Hardwood Silviculture Cooperative

annual report 2003-2004

Highlights of 2003-2004

- Modeling efforts are well underway. George Harper, with the BC Ministry of Forests, has successfully developed a red alder version of TASS. The new version of TIPSY, which is available to the public, is going out for Beta testing very soon. The general release for the new TIPSY is planned for June 2004. For more information on TASS or TIPSY contact the website: www.for.gov.bc.ca/research/gymodels/
- The other regional modeling effort is still on schedule. The Stand Management Cooperative (SMC) has completed assembling the database and now the activity switches to deciding how the actual "modeling" will be accomplished.
- Dave and Andrew, with logistical and financial support from Robert Deal, with the PNW Research Station, are starting a research project to develop volume equations for managed stands of red alder. The sample trees will be collected from the "destructive buffer" areas of the HSC Type 2 installations.
- Dave and Andrew have been busy trying to recruit new members for the HSC. Some efforts may end up successful. Only time will tell.
- Four Type 2 sites have received their 12th year measurement and have had all of the silvicultural treatments applied. The only remaining activities are growth measurements every five years.
- Five more of our Type 2 sites have had the 12th year growth measurement, making a grand total of eleven (of the twenty six) sites with twelve years of measurements.
- The second thinning treatment (15-20' height to live crown thin) and the 9th year growth measurement have been completed on 22 of the 26 Type II sites.

Contents

HSC Executive Summary 2004

This last year has been a very busy and productive year for the Hardwood Silviculture Co-operative (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

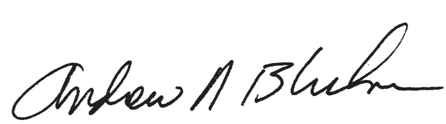
The data collected from these sites is accumulating rapidly. Because of both the extensive and intensive nature of the HSC study design, massive amounts of data are collected, archived, and then used in various data analyses. Many thanks go out to all of the cooperators in getting the data collected and setting research priorities. The database is now large enough to investigate many aspects of red alder stand dynamics. Last year I have analyzed and reported results of all three types of HSC studies (one of which is included in this report).

One of the specific goals the group had was to generate a large enough database to create a red alder growth and yield model. We now have that database and have been busy with two modeling efforts. Our work with the B.C. Ministry of Forests is about to be paid off with the imminent release of a new, red alder version of TIPSY, a publicly available growth and yield model. Furthermore, we have finished assembling a regional red alder database and are currently in the process of choosing modeling options.

The idea of planting and managing red alder stands has now 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. It's hard to do something if you don't know how.

Whoever would have thought way back in 1988, that the idea of alder management would be so popular today? The vision of a small and dedicated group has made managing red alder no longer a dream but a reality.

It has been a very busy and productive year again, I can't wait for the next one!



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.

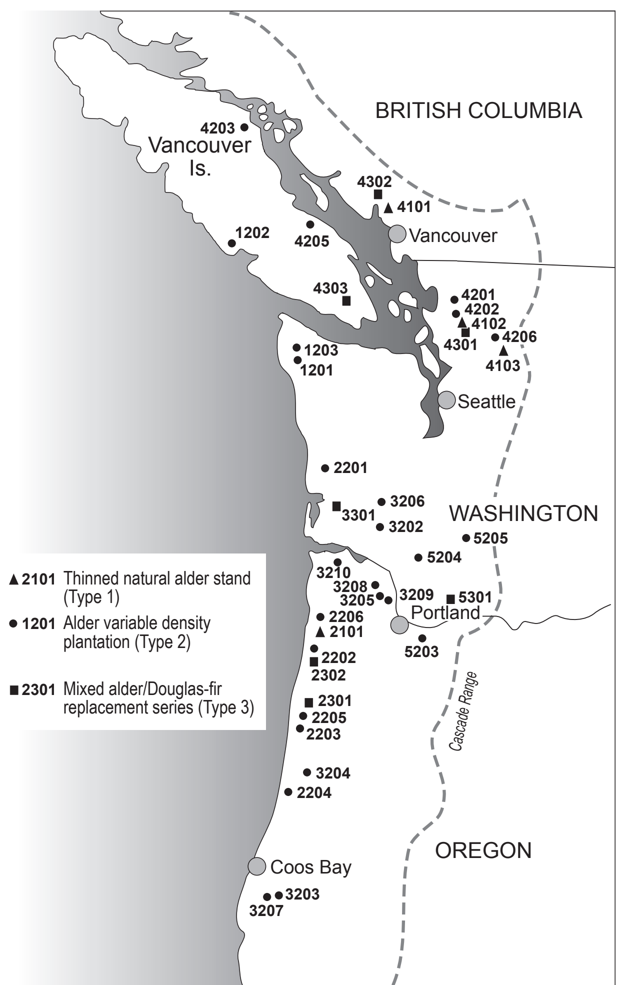
Cooperative Research

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:

1. Type 1 is a natural red alder stand thinned to 230 and 525 trees per acre. There are four Type 1 installations.
2. 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.
3. 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 2004 had much less fieldwork than the previous years, reflecting the gradual decrease in measurement/treatment activities as the stands age. Fieldwork was completed on 11 installations (Table 5):

- One Type 1 installation had the 14th year measurement.
- In the Type 2's, eight installations had fieldwork. A big "Thank You" goes out to the Coos Bay BLM and the South Siuslaw USFS silviculture crews volunteering to measure and prune our orphaned sites.

Table 2. 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	1999/05?	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	2005?
12th yr Measure	2001	2002	2002	2002	2003	2003	2004	2004	2004	2004	2004	2005	2005
30-32' HLC Thin	2001	2007?	NA	2002	2005	2008?	2009	2004	NA	2009	2009	2005?	?
Prune Lift 4 22 ft	2001	2007?	2002	2002	?	2008?	2009	2004	?	2009	2009	2005	?
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 2 (con't). 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?	?	?	?
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	2005?	?	?	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 Ck	Holt Ck	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

- Two Type 3 installations had fieldwork. Doug Belz, an original WaDNR representative to the HSC, came out of retirement to help measure one of the sites.

This coming year's fieldwork (Fall 2004- Winter 2005) has even less fieldwork than last year. There are only 11 foreseeable sites to measure (Table 6):

- One Type 1 site.
- Seven Type 2 sites, with four sites needing measurements and treatments and three with treatments only.
- One Type 3 site.

