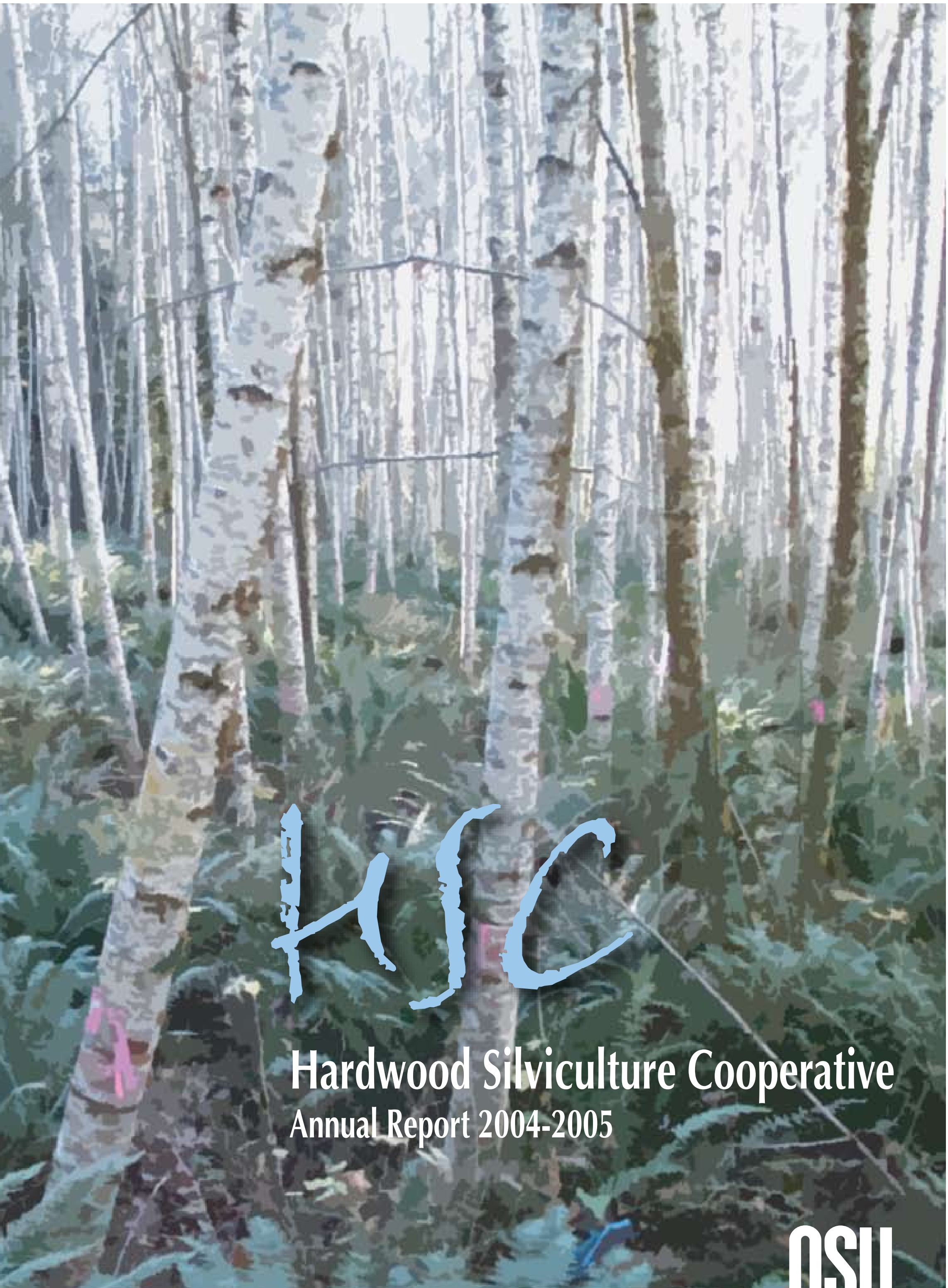

HSC

Hardwood Silviculture Cooperative

Annual Report 2004-2005

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Hardwood

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Cooperative

Hardwood Silviculture Cooperative

Annual Report

2004-2005

Highlights of 2004-2005

- All of the hard work and planning for the “Red alder: A State of Knowledge” symposium paid off. Approximately 180 people attended the symposium held in Seattle on March 23-25, 2005. Regional experts discussed many topics surrounding red alder including the economic, ecological, and social values of red alder. Every presentation was video taped and all presentations can be viewed using the Rural Technology Initiative (RTI) “streaming video” technology. Please see http://www.ruraltech.org/video/2005/alder_symposium/index.asp for downloading instructions. Compact discs are also available and written proceedings will be published.
- BC Ministry of Forests has successfully incorporated red alder into their growth and yield model, TASS. The publicly available version, TIPSY, can now be downloaded free from the internet. For more information on TASS or TIPSY (including downloading directions) contact the website: http://www.for.gov.bc.ca/hre/gymodels/
- The “regional” modeling effort is still on schedule. The Stand Management Cooperative (SMC) has completed assembling the database and now the activity has switched to identifying modeling options, and funding.
- Dave and Andrew, with logistical and financial support from Robert Deal, with the PNW Research Station, have completed the field-sampling stage of a research project to develop volume equations for managed stands of red alder. Andrew and Sean Garber (research assistant at OSU) are currently analyzing the data.
- The HSC may have a new member starting next year. We have a verbal understanding of membership with a hardwood manufacturing company, however, nothing is yet official.
- Three more of our Type 2 sites have had the 12th year growth measurement, making a grand total of fourteen (of the twenty six) sites with twelve years of measurements.
- After this coming winter (Fall 2005- Spring 2006) every Type II site will have had at least its 9th year growth measurement.

C O N T E N T S

HSC Executive Summary 2005

Once again, this last year has been a very busy and productive year for the Hardwood Silviculture Cooperative (HSC). First established in 1988, the HSC was formed to learn more about hardwood management in general, and red alder plantation growth, specifically. The HSC's study design includes thirty-six study installations from Coos Bay, Oregon to Vancouver Island, British Columbia divided into three types:

- 4 thinning studies in natural stands
- 7 replacement series studies of red alder/Douglas-fir mixtures
- 26 variable density plantations with thinning and pruning treatments

The data collected from these sites is accumulating rapidly. Because of both the extensive and intensive nature of the HSC study design, massive amounts of data are collected, archived, and then used in various data analyses. Many thanks go out to all of the cooperators in getting the data collected and setting research priorities. The database is now large enough to investigate many aspects of red alder stand dynamics. Currently, 14 of our 26 plantations are at least 12 years old- maybe half of a rotation!

One of the specific goals this last year was to create a red alder growth and yield model. To that effect, the HSC has been busy with two modeling efforts. First, our work with the B.C. Ministry of Forests has paid off with the release of TIPSY 3.2, a publicly available growth and yield model that includes red alder. Secondly, we have finished assembling a regional red alder database and are currently in the process of choosing modeling options and acquiring funds. Two models (ORGANON and FVS) have been identified as likely candidates; however, the ultimate goal would be to get red alder included in all PNW growth models.

An unexpected (but fortuitous) partnership developed this year as well. The HSC teamed up with the USFS PNW Research Station to develop taper equations for alder plantations. The development of these equations is timely. As already mentioned, alder growth models are being developed based on plantation data. To accurately predict the wood volume in these stands, accurate tree volume equations based on plantation trees are needed. The HSC study design fortunately allowed destructive tree sampling from the "buffers" to test if various silvicultural treatments (initial planting density, pruning, and thinning) affect tree form/taper. Data collection is complete and data analysis is well underway.

There's bad news and good news as far as HSC membership. First the bad news; two long-time representatives, Norm Anderson (WA DNR), and Dale Anders (ODF) have retired and are no longer with us. We wish them both good luck. The good news is they have been replaced by George McFadden and Mike Cafferata. Welcome aboard. Furthermore, we may gain at least one new member this coming year and the symposium just held has generated a lot of interest in alder in general and the HSC, in particular.

Unlike yesteryear, managing red alder stands has gained a certain level of acceptance among foresters in the Pacific Northwest. Part of this is market driven, but part is due to the efforts of the HSC and all of its members. Whoever would have thought way back in 1988, that the idea of alder management would be so popular today? We've come a long way.

History of the HSC

The Hardwood Silviculture Cooperative (HSC) is a multi-faceted research and education program focused on the silviculture red alder (*Alnus rubra*) and mixes of red alder and Douglas-fir (*Pseutotsuga menzeisii*) in the Pacific Northwest. The goal of the HSC is improving the understanding, management, and production of red alder. The activities of the HSC have already resulted in significant gains in understanding of regeneration and stand management, and have highlighted the potential of red alder to contribute to both economic and ecological forest management objectives.

The HSC, begun in 1988, is a combination of industry and both federal and state agency members, each with their own reasons for pursuing red alder management. For instance, some want to grow red alder for high-quality saw logs, while others want to manage red alder as a component of bio-diversity. What members have in common is that they all want to grow red alder to meet their specific objectives.

Members invest in many ways to make the HSC a success. They provide direction and funds to administer the Cooperative. They provide the land for research sites and the field crews for planting, thinning, and taking growth measurements.

