

SMC Quarterly News

Stand Management Cooperative
School of Forest Resources, University of Washington

3rd Quarter 2011



Dave Briggs, SMC
Director

From the Director

The field crew was finally able to complete its schedule of installation visits, although some were delayed due to lingering snow, and the database update has been completed. The Director Search, Finance, and Strategic Planning committees have been active since the Spring meeting to follow up on various action items. They have been focusing on a review of the mission, vision, scope and goals of the strategic plan and have sent a questionnaire to all members asking them for their views on these strategic plan components with respect to where they would like to see the SMC in the next 5 years and next 10 years. They are also developing criteria and questions for interviews of new director candidates and examining the budget for 2012 and beyond. A sub-committee that will interview the director candidates is presently scheduling interview dates.

This issue has information on the fall meeting, a summary of the recent National Science Foundation sponsored Center for Advanced Forestry Systems (CAFS) meeting that we hosted in Seattle, and an article on characteristics and value of lumber from the trees and logs taken from Type II installations as part of the AGENDA 2020 project that did the field, milling, and lab testing work in 2007-09.

FALL SMC POLICY COMMITTEE MEETING

Please note that the Fall 2011 Policy Committee Meeting will be held on September 20-21 at the [Hotel Deca](#) is right off I-5 at 4507 Brooklyn Ave NE, Seattle, please call 800-899-0251 to book your room under the Stand Management Coop's rate of

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\$129. September 20 will be a business meeting and the 21st will be a tour of Kitten Knob (a type I installation) and research at the Pilchuck Tree Farm north of Seattle. Please contact Megan (moshea@u.washington.edu) for registration details.

NSF CENTER FOR ADVANCED FORESTRY SYSTEMS (CAFS) MEETING

The fourth annual CAFS meeting was held in Seattle on June 14-16. The SMC was represented in several oral and poster presentations, including a proposal to begin assessment of wood quality; acoustic velocity for wood stiffness, resistance for wood density, and implementation of the SMC breast height branch protocol in the GGTIV installations. This proposal continues the collaboration of SMC, the NWTIC, and USFS PNWRS. It is envisioned that these measurements, to be obtained after the 2012 and 2013 growing seasons when the installations will be age 9 from seed. These will be the first of what we envision as a series of measurements in the future with the long term objective of developing relationships that can predict future values of these wood quality variables from early measurements. The field trip on the 16th visited the Left Court GGTIV installation on Port Blakely Tree Farms land, one of the paired-tree (Type V) fertilization installations, and the Fall River long term site productivity installation, both on Weyerhaeuser NR land. Many thanks to these companies and especially to Rod Meade for all of the logistics management.

Important. NSF funding of the UW CAFS site is dependent on external funds received from industry and other land managing organizations. This is verified by NSF via two steps: (1) each organization that funds work at the UW must send a letter indicating that it wishes to participate in the UW CAFS site, and (2) each year UW sends a letter to NSF certifying the amount that each of those letter writers contributed. As a CAFS member, you get to vote on prioritization of research projects. Even if your organization is a member of CAFS through one of the other 8 university sites because you contribute to that university and wrote a letter wishing to be a member of that site, this does not make you a member of the UW site. You must write another letter specifically stating that you wish to be a member of the UW site. If your organization presently contributes to the SMC and is one of the few that has not yet joined the UW CAFS site, please contact me (dbriggs@u.washington.edu) if you would like to join. It is a simple, no cost, process that involves writing a letter and I have a letter template that you can use.



CAFS June 16th Field Trip to the SMC GGTIV installations in the Grays Harbor breeding zone.



CAFS June 16th Field Trip to the Fall River long term site productivity installation.

SMC DATABASE

Randy Collier reports that the SMC database update has been completed and sent to those who requested it. If you would like a copy and/or would like a tutorial on its structure, accessing the data, and generating reports, contact Randy Collier, SMC database manager rcollier@u.washington.edu.

SMC PRESENTATIONS

Kevin Ceder attended the 2011 Western Mensurationists meeting in Banff, Alberta where he gave a presentation “Gazing Down: Understory Growth and Yield” about his work developing dynamic understory vegetation models using data from Type I, II, and III installations. The presentation is available at http://staff.washington.edu/thuja/Presentations/Ceder_Understory.pdf.

