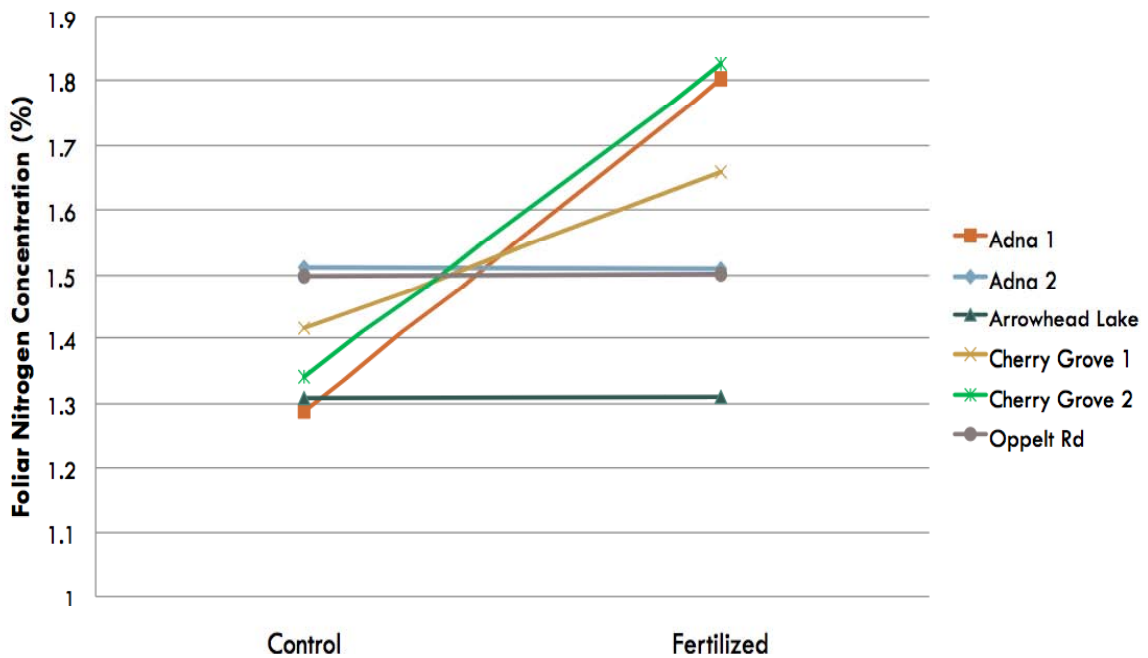


Figure 7. Foliar N concentration response to fertilization at the six sites installed in 2008.

instance, Figure 7 shows the changes in N concentration of foliage in 2009 between the control and fertilized. Three of the six sites show no increase in foliar N and three show substantial increases. Normally, 1.3% foliar N wouldn't indicate potential for strong response to N; however, these are highly stocked, rapidly-growing stands, and the increase in foliar N in three of the sites does seem to indicate potential for response. The Cherry Grove 2, Adna 1 and Arrowhead Lake sites had the lowest foliage N concentrations before fertilization, about 1.3% N. They are the three installations showing higher volume growth. The three installations with the highest N concentrations (all above 1.4% N in the control) showed no increase in N due to the fertilization treatment.

Another way of viewing this is shown in Figure 8, where height-growth response is shown against foliar N concentration, and Figure 9, where BA response is shown against total soil N. With additional growth data and a larger installation base, if such relationships can sort out responders from non-responders, we should be able to offer useful tools for our coop members. This is particularly true if response can be shown to be related to site characteristics that can be remotely sensed (i.e. slope and slope form, aspect, temperature, etc.).

Three-year growth measurements and foliage sampling will be available for the first six installations, and 2 years for the bulk of the other installations in Fall, 2010. The impact of the additional samples on our analysis should be substantial. 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.

A. PROJECT TITLE: Fall River/Matlock/Molalla LTSP:

We worked on the Fall River, Matlock and Molalla LTSPs as an 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 during 2009. 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 with the help of USFS crews, and many volunteers. Warren Devine, a post-doctoral research at the Olympia Lab, is also helping.

Brian Strahm, now a professor at Virginia Tech, published an article entitled "Changes in dissolved organic matter with depth suggest the potential for postharvest organic matter retention to increase subsurface soil carbon pools" in *Forest Ecology and Management*. An abstract of the results is as follows:

"Research into postharvest management of forests often focuses on balancing the need for increased biomass yield against factors that may directly impact the productivity of the subsequent stand (e.g. nutrient and water availability, soil microclimate, etc.). Postharvest organic matter management; however, also exerts a strong influence over the translocation of carbon (C) into and through the soil profile and may provide a mechanism to increase soil C content. The effects of contrasting postharvest organic matter retention treatments (bole-only removal, BO; whole-tree removal, WT) on soil solution C concentration and quality were quantified at the Fall River and Matlock Long-term Soil Productivity (LTSP) studies in Washington State. Solutions were collected monthly at depths of 20 and 100 cm and analyzed for dissolved organic C (DOC), dissolved organic nitrogen (DON) and DOC:DON ratio. Comparisons of DOC concentrations

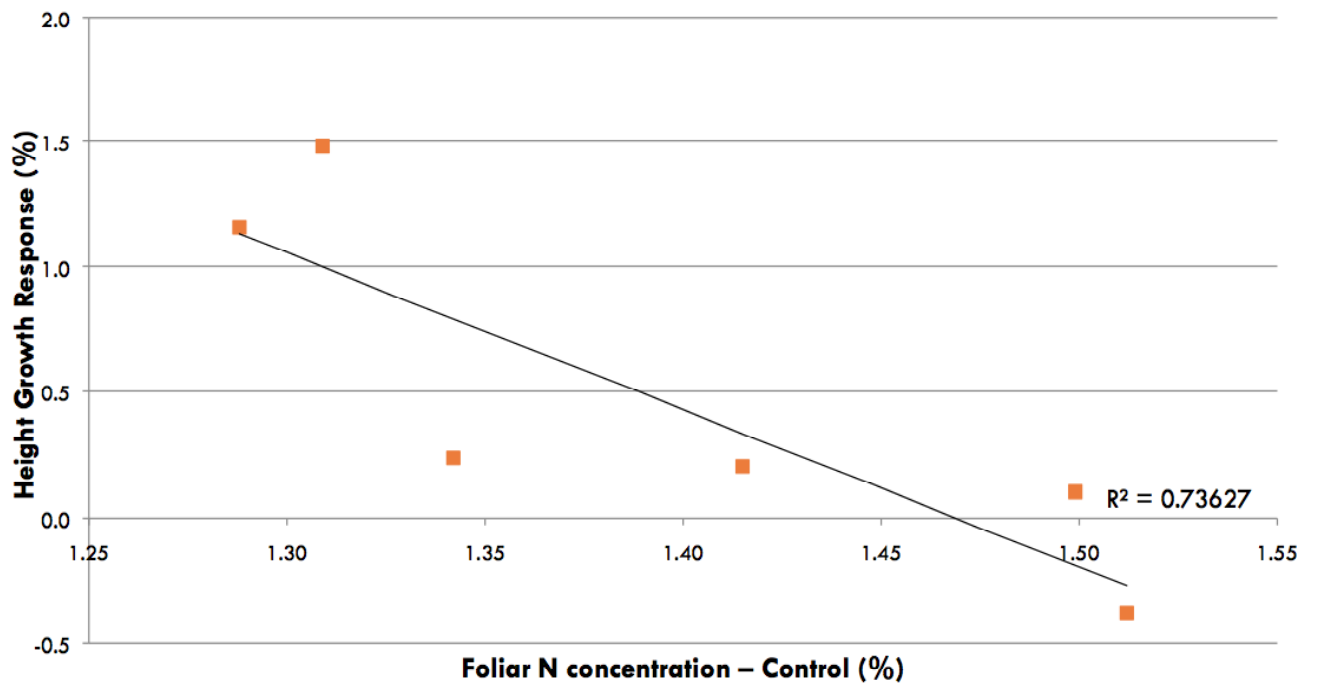


Figure 8. Height growth response to fertilization vs. foliar N at the six sites installed in 2008.

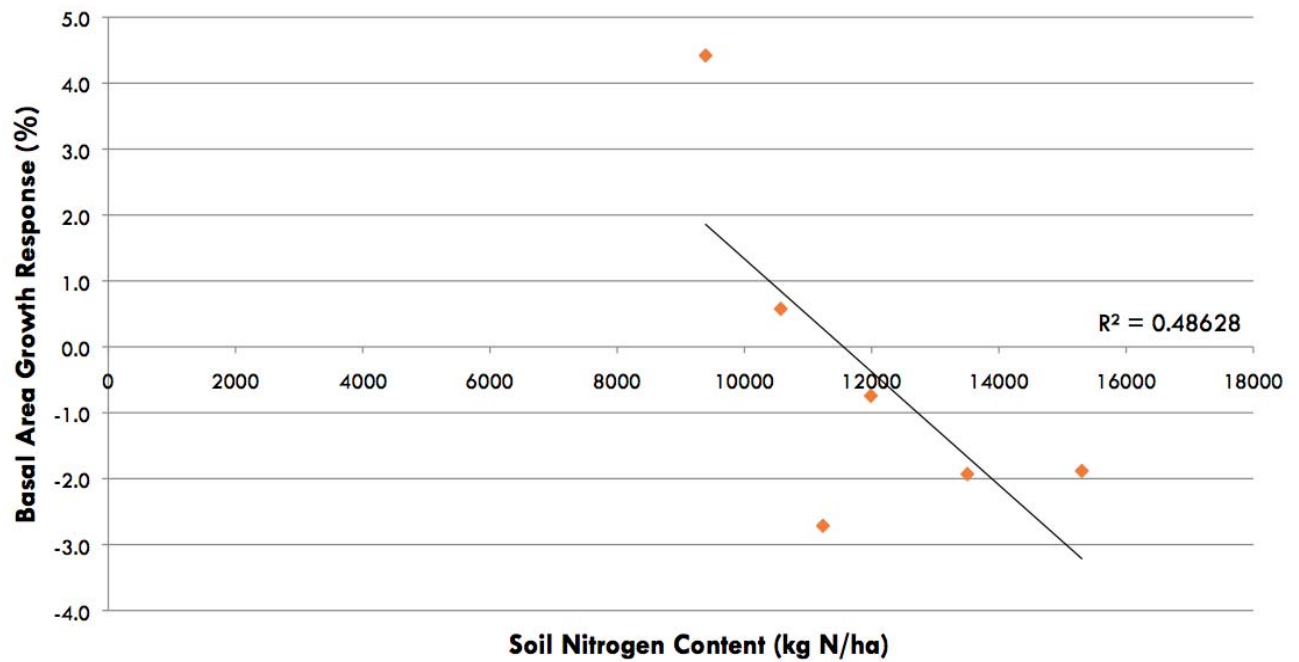


Figure 9. Basal area growth response to fertilization vs. soil total N at the six sites installed in 2008.

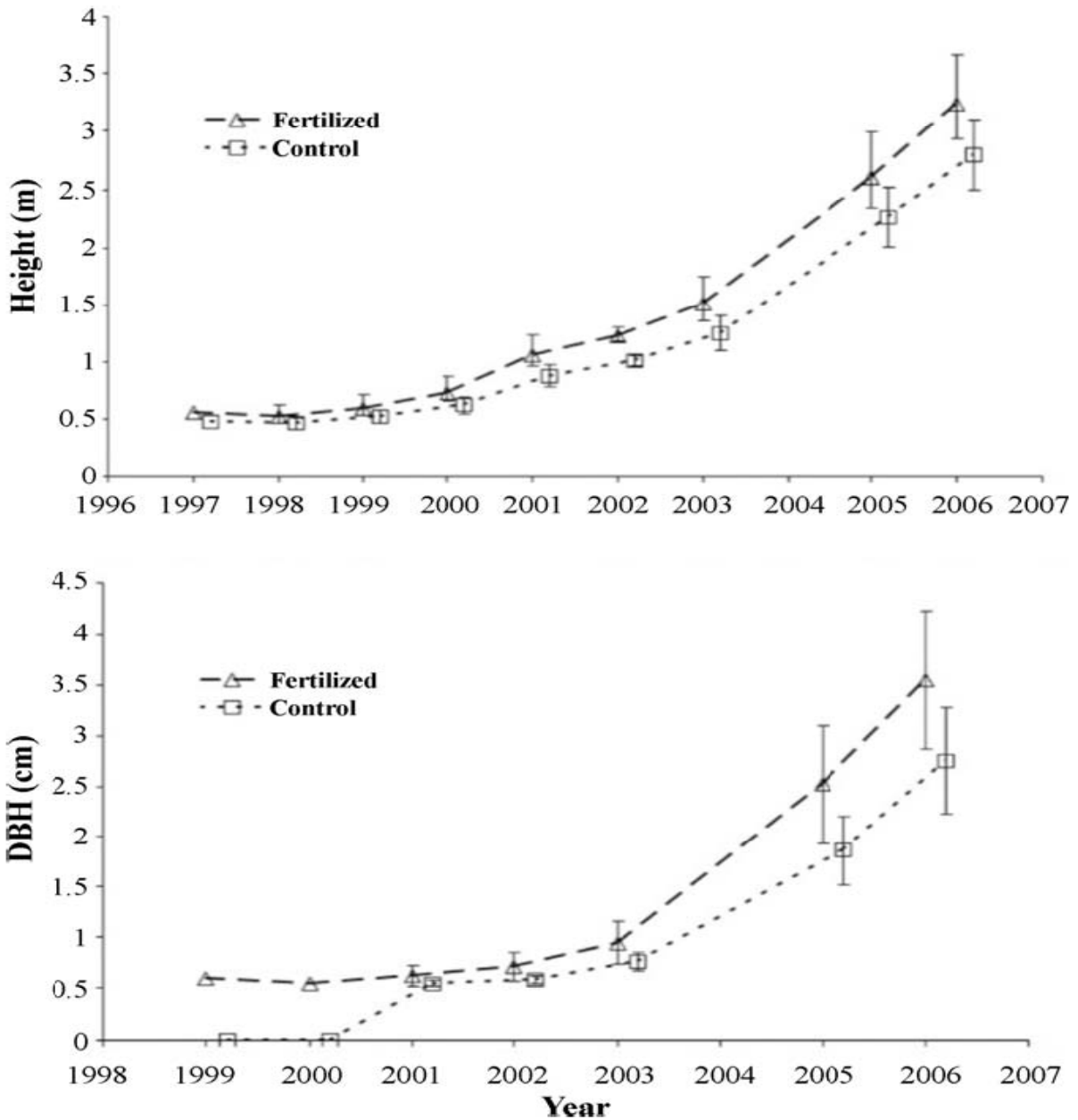


Figure 10. Mean height (m) and mean DBH (cm) of Carryover study Douglas-fir trees. The differences in height were statistically significant ($p < 0.1$) every year measured from 2001 to 2006. In 2006 mean tree height was 15% greater on the previously fertilized plots than on the control. The differences in DBH were statistically significant ($p < 0.1$) in years 2005 and 2006. In 2006 mean DBH was 29% greater on the previously fertilized plots than on the control. Control points are offset to show (+/-) standard error bars.

with depth illustrate divergent trends between the two treatments, with an overall decrease in DOC with depth in the BO treatment and either an increase or no change with depth in the WT treatment. Trends in DON concentrations with depth were less clear, partly due to the very low concentrations observed, although the relationship of DOC:DON with depth shows a decrease in the BO treatment and little to no change in DOC quality in the WT treatment. This illustrates that more recalcitrant organic matter (higher DOC:DON) is being removed from solution as it moves through the soil profile. Only 35-40% of the DOC moving past 20 cm in the BO treatment is present at 100 cm. Conversely, 98-117% of the DOC at 20 cm in the WT treatment is present at 100 cm. Thus, 11 and 30 kg C/ha/y are removed from solution between 20 and 100 cm in the BO treatment at the Matlock and Fall River LTSP studies, respectively. Although much of this C is often assumed to be utilized for microbial respiration, DOC:DON ratios of the potential organic substrates and the unique mineralogy of the soils of this region suggest that a significant portion may in fact be incorporated into a more recalcitrant soil C pool. Thus, postharvest organic matter retention may provide a mechanism to increase soil C sequestration on these soils."