The HSC's highest priority is understanding the response of red alder to intensive management. To accomplish this, the HSC has installed 26 variable-density plantations extending from Coos Bay, Oregon to Vancouver Island, British Columbia. The majority of plantations are located in the Coast Range, with a few in the Cascade Range. The plantation distribution covers a wide range of geographic conditions and site qualities. At each site, cooperators planted large blocks of red alder at densities of 100, 230, 525, and 1200 trees per acre. Each block is subdivided into several treatment plots covering a range of thinning and pruning options (twelve total treatments per site).

In addition to the 26 variable-density plantations, the HSC has related studies in naturally regenerated stands. Young stands (less than 15 years old) of naturally regenerated red alder, 5 to 10 acres in size, were pursued as a means of short-cutting some of the lag time before meaningful thinning results could be obtained from the variable-density plantations. It came as a surprise to find only four naturally regenerated stands of the right age and size available in the entire Pacific Northwest.

The HSC has also established seven mixed species plantations of red alder and Douglas-fir. They are located on land designated as Douglas-fir site class III or below. Each plantation is planted with 300 trees per acre with five proportions of the two species. The site layout is designed to look at the interactions between the two species. We are finding that in low proportions and when soil nitrogen is limited, red alder can improve the growth of Douglas-fir. This improvement is due to the nitrogen fixing ability of red alder. The management challenge is to find the right proportion of the two species to maintain a beneficial relationship.

Since the HSC was established, we have learned a great deal about seed zone transfer, seedling propagation, stocking guidelines, identification of sites appropriate for red alder, and the effects of spacing on early tree growth (see the HSC web-page http://www.cof.orst.edu/coops/hsc for more information). Furthermore, the data set is now complete enough to begin analyzing the growth response of red alder after thinning and/or pruning. Our ultimate goal is a better understanding of the effects of stand density on red alder growth and yield, and wood quality and to develop a red alder growth model.

The HSC red alder stand management studies are well designed and replicated on a scale rarely attempted in forestry. Over the next 20 years, we will harvest much from our investment. Our data set on growth of managed stands will make red alder one of the better-understood forest trees of the Pacific Northwest.

Cooperative Research

Red Alder Stand Management Study

The Red Alder Stand Management Study is divided into three specific types of installations. Study installations are predominately located in the coastal mountain ranges of the Pacific Northwest from Coos Bay, Oregon to Vancouver Island, British Columbia (Figure 1). The three types of study installations are as follows:

- Type 1 is a natural red alder stand thinned to 230 and 525 trees per acre. There are four Type 1 installations.
- Type 2 is a variable-density red alder plantation. At each site, red alder is planted in large blocks at densities of 100, 230, 525, and 1200 trees per acre. Each block is subdivided into several thinning and pruning treatments. There are twenty-six Type 2 installations.
- Type 3 is a mixed species plantation of red alder and Douglas-fir. Each site is planted to 300 trees per acre with five proportions of the two species.

The primary focus of the Red Alder Stand Management study continues to be the Type 2 variable-density plantations. Type 2 installations are distributed across a matrix of five ecological regions and three site qualities (Table 1).

1. Location of installations for the Red Alder Stand Management Study.

Table 1. Matrix of Type 2 installations. Each installation identified by number, ownership, and year planted.

	Site Quality		
	Low	Medium	High
Region	SI50 :23-27 M SI20 :14-17 M	SI50 :28-32 M SI20 :18-20 M	SI50 :33+ M SI20 :21+ M
1) Sitka Spruce North	X	1201 DNR '91	1202 BCMin '94 1203 DNR '96
2) Sitka Spruce South	2202 SNF '91 2206 SNF '95	2203 NWH '92 2204 SNF '94	2201 WHC '90 2205 NWH '94
3) Coast Range	3204 SNF '92 3209 BLM '95	3202 WHC '90 3205 ODF '92 3207 BLM '94 3208 ODF '97	3203 NWH '92 3206 WHC '93 3210 OSU '97
4) North Cascades	4205 BCMin '94	4202 GYN '90 4203 BCMin '93 4206 DNR '95	4201 GYN '89
5) South Cascades	5205 GPNF '97	5203 BLM '92 5204 WHC '93	X

Definition of Acronyms

1. BCMin-British Columbia Ministry of Forests.
2. BLM-Bureau of Land Management.
3. DNR-Washington Department of Natural Resources.
4. GYN-Goodyear-Nelson.
5. GPNF-Gifford Pinchot National Forest.
6. MBSNF-Mt. Baker Snoqualmie National Forest.
7. NWH-Formerly Northwest Hardwoods.
8. ODF-Oregon Department of Forestry.
9. OSU-Oregon State University Forest Research Laboratory.
10. SNF-Siuslaw National Forest.
11. WHC-Washington Hardwood Commission.

With each passing year, more and more treatments are applied and data collected. Tables 2, 3, and 4 describe the data collection schedules for the three installation types. The shaded areas of the tables indicate what activities have been completed and illustrate the tremendous accomplishments of the HSC to date.

Winter 2005 had the least amount of fieldwork in over a decade. This minimal fieldwork reflects not just the gradual decrease in measurement/treatment activities as the stands age but also the vagrancies of the measurement cycles. Fieldwork was completed on 6 installations (Table 5):

- One Type 1 installation (Janicki) had the 14th year measurement.
- Four Type 2's had fieldwork. Maxfield (WADNR) had its 9th year measure, two plots thinned, and a 2nd pruning lift. Hemlock Creek, Blue Mtn. (WHC), and Mohun

Table 2a. Data Collection Schedule for Type 2 Installations. Shaded areas indicate completed activities.

TYPE 2	GYN	WHC	WHC	GYN	DNR	SNF	NWH	NWH	SNF	ODF	BLM	WHC	BCmin
Site Number	4201	2201	3202	4202	1201	2202	2203	3203	3204	3205	5203	3206	4203
Site Name	Humphrey Hill	John's River	Ryderwood	Clear Lake	LaPush	Pollard Alder	Pioneer Trail	Sitkum	Keller-Grass	Shamu	Thompson Cat	Blue Mtn.	Mohun Ck.
Year Planted	1989	1990	1990	1990	1991	1991	1992	1992	1992	1992	1992	1993	1993
1st yr Regen	1990	1991	1991	1991	1992	1992	1993	1993	1993	1993	1993	1994	1994
2nd yr Regen	1991	1992	1992	1992	1993	1993	1994	1994	1994	1994	1994	1995	1995
Plot Installation	1992	1993	1993	1993	1994	1994	1995	1995	1995	1995	1995	1996	1996
3rd yr Measure	1992	1993	1993	1993	1994	1994	1995	1995	1995	1995	1995	1996	1996
3-5 yr Thin	1993	1996	1996	1994	1996	1996	1997	1998	1997	1997	1996	1998	1998
Prune Lift 1 6ft	1995	1996	1996	1996	1996	1996	1997	1998	1997	1997	1996	1998	1998
6th yr Measure	1995	1996	1996	1996	1997	1997	1998	1998	1998	1998	1998	1999	1999
15-20' HLC Thin	1995	1999/07?	1999	1996	1999	1999/02	2000	2001	2001	2000	2000	2002	2001/03
Prune Lift 2 12ft	1995	2002	1999	1996	2002	2000	2000	2001	1999	2000	2000	2002	2002
9th yr Measure	1998	1999	1999	1999	2000	2000	2001	2001	2001	2001	2001	2002	2002
Prune Lift 3 18ft	1998	2007?	2002	1999	2008?	2003	2004	2001	2009	2004	2004	2002	2010?
12th yr Measure	2001	2002	2002	2002	2003	2003	2004	2004	2004	2004	2004	2005	2005
30-32' HLC Thin	2001	2007?	NA	2002	2008	2008?	2009	2004	NA	2009	2009	2007	2010?
Prune Lift 4 22 ft	2001	2007?	2002	2002	?	2008?	2009	2004	?	2009	2009	2007	?
17th yr Measure	2006	2007	2007	2007	2008	2008	2009	2009	2009	2009	2009	2010	2010
22nd yr Measure	2011	2012	2012	2012	2013	2013	2014	2014	2014	2014	2014	2015	2015

Table 2b. Data Collection Schedule for Type 2 Installations. Shaded areas indicate completed activities.

TYPE 2	WHC	BCmin	SNF	NWH	BLM	BCmin	SNF	BLM	DNR	DNR	ODF	OSU	GPNF
Site Number	5204	1202	2204	2205	3207	4205	2206	3209	4206	1203	3208	3210	5205
Site Name	Hemlock Ck.	Lucky Ck.	Cape Mtn.	Siletz	Dora	French Ck.	Mt. Gauldy	Scappoose	Darrington	Maxfield	Weebe Packin'	Wrongway	Tongue Mtn.
Year Planted	1993	1994	1994	1994	1994	1994	1995	1995	1995	1996	1997	1997	1997
1st yr Regen	1994	1995	1995	1995	1995	1995	1996	1996	1996	1997	1998	1998	1998
2nd yr Regen	1995	1996	1996	1996	1996	1996	1997	1997	1997	1998	1999	1999	1998
Plot Installation	1996	1997	1997	1997	1996	1996	1997	1998	1997	1998	2000	2000	2000
3rd yr Measure	1996	1997	1997	1997	1997	1997	1998	1998	1998	1999	2000	2000	2000
3-5 yr Thin	1998	1999	1999	1999	1999	1999	2001	2000	2000/01	2002	2003/06	2003/06	2003/06
Prune Lift 1 6ft	NA	1999	1999	1999	2003	1999	2001	2000	2000	2002	2003	2003	NA
6th yr Measure	1999	2000	2000	2000	2000	2000	2001	2001	2001	2002	2003	2003	2003
15-20' HLC Thin	2002	2006?	2006	2003/06	2003/06	2003/06	2004/07	2004/07	2002/07	2005/08	?	?	?
Prune Lift 2 12ft	NA	2006?	2003	2003	2006	2003	2004	2004	2002	2005	2006?	2006?	NA
9th yr Measure	2002	2003	2003	2003	2003	2003	2004	2004	2004	2005	2006	2006	2006
Prune Lift 3 18ft	NA	?	2011?	2008?	?	2006?	2007?	2007?	2004	?	?	?	NA
12th yr Measure	2005	2006	2006	2006	2006	2006	2007	2007	2007	2008	2009	2009	2009
30-32' HLC Thin	2007	?	?	2006?	?	2006?	?	?	?	?	?	?	?
Prune Lift 4 22 ft	NA	?	?	?	?	?	?	?	?	?	?	?	NA
17th yr Measure	2010	2011	2011	2011	2011	2011	2012	2012	2012	2013	2014	2014	2014
22nd yr Measure	2015	2016	2016	2016	2016	2016	2017	2017	2017	2018	2019	2019	2019

Table 3. Data Collection Schedule for Type 1 Installations. Shaded areas indicate completed activities.