Invited Presentation: “Predicting response to forest fertilization in PNW Douglas-fir plantations” by Rob Harrison, Kim Littke, Dave Briggs and Eric Turnblom, in Organized Session on Forest Soils and Ecosystem Processes in a Changing Environment, at the 8th North American Forest Ecology Workshop in Roanoke Virginia, June 20-23, 2011. Contact Rob Harrison if you would like a copy.

Feature Article

In 2004 we developed a proposal to AGENDA 2020 to sample 4 type II installations to examine the use of standing tree and log acoustic tools to predict stiffness of lumber or veneer that could be recovered. This proposal was successful and in 2006-2007 we harvested 228 trees from the installations with logs from half processed into veneer and the other half processed into lumber. All of the veneer and lumber was sent to the US Forest Products Laboratory in Madison, WI. for assessment of stiffness. By mid-2009 all of the field and laboratory data was available for the tedious process of integration, editing, error checking, etc. The following article by C.L. Huang, Affiliate Associate Professor in the UW School of Forest Resources, David Briggs, SMC Director, and Eini Lowell with the USFS PNW Research Station summarizes characteristics and value of the lumber recovered.

Log Lumber Value of Type II Thinned Douglas-fir Installations

Chih-Lin (CL) Huang, David G. Briggs, and Eini Lowell

Abstract

Lumber data from the 2007 lumber mill trial of four Type II sites were analyzed to summarize visual and structural grade yields. The yields of #2 & Btr range from 91% to 95% and the main reasons for end trim and visual downgrade are wane and knots. Based on the visual grade yield results, log lumber value is determined by log diameter; however, if the lumber is machine graded, some grades will not meet the design value. There are many high MOE pieces within the visual grade lumber to maintain the average MOE of the grade, but the amount of low MOE lumber in the distribution may fail the machine grading requirements. With the decreasing number of integrated forest companies, very limited knowledge sharing exists between manufacturers and log suppliers. The SMC can play an important role in bridging the knowledge gap.

Introduction

Douglas-fir is well-known for its stiffness and is also the most important timber species in the Pacific Northwest (PNW). About 70% of the harvested Douglas-fir is for lumber products, which includes less than 5% machine graded lumber (machine-stress-rated or MSR and machine-evaluated-lumber or MEL). Improved genetic and intensive management practices have increased the diameters of young Douglas-fir plantations, and the impacts of the increased mix of juvenile wood on the perfor-

mance of lumber products are of concern. Although the variability in the # 2 & Btr component is relatively small, diverse structural-grade yield among different plantation stands is not uncommon. The range of moduli of elasticity (MOEs) found among logs of the same morphology or grade is very large, and such a wide-range provides a great opportunity for tree improvement. With the increasing proportion of juvenile wood in the logs coming to market, and before any genetic gains in juvenile wood properties are recognized, it is becoming more challenging to find high stiffness logs for mills producing engineered wood products (EWP) in the PNW.

The SMC had conducted a lumber mill trial in March/April 2007 using representative trees from plots from four Type II Installations (Figure 1, Table 1). These sites were installed in 1987 and followed by different thinning treatments (Table 2). The objectives of the mill trial were to study the relationships between lumber stiffness and stand/tree/log variables, to determine if thinning affects lumber stiffness, and to investigate how to integrate the learning into decision support tools for stand management and log marketing.

The acoustic data and first-log lumber MOE results were summarized and presented at the 15th Wood Non-Destructive Testing Symposium in Duluth, MN (Briggs et al. 2007). This report will quantify lumber value of logs and discuss the effects of MOE on different lumber products.

Materials and Methods

Standing tree breast-height TreeSonic¹ velocity (TSV) was measured on 50 plot-centered trees. Mill trial trees were selected based on the distribution of TSV. A total of twelve trees from each plot were selected using the following four categories: two trees from the lowest 10% TSV, four from the medium-low 40% category, four from the medium-high 40% category, and two from the top 10%. Trees from each category were randomly chosen and allocated 50/50 to the veneer/lumber mill trial. The lumber trial trees were bucked into 33' logs in the woods, with some top logs shorter than 33' based on height to a 4" top. Woods logs were delivered to South Union Sawmill at Elma, WA, and cut into 16' logs in the log yard. Because length of the top logs varied, the uppermost vertical log may have measured less than 16'. Director HM200² data were collected on the 33' logs in the woods and the 16' logs at the mill before they were processed into mostly 2x4 and 2x6 lumber. In addition, the location and size of the largest knot in each quadrant of the 16' log segments were measured to calculate the large limb average diameter (LLAD) or branch

