HSC 2011 annual report

Oregon State UNIVERSITY

Hardwood Silviculture Cooperative

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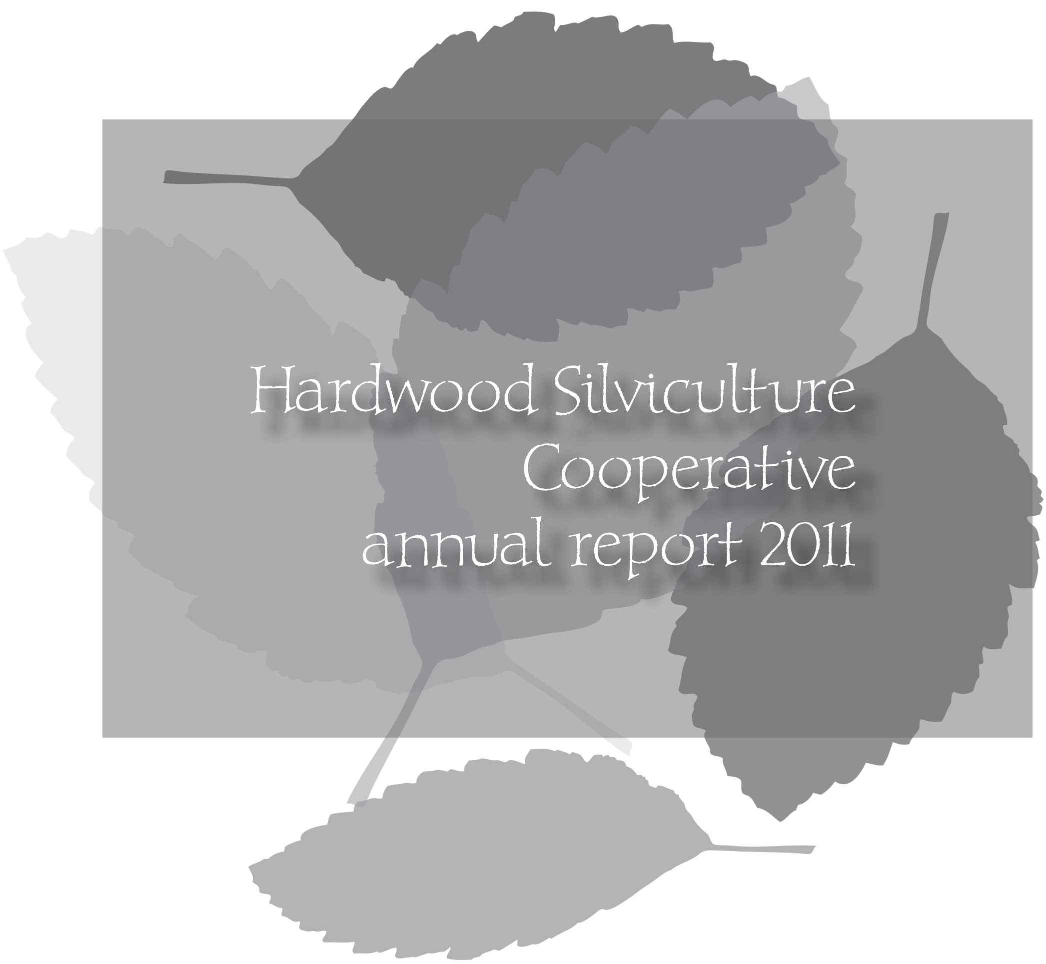
Hardwood Silviculture Cooperative
annual report 2011



Highlights of 2011

- The first ever red alder growth model based on plantation-grown trees is completed and available to the public. RAP-ORGANON, created at OSU by David Hann, Andrew Bluhm, and David Hibbs using Weyerhaeuser Co. and Hardwood Silviculture Cooperative data can be found and downloaded from the ORGANON website: www.cof.orst.edu/cof/fr/research/organon/.
- The first 22nd year measurement was completed on the HSC Type 2 installation Humphrey Hill.
- Five more HSC Type 2 installations had the 17th year measurement; bringing the total to 19 of the 26 installations.
- Three more HSC Type 3 installations had the 17th year measurement; bringing the total to 4 of the 7 installations.
- The logging and data collection is about to start for the collaborative effort between the WA Department of Natural Resources and the HSC investigating volume and stem form effects resulting from thinning natural red alder stands.

Contents

Hardwood Silviculture Cooperative Executive Summary 2011

Established 23 years ago by a small and visionary group, the Hardwood Silviculture Cooperative (HSC) has spearheaded the effort to develop and provide information for foresters interested in red alder management. The HSC established thirty-seven study installations located from the Southern Oregon Coast, up through Vancouver Island and across into the Cascade Mountains. There are three types of research installations:

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

Last year's data collection was very extensive. Data collection and/or treatment application occurred on one third of all the installations! Twelve installations were measured including three Type 2 installations having their 22nd year measurement, eight Type 2 installations having their 17th year measurement or treatment, one Type 1 installation having its 19th year measurement, and three Type 3 installations having their 17th year measurement. Couple the huge amount of fieldwork with all of the low elevation snows we had this winter and I was kept awfully busy!

I am glad to announce that the production of the growth and yield model for red alder plantations (RAP-ORGANON) is finished. This first-of-a-kind model is an essential tool for advancing the management of red alder and its acceptance as a viable timber species in the Pacific Northwest. This model provides growth responses to various site productivities and various silvicultural treatments (i.e. planting density, and thinning) and predictions of stand volume, rotation ages, log sizes, etc.

In addition, the HSC continued working with the WA Department of Natural Resources investigating the effects of thinning on stem form and tree and stand volume. An upper stem measurement was taken on standing trees on the HSC Type 1 installation #4102 (Janicki). The preliminary analysis is included in this report. With the harvest of the trees (scheduled for this summer), multiple measurements along the entire stem of fallen trees will be taken. These data will assist WADNR in fine-tuning their red alder cruise estimates and help improve existing red alder volume/taper equations.

Finally, continued collaborations occurred with external investigators who recognize the value of the HSC research program. These include the Canadian project, "Using red alder as an adaptation strategy to reduce environmental, social and economic risks of climate change in coastal BC". To date, the HSC has provided geographic and tree growth information for all of the HSC installations, has assisted in collecting soil samples from the Type 3 installation in the USA, and collected Douglas-fir foliage samples from these same installations. In addition, Peter Kennedy (Lewis and Clark

College) has proposed using the red alder/Douglas-fir research plots at Cascade Head and H.J. Andrews to study whether ectomycorrhizal fungal communities function differently when associated with alder vs. non-Frankia host species (e.g. Douglas-fir).

No matter how far you look back (two years, ten years, twenty-five years) you can see more and more knowledge and more and more tools developed regarding the management of red alder. Not surprisingly, the HSC has been responsible for many of these developments. The vision, dedication, and continued support of the HSC members have made this possible. We have them to thank.

History of the HSC

The Hardwood Silviculture Cooperative (HSC) is a multi-faceted research and education program focused on the silviculture of 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 to understand 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 may 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 through time 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 management on red alder growth and yield, and wood quality and to develop red alder growth and yield models.

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.