The entire journal article is available at:

<http://soilslab.cfr.washington.edu/publications/Strahm-etal-2009.pdf>

We submitted 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. The proposal was funded for 2009 and 2010.

B. PROJECT TITLE: Carryover Effects of N-fertilization.

Paul Footen continued to make progress on work on the carryover study. Paul should finish his M.S. degree in 2010, and 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*". An abstract of the paper shows the significant long-term impact of N fertilization on the growth of the subsequent plantation:

"The carryover effects of N fertilization on five coastal Pacific Northwest Douglas-fir (*Pseudotsuga menziesii* [Mirb.] Franco) plantations were studied. "Carryover" is defined as the long-term impact of N fertilizer added to a previous stand on the growth of a subsequent stand. Average height and diameter at 1.3 m above-ground (DBH) of 7-9-year-old Douglas-fir trees and biomass and N-content of understory vegetation were assessed on paired control (untreated) and urea-N-fertilized plots that had received cumulative additions of 810-1120 kg N/ha to a previous stand. Overall productivity was significantly greater in the fertilized stands compared to the controls. In 2006, the last growth measurement year, mean seedling height was 15% greater ($p = 0.06$) and mean DBH was 29% greater ($p = 0.04$) on previously fertilized plots compared to control plots. Understory vegetation biomass of fertilized plots was 73% greater ($p = 0.005$), and N-content was 97% greater ($p = 0.004$) compared to control plots. These results show that past N fertilization markedly increased seedling growth in these plantations as well as biomass and N-content of understory vegetation in a subsequent rotation. These findings suggest that N fertilization could potentially increase site productivity of young Douglas-fir stands found on low quality sites in the Pacific Northwest 15-22 years after application by a carryover effect. These plantations have not yet reached the age where marketable materials can be harvested from them, and the growth of trees should be monitored over a longer time period before potential impacts on older stands, if any, can be determined."

The “bottom line” results from the study showed significant increases in total height and DBH of young trees planted after the previous fertilization was done, up to 20 years afterward (Figure 10).

Conclusions from the study include the following:

- 1) Repeated N fertilization of previous stands coupled with postharvest organic matter retention increased DBH by 29% and total height by 15% for a new Douglas-fir plantation in the Pacific Northwest compared to an unfertilized control.
- 2) Biomass and N-content of understory vegetation increased by 73% and 93%, respectively in N-fertilized compared to unfertilized stands.
- 3) The effects of repeated N fertilization may last much longer than previously understood when considering impacts of that fertilization on young, replanted second growth stands instead of first rotation stands.
- 4) Increases in tree growth witnessed on carryover plots should continue to increase with time; meaning earlier first commercial entry and harvest than on the paired controls.

The text of the entire article is available at:

<http://soilslab.cfr.washington.edu/publications/Footen-etal-2009.pdf>

C. PROJECT TITLE: Impacts of N on Carbon Sequestration.

Ben Shryock sampled five of the Type III plantations in late 2008. The purpose of this study was to determine the effects of urea fertilization on carbon sequestration in the soil, understory vegetation and live trees, a follow-up to earlier work by Jana Canary (M.S. student) and Dr. A. B. Adams (postdoc) in naturally-regenerated Regional Forest Nutrition Research Project stands. Papers of their earlier work on SMC sites is available at:

<http://soilslab.cfr.washington.edu/publications/Canary-etal-2000.pdf>

<http://soilslab.cfr.washington.edu/publications/Adams-etal-2005.pdf>

Jana Canary and A.B. Adams 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 costal Douglas-fir plantations.

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 samples 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). Ben's work resulted in a thesis, and he is currently working on a journal article.

Here is an abstract from Ben's thesis:

"Global climate change has become a widely discussed issue. One potential mechanism for mitigating climate change is to reduce the concentration of atmospheric greenhouse gasses such as CO₂, which may be achieved through the sale of carbon (C) credits under the framework of Cap-and-Trade. If long-term C sequestration can be attributed to nitrogen (N) fertilization and quantified, the C credits could be sold. The purpose of our study was to determine the effects of N fertilization on C sequestration in Douglas-fir (*Pseudotsuga menziesii* [Mirb.] Franco) plantations in the coastal Pacific Northwest. The C content of the trees, understory vegetation and soil was quantified for five sites, each with a fertilized plot that received 1121 kg N/ha as urea over 16 years and a control plot that remained unfertilized. By subtracting the difference between treatment and control at Year 0 from the difference between treatment and control at Year 16, it was determined that N fertilization had increased the C in the trees by 5.12 Mg C/ha on average. The fertilized understory vegetation averaged statistically significant (0.16 Mg C/ha) more C than that on the control plots (p=0.045). The average amount of C sequestered in the mineral soil decreased by 18.2 Mg C/ha after the fertilization treatment, but the difference was not statistically significant (alpha = 0.1). These results indicate that responses to fertilization will vary depending on the system of interest; growing biomass tends to respond positively, while the soil response is much more variable."

The entire thesis is available at:

<http://soilslab.cfr.washington.edu/publications/ShryockBen-Thesis-2009.pdf>

PUBLICATIONS

Footen, P.W., R.B. Harrison and B.D. Strahm. 2009. **Long-term Effects of Nitrogen Fertilization on the Productivity of Subsequent Stands of Douglas-fir in the Pacific Northwest.** *Forest Ecology and Management* 258:2194-2198.

Available at: <http://soilslab.cfr.washington.edu/publications/Footen-etal-2009.pdf>

Harrison, R.B., P.W. Footen and B.D. Strahm. 2009. **Deep Soil Horizons: Contribution and Importance to Soil C Pools and in Assessing Whole-ecosystem Response to Management and global change.** Submitted to *Forest Science*.

Harrison, R.B., T.A. Terry, C.W. Licata, B.L. Flaming, R. Meade, I.A. Guerrini, B.D. Strahm, D. Xue, A.B. Adams, M.R. Lolley, A. Sidell, G.L. Wagoner, D. Briggs, E.C. Turnblom. 2009. **Predicting the Biomass of a Douglas-fir/Western Hemlock Plantation in the Coastal Hemlock Zone of Washington: Accounting for bias.** *Western J. Applied For.* 24:180-186.

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Shryock, B. 2009. **The Effects of Urea Fertilization on Carbon Sequestration in Douglas-fir Plantations of the Coastal Pacific Northwest.** Thesis, University of Washington.

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Strahm, B.D., R.B. Harrison, T.A. Terry, T.B. Harrington, A.B. Adams, and P.W. Footen. 2009. **Changes in Dissolved Organic Matter with Depth Suggest the Potential for Postharvest Organic Matter Retention to Increase Subsurface Soil Carbon Pools.** For. Ecol. Mgmt. 258:2347-2352.

Available at: <http://soilslab.cfr.washington.edu/publications/Strahm-etal-2009.pdf>

SILVICULTURE PROJECT PROGRESS REPORT

Project Leader: Eric Turnblom, University of Washington

Graduate Students: Kevin Ceder (Ph.D.), Jeff Comnick (Ph.D.), Nai Saetern (M.S.), Nick Vaughn (Ph.D.), University of Washington

The Silviculture Project continued its mission-driven gathering of high quality data and information on tree and stand growth and development and on tree and product quality. For a detailed list of sites and installations visited see page 46 of this Annual Report. This work also included upgrading and updating several software application programs used in the collection of data and maintenance of the database. For example, the software application used to check Relative Density (RD) and select trees for thinning was found not to work under the newer operating system software loaded on hand-helds. The RD application was re-coded in Visual Basic and now runs as an Excel spreadsheet application.

New protocols for measuring basal diameter in the Genetic Gains / Type IV (GGTIV) joint trials were explored because an increasingly inordinate amount of time was being spent on a complete enumeration (100% sample). Due to the excellent control of vegetation on these sites, the vast majority of all the trees have maintained full live crowns with big live branches extending all the way to the ground, severely impeding the measurement of basal diameter. The original plan was to continue measuring *both* basal diameter and DBH on trees in a plot until 90% of the trees on that plot exceeded breast height. The new protocol calls for measurement of a systematic sample of size 50 for both basal diameter and DBH until 90% of the trees have reached breast height. Spraying for brush and repair of fencing is proceeding as planned. Please see the 1st quarter issue of the 2009 SMC Quarterly News for a report on GGTIV performance through age 3 years from seed. Performance results after four growing seasons (5 years from seed) for the three GGTIV plantations established in 2005 were reported at the 2009 Fall Policy Committee Meeting and are summarized below.

In August 2009, Silviculture Project Technical Advisory Committee (SPTAC) Leader Turnblom led a guided field tour of the Brittain Creek Installations (919 – 921), a trio of pure Douglas-fir, pure western hemlock, and 50-50 mixtures of the two species as part of the Northwest Forest Soils Council Summer Field Tour program. Much was discussed regarding stand dynamics in pure and mixed species plantations, and how mixtures, as well as soil factors, may affect overall productivity. A report was presented at the 2009 Fall Policy Committee Meeting.

Immediately following the 2009 SMC Fall Policy Committee Meeting, SMC members and interested parties toured the Donkey Creek Installation (601) to assess status, discuss continuation of complete vegetation control treatments and other issues related to GGTIVs in general, and to discuss SMC installation “retirement.” Much good discussion ensued. Five years of complete vegetation control was considered adequate, one more treatment will be applied to those installations planted in 2006 to bring the total number of treatments on that set to five. Fences will continue to be maintained for a few more years.

The SPTAC met in December 2009 to discuss the continuing work toward three principal projects identified through strategic planning: development of criteria for installation retirement and measurement work planning purposes, a model validation study to be conducted in close collaboration with the Modeling Project, and a “LOGS-style” Summary Report on the performance of the Type I, II, and III installations in terms of their growth and yield (hereafter referred to as the “Installation Performance Report.” Progress is understandably slow for the model validation and the Installation Performance Report, because no SMC

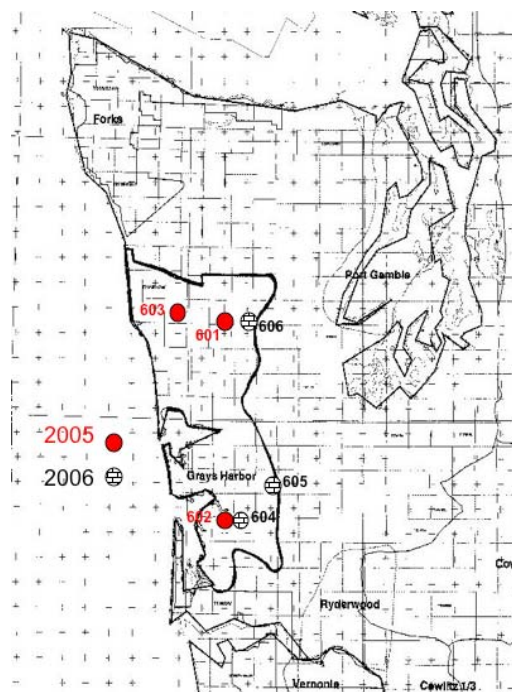
funds have been allocated to advance either of these projects. “No funding” is the death knell for attracting qualified graduate students to assist in these analyses.

Analyses are nearing completion for the Vegetation Composition and Succession in Managed, Coastal Douglas-fir Ecosystems project, sponsored by NCASI Western Wildlife Program. The objectives of the study include the development of current overstory / understory relationships in young, managed Douglas-fir stands at the species level and to build dynamical change models for the understory vegetation linked to how the overstory is changing. The final objective is to test the interpolative and extrapolative properties of both sets of models. Progress was reported at the March 2009 AFPA Western Wildlife Program Technical meeting in Stevenson, WA, and at the 2009 Fall SMC Policy Committee Meeting, a summary of which appears below.

Work also advanced on the “Sun Tree Identification” project sponsored by the Olympic Natural Resources Center (ONRC) and USFS. Graduate student Nick Vaughn assists on this project and has developed some very promising techniques for identifying / separating the sun tree layer as well as other distinct canopy layers in multi-layered canopy forests growing on the Olympic Peninsula. Results to date were reported at the 2009 Fall SMC Policy Committee Meeting, a summary of which appears below.

A new project in collaboration with ONRC / USFS was initiated in 2009 examining the quantity of available and recoverable biomass in the form of logging slash. The area of focus is the North Olympic Peninsula, which includes Clallum, Kitsap, Jefferson, and northern Grays Harbor and Mason counties. The goal is to establish an “investment grade” ratio of recoverable tons of biomass per acre logged for the region. No results are yet available since the study is just getting underway.

Age Five Analysis of the Three Genetic Gains / Type IV Joint Trials (GGTIV) Planted in 2005



As noted at the 2009 Fall SMC Policy Committee Meeting and elsewhere, 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.

There are three (3) factors being studied in this joint trial between SMC and NTIC: genetic gain (three levels), spacing (three levels), and vegetation control (two levels). The experimental design is a generalized, randomized block design, with six “blocks” (installations) with 22 plots in each block representing anywhere from 1 to 5 replications of all factors. Figure I displays the approximate locations and year of planting for the six research sites.

Figure I. Approximate location of all six 22-plot GGTIV installations.

On each plot, we are measuring basal diameter at 6 in. until 90% of trees on the plot exceed breast height, DBH on all trees that have it, total height on all trees, crown width in two directions on a 42-tree subsample, height to live crown on the height tree sample, and comments. The results that follow pertain to the first three installations planted in 2005 only, since measurements for just those three were available for analysis at the time of this writing.

There is strong evidence for installation level effects on all response variables. ($p < 0.001$). Generally, all response variables (basal diameter, DBH, height, etc.) follow the pattern 601 > 603 > 602. For height, the numbers are: 7.5 ft. > 6.3 > 5.4 ft. for 601, 603, and 602, respectively. For DBH: 0.73 in. > 0.56 > 0.45 in. For survival: 90% > 68% > 79% on average.

More specifically, significant differences in height were observed between genetic gain levels after adjusting for installation differences ($p = 0.027$). The intermediate level of gain expressed heights that were 6.5% taller than the woods run stock, and the elite mix was observed to have heights about 7.9% greater than the woods run. Though not statistically significant, trees were slightly taller in denser stands, after adjusting for installation and genetic gain factors. Trees were 6.3 ft. on average in the 15 x 15' spacing, 6.5 ft. in the 10 x 10' spacing, and 6.4 ft. tall in the 7 x 7' spacing. No significant differences between complete weed control (80% or better bare ground) and standard weed control (one herbicide application during site prep.). Figure 2 displays these results in graphical form.