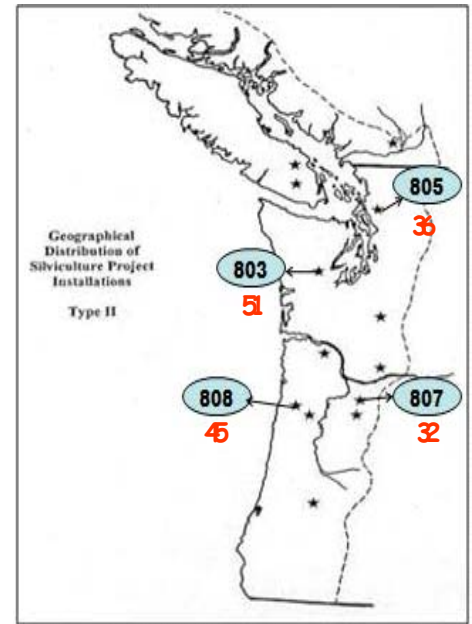


Figure 1 Locations of the Selected Type II Installations (The numbers in red are the ages of the trees at harvesting.)

¹ FAKOP tree thumper: <http://www.fakopp.com/site/treesonic>

² Fibre-gen Hitman log thumper: <http://www.fibre-gen.com/hm200.html>

index (BIX). The location and size of any ramicorn branch present was also recorded. Delay thinned plot of installation 808 was lost to wind-storm, so no data were available.

Finished lumber was visually graded by a certified grader from the Western Wood Products Association (WWPA) and then shipped to Forest Products Laboratory (FPL), Madison, WI for MOE determination. Lumber value from each log (pencil-trim deducted) was calculated using the 2010 year-end average lumber price published by WWPA. MOE was adjusted to 15% moisture content (Evans et al. 2001) to calculate the volume-weighted log MOE. The percentage of lumber that met MSR/MEL grade requirements was simulated based on the moisture content adjusted MOE.

Results and Discussion

Average lumber grade yield, tree size and value are summarized in Table 3. In total, 1,758 pieces of lumber from 317 logs (97 trees) were sawn. A small amount (less than 1% by volume) of 1-in lumber was produced. About 25% of the recovered lumber pieces were 2x4 and the remaining pieces were 2x6. The yields of #2 & Btr range from 91% to 95% and the average tree values are \$32, \$68, \$97, and \$105 for installations 807, 805, 808, and 803 respectively. These averages tree values increase in order by age of the installation (Table 3). Note that the value is based on the 2010 price when markets were poor and should improve with an upturn in the economy and housing market.

The commonly observed high visual grade yield of Douglas-fir plantations is partly due to the intrinsic microfibril angle (MFA) patterns. If compared to other warp prone species, the volume of high MFA or high shrinkage wood in a Douglas-fir log is small, which renders a warp stable lumber product (Fahey et al. 1991). Therefore, the lumber value of a Douglas-fir tree is mainly determined by the size of the log (Figure 2). The clustering of the data points in Figure 2, especially for the small logs, is most likely due to the discrete lumber price and low piece counts per log.

Table 1. The sample SMC Installations, mean values of plots

Inst #	Owner	Location	Yr planted	Yr estab.	Age estab.	Age 2006	SI m ^a (King)	QMD ^b cm	HT40 ^c m
803	Green Diamond	Shelton, WA	1/1955	1987	32	51	44	36	38
805	WADNR	Mt Vernon, WA	1/1970	1988	18	36	47	30	32
807	Port Blakely	Estacada, OR	1/1974	1989	15	32	38	28	25
808	Weyerhaeuser	Dallas, OR	12/1960	1989	29	45	39	33	31

^a SI is site index at 50 years breast-height age

^b QMD is quadratic mean dbh

^c HT40 is the average height of the 40 largest trees by dbh.

Table 2. Thinning regime, dates, age since planting of the installations

Treatment	Thinning	Relative Density (RD)	Thinning Dates				Age When Thinned			
Code	Regime	Trigger Sequence	803	805	807	808	803 (51)	805 (36)	807 (32)	808 (45)
A Control	No thinning		x	x	x	x	x	x	x	x
B Thinned	Minimal Thinning	RD55-RD30, no further thinning	1987	1990	1989	1991	33	21	15	31
C Delayed	Delayed thinning	RD55-RD30, no further thinning	none	none	1993	1993	none	none	19	33
E Light	Repeated, high density	RD55-RD35; RD 55-RD40, subsequent thinnings RD60-RD40	1987	1996	1989	1991	33	27	15	31
D Heavy	Repeated, low density	RD55-RD30, subsequent thinnings at RD50-RD30	1987	1990, 2004	1989, 2001	1993	33	21,34	15,30	33

Table 3. Lumber grade yield, tree size and value of the sampled installations.