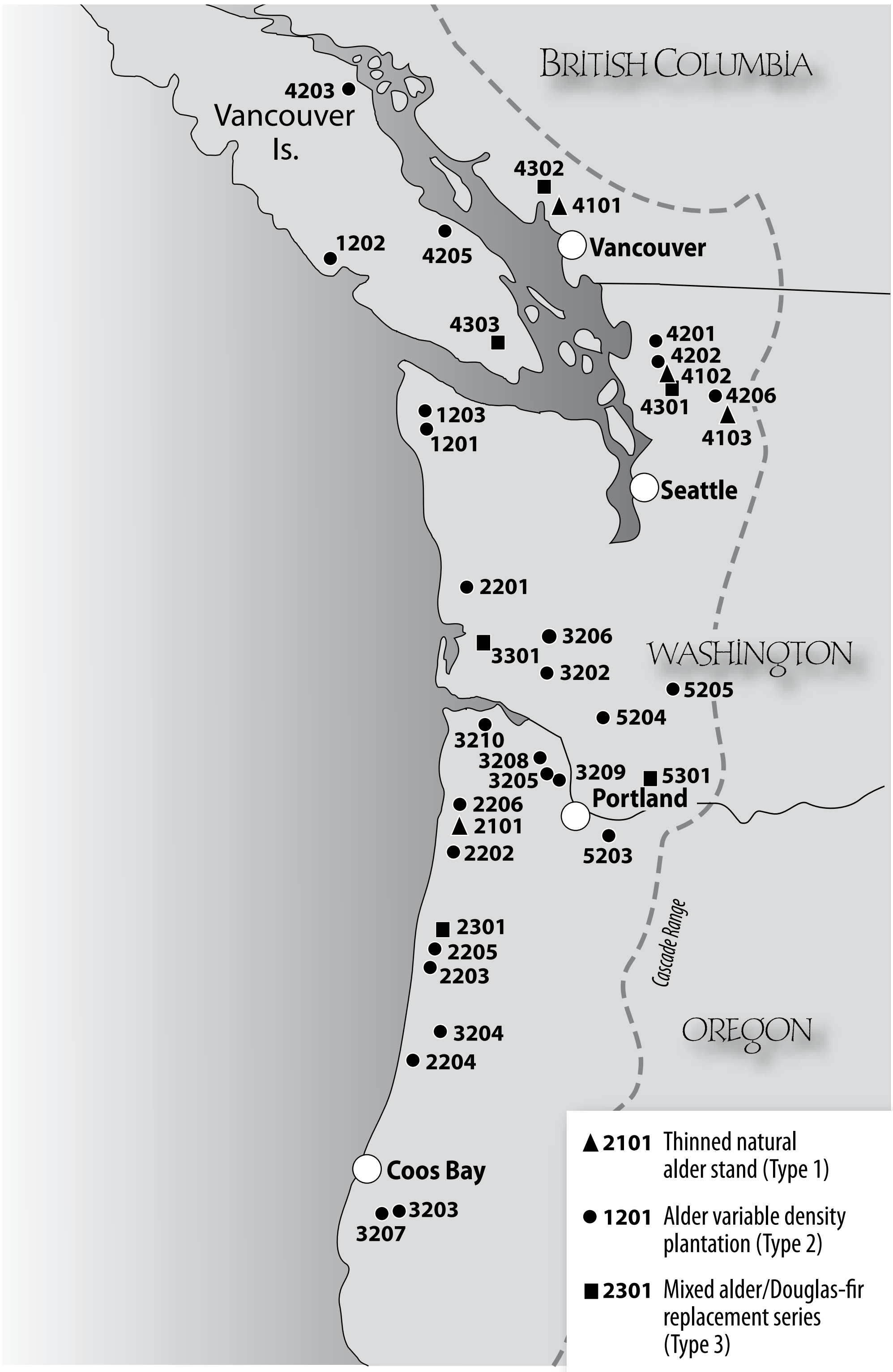


Figure 1. Location of installations for the Red Alder Stand Management Study.

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. There are seven Type 3 installations.

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 quality classes (Table 1).

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

Winter 2010/11 was an extremely busy field season. Measurements and various treatments were completed on 12 of the 37 installations (see Table 5). Last years work included:

- No Type 1 installations had fieldwork.
- Nine Type 2 installations had fieldwork.
- One site- Humphrey Hill (4201, GYN) had its 22nd year measurement.
- Four sites- Lucky Creek (1202, BCMIN), Cape Mtn. (2204, SNF), Dora (3207, BLM), and French Creek (4205, BCMIN) had their 17th year measurement.
- One site- Siletz (2205, ForCap) had its 17th year measurement, its 3rd pruning lift and the last thinning treatment (when HLC~30ft).
- Two sites- Maxfield (1203, WADNR) and Wrongway Creek (3210, OSU) had their 3rd pruning lift and the last thinning treatment (when HLC~30ft).
- One site- LaPush (1201, WADNR) had its last thinning treatment (when HLC~30ft).

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 ANE '92 2204 SNF '94	2201 WHC '90 2205 ANE '94
3) Coast Range	3204 SNF '92 3209 BLM '95	3202 WHC '90 3205 ODF '92 3207 BLM '94 3208 ODF '97	3203 MEN '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

ANE-ANE Hardwoods.
BCMin-British Columbia Ministry of Forests.
BLM-Bureau of Land Management.
CAM-The Campbell Group
DNR-Washington Department of Natural Resources.
GYN-Goodyear-Nelson.
GPNF-Gifford Pinchot National Forest.
MBSNF-Mt. Baker Snoqualmie National Forest.
ODF-Oregon Department of Forestry.
OSU-Oregon State University Forest Research Laboratory.
SNF-Siuslaw National Forest.
WHC-Washington Hardwood Commission.

- Three Type 3 installations had fieldwork.
- Three sites- Monroe-Indian (2301, ForCap), Turner Creek (4301, GYN), and Holt Creek (4303, BCMIN) all had their 17th year measurement.

So, in the big picture:

- Three of the four Type 1 sites have had their 19th year measurement.
- One of the twenty-six Type 2 sites has had its 22nd year measurement.
- Nineteen of the twenty-six Type 2 sites have had their 17th year measurement.
- Twelve of the twenty-six Type 2 sites have all treatments completed.
- Four of the seven Type 3 sites have had their 17th year measurement.

This coming year's fieldwork (Winter 2011/12) will be almost half that of this years. A total of 11 installations need either a measurement or a treatment. See Table 6 for the list of activities.

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	John's R.	Ryderwood	Clear Lake	LaPush	Pollard	Pioneer	Sitkum	Keller-Grass	Shamu	Thompson	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	2010?	2002	1999	2008	2003	2004	2001	2009	2004	2004	2002	2007
12th yr Measure	2001	2002	2002	2002	2003	2003	2004	2004	2004	2004	2004	2005	2005
30-32' HLC Thin	2001	2017?	NA	2002	2011	2008	2009	2004	NA	2007	2009	2007	2010
Prune Lift 4 22 ft	2001	2017?	2002	2002	2013?	2008	2009	2004	2014	2007	2009	2005	2010
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 continued

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	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	2003/06	2003/07
Prune Lift 1 6ft	NA	1999	1999	1999	NA	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	2006/08	2006	2003/06	2003	2003/16	2004/07	2004/07	2002/07	2005/08	2007/12	2007/09	2009/12
Prune Lift 2 12ft	NA	2006	2003	2003	NA	2003	2004	2004	2002	2006	2009	2006	NA
9th yr Measure	2002	2003	2003	2003	2003	2003	2004	2004	2004	2006	2006	2006	2006
Prune Lift 3 18ft	NA	2016	2013	2011	NA	2006	2012	2010	2004	2011	2012	2011	NA
12th yr Measure	2005	2006	2006	2006	2006	2006	2007	2007	2007	2008	2009	2009	2009
30-32' HLC Thin	2007	NA	2016?	2011	2016?	2016?	2012	2010	2012	2011	2014?	2011	20014?
Prune Lift 4 22 ft	NA	2021?	2021?	2016?	NA	2016	2017?	2010	2007	2013?	2014?	2014	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.

