SMC Quarterly News

Stand Management Cooperative
School of Forest Resources, University of Washington
1st Quarter 2010

www.standmgt.org

Dave Briggs, SMC Director

From the Director

Wow, 2010 has arrived! Twenty five years have gone by since the SMC formed in 1985 and 2010 marks my 15th year as SMC Director. As I have been spending a lot of time working on the budget transition from 2009 to 2010, consider that the cumulative sum of member dues has reached $12.3 million and total support including special contracts, external grants and in-kind contributions from institutions has reached $20.4 million. These figures are simple sums of the annual amounts to date, including what we have so far in 2010. For a different perspective, consider what these amounts would translate into if they had been put into an account earning 6% compounded annually. Under this assumption, the member dues account would be $34.3 million and total support account would be $55.0 million.

Because of the economic situation, member dues for 2010 were reduced by 20% at the Fall 2009 Policy Committee meeting. However, there have been some positive events since then. At that time, we assumed that there would be no income in 2010 from special contract work but we now have $7500. Second, we have a new member, International Forestry Consulting, Inc. (see more on our new member later in this issue). With these positive events and with the economy slowly improving we may have a better outlook for 2011.

inside:

New Member

International Forestry Consultants, Inc. (INFO, www.inforestry.com, 11415 NE 128th St, Suite 110, Kirkland, WA 98034) recently joined the SMC. INFO was formed in Seattle in 1966 as a full service forestry consulting organization. The name comes from the company's early emphasis on international forestry consulting projects. Since that time, INFO has positioned itself as a major consultant in the Pacific Northwest, with projects extending throughout the Western United States and Alaska. The company is headquartered in Kirkland, Washington, just east of Seattle. INFO currently manages over 60,000 acres of forestland in Washington State for institutional and individual investors. The majority of tree farms managed by INFO are certified under the Sustainable Forestry Initiative (SFI). INFO also specializes in feasibility studies, forest appraisal, extensive timber surveys on large ownerships, as well as, intensive surveys and management on small acreages. INFO uses in-house geographic information systems (GIS) to map, analyze, and display spatial data. This includes aerial photo interpretation, digitizing, and the use of diverse databases to create detailed maps and analyses. INFO also assists communities and individuals with urban forestry issues including inventories and management planning.

Contacts for the SMC: Griffin Chamberlin, Forester, griffin@inforestry.com

New Student:


Nai Saetern

Nai Saetern is a new Master of Science student who will be developing LOGS-style performance reports of the SMC Type I Installations. Nai K. Saetern received her Bachelor's in Forestry and Natural Resources at University of California, Berkeley in 2008. Her credentials consist of environmental education programs and sustainability efforts. She is interested in management for sustainable use of forest resources. She is currently pursuing master's studies in Forest Management with an emphasis on silviculture in the School of Forest Resources at University of Washington, Seattle. Working under Dr. David Briggs, her work focuses on characterizing Douglas fir growth in the SMC Type I installation.

Spring and Fall SMC Policy Committee Meetings

Please note the following dates and locations for the 2010 Policy Committee Meetings. Details will be forthcoming.

- April 13-14 at the Olympic National Forest Headquarters in Olympia, WA.
- September 21-22 at Oregon State University, Corvallis, OR.

Conifers Update

Some of you may have received the following from Martin Ritchie. For those interested in using the R version of CONIFERS only:

We located and corrected a "feature" in the rconifers package (our thanks to Peter Gould for pointing it out). The problem has now been corrected and uploaded to CRAN as rconifers version 1.0.0. Make sure you have version 1.0.0 when you install. I suggest you use the latest version of R (Version 2.10) although it should run alright on older versions. Note that we have changed the species map feature (made it a little easier to employ actually) and you can see this in some of the examples. Old scripts for setting up the variant (SWO vs SMC) may not function properly, but a couple lines of code will correct this. See examples in rconifers help. If you encounter ANY problems with rconifers, please let me know and I will do my best to correct any flaws in the program.

CONIFERS http://www.fs.fed.us/psw/programs/ecology of western forests/projects/conifers/

Martin Ritchie mritchie@fs.fed.us

International Cedar Symposium
A Tale of Two Cedars: Western Redcedar and Yellow-Cedar. May 24-28, 2010, University of Victoria

This symposium will explore current knowledge and management experience with western redcedar and yellow-cedar: two culturally, commercially, and ecologically important tree species in Alaska, British Columbia, and the Pacific Northwest. The symposium will have 2 days of indoor sessions with keynote and voluntary presentations and a poster session. There will also be one full day or 2 half day field trips to visit natural and managed cedar forests.

For more information visit: http://www.fs.fed.us/pnw/olympia/silv/CedarSymposium.shtml.

SMC Silviculture TAC Meeting Minutes: USFS Lab, Olympia, WA. Dec 22, 2009

Eric Turnblom, Silviculture Project Leader

Attendance: Rick Brooker, Longview Timberlands, LLC, Randy Collier, U Washington Jeff Comnick, U Washington, Bob Curtis ,USFS, retired, Rob Harrison, U Washington, Randall Greggs, Green Diamond Resource Co., Eini Lowell, USFS, Jeff Madsen, Port Blakely Tree Farms, Eric Turnblom, U Washington. The following participated by conference call: Jim Vander-Ploeg, Hancock Forest Management, Steve Wickham, Plum Creek Timber Co., Greg Johnson, Weyerhaeuser Co., and Jake Gibbs, Lone Rock Timber Co.

1. Installation "Retirement"

In light of seemingly ever-tightening budgetary constraints, the Silviculture Technical Advisory Committee (TAC) was asked to look into increasing efficiency of installation measurement by various means, not the least of which is potentially discontinuing measurement of some subset of them, or decreasing the frequency they're visited for repeat measurement. Looking at this in general from a rotation age perspective, various definitions might be used. For example, a set length of time a stand has been in the "zone of imminent competition mortality" on a self-thinning diagram might be used as one criterion for ceasing repeat measurements. Others include a "final" board-foot volume, a "final" QMD, or a "final" piece size. Appendix I shows four figures regarding the SMC Type I installations: 1) the distribution of plots (stands) on Flewelling's Density Management Diagram, 2) the distribution of current yields (MBF) for each stand, 3) the distribution of QMD across stands, and 4) the distribution of DBH of the largest tree, respectively, or, from "top to bottom." Given a fixed number for these criteria in mind, whatever it is, one can get a good idea about how many stands will qualify now, or will soon qualify for retirement. The same can be done for Type II or Type III installations if this seems like a good approach. Discussion followed. Consensus was that one set rotation does not work for all.

After further discussion, a consensus emerged that Project Leader Turnblom will contact each landowner to obtain a "best estimate" for the planned date of harvest for each Type I installation and will lay out a matrix individually tracking the lifespan of each installation. With this data, the number of repeat measurements remaining on each installation under the current measurement cycle will be ascertained, workload can be tracked and balanced efficiently, and we will know approximately when to obtain the "final" measurement just prior to harvest with fewer surprises.

A comment was made that keeping a few installations past rotation is important for pinning down the endpoints of models, allowing for better interpolation, rather than extrapolation. As harvest dates approach for the individual installations, landowners will be contacted to ascertain their willingness to extend the rotation for their stand if it represents a type that is under-represented in the database.

Further discussion revealed a consensus that Type II installations should receive highest priority for "mothballing." This means at a minimum, measurement frequency should be cut in half, or perhaps measurements should be suspended until the final measurement just prior to harvest.

Further discussion revealed a consensus to use the same process for the Type III installations as is planned for the Type I installations.

Further discussion revealed a consensus to keep the measurement cycle on the Type IV installations at two years.

Finally, in a last-ditch attempt to avoid the Friday afternoon call from a cooperator notifying me that one of their installation will be logged Monday morning," (which those present at this meeting felt was largely due to loss of corporate memory), SMC staff will contact landowners every two years (in addition to the four-year regular contact in concert with the four-year measurement cycle). This contact will be used to obtain updates in harvest plans and also to "remind" that there are installations on cooperator's property.