Table 5. Hardwood Silviculture Cooperative Field Activities, Fall 2003-Winter 2004

Type	Activity	Installation	Cooperator
Type 1	14yr Measurement	2101	SNF- Battle Saddle
Type 2	15-20ft HLC Thin,	2206	SNF- Mt. Gauldy (2nd lift)
	Measure & Prune	3209	BLM- Scappoose (2nd lift)
		4206	WDNR- Darrington (3rd lift, thin 1 plot)
	9yr Measurement	2206	SNF- Mt. Gauldy
		3209	BLM- Scappoose
		4206	WDNR- Darrington
	30-32ft HLC Thin,	2203	NWH- Pioneer Trail (3rd lift)
	Measure & Prune	3203	NWH-Sitkum (3rd lift)
		3205	ODF-Shamu (3rd lift)
		5203	BLM-Thompson Cat (3rd lift)
	12yr Measurement	2203	NWH-Pioneer Trail
		3203	NWH-Sitkum
		3204	SNF- Keller Grass
		3205	ODF-Shamu
		5203	BLM-Thompson Cat
Type 3	9yr Measurement	3301	WDNR- Menlo
	12yr Measurement	4302	BCMIN- East Wilson

Table 6. 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,	1203	WADNR- Maxfield (??)
	Measure & Prune	2205	ANE- Siletz (thin 1 plot)
		2201	WHC- Johns River (??)
	9yr Measurement	1203	WADNR- Maxfield
	30-32ft HLC Thin,	5204	WHC- Hemlock Ck. (thin one plot)
	Measure & Prune	4203	BCMIN- Mohun Ck. (??)
		3206	WHC- Blue Mtn (4th lift & thin 1 plot)
		1201	WADNR- LaPush (thin one plot)
	12yr Measurement	5204	WHC- Hemlock Ck.
		4203	BCMIN- Mohun Ck.
		3206	WHC- Blue Mtn.
Type 3	9yr Measurement	2302	SNF- Cedar Hebo

Current Research

Effects of density manipulation on the size and growth of natural stands of pure red alder

Preliminary analysis of the HSC Type 1 study

Introduction

Red alder is the major hardwood tree in the PNW, comprising approximately two-thirds of the hardwood growing stock in the Pacific Northwest (Raettig et al, 1995). In recent years, the price of a large, high quality sawlog has risen considerably. Because of this, thinning is attractive to a landowner interested in maximizing profits. Thinning may shorten rotations by maintaining growth rates of the residual trees by freeing up resources and may promote higher wood quality by removing poorly formed trees (Hibbs, 1993). Two main factors affect the efficacy of a thinning treatment- timing and intensity.

Because red alder is a fast-growing, short-lived tree, red alder stands progress through stand development stages very quickly. Couple this with the fact that red alder can occupy sites with a wide range of productivity, red alder stands of equal ages may look considerably different. Therefore, choosing the timing of thinning red alder is best measured in "stage of development" instead of in years. The best measure of when to thin red alder stands is the live crown ratio and/or taper (both functions of density and tree size). According to Hibbs (1993) if one thins red alder stands late in stand development, the trees will have a very low live crown ratio, and tall, slender stems. Stands thinned early in stand development will have a high live crown ratio, but short, large stems. Therefore the best time to thin is when a long branchless, low-tapered stem is achieved but before the crown gets too small and growth reductions occur. Generally, thinning a naturally regenerated red alder stand should occur somewhere before 15 and 20 years of age (Hibbs, 1993). However, there is no "cookbook" answer as to when to thin a red alder stand because many variables are involved such as site quality, planting density, available markets, rotation age, etc.

What is better understood than the timing of a thin is the intensity of the thin, i.e. how many stems to retain on the site. Hibbs (1987) and Puettmann et al. (1993) have developed a red alder density management diagram which describes the relationship between tree size and stand density that all red alder stands approach. This diagram indicates a range of the maximum and minimum desired stocking levels to minimize growth losses to mortality and underutilized resources.

Many studies have been done on the effects of thinning red alder (see Hibbs et al, 1989 for a review). Consistent results include: 1) tree diameter growth increases with thinning and volume growth per hectare is usually unaffected or reduced by thinning. Many of these studies show varied responses of various growth parameters because of extremes in the range of densities and ages of treatments, unreplicated experiments, confusing terminology, etc. But according to Hibbs (1989), "these studies…provide a limited basis for the design of management recommendations for thinning red alder".

The results from Hibbs (1989) coupled with his density management guide provide some necessary information for management recommendations in thinning red alder. However, do thinning effects differ across the wide range of environmental, site, and stand development stages found in natural stands of red alder? What are the optimal stocking levels following thinning? How does the timing of thinning affect growth responses? To answer these questions, the objective of this study was to see how short- and long-term tree growth changes with 1) the timing of thinning and 2) thinning intensity across a range of environmental and stand conditions. 3 Objectives

Specific hypotheses include:

1) Pre-thinning stand conditions (mean dbh, ht, basal area, dbh distributions) varied among sites but not within sites.

2) Thinning resulted in a change in the diameter distribution and an increase in mean plot diameter.

3) The timing of the thinning, in terms of stand development (not age) affected thinning response; we predict there is an appropriate "window" in stand development that maximizes growth responses:

a) thinning too "late" in stand development will result in less of a growth response following thinning.

4) Residual density affects the thinning response. The lower the residual density:

b) the greater the response in individual tree diameter/basal area,

c) the smaller a growth response in height,

d) and no significantly effect on individual tree volume.

5) Growth responses are a function of both the timing and intensity of thinning.

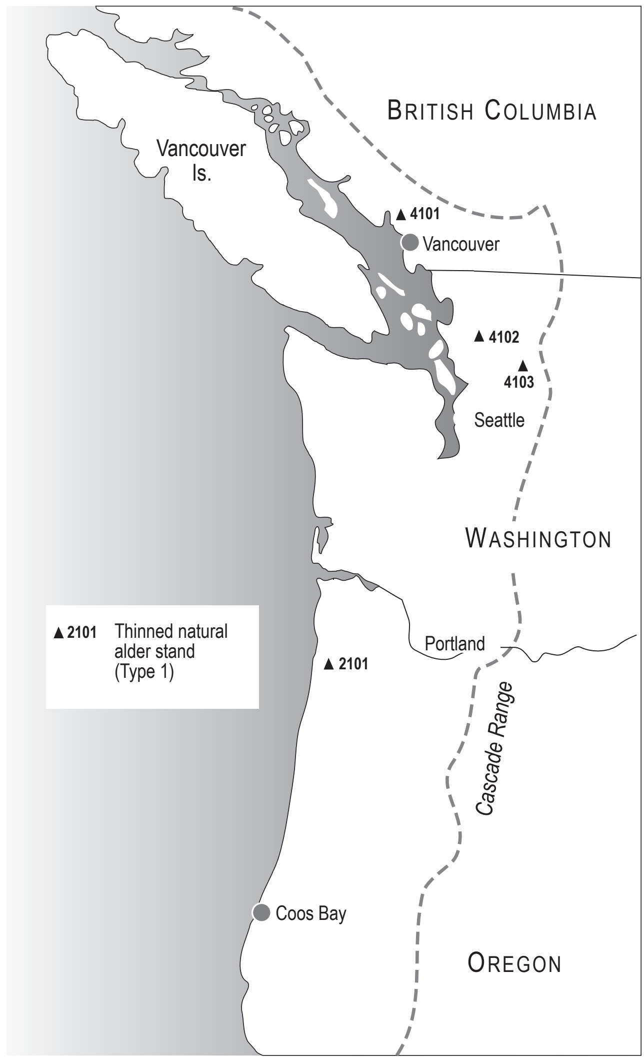
6) Self-thinning would stop regardless of thinning intensity, and accelerate with time in the unthinned stands.

Methods

Site Description

The data in this analysis are from 4 naturally regenerated stands of pure red alder in western Oregon, western Washington, and southwestern British Columbia (121.7-125.4^{0}W, 43.1-50.7^{0}N). The climate is maritime and characterized by mild temperatures, wet, mild winters, cool, dry summers, and heavy precipitation (Franklin and Dyrness, 1973). Soil types are silty to gravelly loams. Elevation ranged from 50m to 510m, slopes ranged from 10% to 60%, and annual precipitation ranged from 115cm to 330cm (Figure 2).