Owner	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

Work includes:

- No Type 1 installations need fieldwork.
- Six Type 2 installations need fieldwork.
- Three installations- John's River (2201, WHC), Ryderwood (3202, WHC), and Clear Lake Hill (4202, GYN) need their 22nd year measurement.
- One installation- Scappoose (3209, BLM) needs its 17th year measurement.
- One installation- Darrington (4206, WADNR) needs its 17th year measurement and the last thinning treatment (when HLC~30ft).
- One installation- Mt. Gauldy (2206, SNF) needs its 17th year measurement, the last thinning treatment (when HLC~30ft), and the 3rd pruning lift.

- One installation- Weebe Packin (3208, ODF) needs its second thinning treatment (when HLC~15-20ft), and the 3rd pruning lift.
- One Type 3 installation needs fieldwork.
- Menlo (3301, WADNR) needs its 17th year measurement

Of note, there are no "orphaned" installations to be measured/treated this year.

Table 5. Hardwood Silviculture Cooperative Field Activities, Winter 2010/11

Type	Activity	Installation	Cooperator
Type 1	None		
Type 2	3rd Pruning Lift	2205	ANE- Siletz
		1203	WADNR- Maxfield
		3210	OSU- Wrongway Creek
	17yr Measurement	1202	BCMIN- Lucky Creek
		2204	SNF- Cape Mtn.
		2205	ANE- Siletz
		3207	BLM- Dora
		4205	BCMIN- French Creek
	30ft HLC Thin	2205	ANE- Siletz
		1203	WADNR- Maxfield
		1201	WADNR-LaPush
		3210	OSU- Wrongway Creek
	22yr Measurement	4201	GYN- Humphrey Hill
Type 3	17yr Measurement	2301	ANE- Monroe Indian
		4301	GYN- Turner Creek
		4303	BCMIN- Holt Creek

Table 6. Hardwood Silviculture Cooperative Field Activities, Winter 2011/12

Type	Activity	Installation	Cooperator
Type 1	None		
Type 2	15ft HLC Thin	3208	ODF- Weebe Packin
	3rd Pruning Lift	2206	SNF- Mt. Gauldy
		3208	ODF- Weebe Packin
	17yr Measurement	2206	SNF- Mt. Gauldy
			BLM- Scappoose
		4206	WADNR- Darrington
	30ft HLC Thin	2206	SNF- Mt. Gauldy
		4206	WADNR- Darrington
	22yr Measurement	2201	WHC- John's River
			WHC- Ryderwood
		4202	GYN- Clear Lake
Type 3	17yr Measurement	3301	WADNR- Menlo

Current HSC Activities

ORGANON Growth and Yield Modeling

The HSC is proud to announce the completion of a new version of ORGANON for red alder plantations called RAP-ORGANON. This version is the first red alder growth and yield model that specifically models the behavior of red alder plantations. As described in previous annual reports, the necessary components/steps were numerous and time consuming. The following steps are summarized below:

- Data from the "Regional Modeling Effort" was explored and deemed, in its entirety, unsuitable. Therefore, only data from Weyerhaeuser and the HSC were used.
- The dataset was cleaned, formatted, then "explored" (i.e. looking at the ranges and patterns of the data, identifying relationships, looking for "weird" behavior, etc.).
- The effect of planting density on height growth was tested (incidentally for both plantations and natural stands).
- Dominant height growth equations were developed to calculate site index.

A suite of equations were then developed. Including:

- Height-diameter equations
- Maximum crown width equations
- Largest crown width equations
- Crown profile equations
- Branch diameter equations
- Height-to-crown-base equations
- Diameter growth equations
- Height growth equations
- Crown recession equations
- Mortality equations

Unfortunately, during the development of these equations, errors in the database were detected. These errors did not affect the existing equations but required reformatting the database for further analysis. On the bright side, we took this opportunity to add additional data collected since the original database had been created. Although requiring additional effort, the updated database was much more robust with thousands of measurements added of (mostly) older trees. New parameter estimates were then calculated for the equations already completed.

After development the equations were then tested. Including testing:

- Maximum size-density trajectory
- Residual equations for the diameter growth equations
- Residual equations for the height growth equations
- Effects of thinning on all of the equations
- Evaluation of RAP-ORGANON for making stand-level equations

The full report of the entire RAP-ORGANON effort "Development and Evaluation of the Tree-Level Equations and Their Combined Stand-Level Behavior in the Red Alder Plantation Version of ORGANON" is available and can be found at: www.cof.orst.edu/cof/fr/research/organon/pubs/FERM_RP1.pdf

With the completion and testing of the component equations, the entire model was then "assembled" into a single package, incorporated and integrated into the entire ORGANON framework, and then sent out to selected individuals for beta testing. No flaws in model behavior were detected.

The RAP-ORGANON version is available to the public and can be downloaded from the following website: www.cof.orst.edu/cof/fr/research/organon/downld.htm.

Thinned Natural Red Alder Stand: Volume and Stem Form

As previously reported in last years annual report, the HSC is working with the WA Department of Natural Resources investigating the effects of thinning on stem form and tree and stand volume. The following is a brief project rationale, overall objectives, results to date, and futher work.

Project Rationale

The WA Dept. of Natural Resources (WADNR) is planning a timber harvest in a hardwood stand that contains the HSC Type 1 installation #4102 (Janicki). This site, established in 1976, was thinned in 1990 and just had its 19^{th} year post-thinning measurement. But before the stand is logged, both the HSC and the WADNR decided capitalize on this opportunity and to collaborate on a stem form and volume project.

Study Objectives

- Test to see if thinning affected stem form
- Test to see if thinning affected log size distribution

- Complete a 100% cruise of all treatment plots
- Calculate merchantable volumes using existing red alder volume/taper equations
- Compare cruise volume estimates with volume equation estimates

Results to Date

To get a quick look to determine if thinning affected stem form, a single upper stem measurement was taken on selected standing trees during the 2010 HSC summer meeting.

The selected trees (10 per plot) were chosen across the diameter distribution for each treatment, predicted diameter outer bark at 17.3ft (DOB) was calculated using the red alder taper equation from Bluhm, Garber, and Hibbs (2007), and form factor (DOB at 17.3ft/DOB at 4.5ft) was also calculated. The sample trees were then marked, numbered, climbed, and DOB at 17.3ft and DOB at 4.5ft was measured (Figure 2). If present, the difference between the predicted and observed DOBs would indicate that thinning affected form factor (and thus, stem shape), and how well the predictions from unthinned, plantation-grown red alder applied to this sample. See Table 7 for sample tree characteristics (both predicted and observed).

Figure 2. Measuring diameter outer bark (DOB) at 17.3ft for the stem volume project.

The main results included:

- The taper equation did a very good job at predicting DOB at 17.3ft. It underperdicted DOB by 0.3in for the Thin to 90tpa treatment while overpredicted DOB by 0.1in for the remaining two treatments.
- The greatest differences in observed minus predicted (bias) estimates were approximately 0.8in for the Thin to 90tpa, and 0.6in for the Thin to 190tpa and the control plot.

