HSC

Hardwood Silvicuture Cooperative

2015 Annual Report

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annual report 2015

Highlights of 2015

- The HSC has a new director. Glenn Ahrens, Oregon State University Extension Forester (and long-ago research assistant for the HSC) has taken over the helm from David Hibbs. We all look forward to his new leadership.
- Three more 22nd year measurements were collected on the Type 2 installations (variable-density red alder plantation), bringing the total to 14 of the 26 installations with 22 year data.
- Seventeen of the 26 Type 2 installations have had all treatments completed.
- More field data was collected investigating the potential effects of management on stem form and tree volume. The data was collected from five HSC Type 2 installations, and the results of analyses are included in this report.
- Testing/validation was done on the red alder variant of ORGANON (RAP-ORGANON) and the CIPS red alder Growth Simulator. The goal was to assess the performance of RAP with data from older plots now that we have 22nd year data. These preliminary results indicate that the current version of RAP-ORGANON consistently under-predicts most tree and stand variables at age 22.

Contents

Executive Summary

Since 1988, the Hardwood Silviculture Cooperative (HSC) has led the effort to develop and provide information for foresters interested in red alder management. The primary activities of the HSC continue to be maintenance, measurements, and analysis of results from the Red Alder Stand Management Study. This study is comprised of thirty-seven study installations located from the Southern Oregon Coast, up through Vancouver Island and across into the Cascade Mountains. In 2015, measurements and treatments went very well on three 22-year-old variable density alder plantations. We now have 22^{nd} year data on 14 of the 26 installations. Additional field data were also collected from five HSC installations to investigate the effects of management on stem form and to support further development of tree taper and volume equations.

2015 was a relatively light year for field work, so more time was available for data management and analysis. Our effort focused on 1) analyzing the additional data on stem taper and volume and 2) assessing the performance of the initial version of the red alder plantation growth and yield model (RAP-ORGANON) with 22nd year data. Results of these preliminary analyses indicate that our initial growth and yield modeling system, developed with data from young stands (12-17 years old) under-predicts tree and stand volume in older stands.

This emphasizes the need for HSC to investigate technical approaches and optimal timing for new work to update both the taper/volume equations and the growth and yield model for managed alder. Our work to develop all of the key components of a growth and yield modeling system provides a solid foundation based on the young stand data. To reap the benefits of our long-term red alder study, we must build on this foundation with continuing improvement of the model using data from older stands.

Our direction for 2016 is to continue installation maintenance, treatments, and measurements including our first 27-year measurement and 22^{nd} year data collection on eight other installations. We will also continue recruiting new HSC members. As HSC Director and Extension Forester, I will also be involved in outreach and education on hardwood management, online and in person.

Pursuing new applied research utilizing our installations is also important for the HSC. The core effort supported by HSC members is maintaining our field installations to provide for an empirical growth and yield model. But our extensive set of long-term variable density plantations also provides good opportunities to develop proposals and seek funding for additional applied research with collaborators. Such research can shed light on underlying mechanisms controlling red alder responses to management such as physiological response to site factors and climate, within-tree growth allocation controlling stem form and taper, interaction of management with pests and pathogens, etc.

The HSC has come a long way over the last 27 years in developing the knowledge and tools applicable to management of red alder. The vision, dedication, and continued support of the HSC members have made this possible. Thank you HSC members for your vision and ongoing support.

Glenn Ahrens

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 menziesii*) 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://hsc.forestry.oregonstate.edu 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.

