From the Director

As I write this, the 03/04 field work has been completed. The field crew visited 50 installations (242 plots), down from 57 installations (325 plots) in the prior year. The database update is going through final checks before being sent to those who requested it. If you wish to get a copy or if you would like some tutorial assistance on using it, contact Randy Collier (rcollier@u.washington.edu) or John Haukaas (jhaukaas@u.washington.edu).

We have already developed a preliminary schedule for 04/05 field season; 81 installations (358 plots) will be visited, including 3 installations of the new Genetic Gain/Type IV trial that will be planted in early 2005. We are also reviewing current installations with respect to when they shift to a different measurement cycle and have identified a few issues that we will bring up for discussion at the Fall Meeting.

This issue features a brief summary of research conducted by Mariano Amoroso for his Master Thesis which he presented at the Spring meeting. He studied the sets of 3 Type III installations located in Brittain Creek and Forks. Each set includes Douglas fir, western hemlock, and a 50/50 mix planted at the range of Type III planting densities. He investigated the growth and yield characteristics of these species in the mixed stand as compared to the pure stands. His thesis is the basis of SMC Working Paper #3, which will soon be available for downloading from the SMC website, www.standmgt.org.

We hope you have a good summer and look forward to seeing you at the Fall Meeting; preliminary information is provided in this issue and we will be sending more details in August.

Dave Briggs, SMC Director
New Analytical Organization Member

FORSight Resources, LLC, 201 SE Park Plaza Dr., Suite 283, Vancouver, WA joined the SMC as an Analytic Organization member. FORSight Resources is a consultant in forest biometrics and growth and yield modeling. Kurt Muller, VP-Regional Operations will be the representative.

SMC Spring Meeting

The SMC Annual Spring Meeting was held at McMenamins Edgefield Inn on April 20-21 with 42 attendees from 24 organizations. Policy Committee Chair Mike Mosman opened the meeting and commented on the mission of the SMC and its continued importance. Director Dave Briggs reviewed highlights of the past year noting that we obtained agreement on the Genetic Gain/Type IV trials in the Grays Harbor breeding zone, and that seedlings for planting in 1995 are now growing. A report on the selection of sites for these trials can be found in this issue. External grants received in 1993 totaled $194,000 and another $17,400 was derived from special study contracts with members. Louise DeMontigny was successful with a proposal to the BC Forest Science Program to support their continued measuring of the BC installations. To see the complete minutes of the Spring meeting and Powerpoint presentations from the Technical Session, go to the SMC website www.standmgt.org and click on “SMC Meetings”.

RFNRP CD & Website

One of the outcomes of the joint fertilization/nutrition needs TAC meeting on April 1st was completion of a set of 4 CD’s that contain all of the annual reports, technical reports, theses, etc. produced by scientists involved with the Regional Forest Nutrition Research Program (RFNRP). This was a necessary first step in developing a synthesis of what was learned from that long-term project. The CD set can be purchased for $45.00 through Megan O’Shea, moshea@u.washington.edu, or you can go to the SMC website www.standmgt.org, “click on RFNRP Publications” and download any of these publications.

Type IV Sites

A group visited additional candidate areas for the Type IV Installations on May 4th. Three excellent sites for the installations to be planted in 2005 and two of the three needed for planting in 2006 have been found. There are other possibilities for the final site but we are still looking for a site superior to those currently proposed. If you have a site in, or close to, the Grays Harbor breeding zone that could be considered please contact Eric Turnblom ect@u.washington.edu for specifications.

Alder Symposium in March 2005

The last symposiums on red alder titled “Utilization and Management of Alder” and “The Biology and Management of Red Alder” were held in 1977 and 1994. Much has changed in the past decade. Alder lumber commands premium values, there are now intensively managed alder plantations, and environmental regulations have been developed that affect landowner management options. As a result of these changes, a group has been developing a symposium focused on what’s new in red alder. The objective of the symposium is to
provide an opportunity for the participants to share and discuss changes that are affecting red alder management and utilization, including advances in our understanding of biology and silviculture, market and economic values, and the regulatory climate.