Also, since DOB at 4.5ft was taken a year earlier, it was hypothesized that the taper equation would underpredict DOB in all cases since DOB had an additional half growing season. This was not the case.

Averaging across treatments it was shown that actual (observed) DOB at 17.3ft

Table 7. Stem form project sample tree characteristics.

Treatment	Tree	Sample#	Dbh(in)	Ht(ft)	HLC(ft)	CR	PredDob	PredFf	ObsDob	ObFf	DOB Bias (obs-Pred)
Thin to 90tpa	554	23	13.2	76	51	0.33	11.70	0.89	12.0	0.91	0.30
Thin to 90tpa	555	22	13.5	76	50	0.34	11.98	0.89	12.0	0.89	0.02
Thin to 90tpa	558	21	13.9	72	53	0.26	12.24	0.88	12.4	0.89	0.16
Thin to 90tpa	559	30	12.6	72	48	0.34	11.13	0.88	11.4	0.90	0.27
Thin to 90tpa	564	24	14.0	67	44	0.35	12.15	0.87	12.9	0.92	0.75
Thin to 90tpa	565	25	13.6	72	45	0.37	11.93	0.88	12.7	0.94	0.77
Thin to 90tpa	569	28	8.8	64	48	0.25	7.68	0.87	7.5	0.85	-0.18
Thin to 90tpa	570	27	14.4	70	48	0.31	12.61	0.88	12.8	0.89	0.19
Thin to 90tpa	572	29	11.1	64	48	0.26	9.67	0.87	9.5	0.85	-0.17
Thin to 90tpa	575	26	9.3	61	51	0.17	8.04	0.86	8.5	0.91	0.46
Thin to 190tpa	511	6	9.4	66	49	0.25	8.26	0.87	8.5	0.90	0.24
Thin to 190tpa	514	7	16.7	67	43	0.36	14.39	0.86	15.0	0.90	0.61
Thin to 190tpa	516	8	10.2	62	48	0.24	8.79	0.87	9.1	0.90	0.31
Thin to 190tpa	523	4	13.7	75	51	0.33	12.10	0.89	12.2	0.89	0.10
Thin to 190tpa	527	5	7.8	58	48	0.17	6.68	0.86	6.3	0.81	-0.38
Thin to 190tpa	535	3	12.1	69	51	0.26	10.61	0.88	10.3	0.85	-0.31
Thin to 190tpa	544	2	12.7	80	60	0.25	11.35	0.90	11.2	0.88	-0.15
Thin to 190tpa	545	1	14.8	81	59	0.28	13.20	0.89	12.5	0.85	-0.70
Thin to 190tpa	553	10	11.0	77	60	0.23	9.85	0.89	9.4	0.85	-0.45
Thin to 190tpa	1001	9	13.1	75	57	0.24	11.64	0.89	11.9	0.91	0.26
Unthinned	8	8	15.6	80	61	0.25	13.96	0.89	13.6	0.87	-0.36
Unthinned	10	10	12.5	75	57	0.24	11.13	0.89	10.9	0.87	-0.23
Unthinned	17	17	11.5	79	59	0.25	10.29	0.89	9.8	0.85	-0.49
Unthinned	39	39	10.6	82	66	0.20	9.51	0.90	9.3	0.88	-0.21
Unthinned	54	54	13.9	83	58	0.30	12.50	0.90	13.1	0.94	0.60
Unthinned	57	57	9.4	69	57	0.17	8.31	0.88	8.4	0.89	0.09
Unthinned	82	82	13.8	75	55	0.26	12.25	0.89	11.8	0.85	-0.45
Unthinned	118	118	8.4	84	66	0.22	7.59	0.91	7.6	0.91	0.01
Unthinned	128	128	13.0	79	65	0.17	11.60	0.90	11.3	0.87	-0.30
Unthinned	129	129	6.0	54	50	0.08	5.16	0.86	5.2	0.86	0.04

was greater than predicted DOB at 17.3ft for the Thin to 90tpa treatment (Table 8). In other words, the heavily thinned trees were more cylindrical than predicted.

Table 8. Summary of DOB @17.3ft and DOB Bias (Observed-Predicted).

Treatment	Pred. DOB@17.3ft	Obs. DOB@17.3ft	DOB Bias
Thin to 90tpa	10.9	11.2	0.3
Thin to 190tpa	10.7	10.6	-0.1
Unthinned	10.2	10.1	-0.1

It was also hypothesized that there would be a positive relationship between bias and DBH. This was partly true. Regression of bias across DBH showed a positive slope (observed DOB increased relative to predicted DOB) for the Thin to 90tpa treatment (Figure 3a), no slope for the Thin to 190tpa treatment (Figure 3b) and a negative slope for the unthinned plot (Figure 3c). This could possibly be the result of the thinned trees are putting on growth at 17.3 ft while the unthinned trees are growing at a much slower rate due to competition.

Further regression of bias across height, height to live crown, and crown ratio showed consistent relationships.

These preliminary results (i.e. only using one point/measurement [17.3ft] per tree) seem to indicate that the taper equation developed for plantation-grown red alder does seem to apply well to both thinned and unthinned natural red alder stands. However, multiple measurements along the stem will be required to confirm this.

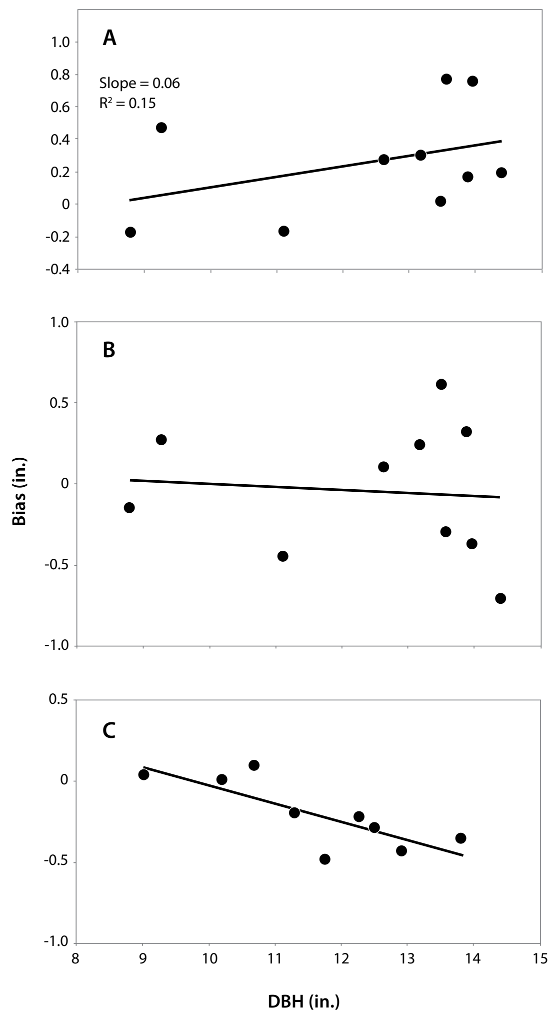


Figure 3. Relationship between DOB at 17.3ft bias (Observed-Predicted) by DBH for A) the Thin to 90tpa Treatment, B) Thin to 190tpa Treatment, and C) Unthinned Treatment.