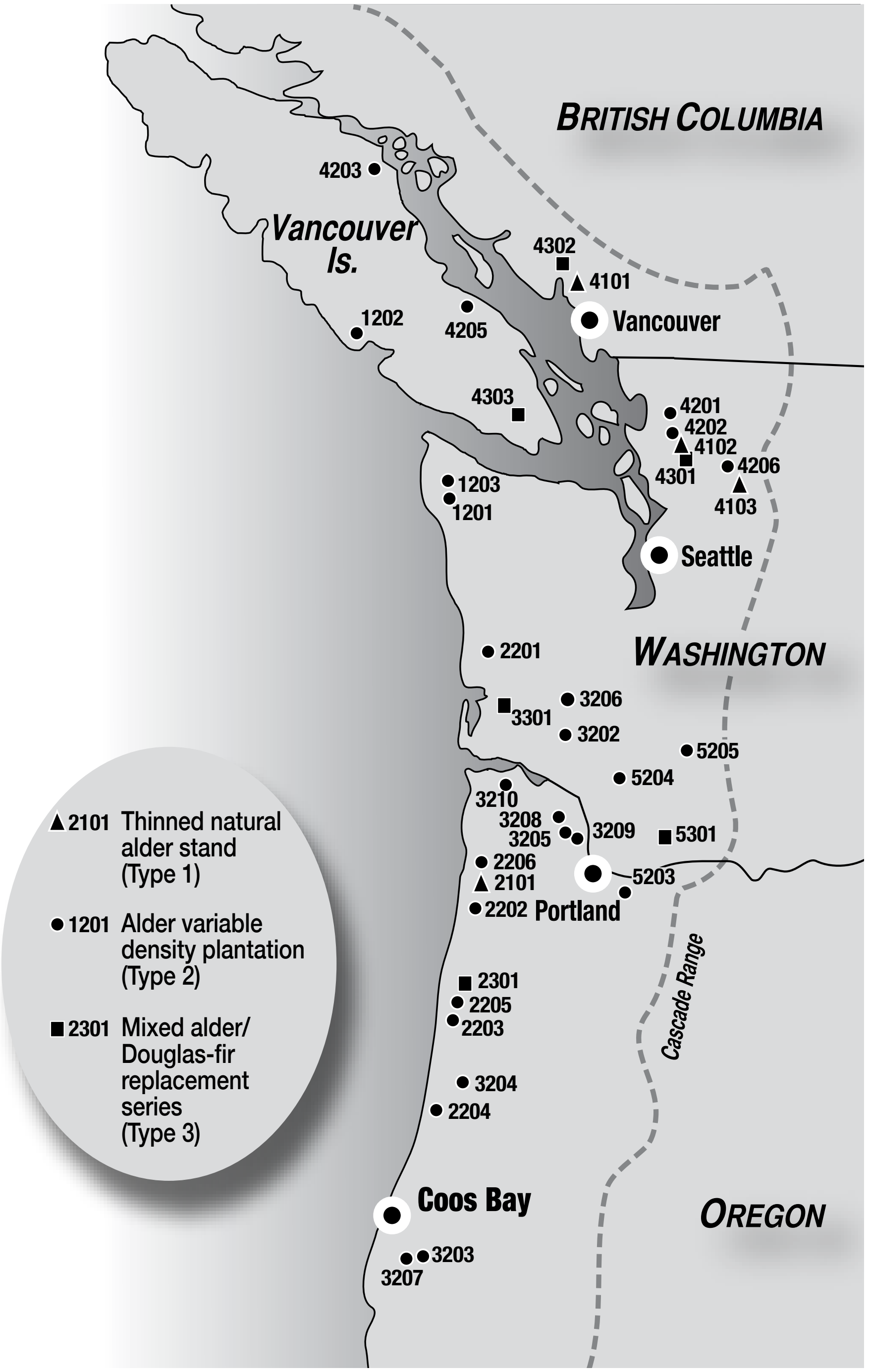
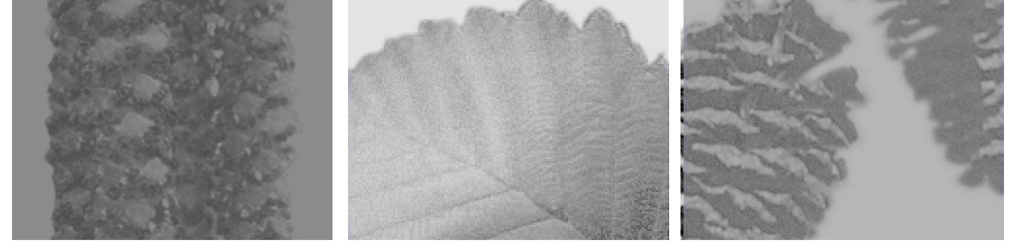


Figure 1. Location of installations for the Red Alder Stand Management Study.



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 2014/15 was lightest field season in decades. Measurements (only) were completed on only three installations (see Table 5). All three sites were due for their 22nd year measurement (Blue Mtn, Hemlock Ck, and Mohun Ck). Scheduling and completing these measurements went smoothly- largely in part because of the cooperators (WHC and BCMIN) and the weather.

In addition to these regular measurements, it was decided at last years' summer meeting to opportunistically collect taper measurements on some of the 22-year-old Type 2 installations. At four of the five sites, 12 (+/-) trees were felled and taper data was collected. There were three trees per treatment for the following treatments: 230tpa Control, 525tpa Control, 525tpa 1st Thin, and 525tpa 2nd Thin.