2. Strategic Plan Progress

2.1 "LOGS-style" Report

For a detailed outline of this proposed analysis project, see the following URL: http://www.cfr.washington.edu/research.smc/meetings/fall%202009/Fall%202009%20Minutes.pdf

There is no money available from the general SMC operating fund to support this task. Nevertheless, it is moving forward in pieces. Jeff Comnick, staff research forester at ONRC and UW Ph.D. Student, will be tackling the Type II piece as part of an Independent Studies / Directed Research project with Turnblom. Nai Saetern, M.S. Student, will likely tackle part of the Type I piece working as an RA on the Corkery Chair money with Briggs and Turnblom.

Ensuing discussion included what response variables should comprise such a report. Information on crowns, branches, snags (emerging data set, by no means complete), etc., is available. Consensus was that to avoid slowing delivery on these reports, following the general pattern initiated by the LOGS study should be followed.

The piece on the Type III installations will follow immediately as resources become available.

It is envisioned that this is not a one-time effort. As data from another complete set of repeat measurements become available, these reports can be updated. Data analyses for these reports will likely become increasingly complex as measurement cycles become increasingly variable due to budgetary constraints.

Other funding avenues are being explored.

2.2 Model Evaluation

For a detailed outline of this proposed analysis project, see the following URL: http://www.cfr.washington.edu/research.smc/meetings/fall%202009/Fall%202009%20Minutes.pdf

Phase I includes identification of a set of models to be benchmarked. Suggestions that came up included FVS (PN and WC variants), ORGANON 8.4, and FPS.

There is no money available from the general SMC operating fund to support this task. Consequently, it is moving forward very, very slowly. Other funding avenues are being explored.

General sentiment was expressed that the Strategic Plan projects discussed at this meeting are important.

3. New/Old Business

The possible use of "the nine" Type I installations that include three (3) auxiliary N fertilization plots to augment the "Carryover" study when harvested was briefly discussed. Consensus was that this was a good idea.

A proposal either to use the buffer regions of these same nine installations immediately for a biomass production and wood quality study (see Appendix II), or to wait until they're harvested for the continuance of the carryover study when a larger destructive sample might be obtained was discussed. Consensus was that this was a good idea and plans should continue to be developed.

The next phase of the Type IV trials was discussed briefly. As many recalled, the original SMC Type IV plan called for six breeding zone regions to be covered: North, central, and southern coastal breeding zones, and north, central, and southern regions of the western Cascades. It was suggested that the Cottage Grove / Roseburg area be targeted next. A modified or smaller version of the existing GGTIV experiment should probably be designed, since the financial resources for continuing this work are likely to be difficult to find.

It was suggested that Microsoft "Live Meeting" be considered next time instead of a simple conference call line, and in preference to "GoToMeeting" internet connectivity for conferencing.

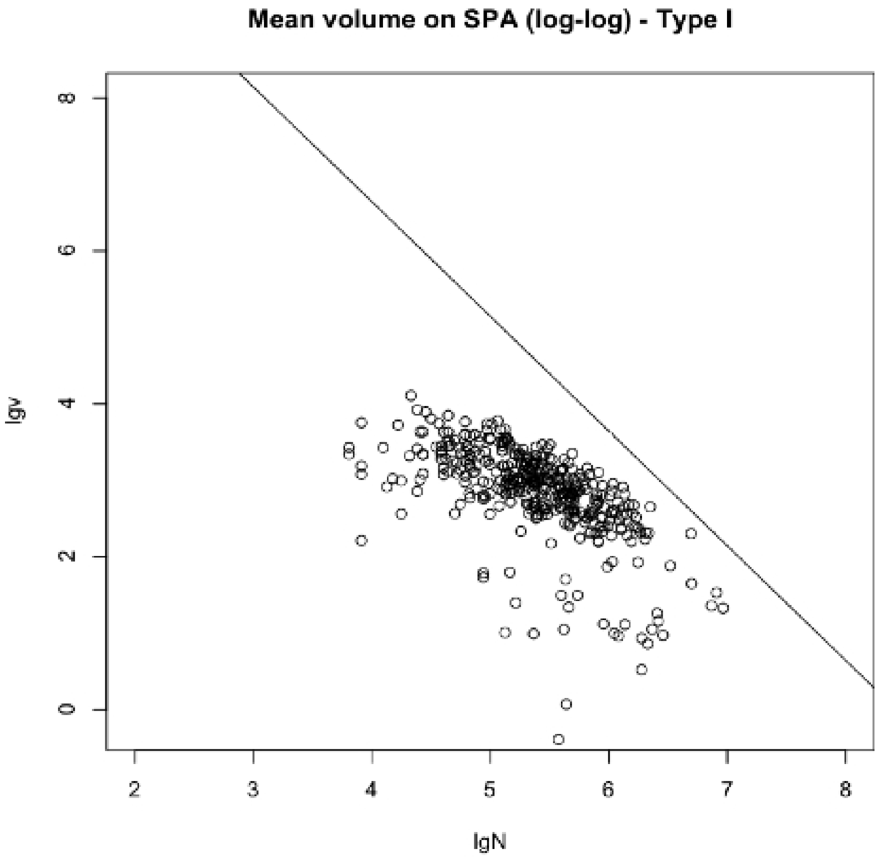

Figure 1. Density-size plot of current data from Type I installations.

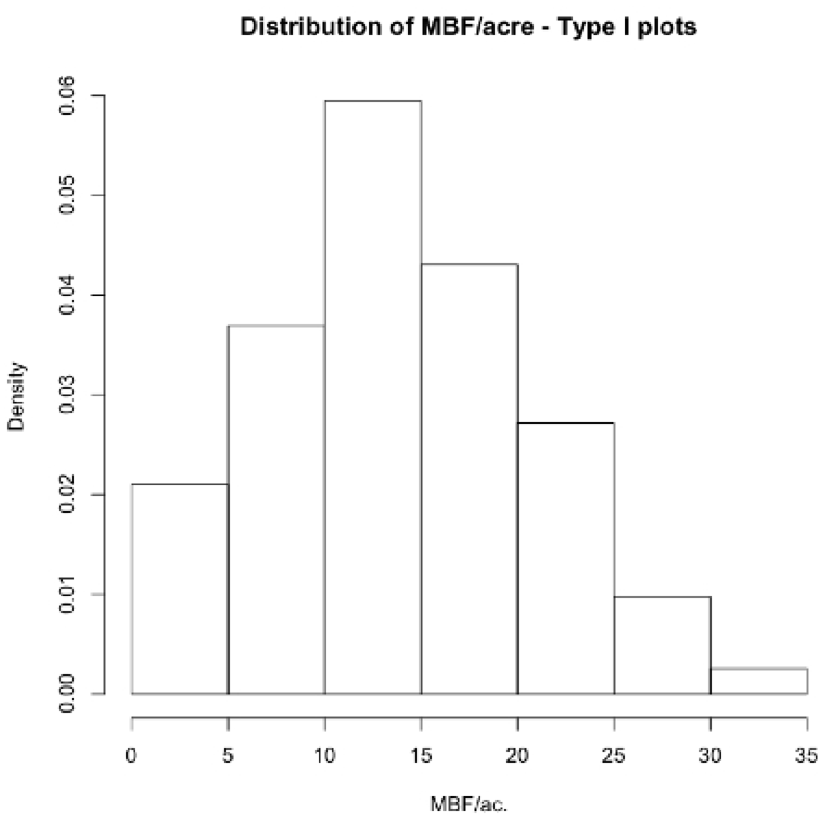

Figure 2. Histogram showing distribution of current yield on Type I installation plots.