The symposium will be held in the HUB Ballroom on the UW campus on March 23-25. March 23 will be a plenary session of invited speakers who will discuss the History and Future Sustainability of Alder and a landowner panel on The Past, Present and Future of Alder. March 24 will have concurrent sessions with the following themes: Alder Silviculture and Management, Biology and Ecology of Alder, Alder Utilization and Markets, and The Economic and Regulatory Climate for Alder. March 25 will be a field trip to natural and plantation alder stands and to an alder lumber manufacturer.

A Call for Papers associated with the themes for the concurrent sessions on March 24 and for Posters has just been distributed. For more information, visit the following website: http://www.cfr.washington.edu/research.smc/main/events.htm

**Fall Meeting**

The SMC Fall Meeting will be held on September 23-24 at the Little Creek Casino Hotel in Shelton, WA. It will start at 1:00 pm immediately following the conclusion of the conference “Effects of Management Practices on Productivity of Western Forests: A Forest Products Focus: http://www.westernforestry.org. We will hold a general business meeting and short technical program on the afternoon of the 23rd. On the 24th we will visit SMC Type III Installations Brittain Creek #919-920-921, which were planted together with spacing plots of Douglas-fir, western hemlock, and a 50/50 mix. This installation is one of those studied by Mariano Amoroso as part of his UW MS thesis. He presented this work at the Spring meeting and a summary is provided in this issue. We will also have a demonstration of the devices for nondestructive testing logs and standing trees by Peter Carter from Fibre-gen which produces these units. Finally, we will stop at one of the sites that will be used for a Genetic Gain/Type IV Installation; we plan to have the plot boundaries marked and have some, if not all of the plots pinned for planting.
On the Genetic Gains / Type IV (GGTIV) Joint Trials

Eric C. Turnblom, SMC Silviculture Team Leader and Assoc. Prof, UW
David G. Briggs, SMC Director and Professor, UW

After many years of design, discussion, and preparation, the prototype GGTIV installations will be established this year. It seems appropriate at this time to summarize here what these trials entail.

The genesis of the trials began with discussions between the Northwest Tree Improvement Cooperative (NWTIC), the Stand Management Cooperative (SMC), and other interested parties on how best to study the interactions between genetic improvements and silvicultural treatments. The SMC Type IV trials began to emerge as one possible way to accomplish this. The Type IV trials were designed to study four factors: genetic gain level, spacing, vegetation control, and fertilization regime. The Type IV trials were also designed to cover 3 Douglas-fir and 3 western hemlock breeding zones west of the Cascades placing six installations within each breeding zone. For logistical and other reasons, the six installations were to be established in a staggered fashion, three in one year, and the remaining three in the next year. To provide broad “ownership” of the trials, to lower costs, and to achieve other economies of space and other ways, the GGTIV joint trials were designed.

The Grays Harbor breeding zone was the first one selected for implementing the joint trials. After further discussion, a consensus emerged that the definition for the fertilization factor in these trials required more study before implementation, especially for this particular breeding zone. Therefore, the Grays Harbor trials do not include fertilization.

The objectives of the GGTIV trials are twofold: 1) to provide information to guide managers currently applying combinations of genetics, spacing and vegetation control; and 2) to 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.