In addition to all of these measurements and treatments, there was always the required plot maintenance. Tasks include: replacing measurement plot corner markers, retagging trees that outgrew the zipties, refreshing or establishing DBH paint lines, and rouging out invading conifers and/or hardwoods.

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

So, in the big picture:

- All scheduled measurements for the four Type 1 sites are completed.
- Fourteen of the twenty-six Type 2 sites have had their 22nd year measurement.
- All of the twenty-six Type 2 sites have had their 17th year measurement.
- Twenty of the twenty-six Type 2 sites have all treatments completed.
- All seven Type 3 sites have had their 17th year measurement.

This coming field season (Winter 2015/16) will have an average amount of fieldwork. The HSC's oldest installation, Humphrey Hill will have its 27th year measurement. Then five installations (Lucky Creek, Cape Mountain, Siletz, Dora, & French Creek) will need their 22nd year measurement and four of these five installations will most likely need a thinning or a pruning

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	1989	1990	1990	1990	1991	1991	1992	1992	1992	1992	1992	1993	1993
2nd yr Regen	1990	1991	1991	1991	1992	1992	1993	1993	1993	1993	1993	1994	1994
Plot Installation	1991	1992	1992	1992	1993	1993	1994	1994	1994	1994	1994	1995	1995
3rd yr Measure	1991	1992	1992	1992	1993	1993	1994	1994	1994	1994	1994	1995	1995
3-5 yr Thin	1992	1995	1995	1993	1995	1995	1996	1997	1996	1996	1995	1997	1997
Prune Lift 1 6ft	1994	1995	1995	1995	1995	1995	1996	1997	1996	1996	1995	1997	1997
6th yr Measure	1994	1995	1995	1995	1996	1996	1997	1997	1997	1997	1997	1998	1998
15-20' HLC Thin	1994	NA	1998	1995	1998	NA	1999	2000	2000	1999	1999	2001	NA
Prune Lift 2 12ft	1994	2001	1998	1995	2001	1999	1999	2000	1998	1999	1999	2001	2001
9th yr Measure	1997	1998	1998	1998	1999	1999	2000	2000	2000	2000	2000	2001	2001
Prune Lift 3 18ft	1997	2009	2001	1998	2007	2002	2003	2000	2008	2003	2003	2001	2006
12th yr Measure	2000	2001	2001	2001	2002	2002	2003	2003	2003	2003	2003	2004	2004
30-32' HLC Thin	2000	NA	NA	2001	2010	2007	2008	2003	NA	2006	2008	2006	2009
Prune Lift 4 22 ft	2000	NA	2001	2001	2017	2007	2008	2003	2013	2006	2008	2004	2009
17th yr Measure	2005	2006	2006	2006	2007	2007	2008	2008	2008	2008	2008	2009	2009
22nd yr Measure	2010	2011	2011	2011	2012	2012	2013	2013	2013	2013	2013	2014	2014
27th yr Measure	2015	2016	2016	2016	2017	2017	2018	2018	2018	2018	2018	2019	2019

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	1993	1994	1994	1994	1994	1994	1995	1995	1995	1996	1997	1997	1997
2nd yr Regen	1994	1995	1995	1995	1995	1995	1996	1996	1996	1997	1998	1998	1997
Plot Installation	1995	1996	1996	1996	1995	1995	1996	1997	1996	1997	1999	1999	1999
3rd yr Measure	1995	1996	1996	1996	1996	1996	1997	1997	1997	1998	1999	1999	1999
3-5 yr Thin	1997	1998	1998	1998	1998	1998	2000	1999	NA	2001	2002	NA	NA
Prune Lift 1 6ft	NA	1998	1998	1998	NA	1998	2000	1999	1999	2001	2002	2002	NA
6th yr Measure	1998	1999	1999	1999	1999	1999	2000	2000	2000	2001	2002	2002	2002
15-20' HLC Thin	2001	NA	2005	NA	2002	2002	NA	NA	NA	NA	NA	NA	NA
Prune Lift 2 12ft	NA	2005	2002	2002	NA	2002	2003	2003	2001	2004	2008	2005	NA
9th yr Measure	2001	2002	2002	2002	2002	2002	2003	2003	2003	2004	2005	2005	2005
Prune Lift 3 18ft	NA	2015	2012	2010	NA	2005	2011	2009	2003	2010	2011	2010	NA
12th yr Measure	2004	2005	2005	2005	2005	2005	2006	2006	2006	2007	2008	2008	2008
30-32' HLC Thin	2006	NA	NA	2010	2020 (?)	2020 (?)	2011	2009	2011	2010	2011	2010	NA
Prune Lift 4 22 ft	NA	NA	NA	2015 (?)	NA	2013	2016	2009	2006	2017	2013	2013	NA
17th yr Measure	2009	2010	2010	2010	2010	2010	2011	2011	2011	2012	2013	2013	2013
22nd yr Measure	2014	2015	2015	2015	2015	2015	2016	2016	2016	2017	2018	2018	2018
27th yr Measure	2019	2020	2020	2020	2020	2020	2021	2021	2021	2022	2023	2023	2023