Future Work

With the harvest of the trees (scheduled for this summer), multiple measurements along the entire stem of fallen trees will be taken. The location for these measurements will be chosen to facilitate the WADNR in fine-tuning their red alder cruise estimates and to help improve existing (or create new) red alder volume/taper equations. For the former objective, measurements of diameter outer bark (DOB) and double bark thickness (DBT) will be taken at Breast height (4.5ft or 1.37m), at the WADNR form factor point (16.5ft or 5.0m), at 40% of the DOB of WADNR form factor point (e.g. if DOB at 16.5ft=8.7in, then at a DOB of 3.5in), and at DOB=5in (12.7cm). For the 40% of the form factor point and the 5in top, the distance from breast height will also be recorded. To achieve the later, the sampling procedure to be used is effectively the same one used by the HSC for the previous taper equation project (see the 2005 HSC Annual Report) which, itself, was based on 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). The procedure is roughly as follows: Before falling, DBH and sample number was permanently marked. After falling, sample tree breast height would be located and stem diameter (and double bark thickness) measured at breast height, 80cm, 50cm, and 20cm. Once these measurements were completed a nail would be driven into the tree at breast height, a tape would be stretched to the top of the tree and total tree height and height to live crown (from breast height) would be determined. DOB and DBT at 10% increments of total tree height (i.e. taper of the trunk) will be measured. An example of the datasheet is illustrated in Figure 4.

Site	Plot	Tree	Sample Points	Distance from DBH	DOB (cm)	Double Bark (cm)
4102	1	503	H100%		0	0
4102	1	503	H95%			
4102	1	503	H90%			
4102	1	503	H80%			
4102	1	503	H70%			
4102	1	503	H60%			
4102	1	503	H50%			
4102	1	503	H40%			
4102	1	503	H30%			
4102	1	503	H20%			
4102	1	503	H10%			
4102	1	503	DBH (1.37m or 4.5ft)	0		
4102	1	503	H80cm	-0.6		
4102	1	503	H50cm	-0.9		
4102	1	503	H20cm	-1.2		
4102	1	503	Form Factor	3.7m or 12ft		
4102	1	503	40% of Form Factor DOB			
4102	1	503	5in DOB Top		12.7cm or 5in	
4102	1	503	Height to Crown Base			

Figure 4. Sample datasheet for the Thinned Natural Red Alder Stand Volume and Stem Form Study

Collaborations

Future Forest Ecosystems Scientific Council (FFESC)

As mentioned in previous annual reports, the HSC has collaborated with multiple Canadian organizations on a project titled "Using red alder as an adaptation strategy to reduce environmental, social and economic risks of climate change in coastal BC". The idea behind the project is that because the range of red alder is expected to increase with climate change, and it is a short rotation, high value crop providing a diversity of wood products, and improving long-term site productivity and ecosystem resiliency, the increased use of red alder is an adaptation strategy that could reduce environmental, social and economic risks of climate change in coastal B.C. The HSC is involved in the environmental (biological) component through its network of long-term research installations.

The HSC has provided geographic and tree growth information and has collected soils data and foliage data to accurately characterize the installations. In May 2010, the HSC collected soil samples from all of the replacement and additive installations in the US. In December 2010, the HSC also collected Douglas-fir foliage from the same installations. Analysis will proceed through the winter with the first results expected in mid- to late 2011.

A description of the project in its entirety, the projects that are underway or completed, and more information can be found at the FFESC website: www.for.gov.bc.ca/hts/future_forests/council/index.htm.

A newly completed manuscript entitled "Climate effects on red alder and Douglas-fir growth in the Pacific Northwest", of which Andrew and Dave are co-authors has just been completed and will soon be submitted for reveiw.

In addition, to the FFESC website, there are periodic newsletters that describe this project. The following article is from Issue 2, September 2010 of "aldern" written by Craig Farnden PhD RPF at the University of British Columbia. Although the article does not directly relate to the FFESC, it contains some interesting and insightful ideas regarding conifer-hardwood mixtures.

Growing Alder and Douglas-fir in Intimate Mixtures

In recent discussions with a number of silviculturists, I have learned that there is considerable interest in establishing intimate mixtures of alder and Douglas-fir on the south coast of BC. There is, however, considerable uncertainty around appropriate site selection and management regimes. Some help along these lines exists in the current literature, and most coastal BC silviculturists can point to case studies where they have observed the species co-existing to produce a timber crop.

Understanding how to grow alder and Douglas-fir in intimate mixtures depends on knowledge of several principles and their interactions:

For the purposes of timber production, alder should ideally be established with a relatively high degree of lateral crowding in order to maintain a single vertical stem and minimal branch sizes, alder will usually exhibit faster early height growth than will Douglas-fir, and excessive overtopping by alder will inhibit Douglas-fir height growth.

In intimate mixtures, stand densities for the alder component must be kept sufficiently low so as to not overtop and suppress the Douglas-fir. The corollary, however, is that in doing so there is insufficient alder density left to provide all of the needed crowding. It is evident, then, that some of the crowding must be provided by the shorter Douglas-fir trees, but to do so their crowns must come close in height to those of the alder.

The ability of Douglas-fir to provide this function will depend on the relative height growth rates of the two species, and these rates are highly variable (Figure 5). For example, a study from Oregon contrasted alder/ Douglas-fir height ratios at two locations. On the better growing site, height ratios were 4.4:1 four years after planting and 2.7:1 after a further 8 years. On the poorer site (with lesser stand heights at the same ages), ratios were 1.8:1 and 1.4:1 respectively. On the better site, Douglas-fir will have minimal if any impact on alder stem form, and it is unlikely that desired alder stem characteristics can be achieved from an intimate mixture. On the alternate site, outcomes for alder stem form in the mixed stand appear more favorable.

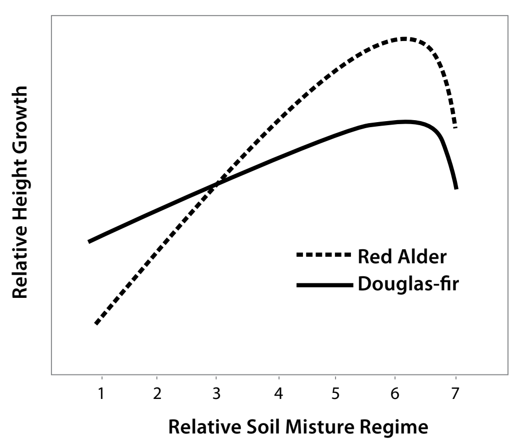


Figure 5. Conceptual diagram of expected unimpeded height achieved by 10- to 15-year old stands of Douglas-fir and red alder across and environmental gradient of soil moisture availability.

Height growth differences can also result in height suppression of the Douglas-fir by overtopping alder crowns. In cases where the early height growth of alder is considerably faster than for

the Douglas-fir, early crown expansion will also be faster. As a result, it will take fewer alder stems to create competitive conditions such that Douglas-fir height growth will be lost. On the poorer site in the study described above where 75% of the 1111 total trees/ha were alder, Douglas-fir height growth was largely unaffected by overtopping competition. On the better site, Douglas-fir growth was significantly reduced where alder composed as little as 30% of the same stand density.

The first step to identifying appropriate sites for establishing intimate mixtures, then, is quantifying the expected growth rates for the two species. There is relatively good information and procedures available in BC for assessing bare ground productivity for Douglas-fir, but not so for alder. There appears to be a general consensus that alder productivity varies considerably with growing season water stress, but also with factors such as soil pH, soil texture and the frequency and intensity of growing season frost. In the short term, measurements on pre-harvest trees on the same site or nearby post-harvest trees on similar site conditions may be the only sources of site quality measures for alder.