TYPE 1	BCmin	SNF	DNR	MBSNF
Site Number	4101	2101	4102	4103
Site Name	Sechelt	Battle Saddle	Janicki	Sauk River
Plot Installation	1989	1990	1991	1994
1st yr Measurement	1989	1990	1991	1994
3rd yr Measurement	1992	1993	1994	1997
6th yr Measurement	1995	1996	1997	2000
9th yr Measurement	1998	1999	2000	2003
14th yr Measurement	2003	2004	2005	2008
19th yr Measurement	2008	2009	2010	2013
24th yr Measurement	2013	2014	2015	2018

Table 4. Data Collection Schedule for Type 3 Installations. Shaded areas indicate completed activities.

TYPE 3	BCmin	NWH	GYN	BCmin	DNR	SNF	GPNF
Site Number	4302	2301	4301	4303	3301	2302	5301
Site Name	East Wilson	Monroe-Indian	Turner Creek	Holt Creek	Menlo	Cedar Hebo	Puget
Year Planted	1992	1994	1994	1994	1995	1996	1997
1st yr Regen Survey	1993	1995	1995	1995	1996	1997	1998
2nd yr Regen Survey	1994	1996	1996	1996	1997	1998	1999
Plot Installation	1993	1996	1996	1996	1998	1999	2000
3rd yr Measurement	1995	1997	1997	1997	1998	1999	2000
6th yr Measurement	1998	2000	2000	2000	2001	2002	2003
9th yr Measurement	2001	2003	2003	2003	2004	2005	2006
12th yr Measurement	2004	2006	2006	2006	2007	2008	2009
17th yr Measurement	2009	2011	2011	2011	2012	2013	2014
22nd yr Measurement	2014	2016	2016	2016	2017	2018	2019

Table 5. Hardwood Silviculture Cooperative Field Activities, Fall 2004-Winter 2005

Type	**Activity**	**Installation**	**Cooperator**
Type 1	14yr Measurement	4102	WADNR- Janicki
Type 2	15-20ft HLC Thin, Measure & Prune	1203	WADNR- Maxfield (2 of 3)
	9yr Measurement	1203	WADNR- Maxfield
	30-32ft HLC Thin, Measure & Prune	4203	BCMIN- Mohun Ck. (??)
		3206	WHC- Blue Mtn (4th lift)
	12yr Measurement	5204	WHC- Hemlock Ck.
		4203	BCMIN- Mohun Ck.
		3206	WHC- Blue Mtn.
Type 3	9yr Measurement	2302	SNF- Cedar Hebo

Creek (BCMin) had their 12th year measurements and various treatments.

- One Type 3 installation (Cedar Hebo) had the 9th year measurement.

This coming year's fieldwork (Fall 2005- Spring 2006) is the exact opposite of last year; measurements need to be taken on 13 sites! In addition to the measurements, there are numerous thinning and pruning treatments (Table 6):

- No Type 1 measurements.
- Nine Type 2 sites need to be measured with thinning and/or pruning on 7 of the 9.
- Four Type 3 sites.
- Three of the sites are "orphaned" which will require a winter measurement meeting and/or volunteer help.

Table 6. Hardwood Silviculture Cooperative Field Activities, Fall 2005-Winter 2006

Type	Activity	Installation	Cooperator
Type 1	None		
Type 2	15-20ft HLC Thin,	1202	BCMin- Lucky Ck. (thin 2 plots, 2nd lift)
	Measure & Prune	2204	SNF- Cape Mtn. (thin 2 plots)
		2205	ANE- Siletz (thin 1 plot)
		3207	BLM- Dora (thin 1 plot, 2nd lift?)
		4205	BCMin- French Ck. (thin 1 plot, 3rd lift)
		3210	OSU- Wrongway Ck. (1st lift)
		5205	GPNF- Tongue Mtn. (thin 1 plot)
	9yr Measurement	3208	ODF- Weebe Packin
		3210	OSU- Wrongway Ck.
		5205	GPNF- Tongue Mtn.
	12yr Measurement	1202	BCMin- Lucky Ck.
		2204	SNF- Cape Mtn.
		2205	ANE- Siletz
		3207	BLM- Dora
		4205	BCMin- French Ck.
	17yr Measurement	4201	GYN- Humphrey Hill
Type 3	9yr Measurement	5301	GPNF- Puget
	12yr Measurement	2301	ANE- Monroe-Indian
		4301	GYN/DNR- Turner Ck.
		4303	BCMin- Holt Ck.

Current HSC Activities

Regional Red Alder Modeling Effort

Database compilation is complete. Small setbacks have occurred but the effort is relatively on time. It was mentioned that the payment of the $15,000 to the SMC debt was organized and would be paid by the time that the data was available. Choosing a desired/suitable model is the next step. We discussed among cooperators about modeling - what models did people use and how might model development be encouraged. Surprising was the number of agencies that use ORGANON. Both the BLM and WDNR said that they use it. The one industry person there said his company uses SPS. We talked about FVS and FPS but had no proponents present. This doesn't mean much as industry was poorly represented and the USFS and Oregon Department of Forestry were not there.

David Hibbs, David Hann, and Andrew Bluhm developed a proposal to model red alder in the framework of ORGANON. Copies of the proposal are available.

There was some interest in trying to get the forest service to work on a model (FVS) because they are free but it was also pointed out that they are very slow. 5 years was suggested as a time line.

Red Alder Volume Equations

Introduction

The HSC partnered up with the USFS PNW Research Station to develop taper equations for alder plantations. The development of these equations is timely. Alder stand growth models are being developed based on plantation growth data. To accurately predict the wood volume in these stands using these growth models, accurate tree volume equations based on plantation trees are needed.

Rationale

It is well understood that changes in stand conditions affect diameter and may even affect height. Consequently stem volume also changes. But does the relative stem profile stay the same? Most existing volume and taper equations are functions of only diameter and height. Will these measurements detect these differences? Furthermore, most volume and taper equations do not include intensively managed stands or other dramatically altered stand conditions.

There is a growing body of research which indicates that changes in stand structure affect tree profiles (i.e. taper) and individual stem volumes. Table 7 is a brief list of research from Oregon State University showing the effect of certain activities on tree form and volume predictions.

The first three; vegetation control, initial spacing, and thinning intensity are all very important factors in managed plantations. Therefore trees in managed plantations may have forms different than that of trees from natural stands and volume estimates may benefit from new equations.

Table 7. Examples of the effects of silvicultural treatments on stem form.

Study	Activity	Shape Change	Consequence
Ketchum	Increase Veg. Control	More neoloid	Overestimate Volume
Lennette	Increase Thinning Intensity	More neoloid	Overestimate Volume
Garber and Maguire	Increase Spacing	More neoloid	Overestimate Volume
Garber and Maguire	Increase Tree Dominance	More neoloid	Overestimate Volume
Weiskittel	Increase Swiss needle Cast	More neoloid	Overestimate Volume

Description

Currently, the only equations available to estimate volume in alder trees from managed stands were derived from natural stands. However, when these older equations are applied to the new plantations, the differences in tree form between natural and planted stands leads to an unknown amount of error in volume estimation. Thus, the purpose of this project is to develop tree volume and taper equations for red alder growing in plantations. Taper equations are important in forestry because they provide 1) predictions of inside bark diameters at any point on the stem, 2) estimates of total stem volume, 3) estimates of merchantable volume and merchantable height to any top diameter and from any stump height, and 4) estimates of individual log volumes (Kozak 1988).

Two user groups will benefit from these new equations. First, alder growth models are being developed to predict tree size under a variety of management strategies. Land managers use these models to compare and select the management approach with the best economic outcome. New volume equations are the missing link between the developing alder growth models and sound economic analysis of the crop. Second, in the timber sale process, land managers and log buyers must estimate standing volumes. These new equations will increase the accuracy of these assessments.

The main benefit of the project is the production of an essential tool for informed management decisions that will be used by public and private forest managers in Oregon and Washington. Oregon State University, through the Hardwood Silviculture Cooperative, has worked for the last 17 years to improve the knowledge base for alder management. The HSC has a matrix of 26 variable density plantations throughout the PNW that can serve as the primary data source for this research effort.