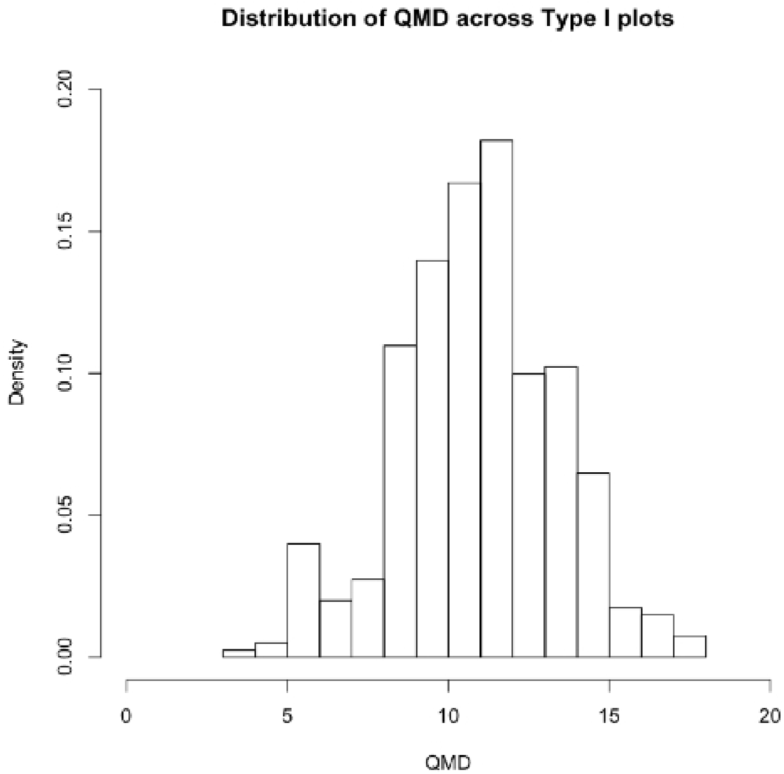

Figure 3. Histogram showing distribution of current QMD on Type I installation plots.

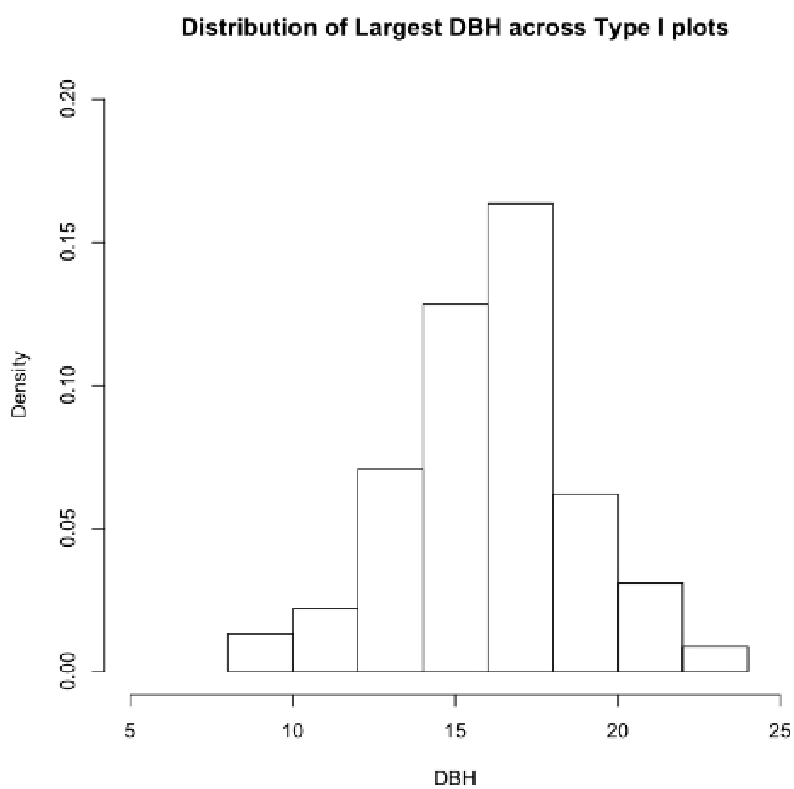

Figure 4. Histogram showing distribution of largest tree currently on Type I installation plots.

APPENDIX II.

VI.TITLE: Biomass production and wood quality of intensively managed Douglas-fir plantations

PRINCIPAL INVESTIGATOR: To be determined
STUDENT: To be determined

PROJECT SUMMARY: This would expand and extend the current projects on the Highway Thinning, Type II, and LOGS sites to nine SMC Type I installations that began intensive management much earlier and which include both thinning and fertilization regimes. Installations were established between 1986 and 1995, in nine Douglas-fir plantations at age 5-13 (attached table). On each, 1 plot was an untreated control. The 2nd plot had the following thinning regime; when relative density (RD) reaches 55 thin to RD 35; then when RD reaches 55 thin to RD 40; thereafter when RD reaches 60 thin to RD 40. The 3rd plot was pre-commercially thinned to 1/2 of the initial stems ha^{-1} and was thinned once when RD reaches 55 thin to RD 35. The 4th plot received PCT to 1/4 of the initial stems ha^{-1}. Plots 5, 6, and 7 were the same as plots 2-4 but also received 224 kg ha^{-1} (200lb/ac) nitrogen as urea at establishment and every 4 years thereafter until a total of 1120 kg ha^{-1} (1000lb/ac) was applied. Installations have been measured every 4 years and fertilization is now complete. We have collected both overstory and understory vegetation data and have soil and foliar analyses.

OBJECTIVES: 1. To develop a volume & biomass growth and yield models for intensively managed plantations that include effects of treatment regimes and soil/climate, 2. Develop counterpart models for wood density (carbon, energy) and other properties (ex. stiffness). 3. To perform seed to harvest life-cycle analysis (LCA) trajectories for each regime to estimate net carbon storage and net energy of each regime. 4. To combine the growth, yield, wood property, and LCA modeling system with decision support tools that can consider integrated utilization of biomass for traditional log, carbon, and energy markets.

APPROACH: Overstory and understory data has been collected by the SMC and is already in the database. Some supplementary soil sampling may be desirable. Most of the additional field work would be associated with destructive sampling of trees in the buffers for biomass and wood properties . We propose to destructively sample 4 trees from the buffer from each of the 63 plots to measure above-ground biomass components and obtain cross section disks at the stump, BH, 20%,40% and 60% height levels for x-ray densitometry (or Silviscan). Acoustic and Resistobraph testing will be conducted concurrently. Combining these data with PRISM temperature and precipitation data for each site provides a unique opportunity to build an integrated biomass-volume-wood property modeling system that incorporates climate change. We will also obtain lidar coverage of the installations to build relationships between lidar metrics and actual ground observations.

PROGRESS & PLANS: Preliminary discussions of this proposal are underway. We would like to expand to include partners from the Southern pine region to broaden the modeling scope across species and climates.

FUNDING: (approx. $550k as follows): Lidar coverage ($100k), field data collection ($100k); destructive sampling of 4 x 63 = 252 trees for biomass ($100k); wood properties of 5 x 252 = 1260 samples ($150k); graduate students and post-doc ($100k).

DISCUSSION NOTES: Potential funding NSF (if play the carbon & climate4 change angle), DOE (if play the energy angle).