At the time of thinning, stand age ranged from 14 to 17 years old, and site quality (base age 50, Worthington et. al., 1960) ranged from 26m to 34m (Table 7). Two of the



2. Location of thinned natural alder HSC installations.

Table 7. List of treatments for the HSC Type 1 installations.

Treatment	Height-to-Live Crown at Entry	Thinning Density tph (tpa)*	Thinning Spacing (m)
104	4.6-6.1 m (15-20’)	568 (230)	4.2 x 4.2m
105	4.6-6.1 m (15-20’)	1297 (525)	2.8 x 2.8m
106	4.6-6.1 m (15-20’)	Control	Unthinned
107	9.1-9.8 m (30-32’)	247 (100)	6.4 x 6.4
108	9.1-9.8 m (30-32’)	568 (230)	4.2 x 4.2m
109	9.1-9.8 m (30-32’)	Control	Unthinned

*tph = trees/hectare, tpa = trees/acre

3. *Unthinned natural red alder stand: Age 23, thinned at age 14 when HLC= 7.7m.*

4. *"Lightly" thinned natural red alder stand: Age 23, thinned at age 14 when HLC= 7.7m.*

5. *"Heavily" thinned natural red alder stand: Age 23, thinned at age 14 when HLC= 7.7m.*

sites fell into the "early" thin treatments (104, 105, and 106) having a mean height to live crown (HLC) of 7.7m. The other two sites fell into the "late" thin treatments (107, 108, and 109) with a HLC of 13.0m. "Early" and "late" thin treatments refer to stand development stages as opposed to stand age.

Treatment plots consisted of a 0.1 to 0.2 ha (0.25-0.5 acre) measurement plot (MP) with a 15 m (50 foot) buffer on all sides. Three of the sites were unreplicated while one site had two treatment replications. Leave trees in the thinned plots were marked with flagging and numbered with tags and all of the alder in the control plots were tagged as well. Thinning was done manually by chainsaws, in the dormant season, based on spacing and vigor. Generally, the best formed trees at the nominal plot spacing were to be left. In thinned plots, all species other than red alder were cut and in control plots all conifers were cut.

Measurements

Before thinning, pre-treatment diameter measurements were taken on all trees of any species in the plots. Immediately after and then every 3 years, data on permanently tagged individual trees was collected in the dormant season. For every tree, stem diameter at 1.37m (DBH), stem defect (fork, lean, sweep) and presence or absence of damage (animal, weather, etc) was recorded. Height was measured on a sub sample of 40 trees spatially well distributed over the plot that included the 10 trees of smallest diameter the 10 of largest diameter, and 20 mid-range trees (based on diameter). Individual tree cubic volume (to a 10 cm/4 inch top) was calculated from Skinner (1959) for trees greater than 15.2cm/6 inches diameter. Annual growth increments were calculated for each three-year interval between measurements as well as for the entire nine-year period.

Statistical Analysis

An ANOVA approach was used to examine the relationships of individual tree quadratic mean diameter (cm), total height (m), and volume (m^3), by the timing and the intensity of the thin, by measurement period mean and annual increment. Reported means are arithmetic, but least squared means were tested for statistical differences using Sheffe's multiple comparison t-test. Although residual thinning density varied across sites, density was modeled as a class variable. Density was log transformed to meet statistical assumptions of normality.

Mean tree diameter was calculated as quadratic mean diameter. Plot means were calculated for diameter, height and volume for the sample of trees on the plot that would represent the 247 trees per hectare with the largest diameter (e.g. crop trees). Since potential growth was of interest, damaged trees that were significantly smaller in diameter and height than undamaged trees were excluded from the analysis (as determined by Tukey's test for mean separation). These severely damaged trees amounted to approximately 10% of the total trees (range 8.0 to 12.4%). Data are comprised of 15 plots and consist of approximately 2,700 trees measured four times: immediately after thinning and 3, 6, and 9 years post-thinning. An alpha=0.05 was used for all statistical comparisons. All analyses were preformed using Statistical Analysis Software (SAS 1999).

Results

Pre-existing stand conditions

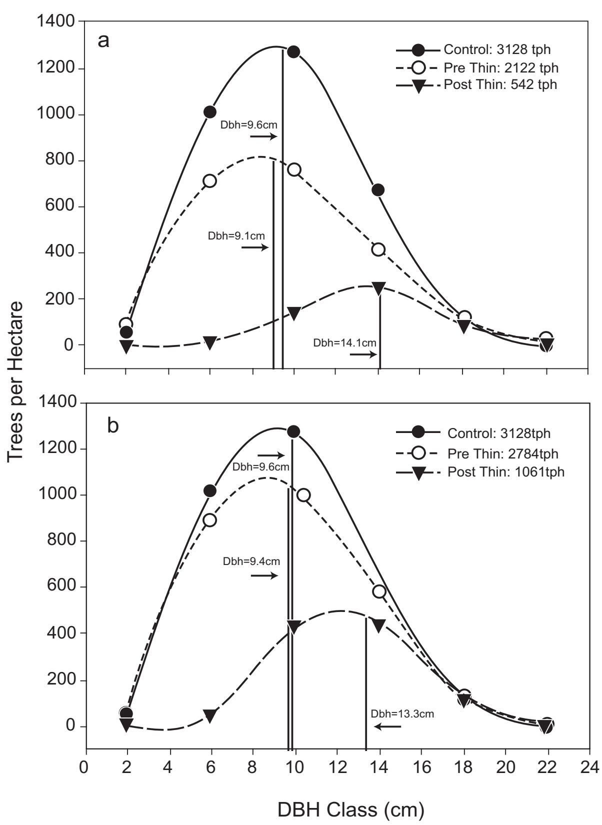
All stands were predominantly red alder with very few individuals of other species in the upper crown classes. Suppressed or regenerating species included bigleaf maple (*Acer macrophyllum*), Sitka spruce (*Picea stichenses*), Douglas-fir (*Pseudotsuga menzeissii*), bitter cherry (*Prunus emarginata*), willows, (*Salix* spp.), western red cedar (*Thuja plicata*), and western hemlock (*Tsuga heterophylla*). Bigleaf maple and western hemlock were the most common associates. Overall, the proportion of red alder density ranged from 68% to 89%. Thinning removed all species other than red alder.

As expected, pre-thinning stand densities, diameters, and basal areas differed by site (Table 8). Mean red alder density was 2810tph, quadratic mean diameter was 11.2cm, basal area was 19.1 m^2/ha, total height was 14.6m, height to live crown was 9.9m, live crown ratio was 0.32, and the ht:dbh was 121.8. See Table 8 for the range of conditions and statistical differences.

Table 8. Type 1 Pre-treatment stand conditions.