Objectives

The specific objectives of this effort are to:

- Test if various silvicultural treatments a) initial planting density, b) pruning, and c) thinning affect tree form/taper.
- Develop taper equation
- Develop volume equations/ volume tables
- Report findings

Protocol

Site Selection

Developing new alder tree volume equations began last summer (2004) with the cutting down of trees grown at different densities from select HSC sites. The experimental design of these sites provided extra trees for this sampling located in the "buffer" area. Sites were selected based on:

- Age- Priority was given to our oldest sites because these trees were 1) closer in size to final rotation sizes, and 2) had sufficient time to respond to previous silvicultural treatments.
- Location- Since time, travel, and budget were a concern; priority was given to sites close to Corvallis (however, the full geographic range of sites were sampled).
- Access- Not all desired sites had easy access or were granted permission to sample. These were therefore excluded.

Based on these criteria, a list of eight prospective sites was developed. Data from a ninth site (Mohun Creek, Campbell River, BC) was also collected through the work of Paul Courtin and the B.C. Ministry of Forests.

Treatment Selection

At each site, specific treatments to be sampled were also prioritized. A minimum of 5 treatments and a maximum of 7 treatments were to be sampled, depending on the treatments present and time constraints. The order of priority was:

- Control plots: 230tpa, 525tpa, and 1200tpa (the 100tpa control plot was excluded due to its non-applicability in commercially managed plantations). This would allow a 3 way camparison across densities.
- Prune plot (230tpa): By comparing with the 230tpa control plot, the effect of pruning within a density could be tested.
- Thinned plot (525tpa, 15-20ft HLC thin): Thinning effects could be tested by comparing with the 525tpa control plot and the 230tpa control plot (since the residual density was 230tpa).
- Various extra plots: In some cases certain treatments were not present, or the crew had extra time at a specific site so two other treatments were sometimes sampled (525tpa 3-5 year thin, 1200tpa 3-5 year thin).

For a full list of HSC Type 2 treatments see Appendix 1.

Table 8- Number of trees sampled for the volume equation study, by site and treatment.

			Treatment							
Name	Number	Owner[1]	230tpa Control	230tpa Prune	525tpa Control	525tpa Early Thin	525tpa Middle Thin	1200tpa Control	1200tpa Early Thin	Total
Pollard Alder	2202	SNF	6	6	6	--	7	4	--	29
Toledo	2203	ANE	6	4	6	--	6	4	--	26
Siletz	2205	ANE	6	--	4	4	--	4	4	22
Sitkum	3203	MEN	7	6	6	--	8	3	--	30
Shamu	3205	ODF	6	6	7	--	6	5	--	30
Humphrey Hill	4201	GYN	8	--	8	--	8	6	--	30
Clear Lake Hill	4202	GYN	7	--	6	--	--	6	--	19
Mohun Creek	4203	BCMin	4	4	4	4	--	4	--	20
Thompson Cat	5203	BLM	6	6	6	--	6	4	--	28
Total			56	32	53	8	41	40	4	234

[1]For a full list of cooperator names, see Table 1.

Tree Selection

To ensure sampling the full range of diameters found at each plot, DBH distribution curves were generated for each site/treatment combination using the latest available data. These curves indicated which DBH classes were represented at each treatment plot. Once the DBH range was determined, the crew chose 2 trees of good form (no forking, broken tops, excessive sweep, etc.) in each DBH class. Sample trees needed to be well distributed throughout the buffer, and at least two tree rows from the edge of the treatment and/or measurement plot. These trees were marked with flagging, and once every tree was marked, measurements commenced. Below is the list of DBH classes used in this study. Often only three DBH classes were represented in each site/treatment combination.

- 24+cm DBH Class - 2 trees
- 19-24cm DBH Class - 2 trees
- 14-19cm DBH Class - 2 trees
- 9-14cm DBH Class - 2 trees

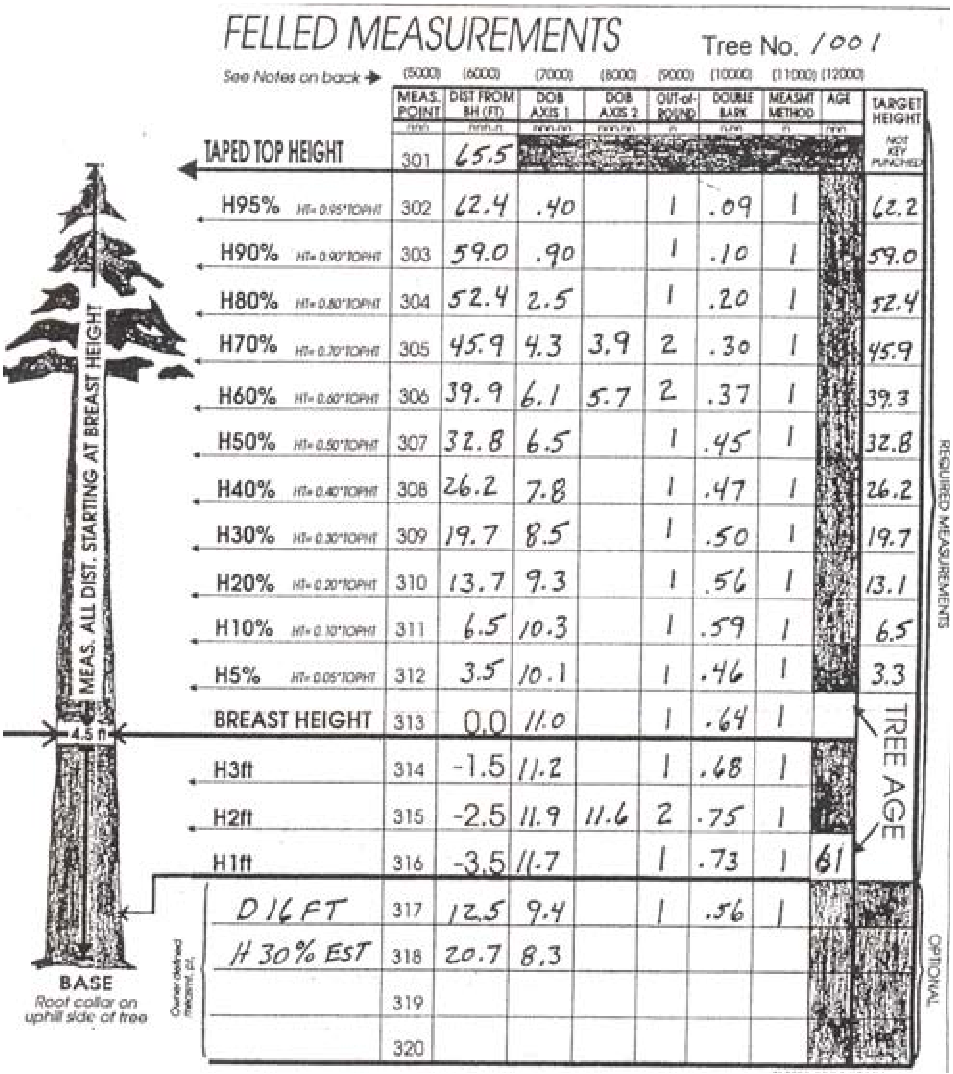
Sampling Procedure

The sampling procedure used here was effectively the same one used for the Inland Northwest Growth and Yield Cooperative Tree Form Equation Project (the data collection field manual was written by Charles Hatch and James Flewelling, 1995). Before falling, DBH was permanently marked and stem diameter (and double bark thickness) measured at breast height, 80cm, 50cm, and 20cm. Once these measurements were completed the tree was felled using a chainsaw making sure not to fall the tree into the measurement plot, across any existing trails, and in such a way to minimize top breakage. Once felled, total tree height and height to live crown was determined. Diameter outerbark and double bark thickness at 10% increments of total tree height (i.e. taper of the trunk) was measured

Data collection was more than successful: after consulting with researchers who have done this sampling before, it was expected that approximately 100 trees could be sampled (given our time, travel, and budget). However a total of 224 trees were sampled plus another 20 trees from British Columbia for a grand total of 234 trees.