Table 1. Characteristics of the Nine Type I Installations with the Density Management – Fertilization Experiment

Installation	704	705	708	713	718	722	725	726	736
County, State	Cowlitz	King	Lewis	Skagit	Linn	Marion	Jefferson	Lincoln	King
State	WA	WA	WA	WA	OR	OR	WA	OR	WA
Latitude	44° 12' 47"	47° 10' 36"	46° 27' 30"	48° 30' 4"	44° 39' 11"	44° 52' 27"	47° 53' 49"	44° 41' 30"	47° 35' 39"
Longitude	122° 50' 49"	121° 43' 4"	122° 4' 8"	121° 37' 36"	122° 40' 16"	122° 33' 58"	122° 46' 25"	123° 56' 34"	121° 43' 31"
Elevation, m	183	823	274	242	335	671	168	91	183
Slope, %	20	30	5	5	10	10	0	10	40
Aspect [1]	270	180	999	180	888	270	999	225	270
Stie I ndex 50 [2], m	37	27	38	37	39	37	37	41	37
Site Index 30 [3], m	25	23	28	27	28	22	27	28	28
Planting Date	Jan -74	Jan -76	Jan -81	Feb -78	Jan -82	Feb-77	Dec -80	Jan -84	Mar-84
Stock Type	2-0,2-1,1-1	1-1 1-	1	unk	2-1,2-0	2-0 1-	0 1-	1 2-	0
Trees ha -1, Inst. Estab. [4]	1420	1729	1062	1329	988	1359	1112	894	1112
Inst. Estab. Year	1987	1987	1988	1988	1989	1989	1990	1990	1992
Age, Plant to Estab. Inst.	13	11	7	10	7	12	10	6	8
DLLBH Meas. Date	2003	2003	2004	2004	2001	2001	2002	2002	2004
Age, Plant to DLLBH Meas.	29	27	23	26	19	24	22	18	20

[1] degrees azimuth, 888 = variable aspect, 999 = flat, no aspect

[2] Site Index 50, based on breast height age, is from King (1966)

[3] Site Index 30, based on age from seed, is from Flewelling et.al (2001) and is the mean for all plots on the installation calculated 8 years after plot establishment

[4] Mean of the 4 ISPA plots on each installation

SMC Nutrition TAC Meeting Summary
USFS Lab, Olympia, WA. December 8, 2009

Rob Harrison, Nutrition Project Leader

On Tuesday, December 8th, 2009, the Nutrition TAC met at the USFS lab. The primary focus of the meeting was the current status of the SMC Type V, Paired-Tree Fertilization study, future plans for the study, and sources of funding.

Attendance: Randall Greggs, Green Diamond, Steve Loy, Green Diamond, Andy Hiegel, Hancock Forest Management, Jeff Madsen, Port Blakely Tree Farm, Gene McCaul, West Fork Timber Co., Scott Holub, Weyerhaeuser NT, Rob Harrison, U Washington, Kim Littke, U Washington, and Eric Turnblom, U Washington, The following participated by conference call: Steve Wickham, Plum Creek Timberlands LLC, Eini Lowell, USFS, and Louise De Montigny, BC Ministry of Forests.

Two reports were given initially.

1) SMC Type V, Paired-tree Fertilization Study

Kim Littke, who is working on a Ph.D. based on the Type V study, presented a report on the current status.

Currently, there are 62 Type V Paired Tree Installations in British Columbia, Washington, and Oregon (Figure 1). 59 installations have had soil sampled and soil moisture sensors installed (Table 1). Soil nitrogen and carbon are highly variable between and within parent materials (Figures 2 and 3). Six installations have been measured for fertilization response two seasons after fertilization (Figure 4). Only one installation responded with basal area growth, while a different installation responded with height growth. The installation that responded with basal area growth also showed larger foliage, heavier foliage, more foliage, and heavier branches in the fertilized treatment than in the control treatment.

Figure 1. Location of SMC Type V installations research installations. Red markers indicate glacial-origin soils, green indicate sedimentary-origin soils, and blue indicate igneous-origin soils.

Soil moisture sensors have recorded one year of data from 29 of the installations. Dry-down curves show that most soils are starting at the same field capacity, but differences in drying are due to soil texture and latitude (Figure 5). Soil texture, wilting point date, and length of drought will be investigated as important variables to the water stress of the stand.

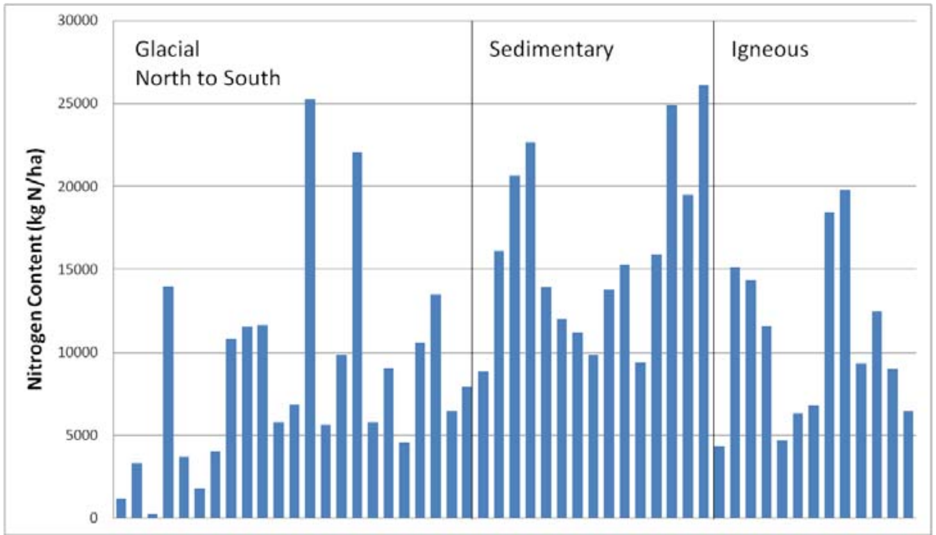

Figure 2. Range of soil nitrogen content (kg/ha) to one meter by latitude and parent material.

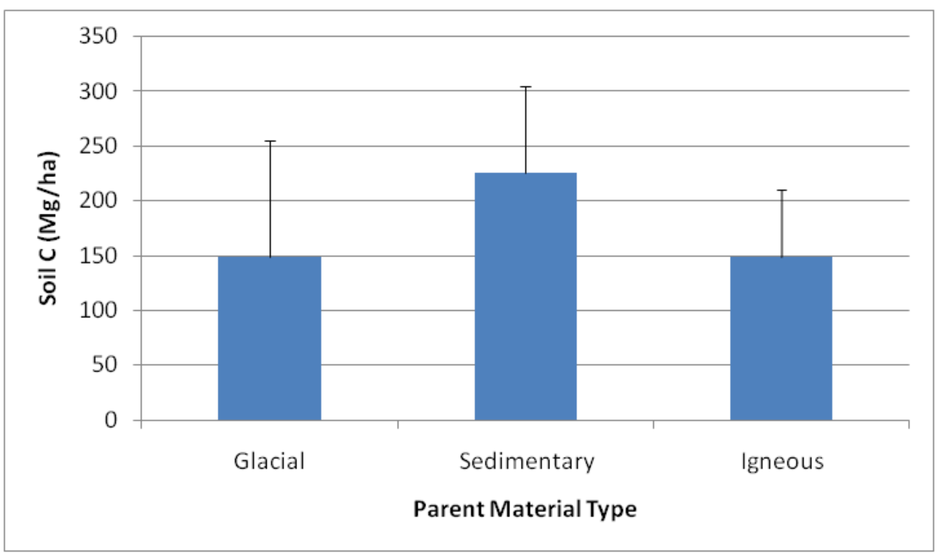

Figure 3. Soil carbon content (Mg/ha) to one meter separated by parent material. Bars are one standard deviation.

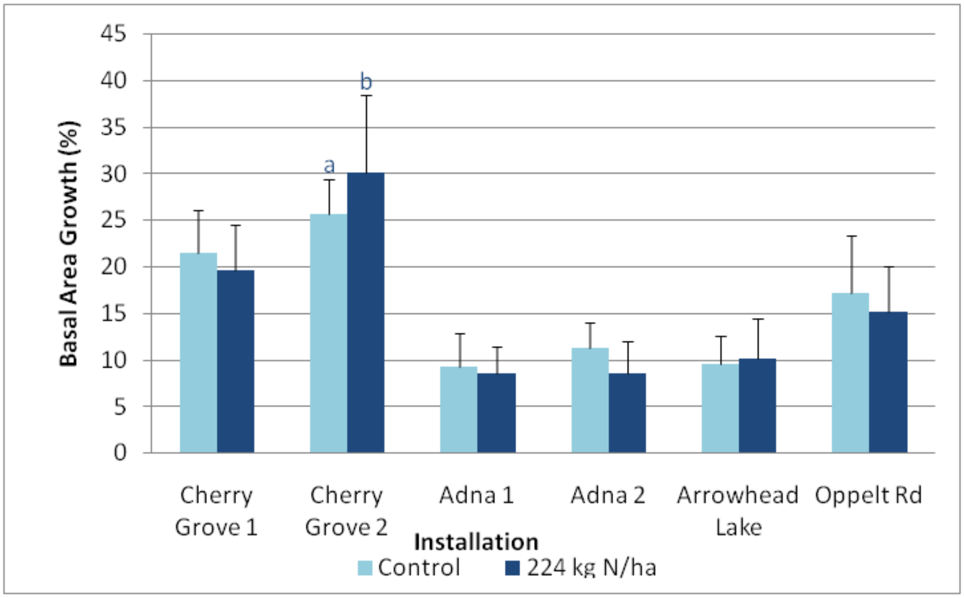

Figure 4. Basal area growth response (%) to urea fertilization after two seasons. Bars are one standard deviation. Different lowercase letters indicate significant difference (a=0.10).