The genetic gain factor is defined to have three levels: G1 – Unimproved, G2 – Intermediate gain (the SMC Type IV Trial portion does not use this level), and G3 – Elite gain. The three levels chosen for the spacing factor are: S1 – 15 x 15’, nominally 200 Stems Per Acre (SPA), S2 – 10 x 10’, nominally 440 SPA (Genetic Gain Trial portion uses this single density only), and S3 – 7 x 7’, nominally 900 SPA. Finally, the vegetation control factor has two levels defined as: V1 – Current Practice (defined as a single site prep; used only in SMC Type IV Trial portion and is consistent with SMC Type III practices), V2 – Complete
(defined as 80% or greater bare ground until crown closure; standard on all Genetic Gain Trial and on Type IV). A typical GGTIV installation might look like what appears in the following figure. There, the square boxes represent plots. Plots designated with a single genetic gain factor pertain to the Genetic Gain portion of the trial, the purple and gold plots are shared between the Genetic Gain portion and the SMC Type IV portion, plots designated with all three factors are pertinent to the Type IV portion, and green shading indicates the incomplete block portion of the SMC Type IV portion where vegetation is treated using “Current Practices.” Three of these will be planted in 2005, and three more in 2006. This will complete the number of replications for the Grays Harbor zone.
Growth and Yield of Douglas-fir & Western Hemlock in Pure and Mixed Planted Stands: Results at Age 12 from the SMC Type III Trials.

Mariano M. Amoroso, MSc., University of Washington

Eric C. Tumblom, University of Washington, Associate Professor, and SMC Silviculture Project Leader

David G. Briggs, University of Washington, Professor, and SMC Director

Introduction

When timber production is the primary objective of management, there is a clear tendency to favor monocultures of the most productive species. The main reason for this is the simplification of management by the use of a single component in the stand, but also, and no less important, because less is known about planted mixed stands and the interactions between species. In contrast, when mixed species stands are favored, the objectives usually include wildlife conservation, aesthetics, resistance to wind damage, risk reduction or compensatory growth, and protection from disease and insect outbreaks. A sacrifice in productivity is usually assumed to occur as a consequence of the use of mixed species stands (Kelty 1992). This research examines the validity of this assumption including the possibility of achieving equal or greater total yields when using mixed species planted stands as opposed to monocultures of equal densities.

In accordance with what previous studies have shown (King 1958, Scholz and Smith 1975, Wierman and Oliver 1979) it is likely that Douglas-fir (Pseudotsuga menziesii (Mirb.) Franco) and western hemlock (Tsuga heterophylla (Raf.) Sarg.) will exhibit “ecological combining ability” and have greater productivity in a mixed stand than the pure stands of its components. However, all of the previous research on Douglas-fir and western hemlock mixtures has examined natural stands. The questions are whether the patterns of stratification and growth of these species observed in natural stands also occurs in plantations, and how trees may be influenced by stand density; both questions have not yet been addressed.

Objectives

The objectives of this study were to assess differences in growth and productivity between Douglas-fir and western hemlock growing both in pure and mixed plantations across a range of planting densities. This research examined growth and yield performance for the first 12 growth seasons after establishment at three density levels (200, 450 and 700 TPA).

Methods

Experimental Sites and Design: This study was conducted at two sites (Brittain Creek and Forks) located on the Olympic peninsula in the state of Washington, US, and a total of six Type III installations (three at each site) were considered in the analysis.

The study had a Complete Randomized Block Split-Plot Design, where Species Composition (pure Douglas-fir; pure western hemlock, and a 50/50 mix of these two species) and Initial Spacings (100, 200, 300, 440, 680, and 1210 trees per acre) were randomly assigned.
Data Analysis
Based on variables measured in the field, mean individual tree and stand attributes were calculated by plot for each of the measurements, and quadratic response surfaces were fit using multiple regression analysis to the dependent variables (DBH, Height, tree volume, BA per acre, etc) in the following general model:

\[ Y = f(\ c_1, c_2, sp_1, sp_2, TPA, Age, TPA^2, Age^2, \text{interactions}) \]

Where:
- \( Y \) denotes the response variable (DBH, Height, etc...),
- \( c_1 \) & \( c_2 \) denote categorical variables used to indicate Douglas-fir and western hemlock as a component of the mixed stands,
- \( sp_1 \) & \( sp_2 \) denote categorical variables used to indicate Douglas-fir and western hemlock as the single component in the pure stands,
- \( TPA \) denotes density expressed in number of trees per acre,
- \( Age \) denotes plantation age in years.

Values for three proposed density levels (200, 450 and 700 trees per acre) were predicted at three ages (4, 8 and 12). The analyses included individual tree and stand growth, as well as absolute and relative stand yield.