Data analysis

Analysis of the data will be done using Kozak's variable-exponent equation form (Kozak 1988). However, other methods such as PCA (principle component analysis)



	MEAS. POINT (5000)	DIST FROM BH (FT) (6000)	DOB AXIS 1 (7000)	DOB AXIS 2 (8000)	OUT-of-ROUND (9000)	DOUBLE BARK (10000)	MEASMT METHOD (11000)	AGE (12000)	TARGET HEIGHT
TAPED TOP HEIGHT	301	65.5							NOT KEY PUNCHED
H95% HT=0.95*TOPHT	302	62.4	.40		1	.09	1		62.2
H90% HT=0.90*TOPHT	303	59.0	.90		1	.10	1		59.0
H80% HT=0.80*TOPHT	304	52.4	2.5		1	.20	1		52.4
H70% HT=0.70*TOPHT	305	45.9	4.3	3.9	2	.30	1		45.9
H60% HT=0.60*TOPHT	306	39.9	6.1	5.7	2	.37	1		39.3
H50% HT=0.50*TOPHT	307	32.8	6.5		1	.45	1		32.8
H40% HT=0.40*TOPHT	308	26.2	7.8		1	.47	1		26.2
H30% HT=0.30*TOPHT	309	19.7	8.5		1	.50	1		19.7
H20% HT=0.20*TOPHT	310	13.7	9.3		1	.56	1		13.1
H10% HT=0.10*TOPHT	311	6.5	10.3		1	.59	1		6.5
H5% HT=0.05*TOPHT	312	3.5	10.1		1	.46	1		3.3
BREAST HEIGHT	313	0.0	11.0		1	.64	1		
H3ft	314	-1.5	11.2		1	.68	1		
H2ft	315	-2.5	11.9	11.6	2	.75	1		
H1ft	316	-3.5	11.7		1	.73	1	61	
D16FT	317	12.5	9.4		1	.56	1		
H 30% EST	318	20.7	8.3						
	319								
	320								

2. Example of the datasheet used for the Inland Northwest Growth and Yield Cooperative Tree Form Equation Project and adapted for the alder tree volume project.

and a segmented polynomial (Max and Burkhart 1976) approach may be explored depending on the satisfaction of fit. This method was chosen partly because it has been shown to model tree form extremely well and because of Sean Garber's familiarity with this method. The general data analysis procedure is as follows:

- Exploratory Data Analysis (EDA)
  - Data will be thoroughly cleaned and a complete dataset composed of tree, plot, and stand variables will be created.
  - Graphs will be created to visually inspect for difference in tree form both among and within plots, treatments, sites, etc. Expressing tree form on a relative scale (h/Ht vs. d/Dbh) will aid in detecting differences.

- Identify suitable/best subsets of factors/variables/covariates to be used in a final model.
    - "Kitchen Sink" Approach-First, choose any variables as deemed necessary or thought to explain variation in tree form. This will be done using the leaps and bounds algorithm in SAS proc reg. Then determine the best subset of covariates (i.e., models). For a given number of variables, the optimum subset model produces the minimum error sum of squares, maximum adjusted r-square and log liklihood, C(P) statistic, AIC, BIC, etc.
- Once the "best" model subsets are identified, continue analysis in S-PLUS
    - GNLS (Generalized Nonlinear Least Squares) is a likelihood-based regression technique and will be used to model fixed effects. Residuals will be analyzed for model fit and presence of autocorrelation.
    - Once this model is identified, we will then go back to SAS and fit the model by tree to identify parameters that have a large variation among individual trees as to identify potential random effects.
    - The final model parameters will be specified and fit using NLME (Nonlinear Mixed Effects model.). Mixed-effects models incorporate both fixed and random effects. This allows for analyzing data that can be classified according to one or more grouping variables.
    - Test covariates, random effects, and correlation structures by using likelihood ratio tests.
    - Validate the model by plotting out tree shapes and looking for bias patterns
- Simulation
    - Using the full (or at least a separate) HSC alder plantation dataset, calculate tree volumes using this equation and look for abnormalities for trees outside the dbh range and from other sites.
    - Calculate tree volumes using this equation and compare to the volume of a cone or volume of a cylinder and existing equations.

Products/deliverables

- Peer-reviewed manuscript- This dataset/project provides a great opportunity to answer some existing questions that mensurationists have about the effects of silvicultural practices on tree form.
- In-house/not peer-reviewed (COF or USFS) research contribution/research note. This would be intended as a tool for foresters to predict alder volume. Could be an equation and/or a volume table/series of tables.

- Computer program that generates (by numerical integration) total and merchantable volume for any given dbh, height, merchantable diameter, etc.
- Communicate results by speaking at appropriate meetings, user groups, conferences, etc.
- Calculate tree volumes using this equation and compare to existing equations (Skinner, 1959; Curtis, et. al, date; Johnson, et. al, 1949). Communicate these results as well.
- Eventually, or better yet, as we go, ensure compatibility of this equation with any or all of the alder growth models the HSC is pursuing (ORGANON, FVS, etc.).

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"Red alder: A State of Knowledge" symposium Summary

On March 23 through 25, 2005, the University of Washington coordinated an international symposium on red alder. There was a one-day field tour, with two days of classroom sessions. More information on the agenda and cooperators is available at http://www.cfr.washington.edu/research.smc/alder%20web/symposiumindex.htm.

Approximately 180 people attended the symposium where experts discussed many topics surrounding red alder including the economic, ecological, and social values of red alder. Every presentation was video taped and all presentations can be viewed using the Rural Technology Initiative (RTI) "streaming video" technology. Please see the following link for downloading instructions: http://www.ruraltech.org/video/2005/alder_symposium/index.asp.

The following are notes compiled by Brad Knotts, Private and Community Forests Program, Oregon Department of Forestry (used here with permission).

Concise Summary

- There is a healthy alder processing industry in the Pacific Northwest. Products include cabinets and pallets.
- Most of the current alder log supply is from natural stands resulting haphazardly from past practices, and just comes out with the conifers. This supply is expected to fall off in the near future, since vegetation control in conifer plantations reduces the incidence of alder. Some of the demand could be met with alder plantations.
- It appears that red alder can be grown in plantations with 25-30 year rotations. The oldest plantations are about 20 years old now. Others are in the 15-year old range. Many of the stands are considered experimental. If age-size-quality goals are met, it looks like the economic return will be adequate.
- Success with alder plantations requires careful management and attention, probably more so than with conifer plantations. One key is managing stem form (through stand density) to get high-quality sawlogs. Pulp and other low-end products will probably not be viable for most managers. Young alder grows extremely rapidly but must be carefully tended to get high-value logs.

- Intensive alder management is in its infancy. Guides are available, but much more research and development is needed.
- Alder provides ecological and cultural benefits as well as economic opportunities.

More Detail

Alder Supply and Manufacturing

- Red alder has progressed from the weed category to being a valuable commodity.
- Pacific Northwest alder mills can handle much more supply than they can get. Supply is limiting.
- Pallet stock production provides some value, but a high percentage of lumber for cabinets and other value-added products is needed to make a mill viable.
- Current sawlog price is about $600/MBF for 2 or 3 saw. This is equal to or greater than the Douglas-fir price.
- Cut wood turns red in response to an infection of a common fungus. This is a key product loss. The staining advances more quickly in warmer weather. Landowners must plan alder felling and hauling accordingly to minimize losses.
- For alder, and any US export, the market is dominated by a few major importers. For alder logs, it is primarily China, for the furniture market.
- Most alder inventory is in WA, OR, and BC (in order of rank). Most harvest is from private land.
- Interest in alder has been driven primarily by the increase in demand for alder logs and products.
- Alder wood "works" well, takes colors well, and is easy on woodworking equipment.

Natural Stands

- These have just "happened" after past logging and disturbance, coming in from seed. Spacing and stem quality are extremely variable.

- The trees tend to be leaning, with broad, flat-topped crowns, forks, and many branches. These trees are susceptible to wind, ice, and snow damage.
- High-quality logs are relatively rare, although overall stand defect is often at about 3% (pretty good).
- The current focus on conifers, with associated vegetation control and reforestation requirements, tends to limit future natural stands.
- Where stands are quite dense (a common occurrence), growth slows early.

Plantations

- Managers are beginning to look to managed alder plantations to meet business and ecological needs. Weyerhaeuser, the British Columbia Ministry of Forests, Washington DNR, Oregon Department of Forestry, and others are all managing red alder plantations. The oldest plantations have probably reached 20 years, short of the planned rotation age.
- The Hardwood Silviculture Cooperative has experimental alder plantations in place in British Columbia, Washington, and Oregon. The cooperative has results through about the first 15 years of these stands.
- It appears that economic returns are acceptable when growing alder 25-30 years for high-quality sawlogs. On managed red alder stands, it appears that 20 MBF/acre is realistic at about a 30-year rotation. The desired products are 12-15 inch average DBH trees at rotation.
- Although it seems to grow easily enough where it is not wanted, alder is trickier to grow than some conifers, and requires careful planning and adherence to management practices.
- Alder, like other hardwoods, seems to "follow the light"; stand density control is critical to keep good stem form, which in turn is critical in getting high-value sawlogs.
- Alder has extremely rapid growth about age 20-30. This allows early sawlog development, but also reduces the margin of error for timing of thinning treatments.

Plantation Management Regime

- Site Selection. In general, good westside Douglas-fir sites are good red alder sites. Alder is very sensitive to frost, cold, drought, and exposed sites.

- Site Preparation. Alder is very sensitive to competition, and no herbicides are registered for broadcast release over alder. Manual vegetation control is difficult. Site preparation (mechanical, burning, and/ or chemical) is critical to minimize competing vegetation.
- Seedlings. Alder stands do come in from seed. However, these stands are not uniform in spacing, and seeding is unreliable from year to year. Plantation managers prefer seedlings. Some nurseries produce plug = ½ stock (3-4 months in a plug block in a greenhouse, then 3-4 months in a transplant bed), while some prefer bare root 1-0s.
- Young alder grow so rapidly that they must be limited in height growth (mowing or other practices) or the seedlings will be too large to handle. Desired seedling parameters are:
    - Good buds, all the way to the root collar (healthy; shades collar to avoid heat damage in field).
    - About 15-30 inches tall; 8-10 mm caliper at 1 inch above the root collar.
    - Need fibrous root system
    - Must be inoculated with *Frankia* spp, a nitrogen-fixing bacteria that grows symbiotically nodules on red alder roots. Without inoculation, the seedlings will just sit there the first year after outplanting.
    - Store at -1 to -2 degrees C.
- Planting. Mid March through mid April is best; this minimizes early exposure to frost, and avoids getting into warm, dry periods (usually). Current recommendations are for planting at 500-700 trees per acre to capture the site, maintain stem form, and get acceptable volume growth. Planters need to be careful to maintain critically important regular spacing, since the seedlings stems just look like bare sticks and planting lines can't easily be seen. Experience has shown that good planters are up to the task, however.
- Density Management. This is a key step; stand density controls growth and stem quality. Density must be low enough to allow acceptable volume growth, but high enough to minimize branching, encourage self-pruning, and maintain good stem form. The rapid growth of young alder means that if thinning is too late, crowns will be too small and crowded, and age-diameter-volume goals at rotation will not be met. Also, spacing needs to be uniform to maintain good stem form.