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

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	1992	1994	1994	1994	1995	1996	1997
2nd yr Regen Survey	1993	1995	1995	1995	1996	1997	1998
Plot Installation	1993	1995	1995	1995	1997	1998	1999
3rd yr Measurement	1994	1996	1996	1996	1997	1998	1999
6th yr Measurement	1997	1999	1999	1999	2000	2001	2002
9th yr Measurement	2000	2002	2002	2002	2003	2004	2005
12th yr Measurement	2003	2005	2005	2005	2006	2007	2008
17th yr Measurement	2008	2010	2010	2010	2011	2012	2013
22nd yr Measurement	2013	2015	2015	2015	2016	2017	2018

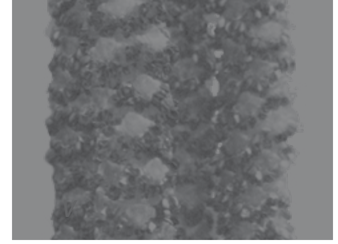
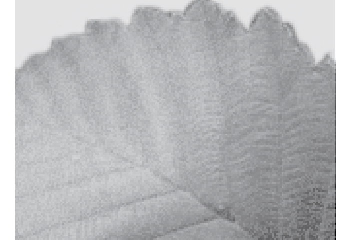
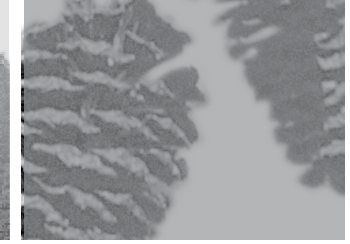
Table 5. Hardwood Silviculture Cooperative Field Activities, Winter 2014/15

Type	Activity	Installation	Cooperator
Type 1	Completed		
Type 2	22yr Measurement	3206	WHC- Blue Mtn
		5204	WHC- Hemlock Ck
		4203	BCMIN- Mohun Ck
Type 3	17yr Measurement	None	

treatment. Regarding the Type 3 experiment, three installations (Monroe-Indian, Turner Creek, & Holt Creek) will need their 22nd year measurements. Luckily, most of these sites have cooperators which will provide personnel support for completing the measurements. See Table 6 for the list of activities.

Table 6. Hardwood Silviculture Cooperative Field Activities, Winter 2015/16

Type	Activity	Installation	Cooperator
Type 1	Completed		
Type 2	3rd Pruning Lift	1202	BCMIN- Lucky Ck (check HT)
	4th Pruning Lift	2205	ANE-Siletz (check HT)
		4205	BCMIN- French Ck
	15-20ft HLC Thin	4205	BCMIN- French Ck
	30ft HLC Thin	2204	SNF- Cape Mtn
		4205	BCMIN- French Ck (check HLC)
	22yr Measurement	1202	BCMIN- Lucky Ck
		2204	SNF- Cape Mtn
		2205	ANE- Siletz
		3207	BLM- Dora
		4205	BCMIN- French Ck
	27yr Measurement	4201	GYN- Humphrey Hill
Type 3	17yr Measurement	2301	ANE- Monroe-Indian
		4301	GYN- Turner Ck
		4303	BCMIN- Holt Ck

Current HSC Activities

Red Alder Stem Form – Tree Taper and Volume Equations

Rationale/Objectives

The HSC built the first-ever taper equation for managed stands of red alder using data from 234 trees across nine of the Type 2 installations (see Bluhm, et.al. 2007. Taper Equation and Volume tables for Plantation-Grown Red Alder. USDS GTR-735). The resulting equation fit the data nicely, however, due to the age of the plantations, the sampled trees were young (~15 years) and of pre-merchantable size. Therefore, it is important to determine if the taper equation built from these younger stands and used in RAP-ORGANON will accurately predict diameters along the profile of the tree and, thus, stem volume. From the onset, it was always intended to supplement this original data with older, larger trees as they came of age. The opportunity to collect additional data arose in 2012 and again in 2013 when the HSC Type 1 installations #4102 (Janicki, WADNR) and #2101 (Battle Saddle, Siuslaw NF) were sampled, respectively. This additional data helped us try to answer the following:

How well does the taper/volume equation developed from plantation grown trees, predict diameter inner bark (DIB) at multiple points along the tree stem?