Results
Height Growth (Figure 1): Growing in pure stands Douglas-fir was significantly taller than western hemlock only at 200 TPA. As components of the mixed stands, Douglas-fir was on average 7 feet taller than western hemlock across all densities.

Growth comparisons for both species in pure and mixed stands showed that western hemlock was on average 3 feet taller growing in pure stands. Douglas-fir, instead, had the same height both in pure and mixed stands when it grew at 200 and 450 TPA but became about 3 feet taller at 700 TPA.

Diameter Growth (Figure 2): Differences in diameter between the two single species stands were significant at 200 TPA only. Growing together, Douglas-fir was on average 1.5 inches greater than western hemlock at all densities.

Western hemlock was 1 inch greater when it grew in pure stands and this was consistent across all densities. Douglas-fir, on the other hand, became half inch greater when it grew at high densities in the mixture.
Volume per Acre (Figure 3): At 200 and 450 TPA, either one or both monocultures resulted in higher significant productivity than the mixture. However, no significant differences were found among the monocultures and the mixture at 700 TPA. Furthermore, at this density the mixed stand resulted in the highest absolute volume per acre.

Relative Yield (Figure 4): A method for analyzing the effects of combining two species in a mixture is by comparing the yield of each species in mixture with its yield in a pure stand (Harper 1977).

\[
R_Y^{\text{Douglas-fir}} = \frac{\text{yield of Douglas-fir in mixture}}{\text{yield Douglas-fir in monoculture}}
\]

\[
R_Y^{\text{western hemlock}} = \frac{\text{yield of western hemlock in mixture}}{\text{yield of western hemlock in monoculture}}
\]

Relative Yield Total (RYT) = \( R_Y^{\text{Douglas-fir}} + R_Y^{\text{western hemlock}} \)

Results for this analysis showed that at 700 TPA RYT was greater than 1 suggesting a beneficial relationship between species and a potential advantage for the mixture compared to the monocultures may exist.

**Discussion**

The increase in productivity seen in the mixture at high densities (RYT > 1 and equal volume compared to the monocultures) seems to be due, in part, to early stratification observed and probably also to fuller use of the site resources. This probably indicates that less interspecific competition was experienced in the mixed stand than intraspecific competition in the pure stands. Even when interactions occurred at low and medium densities, they may not have been of large enough magnitude to cause the mixture to outyield the pure plantations. This study shows the important role density plays on the productivity of mixed stands, and thus its importance in comparing mixtures to pure stands.

**Conclusions**

- At age 12 Douglas-fir outgrew western hemlock in height by an average of 7 feet across all densities.
• Even though the evidence of stratification at this point is partial, the different juvenile height growth observed and the height differences already established for the two species in the mixed plantations support the conclusion that stratification will eventually occur.

• Douglas-fir trees experienced an increase in diameter and height in the mixture compared to the monoculture.

• The relative and absolute yield analyses revealed that at 700 TPA the mixture was as productive as the two monocultures.

• It appears that interactions between the species involved in a mixture occur in different degrees depending on the amount of resources they are obligated to share and/or for which they compete.

• The study results presented here support the important role density plays on the productivity of mixed stands, and thus in comparing mixtures and monocultures.

• Similar analysis after further development of these stands may reveal new insights on these growth relationships and how they are influenced by density.

References


Upcoming Meetings and Events

July 26-29, 2004 – Western Forest and Conservation Nursery Association Annual Meeting. Red Lion Hotel, Redmond, Oregon. For more information on the workshop please visit: http://www.westernforestry.org/westnurseryassoc/nursery.htm


September 23-24 – 2004 Stand Management Cooperative Fall Meeting. This year’s fall meeting will be held as a joint meeting with the Western Forestry & Conservation Association meeting: Effects of Management Practices on Productivity of Western Forests: A Forest Products Focus. The meeting will be held in Olympia on September 20-23. For more information on the Western Forest meeting please visit http://www.westernforestry.org/. More information regarding the SMC meeting will be posted on the SMC’s web page: http://www.standmgt.org.