  - Thin before the live crown ratio gets below 30-40% and/or height to live crown is 20 feet or less.
  - First thin is usually at 4-9 years. It will be precommercial. Fell the cut trees to wipe dead limbs off leave trees.
  - Sprouting and epicormic branching occur, but seem not be significant within and alder stand.
  - One more thinning will probably be necessary, perhaps at about 15-20 years. Depending on markets, this could be a commercial thinning.

- Up to about 1200 TPA, higher stand density yields greater height growth. Through age 12 or so, the crop trees (100 largest per acre) are about 16 meters (50-55 feet) tall.
- At 290-1480 TPA, seem to get good, uniform diameter growth up to age 10.
- 230-525 TPA yields higher volume at age 12 than lower or higher densities.
- Depending on the stand densities chosen, artificial pruning might be desirable, although currently, pruning on any large scale has mostly been experimental. The goal is to minimize the "knotty core" four inches diameter or less, so the outer stem is clear wood. Live alder is good at encapsulating decay in wounds, so branch scars heal over quickly. Pruning too high can increase stem breakage at the bottom of the crown.
- Harvest. If due care is taken, the desired logs can be expected in a 25-30 year rotation.
- Limited fertilization trials have shown that fertilization with phosphorus (P) can improve alder growth. Nitrogen fixers such as red alder need P for that process.
- Because small landowners harvest at more irregular intervals, they may have trouble planning ahead to get alder seedlings. As the alder plantation business grows, more seedlings might be available.
- Risks. Elk and deer antler rub can severely damage 1-3 inch diameter seedlings. Frost can damage half or more of a stand. In British Columbia, alder bark beetle has been a problem. Some landowners wonder if markets will still exist 20-30 years after planting.

Cultural Values

- Native Peoples
- Second to cedar, western PNW native peoples used alder the most of any wood:

    - Carving items (masks, bowls).
    - Basic dye from bark—widely used; nets, totems
    - Firewood, smoking wood
    - Medicinal properties
- The Quinalt Nation harvests and manages red alder in flat area along Hoh River. Income is provided for the nation and for individual member-landowners.

Ecological Values

- Stream productivity (comparing alder with conifer-dominated stands)
    - More light reaches the water; more primary production (algae); more food for grazing invertebrates.
    - More nitrogen from leaf litter; more nutritious food base for shredders, consumers.
    - More in litter fall. Significant amount comes from alder-associated understory shrubs.
    - Conclusion: alder stands have more food for fish, but research has not established a connection between "more food" and "more fish."
- Alder foliage retains proteins (and stays on stem) later in the year—important forage for deer and elk. Apparently, these animals don't prefer alder as a food source in the summer.
- Alder stands (vs. closed conifer stand)- more light reaches the forest floor. This allows diverse shrub community, which promotes a diversity of invertebrate and bird species.
- More bird species are present in the alder foliage layers than in conifers.
- Alder could be an important N subsidy in the face of losses of marine nutrient inputs from salmon carcasses.
- More alder yields more terrestrial invertebrates.
- Alder provides essential nutrients and essential fatty acids (animals can't manufacture the fatty acids—must get it from plants).
- Conclusion: Alder provides important biological benefits. Conifers provide important structural benefits (large wood). Both are needed for proper stream function, so general conversion of streamside red alder stands to conifer

stands appears undesirable. As a general ecological principal, diversity in structure and biological factors is critical.

Interesting Alder Facts

- Young red alder grows very rapidly. It can grow more than 1 meter the first year and can be 50-55 feet tall at age 12.
- Very rapid height growth the first 20 years, then levels off, then stops at 50. Conifers start more slowly, but overtake later and keep on growing.
- Red alder fixes nitrogen—can be 100s of pounds/acre/year. Nitrogen fixers use lots of P—may be limiting. Fertilization of alder is being explored.
- Live red alder is resistant to decay. It compartmentalizes decay from branch scars very well. Dead alder decays rapidly.
- Alder stands regenerate to alder stands only after a disturbance.
- Most of what is “known” about alder is from casual observation, not careful scientific study.
- The patchy white bark appearance is from lichens.
- Red alder is a shade-intolerant pioneer. It can seed in heavily. The seeds will not germinate in the dark or on heavy litterfall.
- Highly sensitive to any competition over the top—needs open conditions for germination and growth.
- Natural stands grow more slowly; tend to senesce at 80-100 yrs.
- For wood production, pure conifer or pure alder is best—otherwise the management is difficult. However, mixed stands can provide other resource benefits.
- Red alder could be used in Swiss needle cast zones instead of western hemlock or cedar.
- Sitka Spruce and Alder
    - Most Sitka spruce are attacked by the Sitka spruce weevil, which kills the leader, leading to multiple tops and deformed stems. Repeat attacks are common and can yield trees that are more like bushes, and not useful for forest products.
    - Growing Sitka spruce under alder canopies shows promise—the shade seems to cool the environment enough that it is not favorable for weevil life cycles, and damage is minimized.

- Higher alder stand densities yield better weevil control, but also lead to whiplash damage (the alder canopy lacerates the stiff spruce leader) and reduced spruce growth. Stand densities must be balanced with these opposing effects in mind.
- Alder management may be a useful tool in trying to manage Sitka spruce.

▼ Crop rotation. Growing alder after alder seems to produce no increase in stand growth. However, Douglas-fir after alder does produce growth gains compared to fir after fir. Increases in soil nitrogen apparently produce the gains.

▼ Mixed stands of red alder and conifers are very complex and difficult to generalize on.

Future Research and Development

▼ Hardwood Silviculture Cooperative has an extensive red alder database that is available and growing. The coop has many alder research plantations in British Columbia, Washington, and Oregon. Data for managed stands is from about 0 to 15 years old. The stands are not past 15 years so yet.

▼ Need more research and development. Focus on potential gains from genetic selection for specific traits. Have made some growth gains already. There is a wide variation in frost hardiness in alder populations. Refine the silviculture.

▼ Small landowners seem to be older, pretty conservative, and resistant to change. They are willing to try different things, but are concerned about risks: uncertain silviculture, markets, and seedling supply. The key for them seems to be education and reliable information from a variety of reliable sources.

▼ Much of what is currently known is based on casual observation or analysis of natural stands. Research and development based on plantation conditions is needed.

References

▼ Hardwood Silvicultural Cooperative http://www.cof.orst.edu/coops/hsc/

▼ USFS Publications (search on treesearch or go to http://216.48.37.142/)

Recent Presentations

The following is a list of presentations given by Andrew Bluhm and/or Dave Hibbs during the last year. The presentations can be obtained by contacting Andrew Bluhm or by visiting the associated link.

- Red Alder Management: Principles and Practices.

  Bluhm, Andrew A., Managing Red Alder Workshop. Washington State University Extension. Mount Vernon, WA. August 28, 2004. See:

  http://ext.nrs.wsu.edu/Video/Alder/index.htm.

- Field tour and discussion of alder management.

  Hibbs, D.E., Alder Management Field Tour. Clackamas County Chapter of the Oregon Small Woodland Owners Association. August 28, 2004. Troutdale, OR.

- The Effect of Thinning on Red Alder Tree Form and Volume.

  Bluhm, Andrew A., HSC Winter meeting, Sedro Wooley, WA. January 11, 2005.

- Effects of Density Manipulation on the Size and Growth of Natural Stands of Red Alder.

  Bluhm, Andrew A., HSC Winter meeting, Sedro Wooley, WA. January 12, 2005.

- Alder: It's Management and Potentials.

  Hibbs, D.E., Red alder: A State of Knowledge symposium. Seattle, WA. March 24, 2005. See:

  http://www.ruraltech.org/video/2005/alder_symposium/index.asp

- Density Management in Alder Stands.

  Bluhm, Andrew, A., Red alder: A State of Knowledge symposium. Seattle, WA. March 25, 2005. See:

  http://www.ruraltech.org/video/2005/alder_symposium/index.asp

- Growth and Yield of Red Alder.

  Hibbs, D.E., Red alder: A State of Knowledge symposium. Seattle, WA. March 25, 2005. See:

  http://www.ruraltech.org/video/2005/alder_symposium/index.asp

Membership Information

Representatives

This year saw some changes in membership representatives. Dale Anders, Oregon Department of Forestry (ODF) Forest Grove Silviculturist has retired. Dale was a long-time member of the HSC and a very strong advocate of alder reforestation. In fact, a few years ago, he mentioned that he was responsible for planting more alder in Oregon than anyone else at the time. He was replaced by Mike Cafferata.

After 37(?) years with the Washington Department of Natural Resources (WA DNR), and with the HSC since the onset, Norm Andersen finally retired. Not only did he help foster WA DNRs "alder friendly" policy, he knew every single hotel, restaurant, and menu item in the Pacific Northwest. George McFadden, who has worked in WA DNRs Northwest Region and as scientific liaison with Cooperative Monitoring and Evaluation Research Committee (CMER) is the new representative.