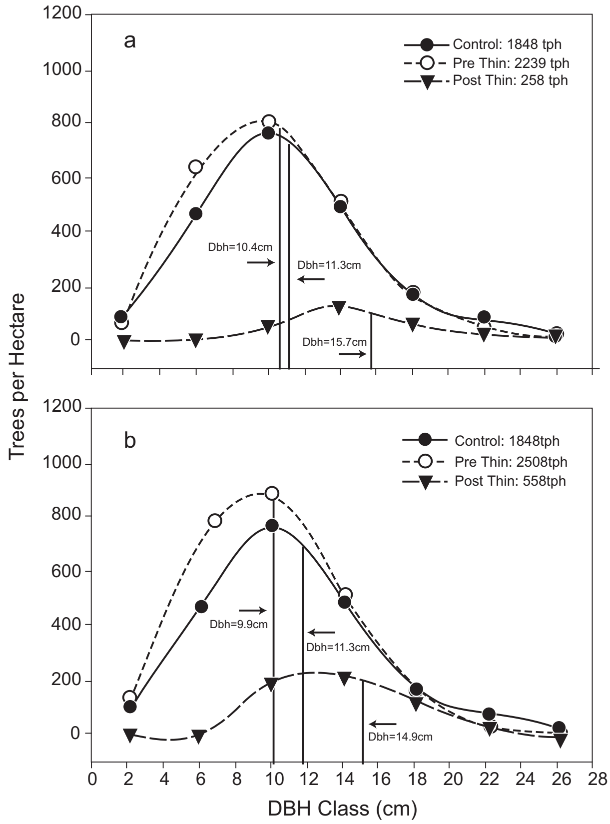
Site	SI 20 (m)	SI 50 (m)	Elev (m)	Aspect	Slope (%)	Thin Age	TPH	DBH (cm)	HT (m)*	HLC (m)*	LCR*	HT: DBH*
Battle Saddle	17	26	512	W	60	14	3484 a	11.1a	12.6a	7.2a	0.42a	99.7a
Sauk River	21	34	457	W	10	14	2965 d	10.8a	14.3d	8.3c	0.41a	128.4c
Sechelt	21	34	50	E	5	18	2640 b	10.9a	15.4b	12.7b	0.17b	144.6b
Janicki	20	33	228	NW	10	14	1545 c	15.4b	17.9c	12.7b	0.28c	119.5c
Mean	19.8	31.8	312	----	21	15	2810	11.2	14.6	9.9	0.32	121.8

Values with the same letter are not significantly different (P<0.05).
*Using only control plot data



6. Pre- and post thin diameter distributions for the 7.7m HLC thin: a) "heavy" thin and b) "light thin.

Variations in stand conditions within a site, however, were minimal. Figure 6 and Figure 7 compare the diameter distributions and average diameters of the control plots versus the thinned treatments. The diameter distribution curves were typical for a pure, even aged stand and varied only in magnitude. Pre-thin mean diameter between the control plots and the treatment plots were statistically similar in all cases. Thinning, as expected, resulted in not only differences in total tree density, but also changed the shape of the diameter distribution to more of a bell-shape. Mean diameter increased significantly after thinning.



7. Pre- and post thin diameter distributions for the 13m HLC thin: a) "heavy" thin and b) "light thin.

Individual Tree Responses

Diameter

In the early thinning treatment, initial post-thin diameters ranged from 16.1 to 16.4cm and nine-years later ranged from 21.1 to 24.2cm, with greater diameters in thinned compared to unthinned plots (Figure 8). However, these differences were not statistically significant for any year. Average annual diameter growth rates were greater for thinned versus unthinned plots and ranged from 1.0cm/yr to 0.62cm/yr for thinned plots and from 0.64 cm/yr to 0.41 cm/yr for the control plots (depending on measurement period). Over the entire 9-year measurement period, mean annual diameter

Table 9. Crop tree measurements immediately after, 3, 6, and 9 years after thinning in red alder stands. Crop trees are the largest 247 trees/ha based on diameter. Values within a year with the same letter are not significantly different (P<0.05).

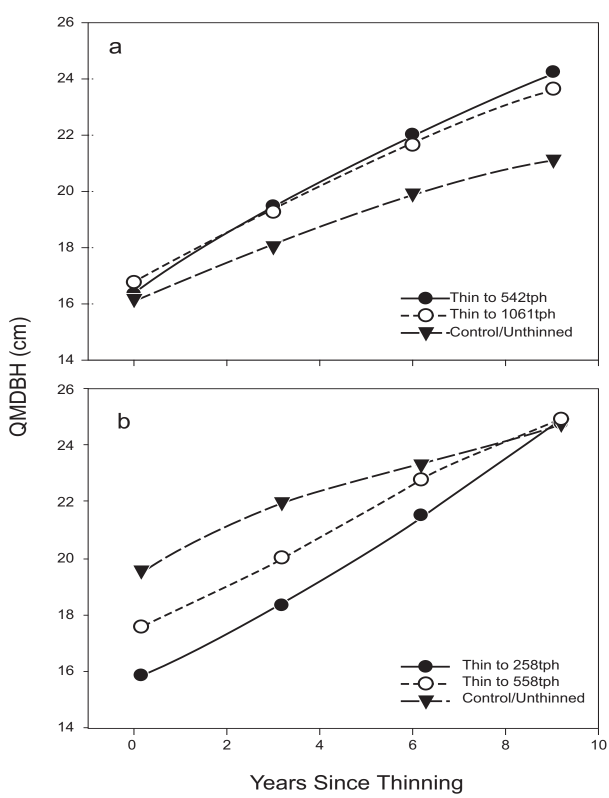
Thinning Treatment	DBH (cm)				Height (m)				Volume/tree (cubic m)[1]			
HLC=7.7m, LCR=0.41	Year 0	Year 3	Year 6	Year 9	Year 0	Year 3	Year 6	Year 9	Year 0	Year 3	Year 6	Year 9
Thin to 568 (104)												
Crop Trees	16.44a	19.45a	21.90a	24.16a	15.61a	16.09a	17.55a	17.97a	0.16a	0.20a	0.28a	0.33a
Thin to 1297 (105)												
Crop Trees	16.75a	19.30a	21.74a	23.60a	14.97a	16.11a	17.94a	19.04a	0.14a	0.21a	0.28a	0.35a
Control (106)												
Crop Trees	16.11a	18.04a	19.88a	21.13a	14.81a	16.20a	17.54a	19.30a	0.14a	0.18a	0.23a	0.29a
HLC=13m, LCR=0.25												
Thin to 247 (107)												
Crop Trees	15.86a	18.32a	21.24a	24.42a	17.52a	17.62a	18.44a	18.25a	0.18a	0.24a	0.30a	0.37a
Thin to 568 (108)												
Crop Trees	16.80ab	19.98ab	22.81a	24.38a	17.07a	18.25a	18.89a	19.70ab	0.18a	0.25ab	0.32a	0.39a
Control (109)												
Crop Trees	18.82b	21.98b	23.29a	24.81a	18.21a	19.41a	21.59a	22.20b	0.22a	0.30b	0.37a	0.41a

[1] Multiply by 35.31 to convert to cubic feet.

Table 10. Mean annual growth rates, by period, of crop trees immediately after 3, 6, and 9 years after thinning in red alder stands, by height to live crown. Crop trees are the largest 247 trees/ha based on diameter. Values within a thinning treatment with the same letter are not significantly different (P<0.05).