Abstracts and Publications

Leith Knowles, Lars Hansen, Geoff Downes, Mark Kimberley, Doug Gaunt, John Lee, and John Roper. Modeling within-tree and between-tree variation in Douglas-fir wood and lumber properties. Paper presented to IUFRO All Division 5 Conference, Rotorua NZ, 11-15 March, 2003. Section 5.01.04 Connection between Forest Resources and Wood Quality: Modeling Approaches and Simulation Software. E-mail contact: Leith.Knowles@forestresearch.co.nz

Abstract

The ability to accurately predict tree growth and wood quality is becoming increasingly important, as plantation management focuses more closely on profitability, and on product performance. Douglas-fir is the second most important tree species for timber production in New Zealand, where it is mainly used for structural purposes. This study presents results from a detailed examination of the wood and lumber properties of eighteen Douglas-fir trees in a stand aged 41 years, grown at Rotoehu Forest from seed originating from Fort Bragg (coastal California). The eighteen trees were selected from 49 trees for intensive study using a ‘response surface’ sampling design to cover the range for density, microfibril angle (MFA) and branch size, and thus for stiffness (MoE). A range of wood properties including MoE, strength (MoR), density and MFA were assessed from cores, discs, small clears extracted from short billets and timber recovered from sawlogs. These tests were designed to cover the radial and vertical distributions within the trees. All properties improved with increasing distance from the pith. Density showed much less of a radial trend than MFA with MoE being intermediate. All properties showed only a small effect of improving quality with increasing height above ground. Between tree variation was high for density and MoE, but relatively low for MFA. A model was constructed to predict timber MoE from the breast height properties of outerwood density and branch index, which explained 64% of the whole-tree timber MoE.

Abstract
This paper reports the first phase of a recent effort to evaluate the performance and use of the FVS-SEAPROG vegetation growth model. In this paper, we present our evaluation of SEAPROG's performance in modeling the growth of even-aged stands regenerated by clearcutting, windthrow, or fire. We evaluated the model by comparing model predictions to observed values from two sets of long-term permanent plots. We examined six variables: trees per acre, quadratic mean diameter, basal area per acre, height of the largest 40 trees per acre, cubic-foot volume per acre, and board-foot volume per acre. The differences between observed and predicted values were large enough to have important implications for the interpretation and use of the model's predictions. Of even greater importance was the evidence for considerable bias in quadratic mean diameter, basal area, height, and volume, all of which were systematically underestimated. Our results appear to validate the concerns expressed by users. Availability: http://www.fs.fed.us/pnw/pubs/rp555.pdf


Abstract
The STHARVEST computer application is Windows-based, public-domain software used to estimate costs for harvesting small-diameter stands or the small-diameter component of a mixed-sized stand. The equipment production rates were developed from existing studies. Equipment operating cost rates were based on November 1998 prices for new equipment and wage rates for the Pacific Northwest. There are four ground-based and two cable harvesting systems. Harvesting costs can be estimated for both clearcutting and partial cutting for an average tree size ranging from 1 to 80 or 150 cubic feet depending on the system selected. Cost estimates are in U.S. dollars per 100 cubic feet or per green ton. Availability: http://www.fs.fed.us/pnw/pubs/gtr582.pdf.


Abstract
An Aquatic and Riparian Effectiveness Monitoring Plan (AREMP) for the Northwest Forest Plan is intended to characterize the ecological condition of watersheds and aquatic ecosystems. So to determine the effectiveness of the Northwest Forest Plan to meet relevant objectives, this report presents the conceptual foundation of options for use in pilot testing and implementing an effectiveness monitoring program for aquatic and riparian systems. The base program would evaluate status and trends of watershed, stream, and riparian conditions by using decision-support models. Although the focus of AREMP is on characterizing ecosystem status and trend, implementing it will also supply information that will be useful in determining causal relations to help explain those trends. Availability: http://www.fs.fed.us/pnw/pubs.