Inst.	AGE	TREE No.	Avg-DBH (inch)	Avg-HT (ft)	Mill Length LOG Processed	Lumber Pieces 25% 2x4 75% 2x6	S (%)	No.1 (%)	No.2 (%)	No.3 (%)	E (%)	VALUE (\$/tree)
803	51	29	15.4	118	119	718	28	41	26	4	1	105
805	36	27	13.8	104	77	368	20	46	29	3	2	68
807	32	17	11.3	81	33	119	6	39	48	6	3	32
808	45	24	17.1	99	88	553	22	38	31	7	2	97
		97			317	1,758	23	41	30	5	2	76

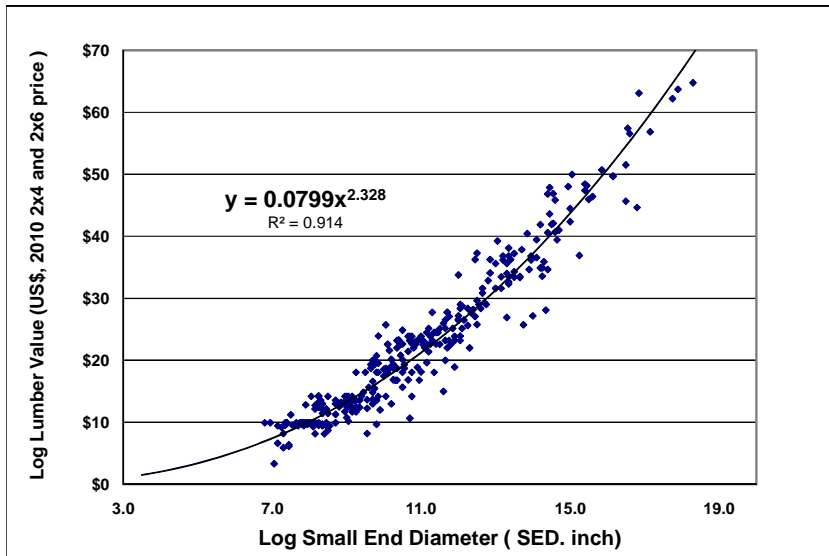


Figure 2. Relationship Between Small End Diameter (SED) and Log Lumber Value

Log lumber value and volume-weighted MOE by log position of the tested installations are summarized in Figures 3 & 4.