Figure 2. Average tree height in the first three GGTIV installations planted in

For DBH, significant differences were also found between genetic gain levels after adjusting for installation effects ($p = 0.018$). The intermediate gain level trees were on average 12.5% thicker than the woods run stock, while the elite gain trees were 11.2% greater in DBH than woods run. Again, though not statistically significant, trees appeared to be slightly thicker in the denser stands: 0.54 in. in the 15 x 15' spacing, 0.60 in. in the 10 x 10' ft. spacing, and 0.58 in. in the 7 x 7' spacing. Here also, no statistically significant effects of vegetation control method on DBH. Figure 3 summarizes these results graphically.

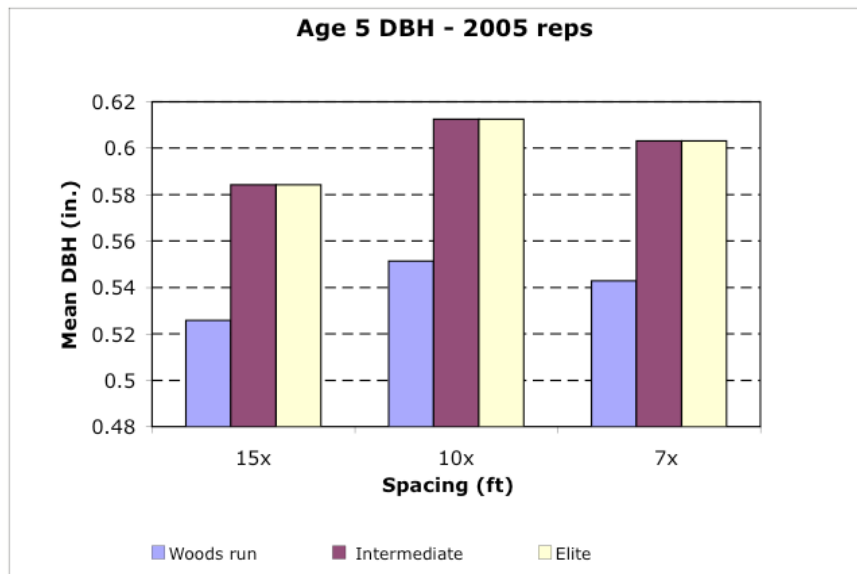


Figure 3. Average DBH in the first three GGTIV installations planted in 2005.

Survival was impacted by density level ($p = 0.019$) and marginally by weed control method ($p = 0.052$) after adjusting for installation effects. All genetic gain levels survived equally well beyond these effects. Survival was greatest in the densest spacings and marginally better in the plots with complete weed control. Figure 4 summarizes these results graphically

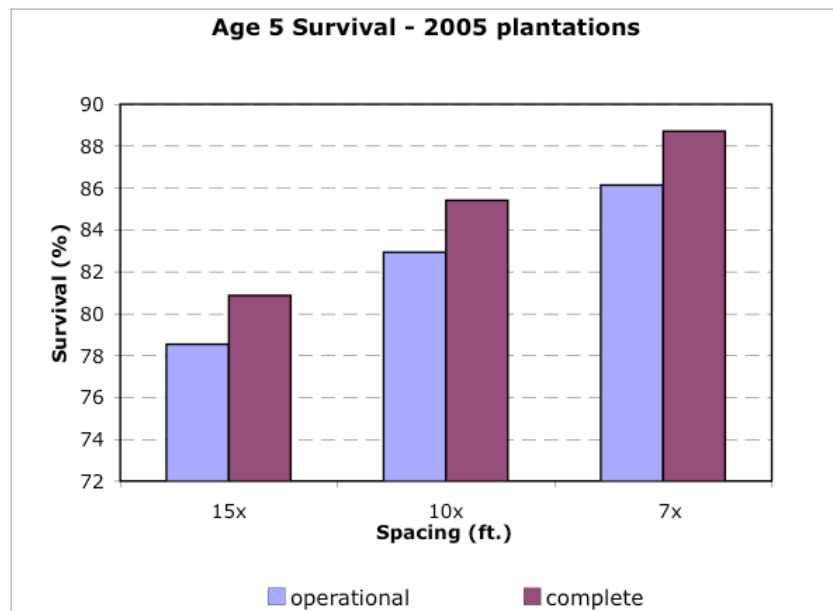


Figure 4. Average survival in the first three GGTIV installations planted in 2005.

In general, we expect the differences observed to date to increase as trees grow older and larger. We will be monitoring these plots every two years until average heights approach 30 ft., then every four years thereafter.

Vegetation Composition & Succession and Understory Diversity in Managed, Coastal Douglas-fir Ecosystems (NCASI project)

This project is developing overstory/understory relationships at the species level in young managed Douglas-fir stands over time, linking them to silvicultural practices. Rather than trying to analyze habitat requirements of any particular wildlife species, the idea behind this study is that impacts of cultural treatments on critical wildlife habitat requirements should be deduced from analyzing the vegetation that comprises habitat in general. 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 continues work on this project with Silviculture Project Leader Turnblom.

The theoretical model framework follows the basic principles outlined by Major in 1951 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.

The non-linear exponential and Weibull function forms initially used to model total vegetation cover at a single point in time possessed too many shortcomings to be useful. Log-linear models that included site parameters (site index, latitude, longitude, etc.), as well as stand attributes (top height, basal area, trees per acre, etc.) were next examined and seemed to perform quite well. The backwards elimination step-wise regression technique was used to screen predictors. The magnitudes and signs of coefficients on predictor variables made sense. Under the basic assumption that light is the limiting factor to the understory growing environment, taller stature life forms were then included as predictor variables in the equations for any particular shorter stature life form. Fits were also good.

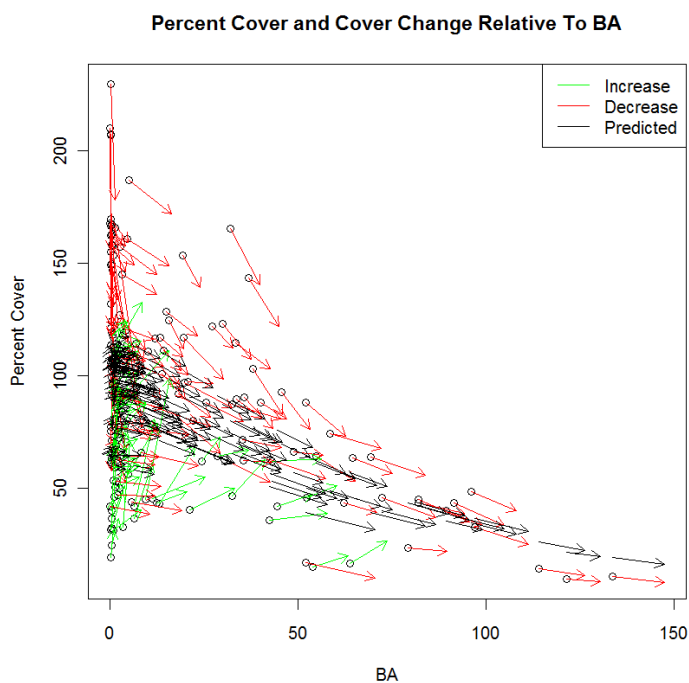


Figure 5. Observed percent cover change (red and green vectors) with compatible change model overlay (blue vectors). The compatible change model does not represent the variability in the observed data well.

Given the better success with new models for predicting current understory vegetation characteristics, the next step was to formulate understory cover change (or projection) models. The basic premise adopted here is compatibility between current cover amount (yield) and change in cover amount (growth), a concept for which one of the early developers was Jerome Clutter. The R function `systemfit` was used to simultaneously fit the current cover and the cover change models. Outcomes were moderately successful. In many cases, the model system did not represent the variability in the data well (Figure 5).

A synergistic system of differential equations, originally used by Savageau for modeling complex chemical reactions in biological systems, was explored next. These systems impose very few constraints on functional forms (unlike the exponential and the Weibull functions) and so are characterized by being rather flexible. They are also able to represent complex feedback mechanisms between parts of the biological system (Figure 6).

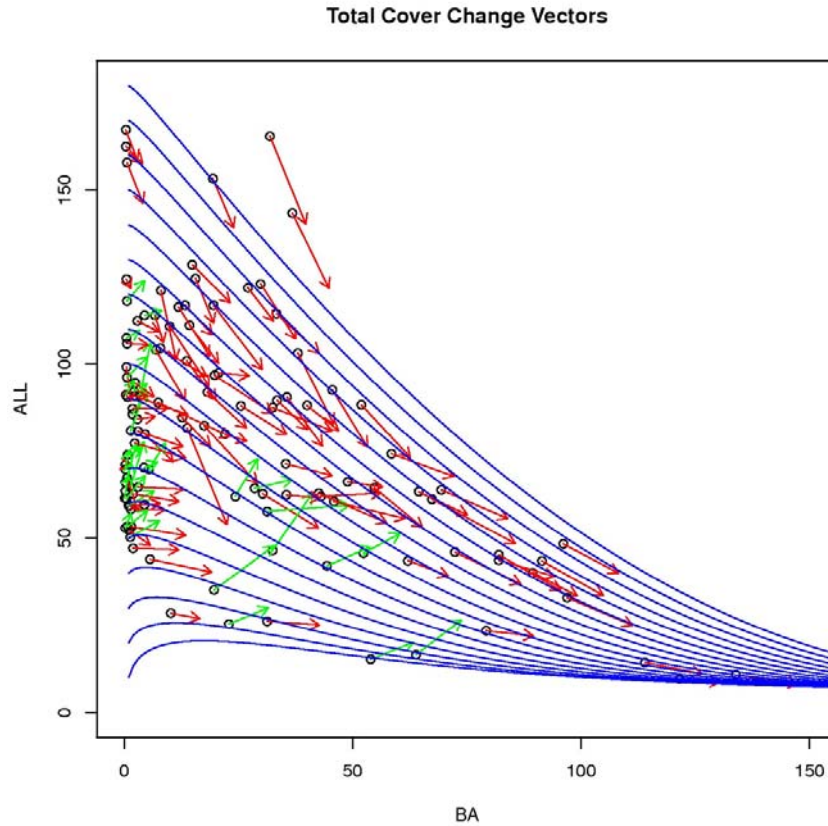


Figure 6. Observed total (ALL) cover change (red and green vectors) with S-System change model overlain (blue lines). The S-System change model represents the variability in the observed data well.

Algorithmic Detection of Sun trees From Inventory Data (ONRC Project)

The Japanese forestry researcher, Yoda, originally coined the term “Sun tree” in his seminal paper on maximum density/size relationships. Yoda’s implicit definition might be made explicit as ‘any tree that has had full sun exposure over a large portion of its crown throughout its lifetime. In other words, a dominant tree that has remained dominant. The identification of sun trees is important, even critical, for using Density Management Diagrams (DMDs), principally developed for single species, single-canopied stands, in multi-specied or multi-layered stands. The sun tree layer commands the major portion of a site’s growing space, therefore is the prime driver of stand dynamics, and is the overriding feature in the stand that must be accounted for to transform a stand’s position on a DMD into an actionable silvicultural treatment. The main point here being that while stand stages of development can be identified as ‘zones’ or ‘regions’ in a DMD (Figure 7), not all stands can be moved to other zones if they are in some sense too ‘far’ from the target zone. Researchers at ONRC wish to use this to manage toward old-growth stand conditions where appropriate.

What has been observed to date is that even though some stands exhibit WOGHI (Weighted Old Growth Habitat Indexes) quite near to the threshold value, when stand attributes including all trees are computed, the stands location on the DMD is quite far from the “complex” zone. We seek to develop an algorithm that properly identifies the sun trees (as well as other layers if present), whose component attributes will place it on the DMD in a way that more clearly identifies its “nearness” to the zone of complex conditions, better reflecting its high WOGHI score.

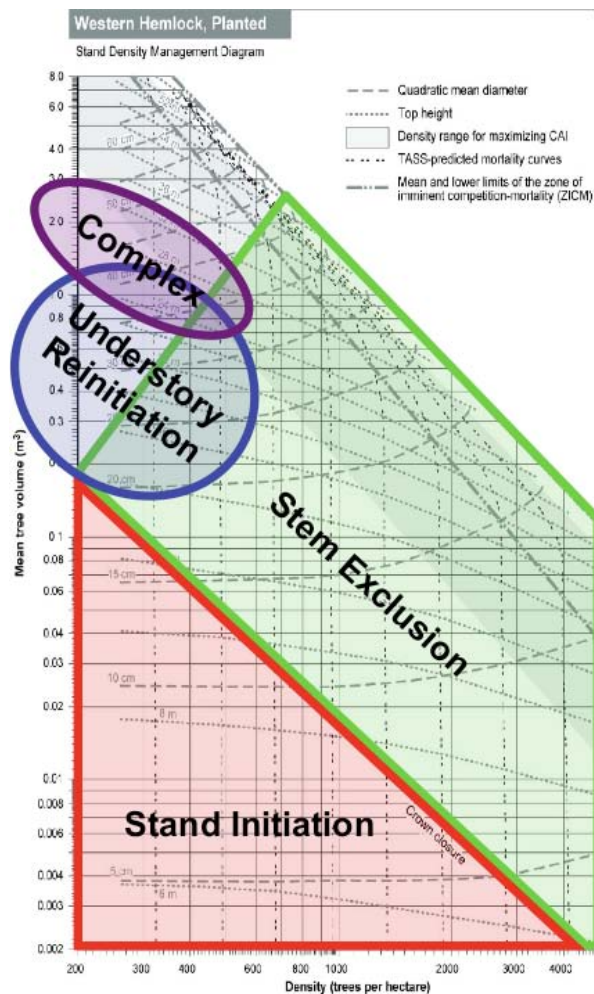


Figure 7. Density Management Diagram for western hemlock with stand development stage “zones” superimposed.

There are at least two promising extant forest canopy layer identification algorithms, one due to Baker and Wilson, the other due to Latham and others, but they both perform sub-optimally when the sun tree component attributes are used to locate the stand on a DMD. For example, Figure 8 shows a plot where the sun trees are defined by the Baker and Wilson algorithm.