How well does the taper equation predict individual tree merchantable volume?

Previous Results

The HSC analyzed the taper data collected on the Janicki (#4102) site, a 33-year-old Type 1 installation. Results were presented in the 2013 HSC Annual Report. General results were as follows:

- The taper equation under-predicted DIB (i.e. observed DIB was greater than predicted DIB) in all but one of the 21 treatment x measurement combinations.
- Mean bias was less than or equal to one inch up to and including the 17.3ft measurement point and increased consistently and substantially from there up the stem.
- The taper equation seemed to do a slightly better job predicting DIBs and heights for the unthinned treatment as compared to either of the thinned treatments.
- Observed cubic foot volume was smallest for the unthinned trees and increased with thinning intensity. Predicted volume values were less than the observed values. Under-predictions ranged from 10% to 20%.

Overall, the results indicate that the taper equation under-predicted DIBs above DBH and into the crown. These under predictions would result in a similar (but, as yet, unknown) under-prediction of log volumes. Across treatments, the taper equation yielded better predictions for the unthinned treatment as compared to the thinned treatment.

The next analysis was done on the Battle (#2101) site, a 37-year-old Type 1 installation. Results were presented in the 2014 HSC Annual Report. General results were as follows:

- The taper equation accurately predicted DIB in most all cases. In other words, for all DIB sample locations, there did not seem to be any noteworthy differences in observed vs. predicted DIBs by any of the treatment x measurement combinations.
- Mean, maximum, and relative bias (the difference between observed (measured) DIB and predicted DIB) were generally small. No general patterns regarding over- or under-predictions were observed except at the base of the live crown (HLC) measurement point where mean relative bias was 9% and almost always positive (under-predicted).
- The taper equation seemed to do equally well predicting DIBs for thinned treatments as well as unthinned treatments.
- The taper equation predicted volume very well. Predictions of log volume were all within 1.0% of observed volumes.

In contrast to results from the Janicki site, these results indicate that the taper equation developed from plantation-grown red alder did an outstanding job predicting DIBs (and thus, log volume) from larger trees of natural origin.

Because of the contrasting results, it was decided that more data was required to help answer the question "Why?"

Current Results

Site characteristics

To determine how well the taper equation would predict DIBs (and volume) on larger trees grown in plantations, taper measurements were taken from five treatments from five HSC Type 2 installations. A description of the sites can be found in Table 7.

Methods, sampling procedure and measurements

The methods, sampling procedure and plot and taper measurements were consistent with those used for the previously sampled sites. Details can be found in the HSC 2013 & 2014 Annual Report.

In general, three trees from the buffers of four treatments were selected across the range of diameters and free of obvious defect (broken tops and major forking). Sample tree characteristics can be seen in Table 7. Once the sample trees were felled, six measurements were taken along the stem at height of: 0.5ft, 2.2ft, 4.5ft, 17.3ft, 32.0ft, and height to the live crown (HLC). In addition, a measurement was taken where the stem diameter was 5in.

Table 7--Site and tree characteristics used in taper model validation, by site.

Site Name	Toledo	Sitkum	Shamu	Thompson	Blue Mtn
Latitude	44.6	43.13	45.93	45.48	46.8
Longitidue	123.9	123.87	122.2	123.78	123.4
Elev (ft)	350	1000	1100	1225	400
Slope (%)	10	12	12	7	5
SI(50) (ft)	110	110	95	90	105
Establishment date	1992	1992	1992	1992	1993
Sample size:					
Trees	16	12	12	12	9
Tree DBH (in):					
Minimum	8.3	9.1	9.1	8.7	7.4
Mean	10.2	11.4	10.8	9.8	9.1
Maximum	12.6	15.0	14.3	11.3	11.1
Tree height (ft):					
Minimum	60.1	76.4	61.5	60.1	64.9
Mean	68.9	85.8	78.4	65.2	69.5
Maximum	76.6	92.4	86.1	69.1	71.8
Tree Height Live Crown (ft):					
Minimum	27.0	41.2	32.1	30.2	28.8
Mean	38.3	52.1	45.7	35.3	40.2
Maximum	55.7	60.7	60.9	39.9	52.1
Tree Crown Ratio:					
Minimum	0.24	0.27	0.27	0.40	0.27
Mean	0.44	0.39	0.42	0.46	0.42
Maximum	0.60	0.55	0.54	0.54	0.56

Objective 1: How well did the taper equation predict DIBs?