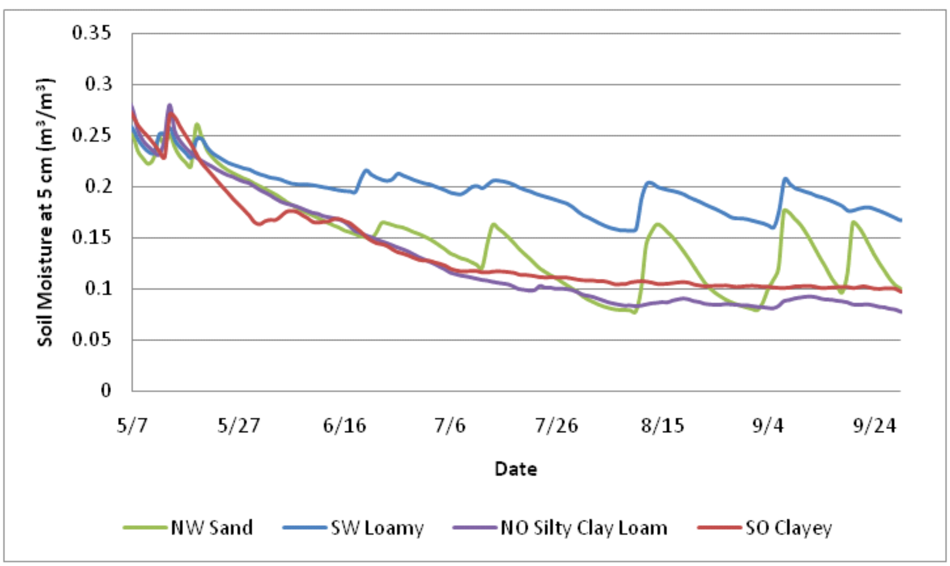

Figure 5. Dry-down curves of soil moisture (m^3/m^3) at 5 cm from soils with varying textures from different latitudes in the Pacific Northwest.

Table 1. Current Type V Paired Tree Installations with soil nutrient data. Sites with no soil nutrient data will be sampled or analyzed soon. Continued on next page.

Installation #	Installation Name	Company	Carbon (Mg/ha)	Nitrogen (kg/ha)
821	Adna 1	Port Blakely	201	11987
822	Adna 2	Port Blakely	182	11234
823	Arrowhead Lake	Port Blakely	179	10572
824	Oppelt Rd	Port Blakely	246	13504
825	Cedar Creek	WA DNR	149	6830
826	Cherry Valley	WA DNR	79	5635
827	Nestucca	Weyerhaeuser Company	300	15899
828	Bunker Creek	Weyerhaeuser Company	135	9877
829	Grants Pass	Weyerhaeuser Company	252	13809
830	Weikswood	Weyerhaeuser Company	390	22669
831	Rancho Rancheria	Plum Creek	81	6473
832	Cherry Grove 2	Weyerhaeuser Company	132	9390
833	Cherry Grove 1	Weyerhaeuser Company	244	15304
834	Dudley	Plum Creek	157	9013
835	Weikswood Slope	Weyerhaeuser Company	201	13929
836	Rabbit Creek	Green Diamond	311	20681
837	Mill Creek	Green Diamond	224	9060
838	Star Lake	Green Diamond	86	4579
839	Russell Ranch	WA DNR	71	4062
840	Coyote Ridge	WA DNR	214	10849
841	Cascadia	Cascade Timber	210	19816
842	Scott Mt	Cascade Timber	253	18430
843	Devore Mt	Lone Rock	234	26121
844	Brush Creek #2	Lone Rock	212	19530
845	Hanes Ranch	Roseburg	234	24917
846	Armstrong-Janicki	Pacific Denkmann	112	5783
847	Victoria GP	Pacific Denkmann	167	11659
848	McKinley	Pacific Denkmann	161	11552
849	Pender Harbour	Province of BC	89	3309
850	Steel Creek	Western Forest Products	36	1179
851	Upper Campbell Lake	TimberWest	10	280
852	Fanny Bay	Province of BC	225	13989
853	Copper Canyon 1	TimberWest	81	3698
854	Copper Canyon 2	TimberWest	41	1830
855	Bucklake	University of Washington	116	7918
856	Murphy	University of Washington	157	11612
857	Clark Creek PP	Plum Creek	143	12502
858	Tiger Lake	Pope Resources/ORM	91	5797

Table 1. Current Type V Paired Tree Installations with soil nutrient data. Sites with no soil nutrient data will be sampled or analyzed soon.

Installation #	Installation Name	Company	Carbon (Mg/ha)	Nitrogen (kg/ha)
859	Duckabush	Green Crow	84	4336
860	Lake Aldwell	Green Crow	79	8823
861	Disco Bay	Green Crow	96	6871
862	Electron	Hancock	100	6476
863	Buckley	Hancock	248	14352
864	Oil City Rd	Green Crow	419	25291
865	Hoquiam	Hancock	280	16131
866	Clark Creek DF	Plum Creek	138	9341
867	Cougar	Pope Resources/ORM	78	4691
868	McClellan Mt	Pope Resources/ORM	76	6314
869	Mitchell Hill	WA DNR	152	9859
870	Newaukum Creek	Hancock	165	15157
871	Echo Glen	WA DNR	417	22098
872	Mineral Creek	West Fork		
873	Tilton River West	West Fork		
874	Morgan Creek	Menasha		
875	Old River Rd	Plum Creek		
876	Tilton River East	Pope Resources/ORM		
877	Wood Rd	Stimson		
878	Les Smith	Stimson		

2) Fall River/Matlock/Molalla Long-term Soil Productivity Studies

This progress report and request for continued support summarizes previous activities and also accomplishments for the first year where the Fall River, WA, Matlock, WA and Molalla, OR, long-term soil productivity studies (LTSP) were studied as an integrated project with NCASI support. These studies are affiliate sites of the LTSP network (Figure 1page 6 and 7), which has most of the same goals of understanding the soil mechanisms controlling forest productivity and determining the potential impacts of forest management on productivity of managed forests. These studies have contributed a great deal of empirical data to the study of managed-forest productivity and have shown that PNW forests are quite resilient to current management practices.

Figure 6 shows the location of core and affiliated LTSP sites. We have worked closely with LTSP scientists in the past, and will continue to in the future by continuing work at our sites, working cooperatively at other sites, attending meetings, and providing a home at the Stand Management Cooperative for the wider LTSP database.

LTSP Activities: Work done to date

We will continue on a schedule to get as many useful results as possible. In general, the following activities have been accomplished at all sites on a rigorous schedule:

1) quantifying the productivity of planted Douglas-fir in response to varying levels of logging debris, competing vegetation, and soil compaction,

2) determining how soil water, nutrient, and temperature responses to the logging debris and vegetation treatments influence tree growth and other processes,

3) assessing the effects of vegetation control on understory plant cover and plant species composition, and

4) comparing carbon (C) and nitrogen (N) losses from soil leaching among treatments. Right now, we are only sampling soil leaching at Matlock. Fall River nutrient leaching losses dropped to near-zero several years ago, and remained at very low levels due to nutrient demand from the rapidly-growing trees. We do not currently have sufficient budget or resources to sample and pay for analysis at Molalla.