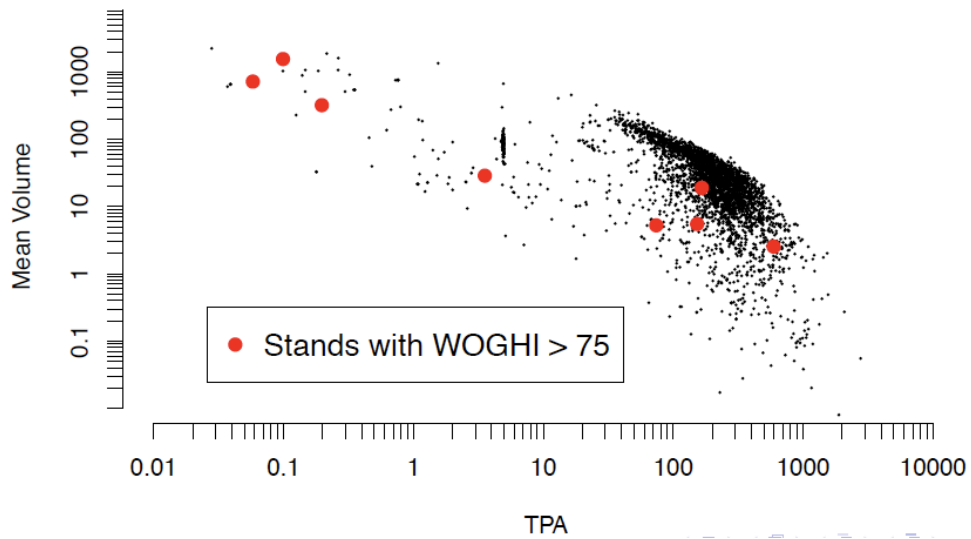


Figure 8. Stands with WOGHI scores near the threshold value of 100 indicating “old growth” (red dots) appear scattered throughout the DMD when the Baker & Wilson algorithm is used to identify sun trees, which belies their actual nearness to the complex zone as indicated in Figure 7.

Working with graduate Student Nick Vaughn we’ve been able to derive an improved algorithm that uses an index incorporating tree total height and crown length that we’ve dubbed the Crown Integration Value (CIV). The CIV and DBH of a tree are then used in a clustering algorithm to define the layers. When the attributes of the sun tree component defined by our clustering algorithm are used to locate the stand on a DMD, a much clearer picture emerges on how “near” the stand is to complex conditions (Figure 9).

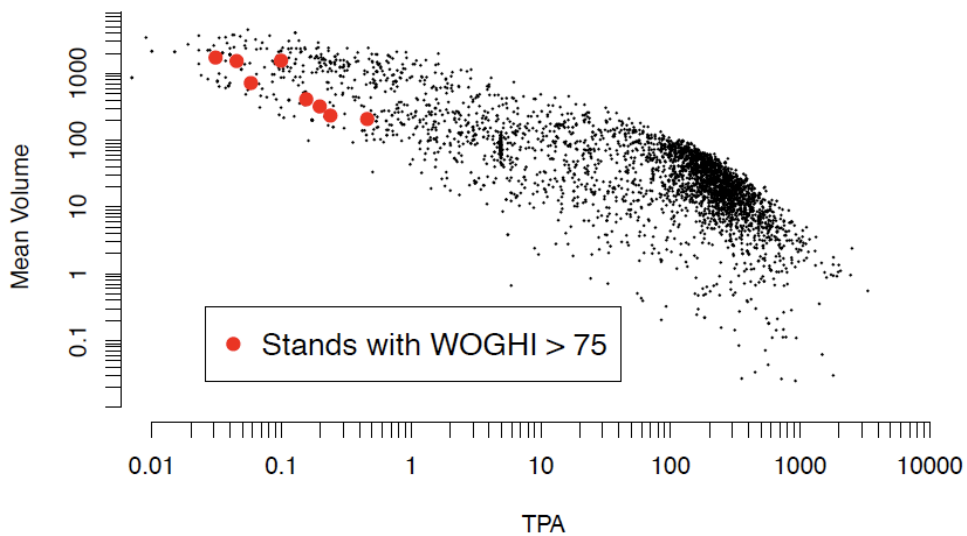


Figure 9. Stands with WOGHI scores near the threshold value of 100 indicating “old growth” (red dots) now appear clustered near the complex zone (Figure 7) on the DMD when the new CIV-based clustering algorithm is used to identify sun trees, indicating clearly their nearness to the “old growth” condition.

The CIV / DBH combination looks promising as a sun tree identification tool. We are now in the process of benchmarking the number of layers given by the new algorithm against human perception, which is necessarily taken to be the actual (or observed) number of layers. Beyond this, the feasibility of using this index for old growth management will need to be checked further by monitoring the location of stands placed on the DMD using this index over time. For example, the trajectories of the stands should not appear to be “jumpy” on the diagram.

Errors in Volume to Dry Weight, Carbon, and Energy Conversions: A case study of the UW Pack Forest Highway Thinning Project after 20 years

Forest inventories, yield tables, and growth and yield models have traditionally focused on estimating and predicting the volume of stem wood that is convertible into logs for products such as lumber and veneer. Wood volume of a stand alone is not adequate for addressing information needs with respect to carbon and energy. One problem is that wood contains about 49% carbon/dry lb and about 8300 btu/dry lb for hardwoods and 9000 btu/dry lb for conifers. Since these carbon and energy products are estimated from dry weight, there is a need to convert from stem wood volume to dry weight. In addition to stem wood, the bark, branches and tops, foliage, stump and roots all contain carbon and energy, so there is a further need to consider the dry weight of these components in a more complete, integrated management and utilization decision framework.

Conversion from wood volume to dry weight can be done by multiplying cubic volume of stem wood by wood specific gravity (SG), also known as relative or basic density, which expresses dry weight per unit green volume relative to the density of water (62.4 lb/cu.ft. or 1 g/cc). However, it is well known that SG varies with age, geographic region, and treatment history. Further, after conversion of stem wood to dry weight, some method must be used to account for the weight in the other tree components.

Conversion can also be done using biomass equations designed to estimate dry weight of stem wood as well as the other above and below ground components. Two methods have commonly been used, one due to Gholz and others, another due to Jenkins and others. Interestingly, the ratio of stem wood volume estimated by the Gholz method to the Jenkins method is always greater than one (1) for trees larger than 10 cm DBH, and approaches values as high as 1.30, representing an uncomfortable difference of up to 30% (Figure 10).

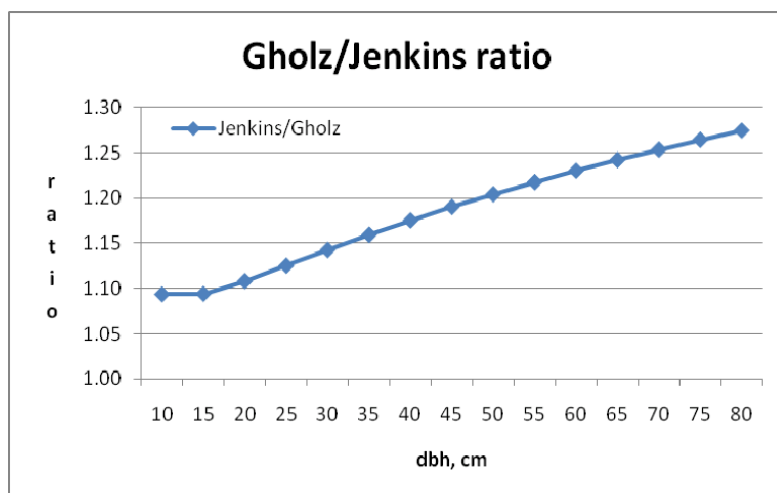


Figure 10. Stem wood biomass estimated using the Gholz method for a range of tree DBHs in ratio to the same quantity as estimated by the Jenkins method.

Since both of these methods estimate biomass solely from DBH, any silvicultural treatment or other factor that produces a DBH increase will be predicted to produce a positive effect on the incremental dry weight, a contradiction to many studies that show positive, negative or no effect of treatments and environmental factors on SG and hence dry weight. While errors of this magnitude may be acceptable for broad regional estimates of biomass, carbon, and energy content they may be considerably less so to management planners or investors.

The objective of this study was to compare the dry weight of Douglas-fir stem wood grown on the Highway Thinning Project site under alternative treatment regimes with estimates based on the Wood Handbook average SG and the Gholz et al. and Jenkins et al. biomass equations.

In brief, the project site is 15 acres and is located on the UW's Charles Lathrop Pack Experimental Forest near Eatonville, WA. It was stocked with Douglas-fir that naturally regenerated after a severe fire in 1922. At study establishment, the stand was about 55-yr old with about 800 trees / acre with about 75% of the trees under 7 in. DBH. During 1977, half the stand was commercially thinned from below, removing most trees under 7 in. DBH. Records indicate that 2500 cu.ft. / acre on average was removed. Stand density and cubic volume were reduced by 67% and 46%, respectively. Average DBH increased by about 2 in. due to the nature of the thinning. Six 1/5-acre plots were randomly located in each of the thinned and unthinned portions of the original stand, half the plots in each six plot set were treated with 42.2 tons/acre of dewatered sewage in winter of '77 – '78. Re-treatment of the plots with 21 tons / acre occurred in 1980 and 1989 and the thinned portion was thinned again in late 1995. Early in summer of 1998, four trees in each plot (48 total) were harvested using stratified random sampling based on plot quadratic mean DBH. The biosolids supplier, UW, and USFS conducted a collaborative lumber recovery study to examine the effects of treatments on subsequent log and lumber quality and value. Sample trees were bucked into 32-ft logs for harvesting and then into 16-ft logs for sawmilling. A cross section disk was removed from the top of the first 16-ft log of each tree for wood properties examination. Disks were taken to the Weyerhaeuser Technology Center (WTC) in Federal Way, WA, and a pith to bark sample was scanned on the WTC X-ray densitometry unit. For this analysis, the 20 years of growth occurring between 1978 and 1997 was used as the basis for estimating dry weight growth and associated carbon storage. (For more specific details, see the 2009 2nd Quarter SMC Quarterly Newsletter.)

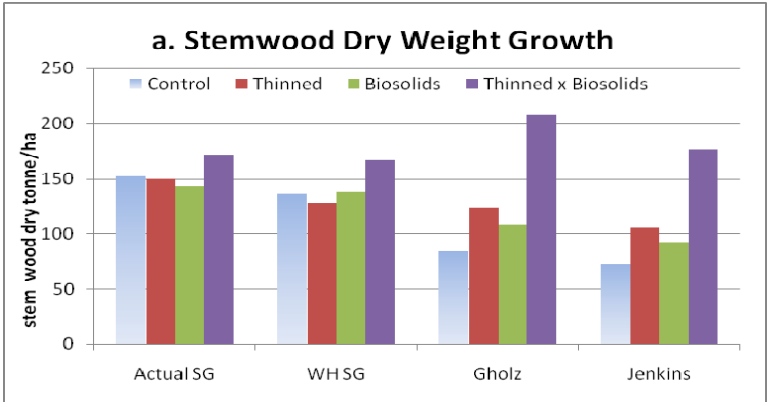


Figure 11. Actual stem wood biomass growth (dry tons) as compared to dry weight growth estimated using the Wood Handbook SG values, the Gholz et al. method, and the Jenkins et al. method.

Actual stem wood dry weight growth is summarized in Figure 11 (left-hand-most set of four bars), along with Wood Handbook, Gholz, and Jenkins estimated growth. Actual dry weight growth of the thinned plots was only 2% less than the control growth. Actual dry weight growth of biosolids alone dropped 6% below the control, and dry weight growth of the biosolids / thinning combination was 12% above the control. Conversion of dry weight growth to carbon at 49% C preserves these observed differences.

Since the SG of trees on this site started above the Wood Handbook value of 0.45, stem wood weights predicted using the Handbook average SG are between 86 to 97% of actual values (set of bars 2nd from left in Figure 11). Since a constant SG is used for all treatments, the % comparison between treatments is exactly the same as the volume comparisons, since these results come from the multiplicative product of volume and an assumed constant SG.

Stem wood dry weights estimated by the Gholz et al. method (set of bars 2nd from right in Figure 11) are 55%, 83%, 76%, and 122% of actual for the control, thinned only, biosolids only, and thinned / biosolids combination, respectively. These values are all higher than Jenkins et al. method (as noted in Figure 10, rightmost set of four bars), which are 48%, 71%, 76%, and 103%, for the same treatment ordering.

To highlight some of the errors relative to the control, on average the biomass equation methods estimate stem wood dry weight to be 47% *higher* in the thinning only treatment compared to the control when it is actually 2% *lower*. The biomass equation methods estimates are 29% *higher* in the biosolids only treatment when it is actually 6% *lower* than the control. Finally the biomass equation methods estimates are 148% higher in the thinned / biosolids combination compared to the control, when in reality the observed difference is only 12% higher than the control. Clearly, the errors associated with using the biomass equation methods are substantial and inconsistent across treatments.

This study illustrates how failing to account for SG changes can highly distort estimates of stem wood dry weight, and all things derived from it such as sequestered carbon and bioenergy. The underlying assumption of the DBH-based biomass equations is that larger trees are always older trees, a situation that can be altered by silvicultural treatment. Further, as noted in the Western Wood Density Survey of 1965 conducted by the USFS, SG of Douglas-fir has a geographic pattern and is influenced by soil and climate, as well.

Currently proposals authored by SMC staff scientists and collaborators are in review to develop improved models of SG for PNW species and to investigate use of non-destructive testing technologies to obtain local SG information without the time and expense of the methods used in this study. The widely ranging bio-geo-climatic conditions that the SMC installations span with their known treatment history presents a great resource for developing these models and testing new technologies.

Elk Browsing Patterns Survey in the Boxcar (604) GGTIV Installation

The Boxcar installation, owned by WA DNR and one of the six Genetic Gain / Type IV trials jointly run by NTIC and SMC, opportunistically became the subject of a retrospective study on elk browsing. Unlike the other five GGTIV installations, the fence at Boxcar was breached by wind thrown trees during the winter storms of 2006-2007 and then again during the winter of 2007-2008. During the summer of 2008 a site characterization was carried out that included assessing every living seedling for elk browse damage. A coding system was devised that accounted for whether or not the leader and/or laterals were browsed, and whether or not the damage was current year, previous year, or both.

The questions to be addressed were whether or not there was any evidence of genetic gain level affected browse severity, whether or not slash depth or presence of stumps affected browse severity, and finally whether or not family within gain level affected browse severity. With replication of each treatment on site, statistics can be calculated, however inference is constrained by the limitations of the study: narrow domain (one single site), which limits the range of applicability of results, lack of control over each plot receiving equal opportunity to be browsed by elk, and assessment being limited to live trees there simply being no way to identify situations where browse was the cause of death of a seedling.

There were no discernible associations between browse severity and genetic gain level. The most lightly browsed plot and the most severely browsed plot were both planted with elite gain stock.

The survey crew reported anecdotal evidence that the most lightly browsed or non-browsed seedlings were typically found in areas where slash was deep. However, no meaningful correlations were found between browse severity and plot average depth of slash, proportion of sample points with slash depth greater than 30 cm, or density and size of stumps on the plot. However, this does not necessarily refute the crew observations insofar as plot average values may not be indicative of any particular microenvironment surrounding a seedling. Slash distribution over the site may be a more important indicator of browse severity potential, than plot average depth values.

Counts in browse severity classes (collapsed into four categories: No damage, First year only, Second year only, and Both years) were cross-tabulated with family number and woods run categories. A chi-squared contingency table analysis was run with a statistically insignificant result. However, it is worthy to note that one high gain family (96049) had far more than expected incidences of browse in both years, while two other elite gain families (96049 and 96052) appeared to have been browsed just in the first year and avoided the second. This may suggest that some members of these families may have reacted somehow to become less palatable after being browsed once.