Individual tree predicted DIB vs. observed DIB values, by treatment, for the measurement points 0.5ft, 32.0ft and HLC are shown in Figures 2a through 2c, respectively. The closer the data points fall on the 1:1 (i.e. diagonal) line, the better the predicted DIBs match the observed DIBs. If the data points fall above the 1:1 line, the DIB predictions are greater than observed DIBs; and if below the line the DIB predictions are less than the observed DIBs. As seen in

Figure 2a, the 0.5ft (stump height) DIB predictions are generally scattered, most likely due to the irregular, fluting, or non-cylindrical properties at the base of the trunk. No strong pattern of over- or under-prediction was evident except, perhaps for the 230tpa Prune treatment. At heights of 2.2ft and 4.5ft, the predicted DIBs closely match the observed values (data not shown). This is mainly a function of the form of the taper equation itself. At 17.3ft, a slight, consistent under prediction of DIB was evident (data not shown). In Figure 2b (32.0ft), DIB predictions are closely disturbed along the 1:1 line, but fall predominantly below the line (i.e. under-predicted). Figure 2c (HLC~48ft) shows a distinct under-prediction of DIB.

For all DIB sample locations, there did not seem to be any noteworthy differences in observed vs. predicted DIBs by treatment.

Bias, the difference between predicted (calculated from the taper equation) DIB and observed (measured) DIB was used to determine how well the taper equation fit the sample trees.

The mean, maximum (either positive or negative), and relative bias, by measurement point and treatment is shown in Table 8. With the exception of the 0.5ft DIB for the 230tpa Prune treatment, all mean biases at the lower (less than or equal to 17.3ft) measurement points were less than -0.5in. At 32.0ft and at the HLC measurement point, mean bias was consistently negative (i.e. under-predicted) and ranged from -0.3in to -0.9in.

Maximum bias (either positive or negative) was greater at the tree base and at the HLC measurement point than elsewhere along the stem. For the former, this seems reasonable considering the larger diameter at that point, but for the latter, this difference remains unexplained. At this point (i.e. higher up the tree) maximum bias has practical implications since it concerns the estimation of log scaling diameter. The maximum bias estimates for the 32.0ft measurement point (a common

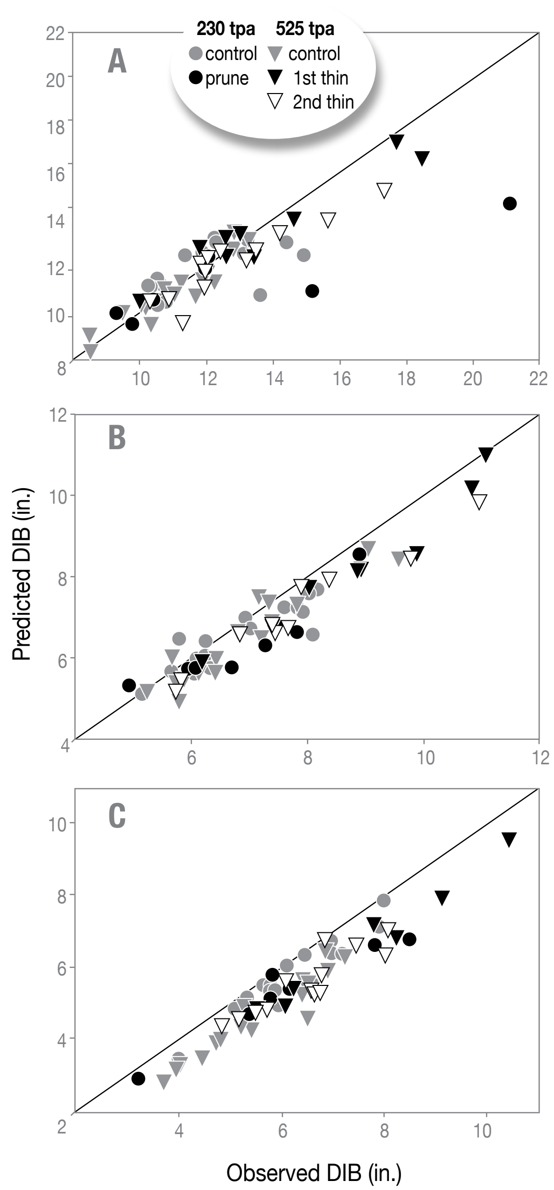


Figure 2. Observed vs. predicted diameter inner bark (DIB) for the (A) 0.5ft., (B) 32.0ft., and (C) height to live crown (HLC) measurement point, by treatment.

small end log position) was always negative (under-predicted) for all treatments and ranged from -1.1in to -1.5in.