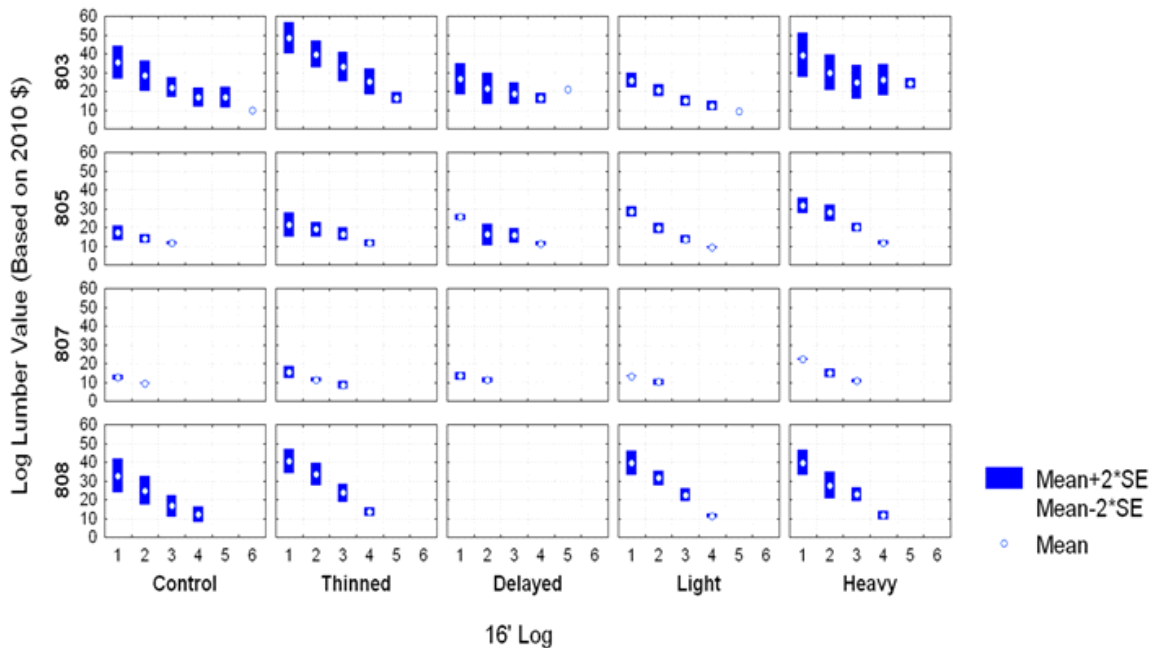


Figure 3. Log lumber value grouped by log position and thinning type. The 16' butt log is log number 1 on the horizontal axis with each succeeding log representing increasing vertical position within the tree.

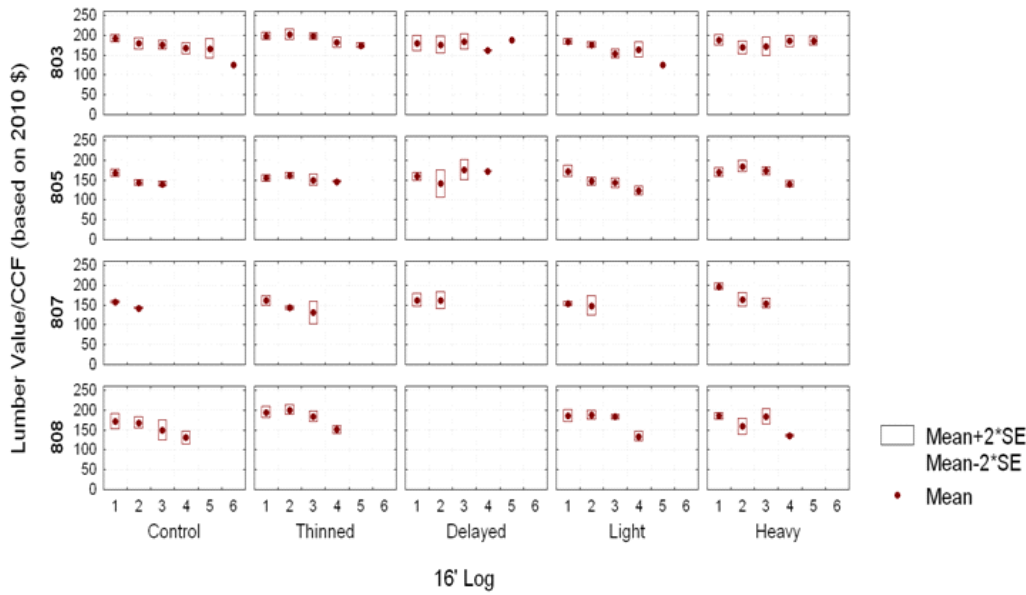


Figure 4. Value of lumber in a log per hundred cubic feet gross log volume grouped by log position and thinning type.

Diameter, taper/form, and branch size are important factors determining the value of visual graded products. Installation 808 has high taper and the decreasing trends of log lumber value in the upper logs is steeper than those of other installations. Lumber value per CCF is mainly determined by lumber recovery factor and knot size. MOE gradients from tree base to tree top are not as consistent as those of log lumber values (Figure 5), especially in the younger stands. Proportion of juvenile wood throughout the stem and associated lower specific gravity and high microfibril angle (Megraw 1986, Jozsa et al. 1989) are variables that impact MOE in younger trees.