New information that would be useful to provide guidance to silviculturists wanting to establish intimate mixtures of alder and Douglas-fir includes:

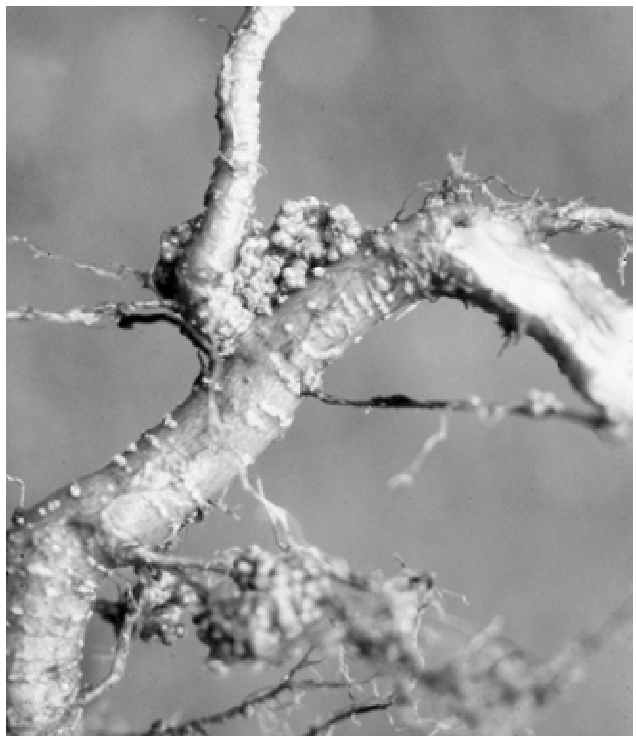
- Growth and yield estimates based on varying stand density combinations of alder and Douglas-fir, on sites with various combinations of Douglas-fir and red alder site index, and
- Improved methods to provide bare ground estimates of site index for red alder.

Some of this information is likely to be forthcoming based on a series of trials established by the Hardwood Silviculture Cooperative based at Oregon State University, along with additional trials established by the BC Ministry of Forests. Additional measurement and analysis of these trials is being undertaken by Dr. Phil Comeau and Francesco Cortini as part of the FFESC Alder Adaptation Strategy project.

Frankia Population Dynamics in Red Alder Stands

As described in previous annual reports, the HSC has been collaborating with Dr. Peter Kennedy, Department of Biology, Lewis and Clark College, on various aspects of nitrogen-fixing *Frankia* populations in red alder forests. Two manuscripts have already been published and a third effort is underway. The following is a rough proposal gleaned from personal communications with Peter.

Dr. Kennedy has received funding from the National Science Foundation to look at the effect of *Frankia* bacteria on the function and diversity of ectomycorrhizal fungal communities. He's particularly interested in looking at whether the functioning (i.e. the enzyme activities) of ectomycorrhizal fungi associated with red alder are different from the same fungi associated with non-*Frankia* host species. His hypothesis is that because *Frankia* provide alder with plenty of nitrogen, that the fungi associated with alder are more active for nutrients such as phosphorous.



In thinking about where to do this research, he believes the research sites established at Cascade Head and HJ Andrews would be ideal to test this hypothesis. Having replicate alder and Douglas-fir plots in two very different climates would allow us to control many abiotic variables. For the project, I would like to collect small soil samples 10 cm x 10 cm x 10 cm from replicate locations in the pure red alder and the pure Douglas-fir plots at each site three times during the year. From those samples we would separate out the mycorrhizal root tips and run them through an enzyme analysis and molecular identification back in the lab. We would like to start the research in the spring of 2012.

Accomplishments 2011

In addition to performing the necessary HSC tasks, Andrew and David have been invited speakers to two meeting this past year.

2011 Oregon/Washington State SAF Joint State Conference

This conference was held in Portland, OR from May 11-13, 2011, with May 13th being the date for five concurrent field tours. Andrew Bluhm (HSC), Florian Deisenhofer and Chris Rasor (WA DNR) were tour captains for the field trip titled "Columbia River: Red Alder Plantations and Conifer Reforestation and Management. This tour had three stops:

- Stop 1: Red alder plantation research installation (HSC site #3209) near Scappoose, OR., maintained by the Hardwood Silviculture Cooperative. Discussions will include alder research and management recommendations, planting and spacing considerations, timing of thinning treatments, and alder growth and yield.
- Stop 2: Operational red alder plantation nearing a commercial thinning age on Washington State DNR lands near Stella, Wash. Discussions will include integrating research and forest operations, red alder site selection, density management, and growth and yield.
- Stop 3: Reforestation research by the DNR with discussion on conifer establishment following herbicide site preparation, leave tree effects, and consequences of animal browsing. Further discussion on forest certification effects, evolving objectives and the influence of conservation commitments.

A link to this conference can be found at: www.forestry.org/oregon/annualmeeting/

Washington Hardwood Commission 2011 Annual Meeting

Andrew and Dave were both invited to participate in this conference, held in Chehalis, WA June 15th & 16th 2011. Andrew was invited to sit on a panel titled "Importance of Science in Sustaining the Hardwood Industry". David was invited to give a presentation on red alder growth and yield modeling titled "Unveiling the new alder growth and yield model- the economics of growing alder".

A link to this conference can be found at:
http://wahardwoodscomm.com/2011_AnnualMtg.htm.

Direction for 2012

As always, the specific goals for 2012 are both continuations of our long-term objectives and new projects:

- Continue efforts to recruit new members.
- Continue HSC treatments, measurements and data tasks.
- Keep the HSC website updated and current.
- Continue efforts in outreach and education.
- Continue working with and analyzing the HSC data.
- Continue growth and yield modeling efforts; primarily to continue testing RAP-ORGANON outputs/predictions.

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 Minutes

Tuesday July 13, 2010

Attendees: Andrew Bluhm, David Hibbs- OSU; Scott McLeod, Chris Hankey, Peter Hurd, Dave Richards, Cory McDonald, Jason Emsley- WA DNR; Jeanette Griese-BLM; Paul Kriegal- Goodyear Nelson; Jim Murphy- Pacific Forest Tech; Del Fisher-Washington Hardwood Commission

- Please refer to the associated handouts for further information.
- If you want electronic copies of the handouts or the annual report, please let me know.

We started the meeting at 8:00 at the WA DNR Sedro Woolley office and traveled to the DNR/HSC Type 1 site #4102 (Janicki) near Clear Lake, WA. This site is a 33 year old natural stand thinned at age 14. There are three treatments: Thinned to 90tpa, Thinned to 190tpa and Unthinned.

Here we first looked at the results of a volume analysis for the site. This is the first such volume/financial analysis done for the HSC Type 1 installations. The analysis used the most recent measurements from the site (last winter), the volume/taper equation found in: Taper Equation and Volume Tables for Plantation-Grown Red Alder, 2007, Bluhm, et.al., PNW-GTR-735, 20ft log lengths, published cubic foot to board foot conversions, and current red alder log prices from Western Oregon.

The main results included:

- Thinning resulted in an increase in diameter growth and a reduction in height growth for both thinning treatments.
- Merchantable stem volume was appx. 3700ft^3/acre for the Unthinned and the Thinned to 190tpa treatments while only appx. 2000ft^3/acre for the Thinned to 90tpa treatment.
- A comparison of stem volume between 4 existing volume equations revealed similar and expected volume estimates.
- Merchantable log volume was just over 14 MBF for the Thinned to 190tpa, 12.5 MBF for the Unthinned treatment and 8 MBF for the Thinned to 90tpa treatment.
- When current log prices were used, the gross revenue was approximately $5500/acre for the Thinned to 190tpa, $4500/acre for the Unthinned treatment and $3000/acre for the Thinned to 90tpa treatment.