Relative bias ((predicted DIB-observed DIB) /observed DIB) is a way to assess the taper equation performance as a function of the DIB measurement. Mean relative bias generally increased with increasing height of the measurement point. Higher up the tree, relative bias was always negative and increased with increasing height. Mean relative bias at 17.3ft was -3.1%, at 32.0ft was -5.5%, and at HLC was -12.2%.

Graphical illustrations of measurement point bias by individual tree and three selected treatments are presented in Figure 3 (a-525tpa Control; b-525tpa 1st Thin; c-525tpa 2nd Thin).

These preliminary results indicate that the taper equation predicts lower stem DIBs very well but under-predicts DIBs above DBH. This under-prediction increases with increasing height. There was no discernable difference in DIB predictions between planting densities or for untreated (control) versus treated (pruned or thinned) plots.

Objective 2: How well does the taper equation predict tree and log volume?

The observed, predicted, and relative bias estimates of the two form quotients are shown in Table 9. Observed Girard Form Class (GFC = DIB at 17.3ft/DOB at 4.5ft) was always slightly higher than predicted GFC. Relative bias was very small; ranging from -1.6% for the 230tpa Control to -5.6% for the 230tpa Prune. There was no discernable difference in GFC relative bias across thinning treatments (ranging from -3.1% to 3.4%). Moving up the stem to the Olney Form Class (OFC = DIB at 32.0ft/DOB at 4.5ft) relative bias was always greater than GFC relative bias; often times double. In addition, OFC relative bias was substantially lower for control plots (mean -4.1%) than for treated plots (mean -6.9%).

Table 8--Mean, maximum, and relative DIB bias by treatment and measurement point (MP).

MP	230tpa Control			230tpa Prune			525tpa Control			525tpa 1st thin			525tpa 2nd Thin		
	Mean Bias (in)	Max Bias (in)	Rel Bias (%)	Mean Bias (in)	Max Bias (in)	Rel Bias (%)	Mean Bias (in)	Max Bias (in)	Rel Bias (%)	Mean Bias (in)	Max Bias (in)	Rel Bias (%)	Mean Bias (in)	Max Bias (in)	Rel Bias (%)
0.5ft	-0.1	-2.8	0.2	-1.4	-6.4	-6.8	0.0	-0.8	0.2	-0.1	-1.7	0.3	-0.5	-2.0	-3.6
2.2ft	0.2	-0.8	1.5	-0.2	-0.6	-1.4	-0.2	-3.7	-1.1	-0.1	-1.3	-0.7	0.0	0.5	0.2
4.5ft	0.1	0.3	0.7	0.0	0.0	0.0	0.0	-0.1	0.1	0.0	0.1	0.3	0.0	0.1	0.1
17.3ft	-0.2	-0.7	-1.6	-0.5	-0.8	-5.6	-0.3	-0.9	-3.3	-0.3	-0.8	-3.1	-0.3	-0.9	-3.4
32ft	-0.3	-1.5	-3.9	-0.5	-1.2	-6.8	-0.3	-1.1	-4.2	-0.5	-1.3	-6.4	-0.6	-1.3	-7.5
HLC[1]	-0.5	-1.1	-7.4	-0.8	-1.7	-11.7	-0.9	-1.9	-15.8	-0.9	-1.4	-12.7	-0.9	-1.6	-13.3

[1] Mean Hlc=42.2ft.