Thinning Treatment	DBH (cm/yr)				Height (m/yr)				VOL/tree (cubic m/yr)*100[1]			
HLC=7.7m, LCR=0.41	Yr 0-3	Yr 3-6	Yr 6-9	Yr 0-9	Yr 0-3	Yr 3-6	Yr 6-9	Yr 0-9	Yr 0-3	Yr 3-6	Yr 6-9	Yr 0-9
Thin to 568 (104)												
Crop Trees	1.00a	0.81a	0.75a	0.86a	0.16a	0.49a	0.14a	0.26a	1.43a	2.45a	1.75a	1.87a
Thin to 1297 (105)												
Crop Trees	0.85a	0.81a	0.62a	0.76a	0.38a	0.61a	0.37a	0.45b	2.22a	2.47a	2.23a	2.31a
Control (106)												
Crop Trees	0.64a	0.61a	0.41a	0.56b	0.46a	0.45a	0.58a	0.50b	1.56a	1.62a	1.84a	1.67a
HLC=13m, LCR=0.25												
Thin to 247 (107)												
Crop Trees	0.87a	1.07a	1.06a	1.00a	0.03a	0.27a	0.06a	0.08a	1.62a	2.15a	2.42a	2.06a
Thin to 568 (108)												
Crop Trees	0.84a	1.03a	0.65ab	0.84b	0.39b	0.22a	0.27a	0.29b	2.22ab	2.27a	2.32a	2.27a
Control (109)												
Crop Trees	0.89a	0.52b	0.32b	0.58c	0.40b	0.73a	0.20a	0.44c	2.95b	2.08a	1.28a	2.10a

[1] Multiply by 0.35 to convert to cubic feet.



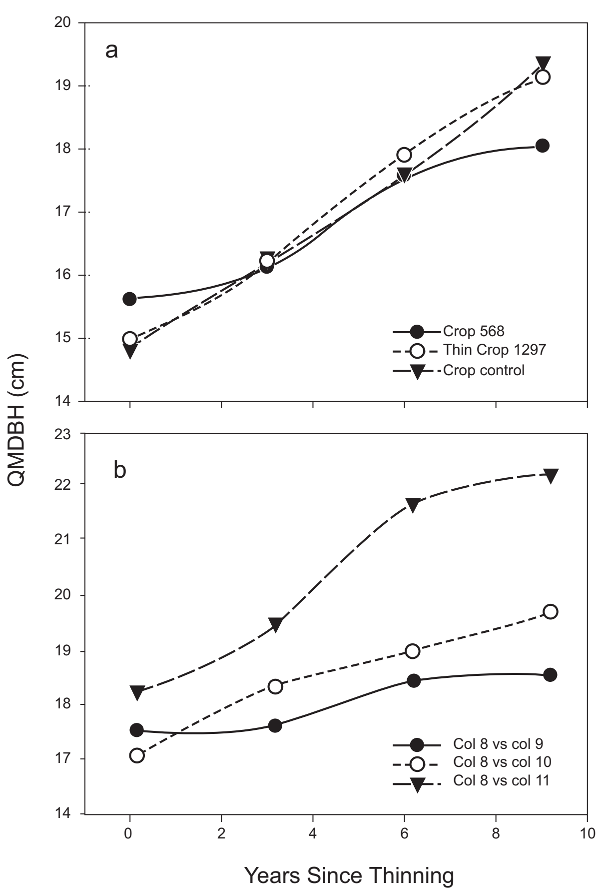
8. Crop tree diameter response following thinning for a) "early" thin and b) "late" thin.

growth rates were 53.6% and 35.7% greater for the heavy and light thin, respectively, as those for the unthinned plots. For all treatments, mean annual diameter growth rates declined throughout the measurement period.

In the late thinning treatment, immediate post-thinning diameters were smaller in the thinned plots with the greatest thinning intensity being significantly smaller than the control. However, 9 years after thinning, the mean diameters of all the plots were virtually identical. Average annual diameter growth rates were also greater for thinned versus unthinned plots across all measurement periods, but the pattern varied by treatment. Over the entire measurement period, mean annual diameter growth rates were significantly different across all treatments, increasing with thinning intensity.

Height

Thinning had little effect on total tree height for the early thin. However, at the end of year 9, tree height for the more heavily thinned treatment was observably less than the lightly thinned or the control treatments (a 6 to 7% reduction). Overall, mean annual height increment ranged from 0.14 m/yr to 0.61 m/yr. Although not statistically significant, mean annual height increment decreased with thinning intensity, for every three-year measurement period. Furthermore, after the entire 9-year period, annual height growth was reduced 48% in the heavily thinned plots compared to the unthinned plots.



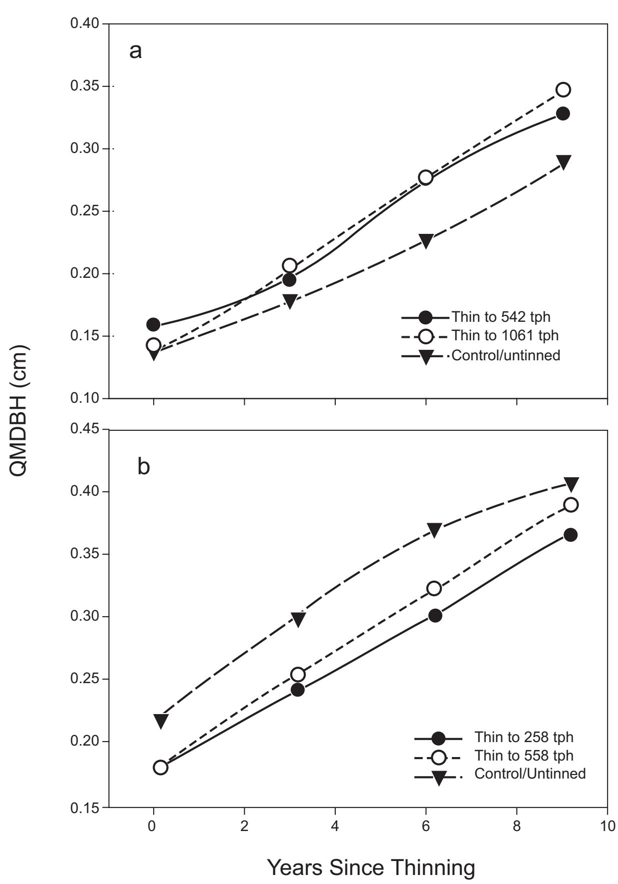
9. Crop tree height response following thinning for a) "early" thin and b) "late" thin.

An even greater reduction in height growth following thinning was observed for the late thin (Figure 9). Total tree height decreased with increasing thinning intensity, with mean crop tree height significantly reduced by 18% in the heavily thinned plots. Overall height increment was significantly different for all three treatments with the heavy thin having an 82% reduction and the lighter thin having a 34% reduction as compared to the unthinned plots.

Individual Tree Volume

There were no significant differences in individual tree volume for the early thinning treatment across any measurement period. Pre-thinning crop tree volumes ranged from 0.14 to 0.16 m^3/tree and 0.29 to 0.35 m^3/tree after nine years (Figure 10). Thinning had either no effect or a positive effect on individual tree volume: the lighter thin and the control plots increased 107% in volume and the heavier thin increased 150% in volume. Nine years following thinning, individual tree volume was 21% greater for the lighter thin and 14% for the heavier thin as compared to the control plots. Volume annual increments ranged from 0.014 to 0.025 m^3/year/tree. There were no significant differences in the annual increment in individual tree volume for any treatment for any measurement period. Volume increment remained relatively constant throughout the entire nine-year period for all treatments. The lighter thin consistently had the greatest volume increment.