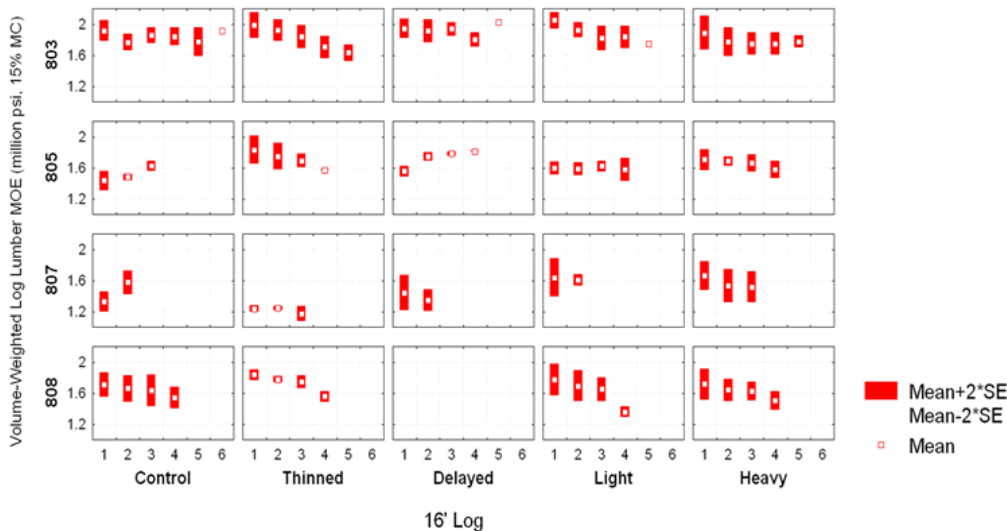


Figure 5. Log lumber MOE by log position and thinning type. The 16' butt log is log number 1 on the horizontal axis with each succeeding log representing increasing vertical position within the tree.

Lumber features that influence visual grades are shown in Table 4 along with average MOE, the percent of lumber that met design value, and density for each installation. As expected, wane and knots are the dominant reasons for trim and downgrade (Figure 6).

Table 4. Lumber properties of the tested sites (% pieces with major types of defects)

Site	MOE million psi	Density (lb/cu.ft) (MC~24%)	% Trim Wane	% Wane	% Face Knot	% Spike Knot	% Edge Knot	% Holes	% Slope of Grain	% Meet Design Value
803	1.934	35.5	7	47	40	12	8	4	1	64
805	1.686	34.4	15	57	51	10	8	2	2	44
807	1.451	32.5	10	57	50	19	9	7	1	26
808	1.671	36.2	8	51	46	11	9	2	3	42
	1.734	34.6	9	51	45	11	8	3	2	50

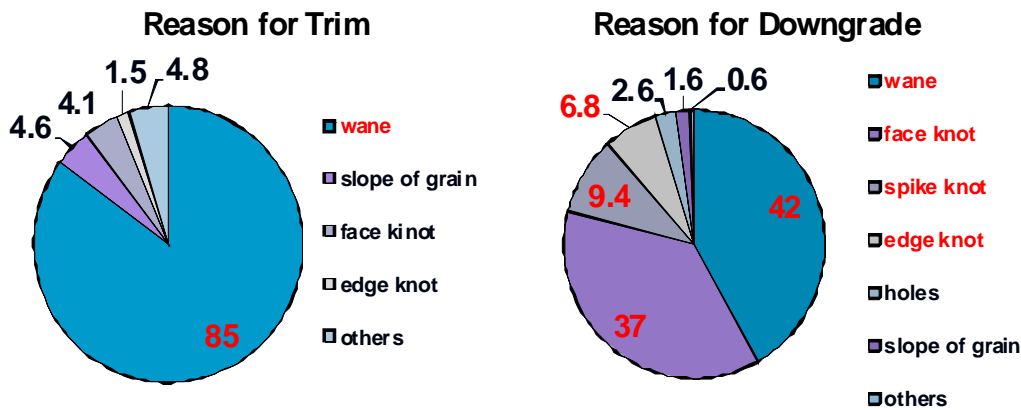


Figure 6. Percentages of end-trim and visual downgrade factors (all lumber combined)

The percent of Douglas-fir visual grade lumber that meets design value is related to the amount of juvenile wood (Barrett and Kellogg 1989). In this study, about 50% of the visual graded lumber met or exceeded the design value (Figure 7). Normally, about 65% of the pieces need to be above the design value to satisfy machine grading rules. The higher grades of the tested plantation lumber will mostly fail the MSR/MEL grading rules if the lumber were machine graded (Table 5).