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857	Clark Creek PP	Plum Creek	143	12502
858	Tiger Lake	Pope Resources/ORM	91	5797

4) the forest floor was a relatively large N store (453 kg/ha), and

5) total N in mineral soil and roots was more than 10-fold greater (13,348 kg/ha) than the N store above the mineral soil (1,323 kg/ha) after treatment,

6) carbon stores above the mineral soil decreased to amounts ranging from 129 Mg/ha in BO to 50 Mg/ha in TT+,

7) total N above the mineral soil averaged 734 kg/ha in BO and BO5, and decreased to 414 and 353 kg/ha in TT and TT+,

8) biomass, C and N removals at harvest varied from 498 to 358 Mg/ha, 244 to 175 Mg/ha, and 925 to 432 kg/ha, respectively, and

9) only 3 to 6% of the total pre-harvest N (above ground biomass + soil to 80-cm depth) was removed in the harvest treatments.

After developing all of the organic matter and nutrient budgets for Molalla and Matlock, we will be able to compare and contrast these results from Fall River for the three sites, and also hope to make similar comparisons for other LTSP network sites.

Discussion on SMC Nutrition Research

We then had a broad discussion on SMC studies. One of the major questions was "is the mix of sites right currently"? All agreed that the SMC Type V study is the highest priority, but that biomass removal and loss studies (i.e. Fall River, Matlock and Molalla), particularly studies that can be tied to an enhanced national energy-from-biomass policy, are very much of high importance to SMC members. The Type V and LTSP studies are related from the standpoint of maintaining/enhancing productivity for whatever use.

The general consensus is that it the Type V study is going quite well, particularly considering that we have 62 installations in a wide variety of physical locations and a pretty broad group of soils. For instance, total N contents of soils range from a low of 300 kg N/ha to over 25,000 kg N/ha, or nearly 100 times. One potential problem with the study is that many of the sites tend to be higher-quality sites; however, it was stated that this might also be a partial strength, since the old RFNRP studies were mostly on lower site qualities, and if we can learn to identify relatively high-productivity sites limited by N availability, the responses should be proportionally greater.

Rob mentioned that we were pursuing a joint supplemental CAFS NSF proposal with the Virginia Tech/NC State Forest Nutrition Cooperative. If funded, the $150,000 amendment would purchase N-15-labeled fertilizer to apply to many of the paired-tree sites, including at least one watershed in on each coast. For political as well as environmental reasons, a Virginia or Maryland watershed draining into the Chesapeake Bay will be picked for the FNC watershed, and we propose that a tributary of Hood Canal would be the SMC watershed, probably on Green Diamond lands. Steve Wickham mentioned that we might also use a site in Oregon, perhaps associated with the Hinkle Creek watershed. We're exploring the possibility of four watersheds, including one in Pamlico Sound, NC and at Hinkle Creek, OR.

A question was whether or not we'd be able to add different rates of N-15 to track different flow paths under different application rates, and the answer is "probably not, but we'll explore it".

We discussed the potential impacts of site and fertilizer for the Type V sites on crown characteristics. It seems that the ground-based LIDAR isn't going to give us much practical information in this regard, and we should develop a means to track crown information separately. Unfortunately, we're pretty sure that would take a lot of extra time, and with budget cuts and an uncertain summer field crew, we don't know if we'll be able to do this.

There was a question about long-term effects of N, and Rob showed a figure (Figure 7) from the carryover study. The high apparent response to previous fertilization is unexpected, based on our earlier hypotheses, we expected response would be much smaller. We will continue to track the five stands in the current study over additional time.

We finished our primary discussion on the potential for an additional "carryover" study, possibly utilizing SMC Type I study sites, which may be available for such a study. It would be ideal if we could include some sedimentary soils in any such study.

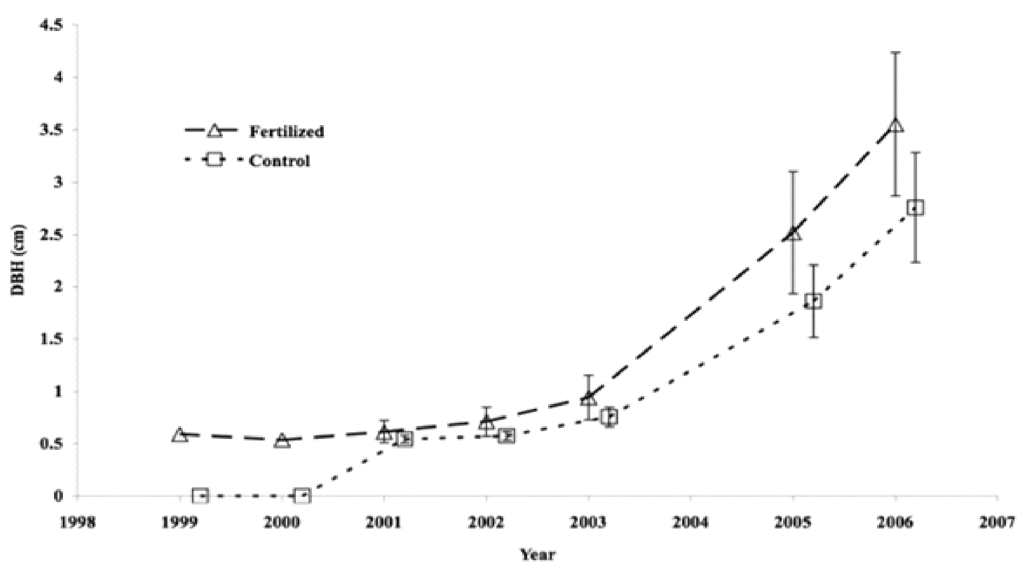

Figure 7. Mean DBH (cm) of Carryover study Douglas-fir trees. The differences in DBH were statistically significant ($p < 0.1$) in years 2005 and 2006. In 2006 mean DBH was 29% greater on the previously fertilized plots than on the control. Control points are offset to show (+/- 1) standard error bars.

Modeling Wood Density

Rapeepan Kantavichai, David Briggs, Eric Turnblom

When clear wood properties are of interest, specific gravity (SG), also known as "relative" or "basic" density, has been the most commonly investigated wood quality attribute. SG, dry weight per unit green cubic volume of wood relative to the density of water, is correlated with strength and stiffness, shrinking and swelling, and other wood properties. Because dry wood contains about 49% carbon and 20 MJ/kg energy, carbon and energy stored in a unit of volume are also directly related to SG. With the development of carbon and bioenergy markets there has been increasing interest in obtaining accurate estimates of dry weight, or biomass, of trees. Two commonly used methods to estimate dry weight of a tree are (1) convert stemwood volume to dry weight using the average density for the species and applying factors to scale up to account for bark, crown and root components and (2) use published biomass equations. In the 2nd Quarter of 2009 we presented an analysis of stemwood of trees grown under a thinning x biosolids fertilization experiment at the Highway Thinning site at Pack Forest. This experiment started in 1977 and ended in 1998 when sample trees were harvested for a product recovery study (Sonne et al. 2004). As part of that study, cross-section disks were taken from the top of the first 5m (16ft) log from which x-ray densitometer SG profiles were obtained by Weyerhaeuser Co. Using 20 year SG based on these profiles and volume growth response to calculate dry weight and carbon storage change by treatment, we found that both methods produced large errors. These errors were attributed to the inability of the species average SG or existing biomass equations to reflect the underlying pattern of SG change with age in a species and their inability to reflect effects of intensive silvicultural treatments or local growing environment factors including soil, temperature, precipitation and water balance.