Based on this analysis and survey observations, browse damage appears to be mostly a function of easy access by elk. Unfortunately, this could not be rigorously tested because the site characterization survey evaluated slash conditions at pre-selected systematically located points, rather than at every seedling location. There is weak evidence that some families may respond in some way to being browsed that makes them less attractive to elk in subsequent years, but it would take a clipping and bioassay study to substantiate this conclusion.

NEW or initiated Publications / Theses / Reports in 2009

- Briggs, D.G., R. Kantavichai, E.C. Turnblom, R.B. Harrison. 2009. **Errors in converting volume to dry weight, carbon and energy – the 20 year UW Pack Forest Highway Thinning Project as a case study.** SMC Quarterly Newsletter, 19(2): 4 – 13.
- Collier, R.L. 2009. **Elk browsing patterns at installation 604 (Boxcar).** SMC Quarterly Newsletter 3rd Quarter, p. 5 – 9. Newsletter of the Stand Management Cooperative, School of Forest Resources, University of Washington, Box 352100, Seattle, WA 98195-2100.
- Harrison, R.B., T.A. Terry, C.W. Licata, B.L. Flaming, R. Meade, I.A. Guerrini, B.D. Strahm, D. Xue, A.B. Adams, M.R. Lolley, A. Sidell, G.L. Wagoner, D.G. Briggs, E.C. Turnblom. 2009. **Biomass and stand characteristics of a highly-productive mixed Douglas-fir and western hemlock plantation in coastal Washington.** W.J. Appl. For. 24(4): 180 – 186.
- Suntana, A., K. Vogt, E.C. Turnblom, and R. Upadhye. 2009. **Bio-methanol potential in Indonesia: Forest biomass as a source of bio-energy that reduces carbon emissions.** Applied Energy 86: 216 – 221.
- Turnblom, Eric, Keith Jayawickrama, and Terrance Ye. 2009. **NWTIC Genetic Gain / SMC Type IV trials: Age three (3) results.** SMC Quarterly Newsletter 1st Quarter, p. 3 – 6. Newsletter of the Stand Management Cooperative, School of Forest Resources, University of Washington, Box 352100, Seattle, WA 98195-2100.

WOOD QUALITY PROJECT PROGRESS REPORT

Project Leader: Eini Lowell, USFS PNW Research Station

TAC REPORT

The Wood Quality TAC did not hold an official meeting in calendar year 2009. A meeting was scheduled for February 2010. TAC members attended SMC Strategic Plan Meetings, other TAC meetings, and the December 2009 Silviculture TAC meeting provided input on retirement of installations and a new proposal.

Input to update Goals 1, 2, and 3 in the tables of objectives in the SMC Strategic Plan was gathered for presentation at the January 2010 Strategic Planning Meeting.

NEW PROJECTS

PROJECT TITLE: “Determining the effect of thinning, site quality and stand density on wood quality using non-destructive testing to develop predictive models”

PRINCIPAL INVESTIGATORS: Eini Lowell (USFS PNWRS), Ross Koppennaal, Al Mitchell, (BC Wood Fibre Center, David Briggs, (UW)

COLLABORATORS: Southern Forest Experiment Station, Stand Management Cooperative

FUNDING: USFS PNW Research Station, \$35,000 (field work, x-ray densitometry, NIR, salary); BC Ministry of Forest Wood Fibre Center (field work, analysis), UW NSF Center for Advanced Forest Systems, 20,000 (field work); UW Precision Forestry Cooperative, \$7,500 (Resistograph)

PROJECT DESCRIPTION: Information concerning the effect of intensive plantation silviculture and genetics on wood properties of PNW conifers is sparse and piecemeal precluding integration of wood quality with growth and yield models to improve understanding and predictions. Furthermore, traditional techniques to acquire data on wood properties are time consuming and expensive which has limited data collection for research purposes and essentially precluded routine collection of wood property data as part of forest inventory procedures. However, recent development of nondestructive testing (NDT) testing technology using acoustic, resistance, and NIR methods presents the opportunity to obtain indirect measures of stiffness (MOE), specific gravity (SG) and other properties from standing trees which would permit pre-harvest assessments of these quality parameters.

Four Levels of Growing Stock (LOGS) thinning trial sites were selected for the study. Each site has 3 replications of 8 thinning treatments plus an unthinned control. At each site, 15 trees are being sampled from each of the control, 70% basal area retention and 30% basal area retention thinning plots for a total of 135 trees per site and 540 total trees for the study. Acoustic velocity over a 1m distance at breast height will be taken at three locations around the circumference of each sample tree. A 20% (3-tree) subsample of trees on each plot will be drilled with a Resistograph and an increment core taken as close as possible to the resistance bore. X-ray densitometry and NIR analysis will be performed on cores by the USDA Forest Service Southern Research Station. The LOGS study was chosen in part because its long time frame spans and exceeds rotation lengths used by many landowners and provides a baseline for

comparisons with younger plantations being grown today. It also represents a significant longitudinal gradient with accompanying differences in climate. We expect to expand this study to younger intensively managed research sites of the Stand Management Cooperative (SMC) in the future.

OBJECTIVES: This project focuses on (1) to determine how acoustic velocity, a predictor of wood stiffness, is affected by tree, stand and site variables, (2) to develop a model to predict wood density, which is strongly linked to quality of traditional wood products and the carbon and energy content of wood, to resistance and assess effects of tree, stand and site variables, and (3) to build models using NIR to predict wood physical (density), mechanical (modulus of elasticity, modulus of rupture), and chemical content (e.g. cellulose and lignin).

PROGRESS: Study design, selection of sample trees and acoustic velocity measurements completed in 2009. Increment cores from 1 site collected and sent to Southern Research Station. Resistograph measurements and remaining cores will be collected in summer 2010.

CONTINUING PROJECTS

A. PROJECT TITLE: “Non-destructive evaluation of wood quality in standing Douglas-fir trees and logs”

PRINCIPAL INVESTIGATORS: David Briggs (UW), Eini Lowell (USFS PNWRS), Eric Turnblom (UW), Bruce Lippke (UW RTI), Peter Carter (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 PNWTIRC 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.

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: The data set has been finalized. Christine Todoroki is continuing to work with the photographed veneer sheets and property measurements.

PUBLICATIONS

- Briggs, D.G., E.C. Turnblom, B.B. Bare. 2005. **Non-destructive Methods and Process Capability Analysis to Assess Conformance of Douglas-fir Stands to Customer Quality Specifications.** New Zealand Journal of Forestry Science 35(2/3):170-188 pp.
- Cherry, M.L., Howe, G.T., Briggs, D., Cress, D., Vikram, V. 2007. **Genetic Variation in Wood Quality in a Clonal Douglas-fir Seed Orchard.** PNWETIRC Report 26. Pacific Northwest Tree Improvement Research Cooperative, Oregon State University, Corvallis, OR. 11 pp.
- Cherry, M.L., Vikram, V., Briggs, D., Cress, D., Howe, G.T. 2007. **Genetic Variation in Direct and Indirect Measures of Wood Stiffness in Coastal Douglas-fir.** PNWETIRC Report 27. Pacific Northwest Tree Improvement Research Cooperative, Oregon State University, Corvallis, OR. 30 pp.
- Briggs, D.G., G. Thienel, E.C. Turnblom, E. Lowell, D. Dykstra, R.J. Ross, X. Wang, and P. Carter. 2008. **Influence of Thinning on Acoustic Velocity of Douglas-fir Trees in Western Washington and Western Oregon.** In: Proc. of the 15th International Symposium on Nondestructive Testing of Wood, Sept. 10-12, Duluth, MN. Forest Products Society, Madison, WI. 113-123 pp.
- Cherry, M.L., Vikram, V., Briggs, D., Cress, D., and Howe, G.T. 2008. **Genetic Variation in Direct and Indirect Measures of Wood Stiffness in Coastal Douglas-fir.** Can. J. For. Res. 38: 2476-2486.
- Thienel, Gonzalo 2008. **"Nondestructive evaluation of wood stiffness in standing Douglas-fir trees in Western Washington and Western Oregon"** Masters Thesis, College of Forest Resources, University of Washington, Seattle, WA. 125 pp.
- Todoroki, C.L., E.C. Lowell, D.P. Dykstra. 2010. **Automated Knot Detection on Douglas-fir Veneer Images Computers** in Engineering and Agriculture. 70(1): 163-171 pp.

B. PROJECT TITLE: “Modeling Specific Gravity Patterns in Four SMC Type II Douglas-fir Installations as Affected by Treatment, Soil and Locale Climate”

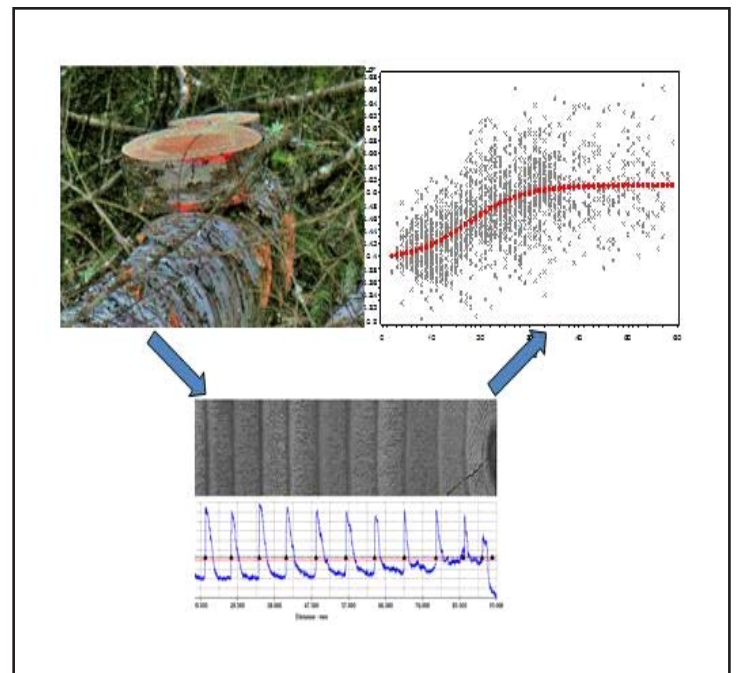
PRINCIPAL INVESTIGATORS: David Briggs, (UW), **Student** Rapeepan Kantavichai, (UW PhD), Eric Turnblom (UW)

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: Model the pith to bark relationships between ring biomass and SG from ring age, treatment, tree, stand, precipitation, temperature, and water balance variables.

PROGRESS: Annual biomass increments of each tree were reconstructed from the x-ray data at multiple points along the bole. Modeling of biomass increment as a function of ring number (age), tree, stand, treatment and climate variables is complete. Modeling the earlywood and latewood components of annual biomass increment as functions of ring number (age), tree, stand, treatment and climate variables is underway.



PUBLICATIONS

PhD dissertation expected in late 2010. Peer reviewed journal articles are being drafted.

C. PROJECT TITLE: “Agenda 2020 Management of PNW forest plantations: Additional site characterization and instrumentation for SMC/CIPS Paired-Tree Fertilization Projects”

PRINCIPAL INVESTIGATORS: Rob Harrison (UW), Doug Maguire (OSU), Eini Lowell (USFS PNWRS), Dave Briggs (UW), Doug Mainwaring (OSU), Eric Turnblom (UW), and **Student** Kim Littke (UW PhD).

FUNDING: Agenda 2020, \$75,000 (2008-2010), BLM (\$50,000)

COLLABORATORS: Currently Weyerhaeuser Company, Green Diamond Resource Company, Port Blakely Tree Farms, Lone Rock Timber, Plum Creek. Most SMC members are expected to install fertilization studies on their lands over the next several years and most are currently locating sites and stands for studies.

PROJECT DESCRIPTION: See Nutrition Project Progress Report 24 for full project update.

OBJECTIVES: Wood Quality TAC has plans to do NDT and other tests following year 6 of growth, the current longevity plan for the study.

COMPLETED PROJECTS

A. PROJECT TITLE: “Effect of Thinning and Fertilization on Diameter of the Largest BH Region Branch in Douglas-fir Plantation Trees”

PRINCIPAL INVESTIGATORS: David Briggs, (UW), Student Rapeean Kantavichai, (UW PhD), Eric Turnblom (UW)

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.

OBJECTIVES: Model the relationships between the tree and growing condition variables and DLLBH at (1) the plot mean (stand) level and (2) the individual tree level?

PROGRESS: Project completed.

PUBLICATIONS:

Briggs, D.G., R. Kantavichai, E.C. Turnblom. 2008. **Effect of Precommercial Thinning Followed by a Fertilization Regime on Branch Diameter in Coastal United States Douglas-fir Plantations.** Can. J. For. Res. 38:1564:1575.

Briggs, D.G., R. Kantavichai, E. C. Turnblom. (In review) **Predicting the Diameter of the Largest Breast-height Region Branch of Douglas-fir Trees in Thinned and Fertilized Plantations.** For. Prod. J.

B. 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, (UW), **Student** Rapeepan Kantavichai, (UW PhD), Eric Turnblom (UW)

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 and 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: Project completed.

PUBLICATIONS

Kantavichai, R.D. G. Briggs, E. C. Turnblom 2010. **Modeling Effects of Soil, Climate, and Silviculture on Growth Ring Specific Gravity of Douglas-fir on a Drought-prone Site in Western Washington Forest** Ecology & Management 259:1085-1092. doi: 10.1016/j.foreco.2009.12.017.

Kantavichai, R. D. G. Briggs, E. C. Turnblom 2010. **Effect of Thinning, Biosolids, and Weather on Annual Ring Specific Gravity and Carbon Accumulation of a 55-year-old Douglas-fir Stand in Western Washington.** Can. J. For. Res. 40(1):72-85.

Kantavichai, R. 2009. **Effects of Silviculture and Climate on Wood Specific Gravity of a 55 year-old Douglas-fir Stand in Western Washington.** Master's Thesis. School of Forest Resources, Univ. of Washington. 62p.

C. PROJECT TITLE: “Material Property Evaluation of Juvenile Wood Strands from Pacific Northwest Softwoods”

PRINCIPAL INVESTIGATORS: Vik Yadama (WSU), Eini Lowell (USFS-PNWST)

FUNDING: PNW Research Station

COLLABORATORS: Stand Management Cooperative

PROJECT DESCRIPTION: Wood from faster growing and small diameter trees could be more efficiently utilized for manufacturing wood composites or engineered wood composites (EWC). This project

investigates the physical and mechanical properties of the strands produced from juvenile wood from young-growth Douglas-fir and hemlock trees that were harvested from the buffer area of two SMC Installations in western Washington. The study would provide basic engineering data needed for understanding the mechanical behavior of wood-strand composites and for designing EWC.

OBJECTIVES:

1. Characterize juvenile and mature woods in sample trees of economically important softwood specie from the Western U.S. and investigate the variation in juvenile wood within the sample trees.
2. Examine the physical and mechanical properties of small clear specimens and wood strands from juvenile and mature woods for each of these species.

PROGRESS: Project completed.

PUBLICATION:

Langum, C.E., V. Yadama, and E.C. Lowell. 2009. **Physical and Mechanical Properties of Young-growth Douglas-fir and Western Hemlock from Western Washington.** For. Prod. J. 59(11/12):37-47.