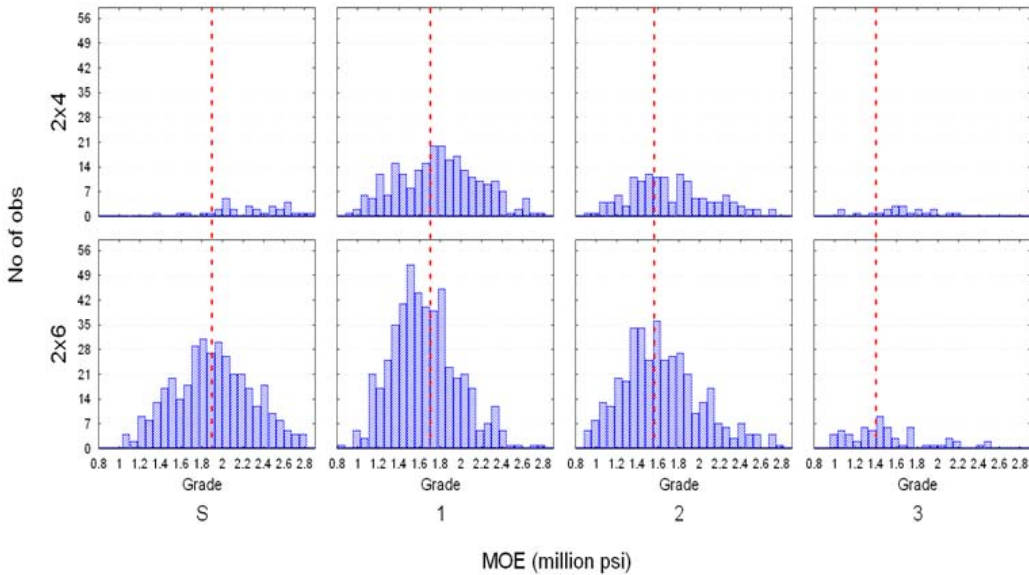


Figure 7. Distribution of lumber MOE by visual grades (the dotted vertical line is the structural design value). Also note the small sample size of Grade 3 and small amount of Select Structural 2x4.

Table 5. Average lumber MOE by visual grades (number in parentheses is MOE design value of the grade)

	S (1.9)	No1 (1.7)	No2 (1.6)	No3(1.4)	Econ
803	^2.054	*1.809	*1.833	**1.821	1.748
805	1.757	1.659	^ 1.603	**1.579	1.610
807	1.704	1.406	1.435	*1.598	1.588
808	1.888	1.642	1.572	1.337	1.453

- ^ MOE average meet the spec but its distribution does n't.
- Meet *MEL and **MSR MOE specs. (The amount of bebw-grade MOE pieces is more benient for MEL grading rules.)
- Note: UTS and other property data were not available for evaluation

The simulations were using only the MOE limit, so if additional design limits were incorporated in the simulations, the amounts of below-grade lumber are expected to be larger. One interesting observation of the test results is that when compared to pine species, MOE of the lower visual grade Douglas-fir lumber is relatively high, which may be explained by the superior intrinsic stiffness property of Douglas-fir. There are many high MOE pieces within the visual grade plantation-grown lumber that keep the average MOE of the grade on par, but the amount of low MOE lumber in the distribution can fail the grading rules. The cause of the additional low MOE pieces is most likely due to the increased proportion of juvenile wood within the log.

For a lumber mill, where the visual grade lumber is the main product, the amount of high MOE material could be enough to satisfy the small MSR/MEL market. Therefore, the effects of low MOE wood on Douglas-fir lumber mills are relatively small as long as majority of the lumber meet the visual specs. On the other hand, MOE is directly related to the value of engineered wood products (EWP), so for EWP mills, the additional low MOE materials directly reduce mill profit. Not only does extra low MOE material cause waste in an EWP mill, but additional high MOE materials also have to be purchased on the open market to fill customer orders. Unlike visually graded lumber, internal strength and stiffness are the key value factors of EWP. Balancing the MOE in a log mix for EWP mills is getting more complicated with the increasing amount of low MOE juvenile wood in the wood basket.

MOE is only one factor among other considerations in making various types of timberland investment and forest management decisions. Plantation forestry is a long term investment and knowledge gained from operational research such as a mill trial enables tree growers to tailor the prescription to meet customer needs and allocate logs for maximum profit. A clear understanding of internal quality of standing timber provides flexibilities for landowners to capture established and emerging markets and for manufactures to meet product specifications, adapt to changing grading rules, and develop new products. Such knowledge is necessary to gain market share and price advantages. Internal wood quality sorting technologies are necessary for log suppliers to deliver the right log to the right mill; however, the vendors may not have sufficient understanding in operation constraints for developing cost-effective tools for the timberlands and the mills. Logs account for 50%-70% of operational cost of a mill, and a consistent and reliable supply of log mix is always on the wish list of a mill manager. For some reason, communication barriers are frequently found between mills and log suppliers. The disappearance of vertically integrated forest companies makes sharing of information more difficult. The SMC can play an important role in bridging the knowledge gaps.