For the late thin treatments, individual tree volume ranged from 0.18 to 0.22 m^3/tree at the time of thinning to 0.37 to 0.41 m^3/tree after nine years and the volume response differed from the early thin in a number of ways. First, although the lightest thin exhibited the greatest volume response, there was less of an increase in individual tree volume across all treatments in the late thin than the early thin. The control plot increased 86% while the lighter and the heavier thin increased 117% and 106%, respectively. Second, after nine years, the greatest individual tree volume was in the control plot, and decreased with thinning intensity. However, the reduction of volume with thinning was proportionally less than for the early thin (95.1% and 90.2%, respectively). There were no differences in annual increment in individual tree volume over the entire nine-year measurement period. Heavy thinning reduced mean volume increment 98% that of the control, while lighter thinning increased volume increment to 108% of the control. However, looking at the various three- year intervals reveals interesting patterns. First, immediately following thinning, the heavier thinned plots had significantly less volume incre-



10. Crop tree volume response following thinning for a) "early" thin and b) "late" thin.

ment (0.016 m^3/year/tree) than the lighter thinned (0.022 m^3/year/tree) and the control plot (0.030 m^3/year/tree). Secondly, annual volume increment increased as time progressed for the thinned plots and decreased for the control plots. For instance, volume increment between 6 years and 9 years after thinning compared to zero to three years after thinning was 50% greater in the heavy thin and 43% less for the control plots.

Density/Mortality

A direct result of thinning is the immediate reduction of density. For the early thin, density was reduced 17% and 34% that of the unthinned treatment for the heavy and the light thin, respectively. Thinning intensities for the late thin were very similar to that of the early thin. Density was reduced 14% and 30% that of the unthinned treatment for the heavy and the light thin, respectively.

In the early thin treatments, no appreciable mortality occurred in either of the thinned plots, even after 9 years. Density of the control plot declined from 3128 trees/hectare to 1845 trees per hectare, 41% mortality. However, in the late thinning treatments, the heavy thin, in addition to the control, experienced mortality albeit for different reasons. The heavily thinned treatment had 19% mortality over the nine-year period, but the vast majority occurred immediately after thinning due to weather damage (mainly stem breakage). The control experienced very similar rates of mortality (45%) as the controls in the early thin treatments, and consisted almost exclusively of the death of suppressed trees (data not shown).

Discussion

Diameter

For both the early and late thinning treatments, diameter growth increased with thinning intensity. In the early thin, diameter increased 47% and 41% for the heavy and light thin respectively. In the late thin, diameter increased 54% and 45% for the heavy and light thin respectively. The control plots for both timings had surprisingly similar diameter growth rates (31% and 32% for the early and late thins, respectively). Therefore, it seems like the timing of thinning red alder is less important than the thinning intensity. Plotting out the diameter response by timing and intensity on the density management guideline (Hibbs 1987), the four thinning treatments spanned a wide range of relative densities. According to Hibbs (1987) the maximum recommended management zone lies between the competition threshold and the operating maximum. This zone defines an area balancing individual tree growth and stand yield. Although the "heaviest" thin reduced relative density to approximately 8% and the "lightest" thin reduced relative density to approximately 37%, the percent diameter increase differed only slightly; 54% compared to a 41% increase. However, both of these thinning intensities are below the competition threshold (25% relative density). Individual tree diameter response is relatively insensitive to thinning intensity at these levels. Differential diameter responses would be expected to occur at higher relative densities.

Height

As reported by previous studies, red alder height growth is reduced following thinning (i.e. thinning shock). However, the effect of stand age (i.e. stand development) and thinning intensity remain unknown. Hibbs et al. (1989) found that thinning reduced height growth of red alder but no consistent patterns with thinning intensity were detected. The results of this study indicate that height response is more closely tied to thinning intensity than stand age. Reductions in height growth occur at any age and any intensity except when thinnings are extremely light. These light thinnings leave densities above the operating maximum line from the density management diagram for red alder. Therefore, to maximize diameter response following thinning (i.e. staying in the "management zone") height growth reductions in red alder will occur: optimizing diameter growth and height growth with thinning are incompatible.

Individual Tree Volume

In the early thin, the larger individual tree volume in the thinned plots versus the control plot is largely the result of the greater diameter response following thinning as compared to the control plots. The greater volume in the "lighter" thin versus the "heavier" thin is a result of the height growth reductions associated with greater thinning intensity.

In the late thin, the minimal treatment differences in tree volume after nine years is a combination of a reduction in tree height for both thinning intensities coupled with the larger pre-thin diameters in the control plots. Therefore, because of the differences in pre-thin diameter, annual increment is a useful response indicator. Thinning reduced volume increment immediately following heavy thinning (due to the immediate height growth reductions associated with both thinning intensities) but resulted in a long-term increase in volume increment with time (due to the increase in diameter following thinning).

Further Research

The results presented here are preliminary results generated from an intensive database. Further analyses will include how thinning affects stand-level variables such as basal area and volume.

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Other Projects

Red Alder Volume Equations

Alder plantations are getting older and the trees are getting bigger. Do these plantation-grown alders have the same form as natural stand alder? How well do our current volume equations predict the volume in an alder tree in a plantation? The HSC has partnered up with the USFS PNW Research Station to answer these questions. A joint venture agreement between the USDA Forest Service, Pacific Northwest Research Station and Oregon State University (HSC) of $50,000 has been approved. 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.

Description

Red alder is now being planted and managed in plantations in Oregon and Washington. 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.

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.

This 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. Red alder has moved from being a problem species in the forest landscape to one that is being planted and managed. Its current mill-delivered log price exceeds that of Douglas-fir. Forest land managers have volume equations developed in natural stands but alder trees in natural stands have a different form than that seen in managed stands. New volume equations are needed to predict accurately volume, and, ultimately, financial return.

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.

Developing new alder tree volume equations will begin this summer with the cutting down of trees grown at different densities from the HSC plantations. The experimental design of these sites provide extra trees for this sampling located in the "destructive buffer" area. Selected sites will span the ranges of tree age, tree size, site index and geographic location. Measurements include, but are not limited to: diameter at breast height, total tree height, height to live (and dead) crown, ground line diameter, diameter outer bark at 10% increments of total tree height (i.e. taper of the trunk), and bark thickness.

This data will be analyzed next winter to develop stem taper and volume equations. If resources are sufficient, the importance of site index, initial stand density and intermediate stand activities on equation form will be explored. When the equations are developed, outreach educational programs will be conducted by the HSC to ensure that the products are generally known and available to the forest management community

TASS Red Alder Modeling Update

George Harper, with the BC Ministry of Forests, has successfully developed a red alder version of TASS. The new version of TIPSY, which is available to the public, is going out for Beta testing very soon. The general release for the new TIPSY is planned for June 2004. For more information on TASS or TIPSY contact the website: www.for.gov.bc.ca/research/gymodels/

Regional Red Alder Modeling Update

The other regional modeling effort is still on schedule. The Stand Management Cooperative (SMC) has completed assembling the database and now the activity has switched to deciding how the actual "modeling" will be accomplished. This topic plus potential funding sources were discussed at the committee meeting held in Olympia, WA on June 17, 2004. Below is the status of the project at that date written by Barri Herman.