MODELING PROJECT PROGRESS REPORT

Project Leader: Dave Marshall, Weyerhaeuser Company

SMC Modeling TAC Activates

- SMC prepared a red alder data base in cooperation with OSU Hardwood Silviculture Cooperative
 - FVS completed a new red alder model (PN variant)
 - OSU's hardwood cooperative is analyzing the red alder data (ORGANON)
- CONIFERS DLL release
- Submitted Agenda 2020 genetics modifier report (Peter Gould PNW Station, Olympia) to *Western Journal of Applied Forestry*.
- SMCTAC Collaborations
 - Wood Quality TAC: WQ modeling discussion
 - Silviculture TAC: growth model evaluations proposal planning

TECHNOLOGY TRANSFER

A. MEETINGS, WORKSHOPS & FIELD TOURS, AND CONFERENCES

1. Footen, P.W., Harrison, R.B., 2009. **Effects of N-Fertilization Carryover on Above and Below Ground Carbon and Nitrogen Storage in Douglas-fir Plantations in the Pacific Northwest.** University of Washington, College of Forest Resources, Graduate student Symposium; March 6, 2009.
2. Footen, P.W., Harrison, R. B., 2009. **Effects of N-Fertilization Carryover on Above and Below Ground Carbon and Nitrogen Storage in Douglas-fir Plantations in the Pacific Northwest.** Northwest Forest Soils Council Spring Meeting, March 9, 2009.
3. Ceder, Kevin R., 2009. **Vegetation Composition and Succession in Managed, Coastal Douglas-fir Ecosystems: Toward a Set of Compatible Prediction and Projection Models.** NCASI Western Wildlife Group Meeting. Stevenson, WA. April 15, 2009.
4. **SMC Policy Committee Meeting**, April 21, Seattle, WA. Webinar.
5. Ceder, Kevin R. **Comparative Silviculture Lab.** Guest lecture/lab session for ESRM 323. University of Washington College of Forest Resources, Spring 2009.
6. Footen, P.W. **Effects of Silvicultural Harvesting on Soils:** Guest lecture for ESRM 323 Silviculture. At the University of Washington College of Forest Resources, Spring 2009.
7. Kantavichai, R. 2009. **Timber and Bioenergy Planning with Effects of Silviculture Treatment.** 13th Symposium on System Analysis in Forest Resource, Charleston, SC, May 26, 2009.
8. Kantavichai, R. 2009. **Effect of Thinning, Biosolids, and Weather on Annual Ring Wood Density and Carbon Accumulation of a 55-Year Old Douglas-fir Stand in Western Washington.** 2009 Western Forest Mensurationists Meeting, Vancouver, WA. June 21, 2009.
9. **Northwest Forest Soils Council Summer Field Tour:** Soils and Forestry on the Northwestern Olympic Peninsula. Forks/Sappho, WA. Aug 26-28.
10. **SMC Policy Committee Meeting**, Sept 12-13, Little Creek Casino, Kamille, WA.
11. Footen, P.W., Harrison, R. B., Strahm, B. D., 2007. **Long-term Effects of N Fertilization on Productivity of Douglas-fir Forests in the Pacific Northwest.** Soil Science Society of America International Convention, Houston, TX Oct. 5-9, 2008.
12. Ceder, Kevin R. **Comparative Silviculture Lab.** Guest lecture/lab session for ESRM 323. University of Washington College of Forest Resources, Spring 2009.
13. Briggs, D.G. 2009. **Wood Qualities of a 40-Year Old Stand.** 2009 Fall Forestry Education Seminar – Understanding and Managing Tree Growth. Washington Farm Forestry Association and Washington Tree Farm Program. Chehalis, WA. Oct 31, 2009
14. **Nutrition Project SMC TAC Meeting**, Dec. 8, Olympia, WA.
15. **Silviculture Project SMC TAC Meeting**, Dec. 22, Olympia, WA.

B. PUBLICATIONS and REPORTS 2006-2008

SMC fact sheets, reports, proceedings, and journal articles produced over the last 4-years are listed in this section. A * preceding the first author indicates a peer-reviewed publication. Many can be obtained from the SMC website; for others contact the authors.

2006

Theses

1. Strahm, B.D. 2006. **Abiotic Retention Mechanisms of Organic and Macronutrient Anions in Variable-Charge Soils.** Ph.D. diss. Univ. of Washington, Seattle. <http://soilslab.cfr.washington.edu/publications/>.

Publications

1. Amoroso, M.M. and E.C. Turnblom. 2006. **Comparing Productivity of Pure and Mixed Douglas-fir and Western Hemlock Plantations in the Pacific Northwest.** Can. J. For. Res. 36(6):1484-1496 pp.
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3. Hann, D.W., D.D. Marshall, and M.L. Hanus. 2006. **Reanalysis of the SMC-ORGANON Equations for Diameter-Growth Rate, Height-Growth Rate, and Mortality Rate of Douglas-fir.** Oregon State University, Forest Research Laboratory, Corvallis, Oregon. Research Contribution 49. 24 pp. A copy can be obtained by emailing a request to ForestryCommunications@oregonstate.edu
4. Strahm, B.D., and R.B. Harrison. 2006. **Nitrate Sorption in a Variable-Charge Forest Soil of the Pacific Northwest.** Soil Science. 17:1:313-321 pp.
5. Vance, E.D., T.A. Terry, R.B. Harrison, C.A. Harrington, B.D. Strahm, and A. Ares. 2006. **The Fall River Long-term Soil Productivity Study: Linking Processes to Operations in Pacific Northwest Douglas-fir.** Western Forester. 51:12-15 pp.
6. Weiskettel, A., D. Maguire, R.A. Monserud, R. Rose, E. Turnblom. **Influence of intensive management on Douglas-fir stem form, branch characteristics, and simulated product recovery.** N. Z. J. For. Sci. 36(21): 170-188.

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1. Flint, Cindy 2007. **“Leaching of nitrogen from the rooting zone of Douglas-fir forests following urea fertilization and potential impacts on water quality of the Hood Canal.”** MS Thesis. College of Forest Resources, University of Washington, Seattle, WA. 68 pp. <http://soilslab.cfr.washington.edu/publications/>
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1. Ares, A., T.A. Terry, K.B., Piatek, R.B., Harrison, C.A., Harrington, R. Meade, R. Leon, R.E. Miller, B.L., Flaming, C.W. Licata, K. Petersen, B.D. Strahm, H.W., Anderson, L.C. Brodie, and J.M. Kraft. 2007. **Pre- and post-harvest stores of carbon and nitrogen in a highly-productive forest site subjected to increasing biomass removals in coastal Washington.** Weyerhaeuser Company Technical Note. 15 pp.
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3. Briggs, D.G. 2007. **Management Practices on Pacific Northwest West-side Industrial Forest Lands: 1991-2005 with Projections to 2010.** Working Paper # 6, Stand Management Cooperative, College of Forest Resources, University of Washington, Seattle, WA. 72 pp.
4. *Briggs, D.G., L. Ingaramo, E.C. Turnblom. **Number and Diameter of Breast-height Region Branches in a Douglas-fir Spacing Trial and Linkage to Log Quality.** Forest Products Journal. 57(9):28-34 pp.
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8. Footen, P.W., R. Harrison, B. Strahm. 2007. **Stand growth response of Douglas-fir to biosolids applications. Report to King County DNR.** College of Forest Resources, University of Washington, Seattle, WA. 61 pp.
9. Hann, D.W., D.D. Marshall, M.L. Hanus 2006. **Reanalysis of the SMC-ORGANON equations for diameter growth rate, height growth rate, and mortality rate of Douglas-fir.** Research Contribution 49. Forest Research Laboratory. Oregon State University, Corvallis, OR. 24 pp.

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 12. *Pittman, S. D., B. B. Bare, D. G. Briggs. 2007. **Hierarchical Production Planning in Forestry Using Price-Directed Decomposition**. Can. J. For. Res. 37:2010-2021 pp.
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 14. *Strahm, B.D., and R.B. Harrison. 2007. **Mineral and organic matter controls on the sorption of macronutrient anions in variable-charge soils**. Soil Science Society of America Journal. 71(6): 1926-1933 pp.
 15. Turnblom, E.C., Andrew Hill, 2007. **Using climate related information to improve short term growth projections**. Final report to USDA Forest Service PNW Research Station JV agreement PNW-02-JV-11261979-145. College of Forest Resources, University of Washington, Seattle, WA. 64 pp.

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2. Thienel, Gonzalo 2008. “**Nondestructive evaluation of wood stiffness in standing Douglas-fir trees in Western Washington and Western Oregon**” Masters Thesis, College of Forest Resources, University of Washington, Seattle, WA. 125 pp.

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1. *Briggs, D.G. R. Kantavichai, E.C. Turnblom. 2008 **Effect of precommercial thinning followed by a fertilization regime on branch diameter in coastal Douglas-fir plantations**. Can. J. For. Res. 38:1564-1575.
 2. *Sucre, E.B., R.B. Harrison, E.C. Turnblom, D.G. Briggs. 2008. **The use of various soil and site variables for estimating growth response of Douglas-fir to multiple applications of urea and determining potential long-term effects on soil properties**. Can. J. For. Res. 38:1458-1469.
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2009

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1. Kantavichai, R. 2009. **Effects of Silviculture and Climate on Wood Specific Gravity of a 55 year-old Douglas-fir Stand in Western Washington**. Master's Thesis. School of Forest Resources, Univ. of Washington. 62p.
2. Shyroch, B. 2009. **The effects of urea fertilization on carbon sequestration in Douglas fir plantations of the coastal Pacific Northwest**. Master's Thesis. School of Forest Resources, Univ. of Washington. 46p.

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1. Briggs, D. 2009. **Research Cooperatives Serve the Forestry Community**. Western Forester. 54(4):1-4
 2. Briggs, D. 2009. **PFC Brings High Tech Tools to Forestry Sector**. Western Forester. 54(4):10.
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1. Kantavichai, R. D. G. Briggs, E. C. Turnblom **“Effect of Thinning, Biosolids, and Weather on Annual Ring Specific Gravity and Carbon Accumulation of a 55 Year-old Douglas-fir Stand in Western Washington”** *Can. J. For. Res.*
2. Briggs, D.G. **Enhancing Forest Value Productivity Through Fiber Quality**, *Journal of Forestry*
3. Kantavichai, R. D. G. Briggs, E. C. Turnblom **“Modeling effects of soil, climate, and silviculture on growth ring specific gravity of Douglas-fir on a drought-prone site in Western Washington”** *Forest Ecology & Management*.

In review

1. Hill, Andrew, E.C. Turnblom. **Improving modeled predictions of short-term Douglas-fir growth in eastern Washington, USA by incorporating local weather information.** *Forest Science*.
2. Hill, Andrew, E.C. Turnblom. **Using local short-term weather and long-term climate information to improve periodic diameter growth prediction for Douglas-fir growing in pure and mixed stands in eastern Washington USA** *Canadian Journal of Forest Research*.
3. Langum, C.E., V. Yadama, and E.C. Lowell. **Physical and Mechanical properties of young-growth Douglas-fir and western hemlock from western Washington.** *For. Prod. J.*
4. Briggs, D.G., R. Kantavichai, E. C. Turnblom. **Predicting the Diameter of the Largest Breast-height Region Branch of Douglas-fir Trees in Thinned and Fertilized Plantations.** *For. Prod. J.*

SOFTWARE

1. Sidell, A., R.B. Harrison. 2000. **Productivity Management “Toolbox”** http://depts.washington.edu/nitrogen/http://www.cfr.washington.edu/research.smc/treelab/Website/TreeLab_home.htm.
2. Gehringer, K., E.C. Turnblom. 2001. **Tree List Generator Software & Manual:** <http://depts.washington.edu/silvproj/tlghome> [download requires password available from Silviculture Project Leader Eric C. Turnblom]. 2006. **Young Tree List Generation Database System**, available in CD, beta test version, contact Randy Collier for a copy at 206-543-5355.
3. Pittman, S., E.C. Turnblom. 2001. **Treelab Software & Manual** <http://www.cfr.washington.edu/>

research.smc/treelab/Website/TreeLab_home.htm.

4. Haukaas, J. 2008. **Tree List Generator: Graphical User Interface.**
<http://depts.washington.edu/silvproj/tlghome/>
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 4.0I** is available from the USFS web site
http://www.fs.fed.us/psw/programs/ecology_of_western_forests/projects/conifers/

CD's
(Contact the SMC for copies 206-543-5355)

1. 2004 RFNRP Publications
2. Alder Symposium "Red Alder: A State of Knowledge" streaming video
3. SMC 20th Anniversary streaming video

BY-LAWS OF THE STAND MANAGEMENT COOPERATIVE

First Adopted: April 22, 2003

Most recent amendment: Sept. 18, 2007

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
 - e. 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.

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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
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- 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. Enaction 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.
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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. Policy Committee. 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 own 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.
6. Requests for data by Institutional Members are made only through the Institution's representative on the Policy Committee. This same representative is responsible for making sure that all users within the Institution: (1) are aware of the proprietary nature of the SMC Database; (2) obtain the data directly from the Institutional representative; (3) do not pass any part of the database to any other party within or outside of the Institution; and (4) secure written permission from the SMC Director to proceed with any analyses. Requests for permission include specific objectives, data required, analysis approach, and intended authors of all planned reports and manuscripts.

II. Publications, Software, Models and Other Works

7. 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.
 8. 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.
 9. 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.
 10. 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).
 11. SMC members and non-members wishing to use or distribute copyrighted materials must obtain appropriate permissions from the copyright owner(s).
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12. 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.
 13. 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

**Stand Management Cooperative, Spring Meeting, April 21, 2009
University of Washington, Seattle, WA**

ATTENDEES

Consultant **Mel Scott**; BC Ministry of Forests, Research Branch, **Louise de Montigny**; The Campbell Group, **Dave Rumker**; Consultant, **Jim Flewelling**; Green Crow, **Harry Bell**; Green Diamond Resource Co., **Randall Greggs, Steve Loy**; Hancock Forest Management, **Dean Stuck**; Hampton Affiliates, **Denis Creel**; Olympic Resource Management, **Scott Holmen**; Oregon State University, **Doug Maguire**; Plum Creek Timber Co., **Conner Fristoe**; Port Blakely Tree Farms LP, **Jeff Madsen**; Rayonier Forest Resources, **Candace Cahill**; University of Washington, **Dave Birggs, Randy Collier, Rob Harrison, John Haukaas, Megan O'Shea, Kim Littke, Carol Shilling, Eric Turnblom**; Washington DNR, **Scott McLeod**; West Fork Timber Co., **Gene McCaul**; Weyerhaeuser NR Co., **Greg Johnson, Dave Marshall, Scott Holub**.

The meeting began at 9:00 with the agenda in Appendix A with 27 participants representing 17 organizations. Policy Committee Chair Louise de Montigny opened the meeting, welcomed the attendees and commented on three new BC reports with outlooks that are very positive for the long-term future of the forest sector. These reports listed below can be found at <http://www.for.gov.bc.ca/mof/reports.htm>

- ✓ *Growing Opportunities: A New Vision for Silviculture in British Columbia*
- ✓ *Generating More Value From Our Forests*
- ✓ *THE WORKING ROUND TABLE ON FORESTRY - Moving Toward a High Value, Globally Competitive, Sustainable Forest Industry*

ACCOMPLISHMENTS

Dave Briggs reviewed accomplishments to date. A few highlights

- Cumulative funding since the SMC began in 1985 has reached \$19.6 million.
- The 08/09 field program was completed on time and the database update will be issued in June.
- We now have 34 Type V paired tree fertilization installations established, fertilized and instrumented for monitoring local environmental conditions and are also instrumenting the six GGTIV installations.
- Due to the Corkery Family Chair we will have a student field crew in summer 2009.
- 1 publication in print, 3 in press, and 7 in review.