- The log volume estimates were slightly less than estimates from another very similar site (Olney, a 35 year old natural stand, thinned at age 14, similar site quality).

Next, we broke out the climbing ladders to collect outside bark diameter (DOB) at 17.3ft on a subset of trees for a preliminary look at if/how thinning affected stem shape. This is a precursor to a project between the HSC and DNR. The main objectives of this project are:

- Calculate merchantable stem volume (bdft/acre) using taper GTR.
- Test to see if thinning affected stem form/shape.
- Test to see if thinning affected log size distribution.
- Compare natural stand estimates (using measured DBH, HT, and CR) with plantation estimates (from taper GTR).
- Compare HSC volume estimates with cruise estimates.

Ten trees were chosen across the diameter distributions for each treatment and predicted DOB and form factor were calculated. The observed/measured DOBs will then be used to see if thinning affected form factor and how well the predictions from unthinned, plantation-grown red alder applied to the sample. Results were presented the next day.

After lunch we visited a 21 year old HSC plantation (#4201, Humphrey Hill), the oldest of the HSC plantations. Like for Janicki, we looked at the results of a volume analysis for the site.

Once again, this is the first such volume/financial analysis done for a HSC Type 2 installation.

The main results included:

- Control Plots:
    - This site is performing (as measured by DBH and Height) better than average when compared to all other HSC sites at least 17 years old.
    - For the control plots, at age 17, DBHs ranged from 6in to almost 10in with DBH increasing with decreasing density.
    - Control plot Heights ranged from 47 to 58ft, with little discernable pattern across densities.
    - The DBH and Height "crossover effect" for the control plots occurred between age 4 and 12.
    - Live crown ratios ranged between 30 and 40% for the three highest densities and was 65% for the 110tpa control.
    - Live crown ratios dropped quickly, to about 40% at age 9 for the two highest densities.
    - Estimated 21 year-old merchantable stem volume was greatest in the 710tpa plot (3,200ft^3/acre) and ranged between 1,700 to 3,200ft^3/acre.

- Merchantable log volume (one 20ft butt log and any additional 10ft logs) was approximately 8 MBF for the 710tpa and the 240tpa plots and approximately 6 MBF for the 1340tpa and 110tpa plots.
- When current log prices were used, the gross revenue was approximately $3000/acre for the 240tpa plot, $2500/acre for the 710tpa and 110tpa plot and $2000/acre for the 1340tpa plot.

- 710tpa Thinned Plots:
  - Both thinning treatments were thinned to about 245tpa; one at the onset of crown/canopy closure (here, at age 4) and one when the height to live crown was between 15 and 20ft (Here, at age 6).
  - Thinning resulted in an increase in diameter growth AND an increase in height growth for both thinning treatments.
  - At age 17, mean quadratic DBH was 7in, 8in, and 9in for the unthinned, thin at age 6 and thin at age 4 plots, respectively.
  - Heights displayed the same pattern as DBH and were 51ft, 54ft, and 62ft for the unthinned, thin at age 6 and thin at age 4 plots, respectively.
  - Live crown ratios ranged between 30 and 40% for all three plots but showed a more early, rapid declines for the unthinned and the thin at age 6 plots as compared to the thin at age 4 plot.
  - Estimated 21 year-old merchantable stem volume was slightly greater for the thin at age 4 plot (3500 ft^3/acre) than the unthinned treatment (3200 ft^3/acre); both being much greater than the thin at age 6 treatment (1700 ft^3/acre).
  - Merchantable log volume (one 20ft butt log and any additional 10ft logs) was just under 12 MBF for the thin at age 4 plot. An astounding increase over the unthinned plot (8 MBF).
  - This increase was the result of a combination of factors: fatter, taller trees, and more trees with a 2nd or even 3rd log.
  - When current log prices were applied, the gross revenue was just over $4000/acre for the thin at age 4 plot, $2600/acre for the unthinned plot and $1700/acre for the thin at age 6 plot.

Looking at the plantation it was immediately obvious that a large majority of it suffered from some aliment. There were many downed trees, and canopy openings. Suggestions of potential damaging agents included: *Armillaria*, low root development due to a hardpan, and freeze/severe weather damage.

Although not included in the volume analysis, we lastly visited the 240tpa prune plot. This portion of the plantation looked much better: the trees were large with nice form and there was less (almost no) damage. Volume estimates for this plot were as high as 16MBF/acre.

Wednesday July 14, 2010:

Attendees: Andrew Bluhm, David Hibbs- OSU; Scott McLeod, Chris Hankey, Peter Hurd, Dave Richards, Cory McDonald, Jason Emsley, Missy Morrison- WA DNR; Jeanette Griese- BLM; Paul Kriegal- Goodyear Nelson; Jim Murphy- Pacific Forest Tech; Del Fisher- Washington Hardwood Commission

Once again, please refer to the associated handouts/presentations for further information.

We started the meeting at 8:00 at the WA DNR Sedro Woolley office.

After welcomes and introductions Andrew presented some results on the upper stem measurements.

The main results included:

- The taper equation did a very good job at predicting DOB at 17.3ft. It underperdicted DOB by 0.3in for the Thin to 90tpa plot while overpredicted DOB by 0.1in for the remaining two plots.
- The greatest differences in observed minus predicted (bias) estimates were approximately 0.8in for the Thin to 90tpa, and 0.6in for the Thin to 190tpa and the control plot.
- It was hypothesized that the taper equation would underpredict DOB in all cases since DOB had an additional half growing season. This was not the case.
- It was also hypothesized that there would be a positive relationship between bias and DBH. This was partly true. Regression of bias across DBH showed a positive slope (observed DOB increased relative to predicted DOB) for the two thinned plots and a negative slope for the unthinned plot (once an egregious outlier was removed). This could possibly be the result of the thinned trees are putting on growth at 17.3 ft while the unthinned trees are growing at a much slower rate due to competition.
- Further regression of bias across HT showed no significant relationship.
- Regression of bias across height to live crown (HLC) showed negative slopes (observed DOB decreased relative to predicted DOB) for the two thinned plots and no relationship for the unthinned plot.
- Regression of bias across crown ratio (CR) showed a positive slope (observed DOB increased relative to predicted DOB) for all three plots.

These preliminary results (i.e. only using one point/measurement [17.3ft] per tree) seem to indicate that the taper equation developed for plantation-grown red alder does seem to apply well to both thinned and unthinned natural red alder stands. However, multiple measurements along the stem will be required to confirm this.

In addition, these results could be used to fine-tune inventory/cruise data gathered from stands of this type for the DNR or other organizations.