Background

There has been a growing interest in a public Red Alder Growth and Yield Model as there has been expanded acceptance of Red Alder as both a tree crop as well as an important biodiversity component in stands. The introduction of new environmental constraints on harvesting riparian areas and the perceived increase in value of alder versus Douglas fir or hybrid-poplar have been strong drivers of this interest. There is relatively good information available relating to silvicultural practices for stand establishment and tending. The most notable technological gap is the lack of a good growth and yield simulator for forecasting future yields of managed Red Alder stands (both intensively managed Red Alder plantations and mixed species stands). Having this capacity is critical to assessing the potential value of silvicultural investments and making decisions to manage forest-land for Red Alder. Hence, there is considerable regional interest in developing a robust growth and yield model.

Structure

The industry, as represented by the Washington Hardwood Commission and several Industrial growers, has expressed concern that there is no freely available, high quality growth and yield model for Red Alder. There is a need for a growth and yield model(s) that handles both pure and mixed species stands (e.g, Douglas fir and alder mix and mixed species in riparian zones). In addition, there is a need to have the capability to link the growth and yield model to other analysis programs that can help landowners evaluate the financial implications of regime options, etc.

There have been several cooperatives that have focused on Red Alder culture and stand management from planting through final harvest. These cooperatives have been collecting data on growth of alder on various sites and under various silvicultural regimes. The data that are available from our colleagues in the U.S. Forest Service, Ministry of Forestry in BC, a variety of industry sources and various University sources need to be compiled into a coherent data base that can be used to construct the growth and yield model.

The Washington Hardwood Commission and Industrial growers are in favor of a cooperative effort to produce a robust and credible Red Alder growth and yield model using current and applicable data. The specific tasks that must be accomplished pertaining to the model include: Clarify model scope (geographic coverage, range of stand conditions and sites, modeling capabilities and specifications)

1. Outline model format and functions
2. Edit and collate applicable data
3. Develop the model to specifications
4. Document model
5. Validate the model

Current State

The alder Growth and Yield Co-operative members developed the technical standards that were used in the development of a joint database held at the SMC at the UW. All of the cooperators have provided their data in the proscribed format to the SMC. CMER provided the initial funds to start the work at the UW, allowing the SMC to compile the database structure and to allow all of the data contributors to submit their data. The data should be checked and compiled by the end of July 2004. Having completed points 1 – 3 above we are now ready to move to points 4 – 6.

Future Work

At a co-operative member meeting held in mid June 2004 the cooperators have decided on several possibilities, these include

1. Working with the SMC at OSU to include the new data in the existing ORGANON model which is a publicly available model.

2. Discuss the development of a new model with interested parties.
3. Approach several independent modelers to construct new equations using the new data and then approach modelers with existing models and have the new equations integrated into the existing models.

We shall also approach several federal, state and other interested bodies that would use this model to discuss their needs and possible funding options. As this data contains site information as well as growth data and the data is from plantations and natural stands in both managed stand and riparian areas, there is a wide base of possible uses.

The list of possible interested parties would include

1.DNR	2. WHC
3. PNW (science delivery)	4. RTI
5. WFFA	6. OSWA
7. ODF	8. OSU

The predicted remaining costs will be approximately

◢ Compilation of the data at the SMC UW	30K
◢ Inclusion of the new data into an existing model	70K
◢ Less initial funding from CMER	15K
◢ Total remaining	85K

Recommendation:

The recommendation is that the SMC at OSU be approached to include the new data in their existing Red Alder growth and yield model contained in ORGANON. Possible partners and financial contributors that could support such a project will be approached before the end of July to determine their interest. Pending financial support we would anticipate a further 9 months to completion of the model.

Red Alder Symposium

The HSC, along with a handful of other sponsors (see below) is currently in the process of developing an international symposium on red alder. The symposium will be held at the University of Washington HUB Ballroom, Seattle, WA on March 23-25, 2005. This will be a multi-day event covering many topics related to the red alder resource and management issues and will include a day of field trips. The following is a brief description of the symposium.

International Symposium. Red Alder: A State of Knowledge

The last symposium on red alder titled "Utilization and Management of Alder" was held in 1977 and much has changed since then. Once considered a weed, alder is now recognized as a premium commercial species and an important ecological component of Pacific Northwest forests. Yet changes that are affecting red alder management and utilization, including advances in our understanding of biology and silviculture, market and non-market values, and the regulatory climate may not be broadly understood. On March 23-25, 2005, the University of Washington will host a symposium to bring together regional experts for a critical examination of the economic, ecological, and social values of red alder. To this end, the symposium has the following organizational structure

March 23: Plenary Session: Invited speakers who will discuss

- The History and Future Sustainability of Alder
- Landowner panel: The Past, Present and Future of Alder

March 24: Moderated Concurrent Sessions

A. Alder Silviculture and Management
B. Biology and Ecology of Alder
C. Alder Utilization and Markets
D. The Economic and Regulatory Climate for Alder

March 25: Field Trip

- natural and plantation alder stands
- alder lumber manufacturer

Symposium Sponsors:

British Columbia Ministry of Forests (?)
Hardwood Silviculture Cooperative, Oregon State University
Stand Management Cooperative, University of Washington
Rural Technology Initiative, University of Washington
USDA Forest Service Focused Science Delivery Program
Washington Hardwoods Commission
Washington State University Extension
Western Forestry and Conservation Association
Western Hardwood Association

If interested in attending, please contact:

Megan O’Shea
College of Forest Resources
Box 352100
University of Washington
Seattle, WA 98195
moshea@u.washington.edu

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.

- Growing red alder: What a small landowner needs to know.

  Bluhm, Andrew A. Forest stewardship class for NIPF owners Washington State University Extension. Carnation, WA. May 19, 2004.

- Growing alder for value. Innovation for Survival of the Northwest Forest Sector: An Integrated Approach.

  Hibbs, D.E. and Andrew Bluhm. November 18, 2003. Puyallup, Washington.

- Intensive management of red alder: principles and practices.

  Bluhm, Andrew A. A training session for WA Department of Natural Resources regional silviculturists. Webster Nursery, Olympia, WA October 15, 2003 and Forks, WA March 25, 2003.

- Red alder tricks of the trade: Keys to successful establishment and management.

  Bluhm, Andrew A. Portland Chapter of Society of American Foresters, OSU Extension Service, and Western Forestry and Conservation Association, Beaverton, OR September 11, 2003 and Washington Farm Forestry Association Annual Meeting, Bellingham, WA April 4, 2003.

- Alder growth and yield modeling cooperative: An update.

  Bluhm, Andrew A. HSC Summer meeting, Corvallis, OR, July 12, 2003

- Red Alder/Douglas-fir mixtures: Effect on Survival and Growth.

  Bluhm, Andrew A. HSC Summer meeting, Corvallis, OR, July 12, 2003

Direction for 2005

The specific goals for 2005 are a continuation of our long-term objectives:

- Continue treatments and measurements of Red Alder Stand Management Study installations.
- Continue working with the BC Ministry of Forests in releasing the new version of TIPSY, the publicly available growth model which now includes red alder.
- Continue working with the "Regional Alder Modeling Group" in acquiring funding and developing a strategy for the final modeling process.
- Continue working with OSU statisticians in the Type II data analyses, for publication in a peer-reviewed journal.
- Hire and train a field crew for the collection of tree form data to develop volume equations for red alder plantations.
- Keep the HSC website updated and current.
- Continue efforts to recruit new members.