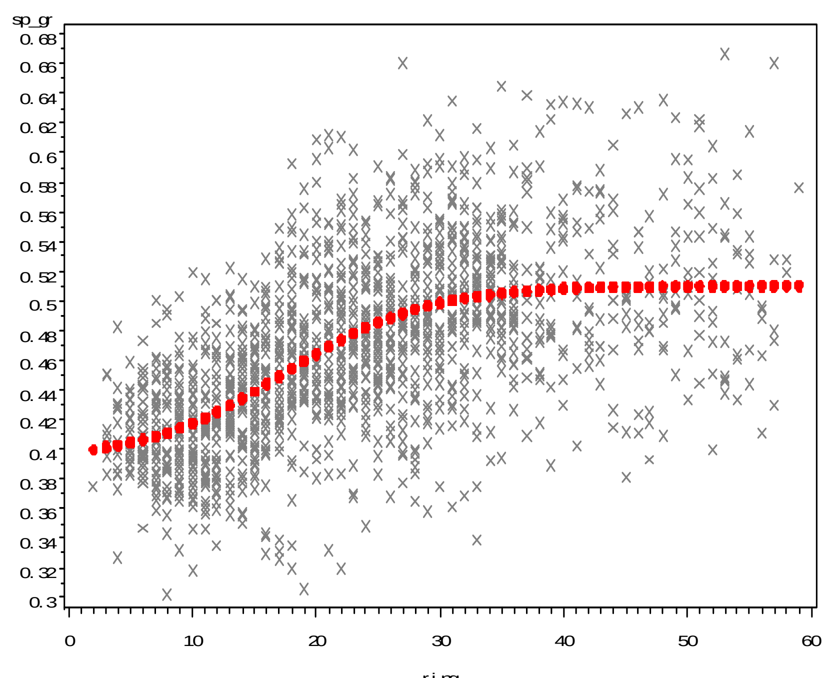

Fig. 1 Scatter plot of ring SG for Rings 2-60 at 5m from stump Logs of 46 Trees and the logistic nonlinear regression fit (red).

The x-ray densitometry data provided the width and SG each whole ring and its earlywood and latewood components. The data is for disks at the 5m height from 46 trees. Ring count of these disk averaged 35 rings through 1977 and 55 rings through 1997 (Figure 1). We used mean monthly temperature and total monthly precipitation series from PRISM (2007) and a water balance model by (Lutz 2008). We conducted two different analyses.

I. Response to Treatments

We examined the rings starting with the first growing season after the treatments were implemented (1978) through the last full growing season (1997) before the mid-1998 harvest. We partitioned the data as follows. Rings for years 1978-1989 were used for model building and rings 1990-1997 were used for model validation. Rings for years 1966-1977 were used to determine if there were significant pre-treatment effects among the subsequent treatment plots (there were none). We built models for whole ring SG (RSG) and for the width and SG of the earlywood (EWW, EWSG) and latewood (LWW, LWSG) components and latewood percent (LW%). In our models we examined the effects of the treatments, local soil, precipitation, temperature and water balance (soil moisture deficit). This analysis has just been published.

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.

Key findings are briefly summarized below

A. Effect of Treatments on RSG:

- SG on this site is generally higher than the average of 0.45 reported for Douglas-fir in the Wood Handbook, consistent with the Western Wood Density Survey (USFS 1965) which shows higher than average SG for the region where Pack Forest is located.
- Thinning increased RSG above the control in 10 of the 12 years between 1978 and 1989 with an overall average increase of 4%. This pattern was sustained until the harvest in 1998. However, with our relatively small sample size, this increase was not statistically significant and examination of ring components revealed that thinning did not significantly change EWSG, LWSG, or LW%. Others have observed increased RSG after thinning on dry, crowded sites. Thinning reduces competition for water which lengthens the growing season and production of dense latewood.
- Biosolids fertilization significantly decreased RSG (8%) compared to the control. Analysis of ring components found that biosolids increased ring width by increasing both EWW and LWW but more growth was in the form of EWW so LW% decreased. Biosolids also decreased EWSG, and LWSG. These effects on ring components explain why overall SG decreased with this treatment.

- Thinning plus biosolids fertilization significantly decreased RSG (8%) compared to the control but the combination was not significantly different than biosolids alone.

B. Effect of Tree, Weather, and Soil.

Two essentially equivalent models were developed, one uses soil moisture deficit (SMD) in July while the other uses July precipitation.

1. Soil moisture deficit model

- Increased July SMD decreased RSG. Examination of ring components found that both EWW and LWW decreased with increased July SMD and that EWSG and LWSG were not changed. The reduced EWW was slight compared to the reduction in LWW, so LW% decreased and this drove RSG down.
- Increased March-May temperature increased RSG. Warmer March-May temperatures did not affect EWW and EWSG but increased LWW, LWSG, and LW%. Warmer spring temperature initiates growth earlier in the year (Larson et al., 2001) with a commensurate earlier transition from earlywood to latewood. This would allow a longer period of dense latewood production and increase RSG.

2. July Precipitation model

- Increased July precipitation decreased EWW, increased LWW and LW%, and did not affect LWSG; the combined effect increased RSG. This is consistent with others who have also found a positive effect of increased precipitation during the growing season on SG.
- Increased March-May temperature decreased EWSG, increased EWW, LWW, and LW%, and did not affect LWSG; with a combined positive effect on RSG. There was also a variant model, presented in the paper but not here, that used August-November temperature.

II. Modeling RSG from pith to bark.

Since the x-ray densitometry data extended to the pith we included this data with what we learned from the post-treatment analysis to build a pith to bark ring SG model. This has also just been published.

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.

RSG of Douglas-fir is characterized by an initial region extending out from the pith where RSG starts at low values, rises rapidly (concave up) and subsequently increases at a decreasing rate (concave down) until there is little practical change. After examining several possible models we chose the 4-parameter logistic function

$$RSG_{RN} = \beta_0 + \frac{\beta_1 - \beta_0}{1 + e^{\left(\frac{\beta_2 - RN}{\beta_3}\right)}}$$

Where RN = ring count (age of cambium) from the pith, β_0 = lower asymptote, β_1 = upper asymptote, β_2= inflection point, and β_3 = shape parameter. Note that if one multiplies this "wood density" equation by the 0.49 dry wood carbon content, the equation becomes a "carbon density" equation. Similarly, if one multiplies this "wood density" equation by the 20MJ/kg dry wood energy content, the equation becomes an "energy density" equation.

Key findings are briefly summarized below

- The lower asymptote, ., was a constant, 0.34, corresponding to the limit of RSG as ring number approaches zero at the pith. Since disks at 5m height from sample trees had about 35 rings before treatments were implemented, the lack of treatment effects on SG near the pith would be expected. Also, since the trees in the stand had a common origin on a common soil and were exposed to the same climate regime, a constant value the initial RSG at the 5m height seems reasonable. It is likely that apical control was the main factor affecting RSG of rings forming as the live crown passed 5m height (Larson et al. 2001).
- The upper asymptote β_1. When a new ring is added to the pith-to-bark series, treatment and growing environment conditions in the year the ring formed determine if its RSG is higher than, lower than, or unchanged from rings formed in preceding years. When a new ring is added to refit the model, it adjusts the RSG trajectory toward a higher, lower, or unchanged upper asymptote. Thus, the upper asymptote is a dynamic value toward which the trajectory is headed as new rings are added. On this site the ring RSG trajectory adjusts toward a

  ✓ lower upper asymptote after biosolids fertilization. RSG of rings formed after biosolids treatment was 8% lower and this was sustained for the 20-year period between treatment and harvest.

- ✓ a higher upper asymptote if the new ring forms when mean March to May temperature is higher.
- ✓ a lower upper asymptote if the new ring forms with higher July SMD.

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- The inflection point β_2, which corresponds to the transition from concave up to concave down behavior, shifted outward as ring area (growth rate) increased. Some authors have used the inflection point as part of procedures to define the transition from juvenile to mature wood (Mutz et al. 2004, Mora et al. 2007). Shifting the inflection point outwards implies that low SG juvenile wood is produced for a longer time when trees are producing rapidly growing juvenile wood rings, an effect noted by Larson et al. (2001). Under the rapid early growth conditions the diameter of the juvenile wood region would increase and the transition from juvenile to mature wood may be delayed. None of the treatments had a significant impact on the inflection point but this was expected because the average age of the sample disks when treatments were implemented was 35 years, well beyond the apparent inflection in Fig. 1 and the 20-year age commonly accepted as the juvenile to mature wood transition for Douglas-fir (DiLucca 1989; Fahey et al., 1991).
- The shape parameter, β_3, was a constant unaffected by tree or environmental factors for this single site.