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- 6 PhD and 3 MS students in residence, all supported by grant, Corkery Family Chair, Gessel Scholarship, and TA funds. Total student support from these latter three sources will be on the order of \$138k in 2009.
 - The UW NSF Center for Advanced Forest Systems proposal for \$70K/year for 5 years was accepted and we anticipate \$40k from NCASI for continuing work on the Fall River, Matlock, and Mollalla LTSP studies. We also have 2 proposals, leveraging the SMC installations for biomass (carbon, energy) research, in review; these total about \$3.3 million.

NOMINATING COMMITTEE

Louise de Montigny's term as Chair of the Policy committee ends after the Fall Meeting and Dave Rumker, current Vice-Chair will become Chair. This will require nomination of individuals for the Vice-Chair position. The Nominating Committee, composed of the outgoing and past Chairs, will develop nominations for the Fall Meeting.

Fall Meeting: We have reserved September 23 at the Little Creek Casino in Kamilche, WA. for the Fall meeting. This was done to coordinate with a workshop on the 22nd sponsored by the Northwest Forest Soils Council and Western Forestry & Conservation Association. We chose this approach to allow those who would attend both to minimize travel costs. There was discussion concerning the lack of a field trip which we traditionally have held as part of the Fall Meeting and whether the Kamilche location would be the best venue to do this. We could either add a field trip from Kamilche on the 24th or consider a different date and location. Members were asked to provide input regarding their preferences and ideas for location and field trip alternatives. We set June 1st as a deadline to finalize the Fall Meeting so we can ensure location reservations and post information in the June Newsletter.

BUDGET

David Briggs reviewed the ending budget for 2008, projection for 2009, and scenarios for 2010,

2008: 2008 ended with a \$23,353 surplus of to carry into 2009.

2009: Net income for 2009 dropped from 616,866 in 2009 to 587,798. The decrease results from the loss (\$8189) of Forest Systems, Inc., which sold its lands, credits (\$15,207) to landowners for costs incurred during 2008 for GGTIV installation maintenance, and a drop in special contracts of about \$4500. When combined with the balance from 2008, operational funding for 2009 is \$611,151. Without any opportunities to use grants to pay for salaries and expenses, the 2009 budget would have a projected deficit of about \$53,000. However, with buyouts from grants, primarily CAFS, the deficit is projected to be about \$16,000. Other opportunities to reduce this may occur as the year progresses and investigating steps to reduce expenses in anticipation of serious budget issues in 2010 due to the current economic situation.

2010: 10, 20, 30, and 40% deficit scenarios were presented under the assumptions that there would be no grant funds to cover some expenses and that the entering balance from 2009 would be zero. While some opportunities to cut line-items of the budget exist, many have already been taken and those that are realistic to take do not add up to sufficient amounts to overcome projected deficits. Consequently, the main approach envisioned in the scenarios was to reduce the operating year in increments up to 3 months. These would be implemented by reducing staff employment levels from a full time equivalent (1.0fte) to a lesser level by some fraction and by reducing faculty summer salaries. When salaries are reduced, benefits and indirect costs reduce simultaneously and most costs of operation during the shut-down period would cease. Discussion led to a recommendation to look at 50% and 60% deficit scenarios and a Finance Com-

mittee (D. Briggs, M. O'Shea, C. Fristoe, R. Greggs, G. Johnson, J. Madsen, G. McCaul, Scott McLeod, D. Stuck) was formed to further develop and refine likely scenarios for 2010 and to look at years beyond 2010.

TAC Project Leader Reports: Reports for the Nutrition Project (Rob Harrison), Silviculture Project (Eric Turnblom), Modeling Project (Dave Marshall), and Wood Quality Project (Dave Briggs for Eini Lowell) can be found in Powerpoints on the SMC website (www.standmgt.org) and many of the progress items are listed among the Accomplishments in Appendix B.

Center For Advanced Forest Systems (CAFS): David Briggs reported on the success of the UW proposal to join CAFS. Since the approval was not in time for UW to participate in the February 2009 CAFS meeting, we were asked to develop our own allocations among the proposed projects that were included within the UW proposal to join CAFS. The projects chosen are:

1. Understanding site specific factors affecting the nutrient demands and response to fertilization by Douglas-fir. (\$20K allocated in 2009 to set up paired tree installations and purchase and deploy environmental sensors).
2. Remote sensing for measuring and monitoring the response of plantations to intensive management (\$20k allocated in 2009 for RA to field test terrestrial Lidar; \$7600 supplement from NSF for undergraduate research).
3. Modeling the effects of intensive plantation silviculture on wood density, stiffness, knots and other properties (\$18k allocated in 2009 for assessing wood density and stiffness of trees with nondestructive methods).

NEW RESEARCH OPPORTUNITIES & PROPOSALS

D. Briggs briefly reviewed pending proposals that are related to issues associated with estimating forest carbon and energy. Since the carbon and energy content of wood are based on dry weight, and since all of the tree biomass contains carbon and energy, one must either (1) convert a stem volume estimate (growth model, yield table, etc.) using the wood specific gravity (density) and then scale up to account for the rest of the tree biomass or (2) or apply existing biomass equations. When compared to actual data, these approaches fail to account for effects of age, silvicultural treatments, and growing environment and produce large errors. These proposals would use the SMC installations as a basis for developing and testing, improved methods for estimating wood density and biomass. The larger proposal would cover multiple species on the west side and east side over their geographic range but would start with the SMC installations. The second more specifically focuses on examining possible use of non-destructive testing methods to collect wood density information in the field with less expense and turnaround time than using traditional increment cores or cross-section disks.

Biomass Research & Development Initiative DE-PS36-09GO99016. Federal funds requested: \$3,250,000(USDA). Objectives

1. Determine what level of growth and biomass removal is sustainable for bio-fuel production from the dry ponderosa pine dominated forests of eastern Washington, intensively managed industrial plantations in western Washington, and intensively managed short-rotation bio-fuel plantations in western Washington, without depleting soil nutrient reserves.
2. Determine what level of growth and biomass removal is feasible given the spatial configu-

ration of resource sites, transportation networks, land ownership pattern, and the potential locations of processing plants.

3. Examine the regional and local variability in tree species biomass productivity relative to soil types and climate change.

Development of Integrated Assessment Models for Optimal Woody Biomass Utilization. USFS \$150k (\$40K UW). Objective

1. Develop economic assessment models that incorporate wood quality, carbon and bioenergy values and end markets for use with acoustic-based nondestructive assessment technologies;
2. Identify implementation strategies and guidelines for use with standing trees, stems and logs for regional application across the varied forest cover types in the U.S.
3. Develop a **nondestructive approach** to accurately determine wood density for individual species within a localized forest stand. Examples are to compare acoustic, resistograph and other NDT measures vs x-ray densitometry from increment cores.

The meeting adjourned at 12:30.

APPENDIX A.

STAND MANAGEMENT COOPERATIVE SPRING MEETING UW College of Forest Resources, 22 Anderson Hall April 21, 2009

AGENDA	
8:00-8:45	GoToWebinar Sign in
8:30	Coffee & Rols
9:00	Welcome Louise de Montigny Policy Committee Chair Introductions: David Briggs, Director ✓ Accomplishments & Plans for 2009 ✓ Nominating Committee → next SMC Vice-Chair ✓ SMC Fall Meeting → Sept 22-23 ✓ Other Announcements
9:30	Budget 2008/2009 Review & 2010 Budget Fore cast - David Briggs
10:00	Nutrition TAC Report – Rob Harrison, Nutrition Project Leader
10:20	Silviculture TAC Report - Eric Turnblom, Silviculture Project Leader ✓ 2008/2009 Field Season, Database Update
10:40	Wood Quality TAC Report - Eini Lowell, Wood Quality Project Leader
11:00	Modeling TAC Report: - David Marshall, Modeling Project Leader
11:20	UW NSF Center for Advanced Forest Systems Site: Status, 2009 Projects - David Briggs, Site Director
11:40	Forest Carbon/Bioenergy Research: Role & opportunities for of SMC - David Briggs USDA Bio-energy proposal, upcoming opportunities
12:00	Adjourn

STAND MANAGEMENT COOPERATIVE FALL MEETING Kamilche, WA. September 23-24, 2009,

ATTENDEES

Bureau of Land Management, Jeannette Griese; **Campbell Group**, Dave Hamlin, Dave Rumker; **Forest Capital Partners**, Scott Ketchum; **Green Crow**, Harry Bell; **Green Diamond Resource Company**, Randall Greggs, Steve Loy; **Hancock Forest Management**, Dean Stuck; **Lone Rock Timber Co.**, Brian Nelson; **Olympic Resource Management**, Scott Holmen; **Oregon Department of Forestry**, Tod Haren; **Oregon State University**, Doug Maguire, Doug Mainwaring; **Plum Creek Timber Co.**, Steve Wickham, Steve Gavelle; **Port Blakely Tree Farms LP**, Jeff Madsen, Mike Warjone; **Quinault Indian Nation**, Jim Plampin; **Rayonier Forest Resources**, Candace Cahill; **Roseburg Forest Products**, Sean Garber; **Consultant**, Mel Scott; **Stimson Lumber Co**, Margaret Banks, Roger VanDyke; **TimberWest-Coast Timberlands**, Tim Crowder; **University of Washington**, Dave Briggs, Keven Ceder, Bob Gonyea, Rob Harrison, Bert Hasselberg, Rapeepan Kantavichai, Kim Littke, Megan O'Shea, Eric Turnblom, Rob Harrison, Guang Zheng; **USFS PNW RS**, Eini Lowell; **WA DNR**, Scott McLeod; **West Fork Timber CO**, Gene McCaul; **Weyerhaeuser Company**, Scott Holub, Greg Johnson, Dave Marshall.

The meeting held at the Little Creek Casino Resort, Kamilche, WA, began at 8:30 with the agenda in Appendix A; there were 41 attendees from 23 organizations. Policy Committee Chair Louise de Montigny was not able to attend so Vice-Chair Dave Rumker opened the meeting and welcomed the attendees. He noted that the budget discussion would be a key item of the meeting given the difficult economic times and stressed the need to balance current budgetary issues of members with the very successful long-term program of the SMC. It will be important to keep the ongoing field research/database on track and not lose critical highly skilled staff.

ACCOMPLISHMENTS

Dave Briggs reviewed accomplishments to date. A few highlights

- Membership: Forest Systems has sold its lands and is no longer a member but Stimson Lumber Co., Forest Grove, OR became a member.
- The database update with 08/09 field data was delivered to members in mid-summer.
- 56 Type V paired tree fertilization installations have been established of which 53 have soil pits and environmental sensors; funding is from AGENDA 2020 and CAFS. Additional installations are being sought to fill gaps in coverage.
- GGTIV installations: The summer field crew completed site characterization of the three installations planted in 2005 so we have tree and competing vegetation data after the 2nd and 4th growing seasons for this group. All GGTIV installations now have the same environmental sensors that are being placed in the Type V installations.
- In addition to work on the GGTIV and Type V installations the summer field crew (Paul Footen, Kim Littke, Ryan Reith, Carol Shilling, and Gonzalo Thienel) completed vegetation/habitat assessments on 3 installations (21 plots), soil sampling (3 installations), and pitch moth surveys (11 plots).
- One graduate student completed and 9 graduate students in residence; all funded by external grants and UW Gessel Scholarships, the Corkery Family Chair, and teaching assistantships.

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- 4 articles in print, 2 accepted, 10 in review
 - NSF Center for Advanced Forest Systems. The UW proposal to join was accepted (\$70,000 per year for 5 years) and work is underway on three projects (1) additional support for environmental monitoring of the TypeV installations, (2) support of basic research on use of terrestrial LiDAR to measure tree and crown characteristics and response to treatments, and (3) development of non-destructive techniques to measure and model wood specific gravity to estimate dry weight, carbon, and energy content of standing trees. An application for a \$7600 supplement for undergraduate research was also successful.
 - BC Ministry of Forestry obtained a \$70k grant to support measurement of SMC installations in BC.
 - NCASI will provide \$30-40K to support continued work at Fall River, Matlock, and Molalla.

ANNOUNCEMENTS

NSF Center for Advanced Forest Systems meeting will be on April 27-29, 2010. We decided to hold the SMC Spring Meeting about 2 weeks prior to this date to review our projects and priorities in preparation for this meeting.

The Fall 2010 meeting was briefly discussed with tentative plans to hold in at Oregon State University in mid-September.

SMC 25th Anniversary. 2010 will mark the 25th year since the SMC began. The Strategic Planning Committee will begin to develop plans to commemorate this event.

Director David Briggs announced that he plans to retire in 2013 and that the SMC should begin to discuss plans for a replacement.

NOMINATING COMMITTEE REPORT

The Fall 2009 meeting marked the end of Louise de Montigny's term as Chair of the Policy Committee and Dave Rumker, the current Vice-Chair will take over as Chair. At the Spring Meeting the Nominating Committee, composed of current and past Policy Committee Chairs, was asked to recommend nominees to become the next Vice Chair at this meeting. The committee report nominated Jeff Madsen. After asking for other nominations from the floor and receiving none, Margaret Banks moved (Candace Cahill seconded) that Jeff Madsen be elected next Vice Chair of the Policy Committee. The motion was approved unanimously.

BUDGET

David Briggs reviewed the status of the 2008 budget and projections for 2010 developed in consultation with the Finance Committee. Without any payments of expenses from grants, the budget would have had a deficit of \$23,909. This is mainly due to inflation coupled with only two dues increases, 5% in 1997 and 5% in 2006. Placement of Director and Nutrition and Silviculture Project Leaders on the SMC budget starting with 1997 enabled them to focus on obtaining grants that have offset inflation and the need for dues increases. It should be noted that both dues increases were associated with creating additional funds to support modeling development. However, with inflation pushing the deficit to higher levels and the economic crisis causing some members to announce that they would not be able to pay full dues in 2010, a finance committee was created and developed the following actions:

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1. We would not ask for a dues increase.
 2. We laid off one of our two database management staff.
 3. Summer salary for the Director was cut from 1.5 to 0.5 months and summer salaries for the Nutrition and Silviculture Project Leaders were cut from 2.5 to 2.0 months.
 4. Salaries for the remaining staff were reduced by 7.7%.
 5. We curtailed all other expenditures as much as possible.

These actions were implemented in July; actions 3 and 4 effectively meant a 2-week shut down for all personnel during the last half of 2009. The net effect of these changes and payment of some expenses from the CAFS grant changed the ending balance from the \$23,909 deficit to a projected surplus of nearly \$80,000. The intent was to create as large a balance as possible to buffer economic uncertainties affecting 2010 and 2011.