The floor was then opened for a discussion/question and answer session of various hardwood related management issues. Topics touched upon were:

- Dave Richards, Chief Check Cruiser, DNR, said that he cruised the 10 sample trees in the control plot that we measured and estimated that there was approximately 14 MBF/acre and that merchantable height was app. 55ft. Estimates from the taper equation were 12.5 MBF and 50ft.
- He also mentioned that the Scribner system for estimating volume is a very forgiving/sloppy system that leaves a lot of room for estimate variation.
- The DNR uses Flewelling's FVS growth model mainly because it is easy to use.
- FVS has open volume equations, a DLL that can run ORGANON and good support.
- Fred Martin, a DNR modeler spent a lot of time comparing various growth models.
- As for site preparation chemicals for red alder; currently Atrazine is labeled and effective.
- Generally, the preferred red alder planting density is around 600 trees/acre.
- Concerning red alder/Douglas-fir mixes:
    - Owners need to decide on which species to manage; it is very difficult to both species simultaneously in intimate mixtures.
    - It has been observed that some of the best-looking red alder (commercial wise) is found in species mixtures.
    - Currently, the DNR uses a minimum of 0.25 acre patch size before considering managing for red alder in a slashing contract.
    - By leaving scattered red alder in Douglas-fir plantations, two positive outcomes can be obtained: 1) increased Douglas-fir growth due to red alder Nitrogen fixation, and 2) helping long-term supply of red alder.
- Bigleaf maple clumps:
    - The selection and management of sprout stumps should be done around 10-12 years; thereby the chosen sprouts are large enough to shade out and re-sprouting shoots.
    - It is better to select sprouts closest to the ground.
    - A decision aid exists regarding the number of sprouts to leave per circumference of "parent" stump.
- Bigleaf maple seedlings:
    - If have a seedling origin stand of Bigleaf maple, with lack of options, use the red alder stocking guides.

- Birch/Cherry:
  - Both species used to be priced higher.
  - If they are nice trees, they should be managed similar to Bigleaf maple.
  - "Don't be afraid of these species". They are merchantable and a component to species/stand diversity.

Andrew then proceeded with a review of last years' fieldwork, the coming years' fieldwork and an overview of the data collection schedule for all three installation types.

Winter 2009/10 was a relatively light field season. Measurements and various treatments were completed on 6 of the 37 installations. Last years work included:

- One Type 1 installation was measured.
- Janicki (4102, WADNR) had its 19th year measurement. This is the 3rd Type 1 installation with 19 year post-thinning data.
- Five Type 2 installations had fieldwork.
- Three sites- Blue Mtn. (3206, WHC), Campbell River (4203, BCMIN), and Hemlock Creek (5204, WHC) had their 17th year measurement. In addition, Campbell River and Scappoose (3209, BLM) had their 4th and final pruning lift and their last thinning treatment. Finally, John's River (2201, WHC) had its 3rd pruning lift.
- As of this year, 14 of the 26 Type 2 installations have had their 17th year measurement and 11 of these have all treatments completed.
- No Type 3 installations had fieldwork.

This coming year's fieldwork (Winter 2010/11) will have almost double the fieldwork as last year. A total of 12 installations need either a measurement or a treatment. Work includes:

- No Type 1 measurement:
- Nine Type 2 installations:
- Humphrey Hill (4201, GYN): 22nd year measurement
- Lucky Creek (1202, BCMIN): 17th year measurement and 3rd pruning lift
- Cape Mtn. (2204, SNF): 17th year measurement, 3rd pruning lift and possibly the 30ft HLC thin
- Siletz (2205, ANE): 17th year measurement, 3rd pruning lift and possibly the 30ft HLC thin
- Dora (3207, BLM): 17th year measurement
- French Creek (4205, BCMIN): 17th year measurement, 4th pruning lift and the 30ft HLC thin
- Maxfield (1203, WADNR): 3rd pruning lift and the 30ft HLC thin
- Wrongway Creek (3210, OSU): 3rd pruning lift and the 30ft HLC thin

- LaPush (1201, WADNR): the 30ft HLC thin

Three Type 3 installations:

- Monroe-Indian (2301, ANE): 17th year measurement
- Turner Creek (4301, GYN): 17th year measurement
- Holt Creek (4303, BCMIN): 17th year measurement

Of note, there is one "orphaned" installation (3210, Wrongway Creek) to be measured/treated that does not have a field crew available. This will be taken care of with the HSC Winter meeting/work party.

As fall approaches, Andrew will contact each HSC member to provide specific on the activities and schedule the fieldwork.

Andrew then provided an overview of the data collection schedule for all three installation types.

- All installation types have now "switched over" to a 5 year measurement cycle.
- Three more HSC Type 2 installations had the 17th year measurement; bringing the total to 14 of the 26 installations.
- Four HSC Type 2 installations had all treatments completed; bringing the total to 11 of the 26 installations.
- All Type 3 installations have had at least their 12th year measurements.

David Hibbs then gave an abridged presentation of that given by Chris Rasor, WA DNR entitled "What About the Future of Hardwoods?". The original presentation was given at the Washington Hardwood Commission meeting June 16, 2010. Please refer to the associated handouts or contact myself or Chris for the full presentation.

Andrew then updated the group on the ORGANON modeling effort. In summary:

- All control plot equations are completed.
- Currently evaluating and validating mortality equation.
- Currently modeling thinning responses. Preliminary investigation reveals:
    - DBH growth: Control plot equation underpredicts growth ~15%. Therefore, a modifier equation may be necessary
    - HT growth: Control plot equation adequately predicts growth. Therefore, a modifier equation may not be necessary (usually control overpredicts HT growth)
    - Crown recession: nothing obvious
- Since two definitions of crown base were used, a decision needs to be made on which HCB definition (and therefore, subsequent equation) to use.
- Any other species besides red alder in the input tree list needs to be grown in the model to account for its competitive influence on the neighboring trees.

For Douglas-fir models this has been addressed by converting "all other species" growth to a Douglas-fir site index curve. However, this RAP version of ORGANON uses a red alder site index equation as its base growth curve. Therefore, it is necessary to somehow define/include the relationship between Douglas-fir growth and red alder growth. How to define this relationship is unclear.

- Once the model is assembled, the model needs to be tested? Outstanding questions are: Who will do it? HSC staff? HSC cooperators? Others? How will it be funded?

Andrew then gave an abridged presentation of that prepared by Greg Johnson, Weyerhaeuser Co., entitled "Growth Model Runoff II". The original presentation was given to the Growth Model Users Group meeting December 15, 2005. Although it concerns itself with Douglas-fir, the conclusion of "caveat emptor" would apply to multiple red alder growth models. Please refer to the associated handouts or go to www.growthmodel.org/papers/gmroll.pdf.

Next, the topic turned to the HSC budget. Just like in FY2009, in FY 2010, dues received were less than expected. This allowed the HSC enough income to fund Andrew for only 4 months instead of 5 months. All other expenses for FY 2010 were consistent with the projections.

For FY 2011, the assumption is that the dues will be the same as that of FY 2010. However, the amount of fieldwork is greater in FY2011 (as compared to FY 2010) therefore, a further reduction in Andrews time will be necessitated. Needless to say, this trend is concerning.

To help identify what Andrew has time for and conversely what he is not able to accomplish with his reduced time, Dave and Andrew assembled a list of deliverables- what's being done, and what is not.

Please see the associated handouts for the specifics.

Many thanks go out to Scott McLeod and Chris Hankey (WA DNR) for helping with logistics and providing the meeting location.

As a reminder, there will be a Winter 2010/11 winter meeting. Potential dates are the 2nd or 3rd week of January. If you have any preference as to the dates, please contact the HSC.

Appendix 3

Financial Support Received in 2010-2011

Cooperator		Support
BC Ministry of Forests		-----
Bureau of Land Management		$9,000
Forest Capital		$8,500
Goodyear-Nelson Hardwood Lumber Company		$5,500
Oregon Department of Forestry		$4,250
Siuslaw National Forest		------
Trillium Corporation		------
Washington Department of Natural Resources		$4,250
Washington Hardwood Commission		------
	Subtotal	$29,000
Forestry Research Laboratory		$30,345
	Total	$59,345

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