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Abstracts and Publications

Richardson, J.J., & Moskal, L.M., Strengths and limitations of assessing forest density and spatial configuration with aerial LiDAR, Remote Sensing of Environment (2011), doi:10.1016/j.rse.2011.05.020.

Changes in the structural state of forests of the semi-arid U.S.A., such as an increase in tree density, are widely believed to be leading to an ecological crisis, but accurate methods of quantifying forest density and configuration are lacking at landscape scales. An individual tree canopy (ITC) method based on aerial LiDAR has been developed to assess forest structure by estimating the density and spatial configuration of trees in four different height classes. The method has been tested against field measured forest inventory data from two geographically distinct forests with independent LiDAR acquisitions. The results show two distinct patterns: accurate, unbiased density estimates for trees taller than 20 m, and underestimation of density in trees less than 20 m tall. The underestimation of smaller trees is suggested to be a limitation of LiDAR remote sensing. Ecological applications of the method are demonstrated through landscape metrics analysis of density and configuration rasters.

Colin J. Ferster, a J.A. (Tony) Trofymow, Nicholas C. Coops, Baozhang Chen, T. Andrew Black, François A. Gougeon b. Determination of ecosystem carbon-stock distributions in the flux footprint of an eddy-covariance tower in a coastal forest in British Columbia. Canadian Journal of Forest Research, Published on the web , 10.1139/x11-055.

<http://www.nrcresearchpress.com/doi/abs/10.1139/x11-055>.

An important consideration when interpreting eddy-covariance (EC) flux-tower measurements is the spatial distribution of forest land surface cover and soil type within the EC flux-tower footprint. At many EC flux-tower sites, there is a range of geospatial data available with the ability to estimate the spatial distribution of forest land cover and soils. Developing methods that utilize multiple geospatial data sets will result in more thorough estimates of ecosystem C stock distributions. The objective of this study was to develop, apply, and validate methods to obtain comprehensive estimates of the spatial distribution of ecosystem C stock components from live-tree, detritus, and soil pools within an EC flux-tower footprint. First, a set of geospatial data sets was collected and assessed for

Abstracts and Publications cont.

its predictive ability for the measured aboveground C stocks. Next, large tree and snag aboveground C stocks were estimated using two methods: (i) a geospatial regression model, and (ii) most similar neighbor (k-MSN) spatial prediction methodology, and the results were compared with those of a multiple linear regression model using light detection and ranging (LiDAR) data alone. Finally, we applied the spatial prediction methodology to estimate the spatial distribution of other C stock components (including soil C and woody debris).

Vikas Vikram, Marilyn L. Cherry, David Briggs, Daniel W. Cress, Robert Evans, Glenn T. Howe. Stiffness of Douglas-fir: effects of wood properties and genetics. Canadian Journal of Forest Research, 2011, 41:(6) 1160-1173, 10.1139/x11-039.

Abstract: Because stiffness (modulus of elasticity (MOE)) is important for structural wood products, breeders and silviculturists seek to efficiently measure and improve this trait. We studied MOE in a 25-year-old progeny test of Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco) using field-based tools (ST300 and HM200) to measure stress wave MOE of standing trees and logs. We measured density, static bending MOE, and transverse vibration MOE on 2 × 4s, and density, SilviScan MOE, and SilviScan microfibril angle on small clearwood samples. Bending MOE had moderate to strong phenotypic and genetic correlations with stress wave MOE of trees and logs, transverse vibration MOE of 2 × 4s, and the densities of 2 × 4s and basal wood discs but was weakly correlated with the numbers and sizes of knots. The best lumber grade had the highest bending stiffness and smallest edge knots. Bending stiffness had a strong positive correlation with the density of small clearwood samples and a moderate negative correlation with microfibril angle. Compared with microfibril angle and edge knots, path analyses indicated that density had the strongest direct effect on bending MOE. We recommend that breeders measure and select for stress wave velocity to improve bending stiffness in Douglas-fir. Genetic gains can be increased by including wood density, but genetic selection for fewer or smaller knots will be ineffective.