Using the 2009 projection the Finance Committee examined six scenarios for 2010 and their implications for 2011. After review of these and the following motion was crafted

It is moved that

1. *The SMC invoice those who have indicated mandated dues cuts at their resultant dues amounts for 2010.*
2. *The SMC invoice all others at 80% of their full 2010 dues (a 20% cut).*
3. *That the SMC 2010 budget be managed to produce an ending balance of \$20,000.*
4. *That the Strategic Planning Committee examine concerns regarding restitution for unpaid dues and make recommendations for inclusion in the SMC By Laws.*
5. *That this vote is just for 2010 dues and budget management. The Finance Committee will assess the situation for 2011 as 2010 unfolds and develop a recommendation for the 2011 budget for vote at the Fall 2010 meeting.*

Randall Greggs moved that the SMC accept the motion (Sean Garber seconded) and it was accepted by a vote of 10 in favor and 7 opposed. It should be noted that the committee expressed strong concern that the budget be managed to have as little impact on the long-term program and highly skilled staff as possible.

STRATEGIC PLAN

The following projects were identified under the current strategic plan

1. A model validation study: a joint effort of the Modeling and Silviculture TAC's
2. An analysis of performance of the Type I, II, and III installations in a "LOGS" style report: Silviculture TAC
3. Development of criteria for "retirement" of SMC installations: Silviculture TAC as lead
4. Create the paired-tree fertilization trials: Nutrition, Silviculture, and Wood Quality TAC's
5. Progress on these was presented during the Project Leader reports.

The UW proposal to join the NSF I/UCRC Center for Advanced Forest Systems (CAFS) program was approved in February. As long as UW receives more than \$300k in a year from its industry supporters, it will receive \$70k in that year. To date UW has received \$70k for 2009 and \$70k for 2010. We are presently allocating CAFS funds to the following three projects:

Understanding site specific factors affecting the nutrient demands and response to fertilization by Douglas-fir. (\$20k allocated in 2009 to set up paired tree installations and purchase and deploy environmental sensors).

Remote sensing for measuring and monitoring the response of plantations to intensive management (\$20k allocated in 2009 for RA to field test terrestrial Lidar; \$7600 supplement from NSF for undergraduate research)

Modeling the effects of intensive plantation silviculture on wood density, stiffness, knots and other properties (\$18k allocated in 2009 for assessing wood density and stiffness of trees with nondestructive methods)

These projects were reviewed in more detail during other portions of the program.

MODELING PROJECT REPORT: DAVE MARSHALL

- A. FVS <http://www.fs.fed.us/fmssc/> Latest Release: September 2009 (PN variant)
- What's New
 - Economics Extension (Fred Martin, WA DNR)
 - carbon accounting tools
 - genetic modifier paper accepted to *Western J of Applied Forestry* (Peter Gould)
 - Current Work
 - FVS CLIMATE (version 0.1) is available for testing (contact Erin Smith-Mateja: eesmith@fs.fed.us)
- B. ORGANON <http://www.cof.orst.edu/cof/fr/research/organon/> Latest Release: Sept. 19, 2009 (Edition 8.4)
- Console and DLL (with revised call statements) versions
 - Genetic modifiers (Gould et al. 2009)
 - Swiss needle case modifiers (Maguire et al.)
 - New western hemlock diameter growth (SMC)
- C. Red Alder Plantation Modeling
- SMC built the data base
 - Hardwood Silviculture Coop (OSU)
 - FVS analysis 2008 (Erin Smith-Mateja: eesmith@fs.fed.us)
 - Top height/site index model published (FE&M)
- D. ORGANON version status
- ✓ Equations Completed: Height/diameter, maximum crown width of open grown trees, largest crown width of stand grown trees, crown profile, height to crown base, diameter growth rate, height growth rate, crown recession rate
 - ✓ Equations to be completed: Maximum size-density trajectory, mortality rate, thinning modifiers

E. CONIFERS http://www.fs.fed.us/psw/programs/ecology_of_western_forests/projects/conifers/

Latest Release: January 2009

- Current Work
 - ✓ Resolving Windows Vista conflicts; contact Martin if you have problems (mritchie@fs.fed.us)
 - ✓ Nick Vaughn submitted SMC analysis to *Forest Science* (in review)
 - ✓ Discussing possible modifications with Doug Maguire from analysis of VMRC data (CIPS)

F. CURRENT Modeling Project Priorities

- Priority 1
 - ✓ Genetic modifiers in ORGANON (completed)
 - ✓ Completion of red alder analysis (progressing)
 - ✓ Collaborate with CIPS on process model proposal (ongoing)
 - ✓ Growth model evaluation (Eric)
- Priority 2
 - ✓ Work with wood quality TAC on wood quality modeling (?)
 - ✓ Update thinning and fertilization analysis (2010?)
- Priority 3-funding opportunities (ongoing)
 - ✓ Biofuel and biomass modeling
 - ✓ Climate and weather modeling

NUTRITION PROJECT REPORT: ROB HARRISON

A. Carryover Study

- Paul Footen (M.S. student) found small but statistically significant differences in mean DBH and height after about the 5th year since planting and also understory differences.
- Paul is completing understory/site characterization work, manuscript accepted for North American Forest Soils conference.
- Funding now primarily from TA/Gessel, sample analysis/travel paid from SMC.

B. Fall River/Matlock/Molalla LTSPs

- Funding new \$40K 2008-2009 \$555K total, initial new NCASI funding for 2009-2010 \$30-40K, \$585-595K total.
- Brian Strahm (Ph.D.) now professor at Virginia Tech, wrote 2 pubs, SSSAJ and FEM pubs this year, North American Forest Soils Conf.
- New Ph.D. student Carol Shilling, TA/Gessel support, nearing completion of 5-year aboveground biomass and some root work at Matlock and Molalla LTSPs.

C. Effects of urea fertilization on carbon sequestration in Douglas-fir plantations of the Pacific Northwest: Ben Shyroch is completing a Masters using Type I installations; presented during the afternoon session.

D. Paired Tree: presently have 56; Kim Little presented status in the afternoon session.

E. Future

- Paul Footen returning for PhD, tentatively LTSP
- New student Joy Liu from Taiwan
- Funding
 - ✓ current \$25K/yr Agenda 2020 for 3 years
 - ✓ \$40K/yr NCASI (2008-9), \$30K/yr (2009-10) continuing
 - ✓ Approx.\$100K/y equiv.TA/Gessel fellowships

SILVICULTURE PROJECT REPORT: ERIC TURNBLOM

A. GGTIV Installations

- Maintenance: Fences repaired as required, plot corners re-remounted as needed, complete vegetation control, 80% bare ground specification, included spraying relevant plots at all six installations (used atrazine and transline) and monitored germinants through June.
- Measurement: the 2005 plantations received full measurements, summer vegetation surveys and habitat characterization (duff depth, vertical porosity, etc.)

B. Type III Mixed Species installations

- Pure and 50-50 mixtures of DF and WH in alternating rows; two replicates
- Substitutive (replacement series) experiment (opposed to additive)
- Planted with best quality seedlings available at the time (2-1 DF; 1-1 WH)
- Mariano Amoroso analyzed the age 12 data for his MS thesis, now have age 18 data analyses underway.

C. Reviewed plan for 2009/10 field season measurements

D. Strategic Plan Projects

I. Model Validation

- Collaboration: Co-PIs are Greg Johnson, Dave Hamlin, David Marshall
 - Recent observations (Johnson) have shown models to exhibit differing effects of thinning, fertilization
 - Attempts to refine, restructure, hybridize empirical models would be well informed by identification of any knowledge gaps that may be causing differences in modeling treatment effects
 - Three phases
 - ✓ Identify criteria and indicators for sources of high quality data in concert with meta-analysis of available literature; Begin Identifying existing models for validation
 - ✓ Use criteria and indicators from 1) to search for data sets and obtain necessary agreements for data sharing; finalize list of models to validate; Develop standard set of model runs
 - ✓ Perform model runs from 2)-analyze results
 - Deliverable: Technical report delivered to model developers, data sharing agencies, SMC cooperators, collaborators
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- Financial support for one (1) GSA for 2.25 yr, computer & software, supplies and materials not to exceed \$34,200.
2. LOGS style performance summaries of Type I, II, and III installations
 - Growth & Yield analysis of standard variable set: DBH, Height, tree volume, stand volume, survival (TPA), size distributions
 - Technical report delivered to SMC cooperators, collaborators
 - Financial support for one (1) GSA for 1.5 yr, computer & software, supplies and materials not to exceed \$24,000.
 3. Criteria for retiring installations: Ideas that have been proposed were reviewed and will be discussed at a TAC meeting later this fall.

E. Other projects

1. Vegetation Composition and Succession in Managed, Coastal Douglas-fir Ecosystems
 - Sponsored by NCASI, Kevin Ceder is working on this for his PhD
 - Objectives
 - ✓ To develop overstory / understory relationships in young, managed Douglas-fir stands at the species level as affected by initial spacing and thinning
 - ✓ To benchmark the developed relationships against a small, independent vegetation dataset
 - ✓ Testing extrapolative power of the models by comparing to observed data from differently treated stands (thinned and pruned) not used in model building.
2. Sun-Tree Identification in Tree Lists of Multi-Strata Stands
 - Sponsored by USFS, cooperating with OESF / ONRC
 - Conjecture: top level or uppermost stratum may “drive” size / density relationships, hence stand dynamics
 - Nick Vaughn is the grad student assistant, exploring various metrics for crown closure distribution, crown length distribution, etc.

WOOD QUALITY PROJECT REPORT: EINI LOWELL

- A. Determining the effect of thinning, site quality and stand density on wood quality using non-destructive testing to develop predictive models (stiffness, wood density, dry weight-biomass, carbon, energy)
 - PNW Research Station, Canadian Forest Service (Wood Fibre Centre), and the SMC
 - Sample: 4 LOGS Installations (135 trees/installation); 3 treatments (thinning regimes and control); 3 plots per treatment; 15 trees per plot
 - Data collection: ST300 longitudinal acoustic, Fakopp microsecond timer (transverse acoustic), Resistograph, Pilodyn. Will get increment cores (x-ray densitometry) from sub-sample of trees
- B. SMC/CIPS Paired-Tree Fertilization Projects
 - Agenda 2020 (2008): Harrison, Maguire, Lowell, Briggs, Mainwaring, Turnblom, Little

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- Discussed additional site characterization and instrumentation to determine how key measures of wood quality are affected by site factors, stand conditions, management practices, and genetics
 - Technologies under investigation are nondestructive testing on the stems of the plot center trees and terrestrial lidar to estimate changes in branches and stem form

C. Non-destructive evaluation of wood quality in standing Douglas-fir trees and logs

- Agenda 2020 (2004): Briggs, Lowell, Turnblom, Lippke, Carter
- Integrated and edited database expected to be finished at end of 2009, analyses and papers will follow.
- x-ray densitometer data from ends of each log received from Weyerhaeuser and is being analyzed by Rapeepan Kantavichai.
- Veneer modeling continues in cooperation with Christine Todoroki, Scion, New Zealand.

FOLLOW UP ACTIONS

1. Schedule the Spring 2010 meeting approximately mid-April to allow time to prepare for the CAFS meeting on April 27-29.
2. Each of the TAC's will be scheduling a meeting later this Fall. Two key items to discuss will be
 - a. review priorities for retaining field installations
 - b. changes in field installation measurement procedures
3. The Strategic Planning Committee will hold meetings to
 - a. Review and recommend priorities for discussion at the Spring meeting in preparation for the CAFS meeting in April 2010.
 - b. Discuss potential new strategic planning priorities.
 - c. Evaluate and recommend on suggestions concerning restitution for unpaid dues
 - d. Begin planning for the 25th anniversary of the SMC.
 - e. Begin discussions concerning closer coordination between CIPS, PFC, and SMC
 - f. Director Briggs indicated his plan to retire in 2013. The SMC should begin discussions with the UW administration concerning future leadership arrangements.
4. The Finance Committee will continue to monitor the budget as it unfolds in 2010.

TECHNICAL SESSION

These presentations can be downloaded from the SMC website (www.standmgt.org) and provided an excellent perspective the field tour visits on the following day.

Appendix

STAND MANAGEMENT COOPERATIVE FALL MEETING Little Creek Casino Hotel Kamilche, WA. September 23-24, 2009

AGENDA	
23 Sept	BUSINESS MEETING
8:00	Registration. Coffee & Rolls
8:30	Welcome & Introductions
8:45	2009 Accomplishments, Announcements, etc.
8:55	Nominating Committee: Election of Policy Committee Vice-Chair
9:10	2009 Budget Status, 2010 Budget Projection
9:40	Strategic Plan Growth Model Validation Type I-III Performance UW NSF /UCRC CAFS projects Other opportunities
10:20	Break
10:35	Nutrition Project Report Rob Harrison
10:55	Wood Quality Project Report Eini Lowell
11:15	Modeling Project Report David Marshall
11:35	Silviculture Project Report Eric Turnblom
12:00	Lunch
TECHNICAL SESSION (under development)	
1:00	Age 5 response of the 3 GGTV sites (Keith Jayawickrama, Eric Turnblom, Terrance Ye)
1:20	"Estimation of wood properties, stem biomass and stem weight of Douglas-fir in Pacific northwest" (R. Kantavichai and D. Briggs)
1:40	Paul Footen (not available – Rob to present)
2:00	"Predicting nitrogen fertilizer response in Douglas-fir" (Kim Littke)
2:20	"The effect of urea-fertilization on carbon sequestration in Douglas-fir plantations of the Pacific Northwest" (Ben Shyrook, not available – Rob to present)
2:40	Pure and mixed Douglas-fir and w. hemlock plantation production: Age 18 results (Turnblom)
3:00	Break
3:20	"Obtaining forest stand inventory parameter and volume from terrestrial LiDAR" Guang Zheng
3:40	"Who's in control here? The challenges of modeling understory vegetation in young stands" Kevin Ceder
4:00	Algorithmic Detection of Suntrees From Inventory Data (Turnblom, Vaughn)
4:20	Carol Shilling (not available – Rob to present) Comparison of aboveground biomass of 5-year old Douglas-fir (<i>Pseudotsuga menziesii</i> (Mirb.) Franco) and associated allometric biomass equations at three sites with varying temperature, precipitation, and soil composition.
4:40	
5:00	Adjourn
6:00	Dinner at Xinh's Clam and Oyster House, Shelton, WA
24 Sept	FIELD TRIP
7:30	Depart from Little Creek Casino for the Donkey Creek Genetic Gain/Type IV Installation: Travel time 45 min
8:30	Arrive at Donkey Creek
2:30	Adjourn & Return to Little Creek Casino

STAND MANAGEMENT COOPERATIVE STAFF

University of Washington, Seattle:	Dave Briggs, SMC Director William Bizak, Hourly Field Assistant Randy Collier, Senior Computer Specialist Bob Gonyea, Field Coordinator Rob Harrison, Nutrition Project Leader Bert Hasselberg, Field Technician Megan O'Shea, Administrative Specialist Eric Turnblom, Silviculture Project Leader
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 Rapeepan Kantavichai, PhD, Kim Littke, PhD Maria Petrova, MS Carol Shilling, PhD Gonzalo Thienel, MS, PhD Nick Vaughn, PhD
Undergraduate Students:	Ryan Reit

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