Dale and Norm, thanks for all of your support and we wish you well!

New Members

As mentioned in the beginning of this report, the HSC will most likely have a new member starting Fiscal Year 2006. The potential member will be a hardwood manufacturing company owning mills throughout Washington. A Memorandum of Agreement (MOA) has been drawn up and both parties are excited about the possible new partnership.

The "Red alder: A State of Knowledge" symposium generated a lot of interest in managing alder and drew attendees spanning all facets of forestry; small landowners, contractors, consultants, public agencies, private timber companies, mill owners, marketers, etc. Andrew is using the momentum from the symposium and actively trying to recruit more new members.

Direction for 2006

The specific goals for 2006 are both continuations of our long-term objectives and two new projects:

- Continue treatments and measurements of Red Alder Stand Management Study installations.
- Continue working with OSU statisticians in the Type II data analyses, for publication in a peer-reviewed journal.
- Keep the HSC website updated and current.
- Continue efforts to recruit new members.
- Continue working with the "Regional Alder Modeling Group" in acquiring funding and developing a strategy for the final modeling process.
- Continue the analysis of volume equations for red alder plantations. Try to publish results in a journal and as a tool for practicing foresters.

APPENDIX 1

Summary of Red Alder Stand Management Study Treatments

Type 1- Thinned Natural Red Alder Stands

1. Control- measure only, stand left at existing density
2. 230 trees/acre (tpa) re-spacing density in year 3 to 5
3. 525 tpa re-spacing density in year 3 to 5
4. 230 tpa re-spacing density when height to live crown (HLC) is 15 to 20 feet
5. 525 tpa re-spacing density when HLC is 15 to 20 feet
6. Control- measure only, stand left at existing density
7. 100 tpa re-spacing density when HLC is 30 feet
8. 230 tpa re-spacing density when HLC is 30 feet
9. Control- measure only, stand left at existing density

Type 2- Red Alder Variable Density Plantations

1. 100 tpa control- measure only
2. 230 tpa control-measure only
3. 230 tpa pruned to 6 ft. lift, 12 ft lift, 18 ft lift, 24 ft lift
4. 525 tpa control -measure only
5. 525 tpa thin to 230 tpa in year 3 to 5
6. 525 tpa thin to 230 tpa when HLC is 15 to 20 feet
7. 525 tpa thin to 230 tpa when HLC is 30 to 32 feet
8. 1200 tpa control- measure only
9. 1200 tpa thin to 230 tpa in year 3 to 5
10. 1200 tpa thin to 230 tpa when HLC is 15 to 20 feet
12. 1200 tpa thin to 100 tpa when HLC is 15 to 20 feet
13. 525 tpa thin to 100 tpa when HLC is 15 to 20 feet

Type 3- Mixed Red Alder Douglas-fir Plantations

1. 100% red alder planted at 300 tpa density
2. 50% red alder and 50% Douglas-fir planted at 300 tpa density
3. 25% red alder and 75% Douglas-fir planted at 300 tpa density
4. 11% red alder and 89% Douglas-fir planted at 300 tpa density
5. 100% Douglas-fir planted at 300 tpa density

Appendix 2

HSC Management Committee Meeting Minutes

Summer 2004 Management Committee Meeting: PNW Research Station in Olympia, WA

Wednesday July 7, 2004:

Attendees: Andrew Bluhm and Dave Hibbs- OSU; Doug Robin- ODF; Norm Andersen, Florian Deisenhofer, George McFadden, Lyle Almond, and Jeff De Bell- WA DNR; Larry Larsen and Jeannette Griese- BLM; Robert Deal- PNW, Portland, OR; Connie Harrington and Warren Devine- PNW, Olympia; Del Fisher- Washington Hardwood Commission; Larry Mason- UW, Rural Technology Initiative; Don Hanley- WSU Extension

The meeting began at 8:00am at the PNW Research Station in Olympia, WA. Many thanks go out to Connie Harrington for providing the meeting space and many of the logistical planning.

After welcomes and introductions, Andrew reviewed the last year and the coming year measurements. Last year had an "average" amount of field work. Next year has even less, with no "orphaned sites" to measure. Please see the annual report included here for a description of the fieldwork schedules.

Unlike the previous annual meetings, no presentations were given at this meeting. Instead, the group discussed many things related to red alder and its management.

Connie Harrington handed out copies of her presentation "Managing Red Alder for High Value Wood Production" that she gave at the Washington Hardwood Commission meeting on June 24, 2004 as well as copies of two papers relating to red alder decay. Finally, she handed out a list of USFS references relating to red alder. This database can be found by going to www.treesearch.fs.fed.us.

Dave Hibbs and Andrew Bluhm then discussed some of the other research projects that the HSC has become involved in. The main two projects are the Volume Equation Project and the Regional Red Alder Modeling Effort. Please see the included annual report for more information on these projects.

After that we went around the room discussing what other projects people were involved in. Don Hanley mentioned the Red Alder symposium being held at UW March 23-25, 2005. He urged everyone to attend and if interested, to submit a paper or poster. For more information, see the annual report or contact the HSC.

Lyle Almond then discussed his master's thesis project on the role of red alder to reduce tip weevil damage in Sitka spruce. His current research is focusing more on silvicultural treatments to optimize this reduction.

Robert Deal, who gave a great talk two winters ago at an HSC meeting, mentioned that his research on the role of alder in Alaskan forests has recently been published in Northwest Science and the Canadian Journal of Forest Research.

Jeff DeBell summed up the field trip for the previously mentioned WHC meeting to Pilichuk tree farm where they looked at red alder/red cedar species mixtures. The group agreed that this would make a good field stop for future HSC meetings.

Then, the topic turned to the HSC budget. Andrew pointed out that incoming funds have remained constant the last few years; with the exception that one member did not pay dues last year. This fact, coupled with the fact that OSU has begun charging a 10% overhead fee for all cooperatives, will create a deficit for FY 04. As a way of remaining within the budget, Andrew's time will be reduced from 10 months at 0.8 time to 9 months at 0.8 time. Costs have remained constant the last few years and will seem to remain so.

Normally, the HSC winter meetings are planned around where "orphaned sites" need to be measured. However, this coming field season has no orphaned sites. So therefore we left the idea open whether or not to even have a winter meeting. If we do meet, the meeting will be held Tuesday and Wednesday January 11-12, 2005.

We then loaded up to visit the next-door WA DNR Webster nursery. Tim Crockett, the bareroot manager, led us through the nursery's plug 1/2 red alder production stock. The week before, they planted them out and the seedlings look great. The nursery is still fine tuning it's sowing and transplanting dates to optimize seedling performance. The greatest challenge they now face is keeping the seedlings small enough for planting. Three options are being discussed and tested: root wrenching, water stress, and top mowing. After that we went over to a small experimental area where seedlings subjected to the above treatments last year were planted out. Many of the top mowed seedlings looked great- with single tops. A few had double tops and this when the mowing occurred way above a leaf bud.

Connie Harrington and Warren Devine then led us around their white oak outplanting study. Here they subjected outplanted white oak (with brush mats and growing tubes) to various root prune, irrigation, and fertilization treatments. The study was just underway and therefore no results were available.

After lunch we visited one of the oldest plantings of red alder. The property is currently owned by Trans Alta, which has 14,000 acres of coalmines and coal burning electricity plants. Greg Jones and John Wisch explained that after a surface coalmine has been exhausted, a very regulated sequence of steps needs to be taken to reclamate the area. At first the company liked to convert to ryegrass, but now they prefer reforestation.

But way back in 1982, Connie and John took nursery-grown red alder seedlings and established a spacing trial. Do to the high variability in mortality, Connie superimposed a pruning trial. As we wandered through the area Connie discussed some of the results of her study:

- the timing of pruning makes no difference in healing rates/incidence of decay,
- live and dead branch pruning makes no difference in healing rates/incidence of decay,
- epicormic branches have very little negative effects on wood quality,
- visible branch scars may have clear wood behind them,
- overall red alder has less decay than any other Western hardwood, and
- potential increase in the money made from pruning will generally go to the mill owner rather than the landowner.

With that, we all split off into small groups discussing various aspects of red alder management and looking forward to whatever the future may bring.

Winter 2005 Management Committee Meeting: WA DNR Northwest Regional office in Sedro Wooley, WA

Tuesday January 11, 2005:

Attendees: Andrew Bluhm and Dave Hibbs- OSU; George McFadden, Lyle Almond, and Alison Hitchcock- WA DNR; Larry Larsen and Jeannette Griese- BLM; Robert Deal- PNW, Portland, OR; Del Fisher- Washington Hardwood Commission; Paul Kriegal-Goodyear Nelson; Jim Murphy- Pacific Forest Tech.; Paul Courtin- BC Ministry of Forests; Dick Whitmore- Washington Alder; Randy Bartelt- Trillium Corp.

The meeting began at 8:00am at the WA DNR Northwest Regional office in Sedro Wooley, WA. Many thanks go out to Norm Andersen, George McFadden and Alison

Hitchcock for providing the meeting space and much of the logistical planning.