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 Management Committee Meeting

Thursday July 11, 2003:

Attendees: Andrew Bluhm- OSU; John Johanson and Stu Johnston- Siuslaw National Forest; George Harper- BC Ministry of Forests; Doug Robin- ODF; Norm Andersen and Florian Deisenhofer- WA DNR; Larry Larsen and Floyd Freeman- BLM; Robert Deal- PNW, Portland, OR; Rod Meade-Weyerhaeuser Company; Vern Farrel- Olympic National Forest

The meeting began at 8:30am in the Richardson Hall parking lot. After arranging parking passes and travel logistics we headed out for a day of field tours in the Siletz, OR area.

The first stop was at one of Mike Newton's and Liz Cole's mixed-species Nelder plots. A Nelder design is an interesting design allowing for studying the effects of both density and species proportion. Their study examines the relationships of alder, hemlock, and salmonberry. It is unique in alder research as being one of the first experiments in the PNW with planted alder. Please see the attached packet that describes the study design and results.

Then, after lunch, the group stopped at a riparian buffer of a recent logging operation. Here, Liz Dent, Manager of ODF's Forest Practices Monitoring Program discussed the Oregon Forest Practices Act. Discussions centered around three main topics:

1) The act in general, what it is, Riparian Management Areas (RMA's), definitions of stream types, buffer widths, hardwood conversion rules, etc.

2) How Oregon's rules differ from riparian rules in Washington and British Columbia,

3) Effectiveness of the current rules and the monitoring program.

In 2002, the Oregon Forest Resources Institute along with ODF published an illustrated manual explaining the Oregon Forest Practices Act. Copies of this manual (which received great reviews) can be ordered from:

Oregon Forest Resources Institute

317 SW Sixth Ave., Suite 400

Portland, OR 97204

Phone: 800-719-9195

Web: www.oregonforests.org

Furthermore, ODF has a great website pertaining to the Forest Practices Act and the Monitoring Program. For more information lease see the website:

http://www.odf.state.or.us/DIVISIONS/protection/forest_practices/

Following this stop we drove up the hill to visit one of the HSC Type 3 installations. This was the very first time the group has visited one of our alder/Douglas-fir replacement series and the first time data from these studies has been analyzed and presented. Please see the attached handout for the study site description and preliminary analysis results. Discussions here ranged from why more mortality/growth differences among species were not seen, to what the stands may look like in the future, to how to operationally grow mixed-species stands.

The last stop was at an HSC Type 2 installation (a variable density alder plantation). The HSC group visits these plantations frequently, but it had a lot to offer since two thinning treatments and a pruning treatment were conducted just last year. Not a lot of time was left in the day so Andrew focused discussions on the effects of thinning (timing, original density, and residual density) on branch size and tree form. Recent analyses were conducted on the growth responses of these plantations and are included in this report.

Friday July 12, 2003:

Attendees: Andrew Bluhm- OSU; John Johanson and Stu Johnston- Siuslaw National Forest; George Harper- BC Ministry of Forests; Doug Robin- ODF; Norm Andersen and Robin Biesecker- WA DNR; Larry Larsen- BLM; Rod Meade-Weyerhaeuser Company; Del Fischer- Washington Hardwood Commission; Steve Griffith- Optware Solutions; Amy Grotta- Wood Science and Engineering, OSU

The meeting began at 8:00am in Richardson Hall. After welcomes and introductions, Andrew reviewed the last year and the coming year measurements. Last year was the busiest field season in many years. Next winter, fieldwork returns to a more "average" level. Please see the annual report included in this report for a description of the fieldwork schedules.

The following is a list of the remaining presentations given at the meeting. There was one more presentation scheduled for this meeting, but due to time constraints it was not presented. Most of these PowerPoint presentations are included in this report:

Presentation: Alder growth and yield modeling cooperative.

Andrew Bluhm; Associate Director, Hardwood Silviculture Cooperative, OSU

Presentation: Red Alder/Douglas-fir mixtures: Effect on Survival and Growth.

Andrew Bluhm; Associate Director, Hardwood Silviculture Cooperative, OSU

Presentation: Douglas-fir/red alder mixtures: Implications for wood quality.

Amy Grotta; Faculty Research Assistant, Dept. of Wood Science and Engineering, OSU

Presentation: An introduction to TASS, a forest growth model.

George Harper: Research Scientist, Stand Development Research Branch, BC Ministry of Forests

Not presented: Effect of thinning on red alder tree form and volume.

Andrew Bluhm; Associate Director, Hardwood Silviculture Cooperative, OSU

George's talk about TASS/TIPSY was mostly a review of what efforts went into calibrating TASS for red alder and then he went through actually running the model. His handout included in this report summarizes his talk, but to see the real power/possibilities with this growth and yield model, one should run the software. The model (in this case TIPSY) will be publicly available very soon and is currently available for anyone who wants to test it. Please see the website: www.for.gov.bc.ca/research/gymodels/TASS/ for more information or contact George directly if interested in testing the model (email: George.Harper@gems4.gov.bc.ca Phone: 250-387-8904).

The talk that Andrew did not give was an extension of the work he and Glenn Ahrens are doing on thinning natural stands of red alder. Andrew presented the effects of thinning on volume at the last summer meeting, but further analysis was desired. Please see the handout, which describes the effect of thinning on tree form, as well as the effect on logging costs. The logging cost estimates were derived from a questionnaire that Glenn Ahrens developed. However, he is interested in getting more reliable estimates. Therefore, included here is the questionnaire and if you or someone you know can provide the information and send it back to him, it would greatly help.

Switching gears from presentations to discussions, the first topic brought up was the availability (or lack there of) of red alder seedlings. Norm Andersen kindly updated the group on the WA DNR Webster nursery efforts in producing red alder. That information is also included in this report.

Then, the topic turned to the HSC budget. Andrew pointed out that incoming funds have remained constant the last few years; a good thing regarding the condition of the forestry sector in the PNW. Expenses have also remained fairly constant and remain below dues/income. However, starting in FY04, OSU will begin charging a 10% overhead fee for all cooperatives, which could affect the income/expenses picture. As a way of reducing some expenses, it was suggested that Andrew try to recruit field help from active members instead of hiring outside help. Furthermore, as the costs of printing/publishing the HSC Annual Reports are going up (due to greater numbers being published, it was suggested that we consider eliminating paper copies and switching to a more electronic format. However, being that this year's annual report is already printed, this change will likely occur next year.

As always, the HSC's "orphaned sites" came up. Since last year had a large number of these sites, Andrew had difficulty finding help to measure them. Therefore, he measured many days last winter alone in the woods. The group responded unfavorably to Andrew measuring these sites alone. Therefore, for safety reasons it was suggested to try to recruit field help from active members, even if the help is not on their property. Therefore it was decided that Andrew contacts active members and tries to recruit a field crew before he starts measuring any of these sites.

The topic of "orphaned sites" led directly to scheduling the HSC Winter 2004 meeting since these winter meetings are mainly to measure these sites. Next year there are two sites without cooperators: One near Newport, OR and the other near Coos Bay, OR. If there is not any assistance in conducting the field work at either of the two sites, it was decided to meet in Coos Bay. However, if Andrew can receive help at the Coos Bay site then the meeting may take place in Newport, OR. Andrew will keep all members notified of the location. Regardless, the dates of the HSC Winter 2004 meeting will be Tuesday and Wednesday January 13-14, 2004.

Appendix 3

Financial Support Received in 2003-2004

Cooperator		Support
BC Ministry of Forests		--------
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	$47,000
Forestry Research Laboratory		$42,000
	Total	$89,000