III. Current Research

When the SMC sampled the four Type II installations for the non-destructive testing product recovery study, disks were collected at the stump and about every 5m (16 ft for sawlogs and 17 ft for peelers) to the top of the last log. Weyerhaeuser Co. performed x-ray densitometry on strips from these disks. This creates a more powerful data set since we have more trees, more sites, and multiple samples within each tree. In addition to modeling SG and its components both horizontally and vertically within trees as affected by within site treatments, soil, and climate, we can also consider differences between sites. That is, we can look at how climate variations over time at a site affect the on-site RSG trajectories and we can examine the effect of soil/climate differences between sites. Furthermore, the x-ray densitometer data from multiple heights can be used to reconstruct the annual growth rings of each tree and calculate their dry weight. The annual dry weights, or biomass (carbon, energy) increments, can also be modeled in terms of treatment, soil and climate effects. Modeling RSG and biomass increment patterns with the Type II datasets is well underway and is the PhD dissertation topic of Rapeepan Kantavichai.

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Larson, P.R., D.D. Kretschmann, A. Clark III, J.G. Isebrands. 2001. Formation and properties of juvenile wood in southern pines: a sysnopsis. FPL-GTR-129 USDA Forest Service, Forest Products Laboratory, Madison, WI. 42pp.

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Mutz, R., Guilley, E., Sauter, U.H., Nepveu, G., 2004. Modelling juvenile-mature wood transition in Scots pine (Pinus sylvestris L.) using nonlinear mixed-effects model. Ann. For. Sci. 61, 831–841pp.

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USFS 1965. Western Wood Density survey Report No. 1. Research Paper FPL-27. USDA Forest Service Forest Products Laboratory, Madison, WI.

Abstracts and Publications cont.

Chatterjee, A., Vance, G. F. , and Tinker, D. B. Carbon pools of managed and unmanaged stands of ponderosa and lodgepole pine forests in Wyoming. Can. J. For. Res. 39(10): 1893–1900 (2009).

Abstract

Forest management practices can have a significant effect on above- and below-ground carbon (C) pools. To better understand the distribution of forest C pools, we evaluated representative forest stands within two dominant Wyoming forest types to assess differences resulting from management practices that have occurred over several decades. Study sites included four ponderosa pine (Pinus ponderosa Douglas ex Lawson & C.Lawson) treatments (100-year-old unmanaged, 46-year-old even-aged, 110-year-old uneven-aged, and 90-year-old intensively harvested) and two lodgepole pine (Pinus contorta Engelm. var. latifolia (Engelm. ex Wats.) Critchfield) treatments (145-year-old unmanaged and 45-year-old even-aged). Comparisons of aboveground C pools revealed that distributions of live and dead biomass C pools were different between unmanaged and managed stands; however, belowground soil C pools were similar among stands within the two forest types. Overall, unmanaged stands of both forest types had higher total ecosystem C pools (249 and 247 Mg C·ha^{-1} for ponderosa and lodgepole pine, respectively) compared with managed stands (ponderosa pine: even-aged, 164 Mg C·ha^{-1}; uneven-aged, 170 Mg C·ha^{-1}; intensively harvested, 200 Mg C·ha^{-1}; and lodgepole pine even-aged, 117 Mg C·ha^{-1}). Our results indicate timber harvesting has a major influence on total ecosystem C pools by reducing live tree biomass.

Harrison, Robert B.; Terry, Thomas A.; Licata, Christopher W.; Flaming, Barry L.; Meade, Rod; Guerrini, Irae A.; Strahm, Brian D.; Xue, Dongsen; Lolley, M. Reese; Sidell, Amy R.; Wagoner, Gage L.; Briggs, David; Turnblom, Eric C. Biomass and stand characteristics of a highly productive mixed Douglas-Fir and western hemlock plantation in coastal Washington. Western Journal of Applied Forestry, Volume 24, Number 4, October 2009 , pp. 180-186(7).

Abstract

Aboveground biomass predictive equations were developed for a highly productive 47-year-old mixed Douglas-fir and western hemlock stand in southwest Washington State to characterize the preharvest stand attributes for the Fall River Long-Term Site Productivity Study. The equations were developed using detailed biomass data taken from 31 Douglas-fir and 11 western hemlock trees within the original stand. The stand had an average of 615 live trees per hectare, with an average dbh of 35.6 cm (39.1 cm for Douglas-fir and 33.3 cm for western hemlock) and an average total tree height of 31.6 m (32.8 m for Douglas-fir and 30.2 m for western hemlock). Equations developed were of the form $\ln Y = b_1 + b_2 \ln \text{dbh}$, where Y = biomass in kg, dbh = diameter in cm at 1.3 m height, b_1 = intercept, and b_2 = slope of equation. Each tree part was estimated separately and also combined into total aboveground biomass. The total aboveground biomass estimation equations were $\ln Y = -0.9950 + 2.0765 \ln \text{dbh}$ for Douglas-fir, andln $Y = -1.6612 + 2.2321 \ln \text{dbh}$ for western hemlock. The estimate of the aboveground live-tree biomass was of 395 Mg ha^{-1} (235 Mg ha^{-1} for Douglas-fir and 160 Mg ha^{-1} for western hemlock), with 9.5, 29.3, 12.9, 308, and 32.7 Mg ha^{-1} in the foliage, live branches, dead branches, stem wood, and stem bark, respectively. When compared with biomass estimates from six other studies, ranging in age from 22 to 110 years and from 96.3 to 636 Mg ha^{-1}, the biomass of the Fall River site was relatively high for its age, indicating very high productivity.

Abstracts and Publications cont.

Hawkins, B. J., Stoehr, M. Growth, phenology, and cold hardiness of 32 Douglas-fir full-sib families. Canadian Journal of Forest Research, Volume 39, Number 10, 1 October 2009 , pp. 1821-1834(14).

Abstract
Thirty-two full-sib families of coastal Douglas-fir (Pseudotsuga menziesii (Mirb.) Franco var. menziesii) with a range of predicted breeding values were monitored for growth rate, phenology, and cold hardiness over 2 years on two sites to investigate if other traits are being selected when family selection is based on height. Significant differences among families existed in most phenological, growth, and cold-hardiness traits. On average, taller families burst bud later but did not have significantly different growth rates or length of growing period than other families. We found no significant correlations between family date of bud burst and cold hardiness in late spring or between duration of shoot growth or height and autumn freezing damage. Family differences in freezing tolerance were greatest in September and October. In these months, family current-year leaf nitrogen was positively correlated with cold hardiness. Families that were most hardy in the autumn were not the most hardy families in spring. We conclude that, for the studied breeding series, selection based on height does not have a significant impact on cold hardiness. We found no consistent relationships between phenological, growth, or cold-hardiness parameters and final height that could explain family ranking by height. Relationships between grandparent elevation and dates of bud burst and cold hardiness were observed.

Upcoming Meetings and Events

February 25-26, 2010, Pacific Northwest Timberlands Seminar. Portland, OR.
http://www.theseminargroup.net/eminar.lasso?seminar=10.UPLOR

April 13-14, 2010, SMC Annual Spring Meeting, Olympic National Forest Headquarters, Olympia, WA.
http://www.cfr.washington.edu/research.smc/pages/events.html

April 22, 2010, Forest Road Drainage: From F undamentals to Watershed Impacts. Holiday Inn Springfield, OR.
http://www.westernforestry.org/

April 26-29, 2010, Center fpr Advanced Forestry Systems (CAFS) 2010 Annual Meeting. Indianapolis, Indiana.
http://.cnr.ncsu.edu/fer/cafs/meetings.html

May 24-28, 2010, International Cedar Symposium, A Tale of Two Cedars: Western Redcedar and Yellow-Cedar. University of Victoria. http://www.fs.fed.us/pnw/olympia/silv/CedarSymposium.shtml.

September 21-22 SMC Anual Fall Meeting, Oregon State University, Corvallis, OR. http://www.cfr.washington.edu/research.smc/pages/events.html

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