After welcomes and introductions, Andrew reviewed this winter's fieldwork. There is relatively little fieldwork with no "orphaned sites" to measure. Fieldwork is going as planned. One change in the data collection protocol was suggested. From this point forward, selected height trees will be trees with previous height measurements. Exceptions will be trees suffering top damage or dead trees. In this case, a "replacement" tree will be measured, that closely matches the diameter of the damaged or dead tree. This was decided for two reasons; 1) repeat height measurements on individual trees are better for modeling purposes and 2) this streamlines and makes much easier the height tree selection process, always a time consuming process. The group accepted the proposed change.

Andrew Bluhm then discussed some of the other research projects that the HSC is involved in.

B.C. Ministry of Forests Growth Model Effort

TASS/TIPSY- TIPSY version 3.2 is out and available to the public. It is the newest and most up to date version now containing red alder yield information. See the BS Ministry website for instructions on how to obtain a copy of this growth model. http://www.for.gov.bc.ca/hre/software/download.htm

Volume Equation Project

The HSC has partnered up with the USFS PNW Research Station to develop taper equations for alder plantations. The development of these equations is timely. Alder stand growth models are being developed based on plantations growth data. To accurately predict the wood volume in these stands using these growth models, accurate tree volume equations based on plantation trees are needed. Data collection was more than successful: we expected to sample approximately 100 trees but sampled a total of 211 trees. Data analysis is just underway. Please see the handout from the meeting.

Regional Red Alder Modeling Effort

Database compilation is complete. Small setbacks have occurred but the effort is relatively on time. It was mentioned that the payment of the $15,000 to the SMC debt was organized and would be paid by the time that the data was available. Choosing a desired/suitable model is the next step. We discussed among cooperators about modeling - what models did people use and how might model development be encouraged. Surprising was the number of agencies that use ORGANON. Both the BLM and WDNR said that they use it. The one industry person there said his company uses SPS. We talked about FVS and FPS but had no proponents present. This doesn't mean much as industry was poorly represented and the USFS and Oregon Department of Forestry were not there.

David Hibbs, David Hann, and Andrew Bluhm developed a proposal to model red alder in the framework of ORGANON. Please see the handout from the meeting.

There was some interest in trying to get the forest service to work on a model (FVS) because they are free but it was also pointed out that they are very slow. 5 years was suggested as a time line.

International Symposium: Red Alder, a state of knowledge

The HSC is actively involved in the organization and development of the symposium on March 23-25, 2005 at the University of Washington. Everyone was encouraged to attend and register. See the website for more information: http://westernforestry.org/intsympalder/redalder.htm

Data analysis

Andrew Bluhm has been analyzing the HSC Type 1 (thinned natural stands) and Type 2 (variable-density alder plantations). Much work has been accomplished but the final goal of publishing papers on these subjects is far from complete due to higher HSC priorities. However, these analyses and results have been presented in recent HSC annual reports.

After a break, discussion turned to the topic of whether or not to modify the Type 2 data collection interval. There were two options identified:

1) Keeping measurement intervals every three years to age 12 then switching to 5 year intervals.

2) Changing the measurement interval from every three years to age 12 to every three years to age 15, then switching to 5 year intervals.

Please see the handout from the meeting. Attitudes over changing the measurement interval were mixed. It was decided for David and Andrew to talk more with modelers, calculate just how much this change would cost cooperators, and further discuss this with the two affected parties.

The next item was a presentation titled "An Analysis of Mixed Red Alder-Sitka

Spruce Stand Development Patterns and Structures That Effectively Reduce Damage to Sitka Spruce by Spruce-tip Weevil" by Lyle Almond. This is some very interesting work in which an alder canopy seems to reduce the incidence of spruce weevil. Please see the handout from the meeting (almond abstract.doc) for more information or a copy of his presentation, contact Lyle at (360)-640-2617 or lylealmond@olypen.com.

Andrew Bluhm then presented "The Effect of Thinning on Red Alder Tree Form and Volume". This talk had three sections; 1) the general effect of silvicultural practices on tree form, 2) a review of a thinning study on Eastern oaks, and 3) results from the red alder "Olney" experiment. Briefly, this natural alder stand was thinned to 2 different levels of density at age 14 and 20 years later, stem form was measured. Stem form (D.O.B. @32′/DBH) increased with thinning intensity. If you would like a copy of this presentation, please contact Andrew at (541-737-6100) or Andrew.Bluhm@oregonstate.edu.

The meeting then moved across I-5 to the Washington Alder, LLC. mill in Mt. Vernon. The mill, its owner, and employees provided the group with an interesting, and in-depth tour of their facilities. Specializing in Red Alder, bigleaf Maple and some paper birch and bitter cherry, Washington Alder has been manufacturing and supplying quality hardwood lumber since 1999. They produce nearly 100 million board feet per year of kiln-dried, furniture grade lumber and pallet material, the vast majority being alder and the other species making up the remainder. Dick Whitmore guided us through the mill, the boiler, the kilns, and the log yard. At the yard, Jim Calio, a certified scaler illustrated common log defects and the discussion centered on site conditions, silvicultural practices, and harvesting activities that effect log quality.

The last stop of the day was at a red alder/red cedar mix on Pilchuck Tree Farm property east of Conway, WA. Alan Staringer, a forest manager with the company, provided a handout of the site as well as all of the background information regarding the site. Alder and cedar were planted either in pure mixtures, or at proportions of 25% alder/75% cedar or 50% alder and cedar at basically an 8ft by 8ft spacing. The cedar was planted in 1990 and the alder was planted 7 or 8 years later. Only this year were the trees tagged and measured (in cooperation with the Pacific Northwest Research Station, Olympia) so no data was available. Observations made include:

- pure alder planted at a 16ft spacing suffered more mortality and were noticeably shorter, limbier and with more taper than those planted at an 8ft spacing

- alder in either proportion grew out of the cedar approximately 2 years ago (5 years after the alder was planted
- growth (height and diameter) of both the alder and cedar seemed generally similar in either proportion
- alder limb size seemed smaller and cedar height to live crown seemed higher in the 75% cedar mix

These observations seemed promising for operational mixes to provide a short-rotation alder crop with a longer-term cedar crop without sacrificing growth of either species. Many thanks go out to Alan and Pilchuck tree farms for establishing, maintaining and touring this valuable research site.

Wednesday January 12, 2005:

Attendees: Andrew Bluhm and Dave Hibbs- OSU; George McFadden, Lyle Almond, and Alison Hitchcock- WA DNR; Larry Larsen and Jeannette Griese- BLM; Robert Deal- PNW, Portland, OR; Paul Kriegal-Goodyear Nelson; Paul Courtin- BC Ministry of Forests

The day began at 8:00am at the WA DNR Northwest Regional office in Sedro Wooley, WA. Before we headed out to conduct the 14th year measure on a thinned natural stand owned by WA DNR (Janicki, #4102), Andrew Bluhm presented early results of this Type 1 analysis. Treatments, methods, and results of this analysis have been published in the 2004 HSC Annual Report. This report can be found on the HSC website (http://www.cof.orst.edu/coops/hsc/report/index.htm) or by contacting Andrew at (541-737-6100) or Andrew.Bluhm@oregonstate.edu.

A summary of results include:

Individual crop tree diameter:

- For both the early and the late thin, diameter growth rates were greater for the thinned plots compared to the controls
- Immediately after thinning diameter growth rates for both thinning intensities were relatively similar, however, through time, these accelerated growth rates are maintained only in the most intensively thinned treatments
- These results indicate that diameter response is more sensitive to the intensity of thinning than the timing of thinning.

Individual crop tree height:

- In the early thin, height growth rates were similar for both the thinned plots and the control (i.e. very little "thinning shock" was observed).
- In the late thin, height growth rates were less for the thinned plots compared to the control (i.e. "thinning shock" was observed) and height growth declined with increasing thinning intensity (i.e. very little "thinning shock" was observed. However, personal observations suggest this result is at least partially the result of one site suffering post-thin stem breakage).
- These results indicate that height response is more sensitive to the timing of thinning than the intensity of thinning.

Individual crop tree volume:

- In the early thin, the increased diameter growth and the similar height growth of the thinned plots resulted in both thinning intensities having greater individual tree volumes compared to the control.
- In the late thin, the decreased height growth of the thinned plots resulted in less volume in the thinned treatments. However, trends indicate that both of the thinning intensities will exceed the controls in volume due to the accelerated diameter growth rates.

Total plot volume:

- In the early thin, the larger trees in both thinning treatments exceed the reductions in the total number of trees due to removal, resulting in a greater total volume. Total volume for both thinning intensities was relatively similar
- In the late thin, greatest volumes were found in the control plots due to 1) the decreased height growth of the thinned plots, and 2) the greater the proportion of the stems removed during thinning. Among the thinned treatments, total volume is reduced with increasing thinning intensity.

Please see the handout from the meeting for more information.

After these results and their implications were discussed, we braved the cold weather and snow to conduct another round of these measurements.

Many thanks go out to those who assisted in the meeting logistics and tree measurements.

APPENDIX 3

Financial Support Received in 2004-2005

Cooperator	Support
BC Ministry of Forests	$8,500
Bureau of Land Management	$8,500
Goodyear-Nelson Hardwood Lumber Company	$4,500
Oregon Department of Forestry	$8,500
Siuslaw National Forest	$8,500
USDA Forest Service PNW Station	In kind
Washington Department of Natural Resources	$8,500
Washington Hardwood Commission	$8,500
Subtotal	$55,500
Forestry Research Laboratory	$42,000
Total	$97,500

www.cof.orst.edu/coops/hsc/