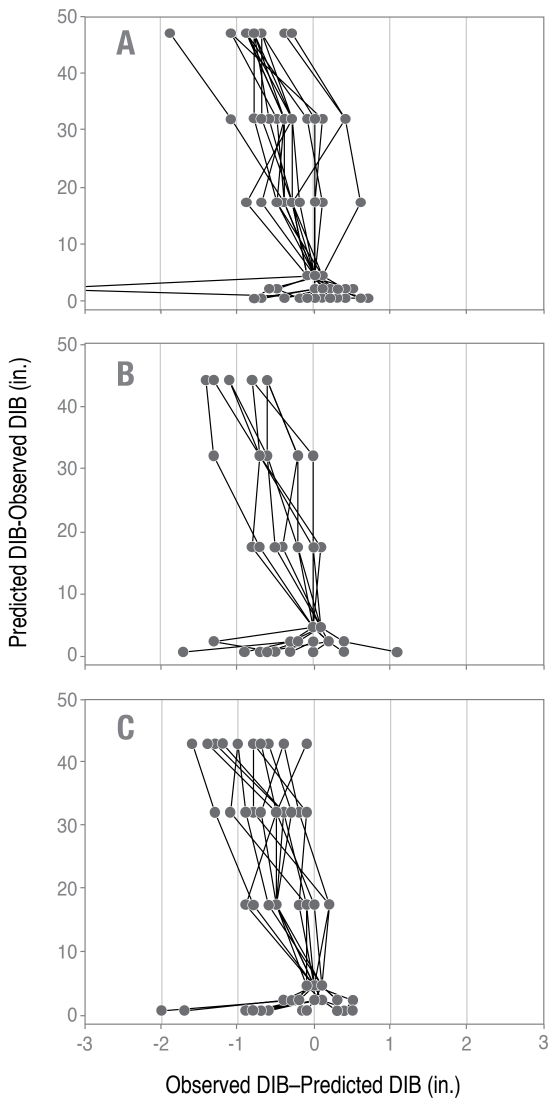


Figure 3. Diameter inner bark (DIB) measurement point bias (predicted DIB– observed DIB) for the (A) 525tpa control (n=16), (B) 525tpa 1st Thin (n=9), and (C) 525tpa 2nd Thin treatment (n=13).

The taper equation accurately yet consistently under-predicted merchantable height (DOB 5.0in). Absolute differences between predicted and observed values were between -1.6ft and -0.3ft and relative bias was between -3.1% and -0.4%.

Likewise, the taper equation consistently under-predicted merchantable volume (0.5ft stump height & 5in DOB top) by 1.0ft^3 (range -1.3ft^3 to -0.8ft^3). This yielded a corresponding relative mean bias of -6.8% (range -8.5% to -5.1%).

To test how well the taper equation predicted individual log volume, a single 31.5ft length log was used since every tree had DIB sample heights at 0.5ft and 32.0ft. As seen in Table 9, observed cubic foot log volume was considerably smaller for the unthinned trees (mean 13.6ft^3) than the thinned trees (mean 18.9ft^3). Predicted log volumes were always less than observed log volumes with a mean difference just under 2.0ft^3 (range -2.6ft^3 to -1.3ft^3). This consistent under-prediction corresponded to a relative mean bias of -10.9% (range -14.7% to -7.7%).

Conclusion

These results indicate that the existing taper equation consistently under-predicted DIBs above breast height, with the under-prediction (i.e. error) increasing with increasing measurement point height. These under-predictions of DIB higher up the stem resulted in a corresponding under-prediction of merchantable volume and log volume. Under-predictions in merchantable volume averaged about 7% and in a single 31.5ft log about 11%. There was no discernable pattern in the accuracy of predictions across planting densities or treatment.

Table 9--Girard and Olney form class,merchantable height (ft), and volume (ft^3)by treatment.

MP	230tpa Control			230tpa Prune			525tpa Control			525tpa 1st Thin			525tpa 2nd Thin		
	Obs	Pred	Bias (%)	Obs	Pred	Bias (%)	Obs	Pred	Bias (%)	Obs	Pred	Bias (%)	Obs	Pred	Bias (%)
Girard Form Class[1]	0.84	0.83	-1.63	0.88	0.83	-5.60	0.87	0.84	-3.33	0.87	0.84	-3.08	0.87	0.84	-3.44
Olney Form Class[2]	0.67	0.64	-3.95	0.69	0.64	-6.78	0.71	0.68	-4.23	0.74	0.69	-6.36	0.73	0.67	-7.45
Merch Ht[3]	40.7	40.1	-1.3	39.8	39.6	-0.4	45.3	43.7	-3.1	52.4	51.1	-2.1	47.0	45.7	-2.6
Merch (ft3) Volume[4]	14.5	13.7	-5.4	14.0	12.8	-8.5	14.5	13.4	-8.3	23.8	22.5	-6.6	17.8	17.0	-5.1
Log (ft3) Volume[4]	14.1	12.8	-7.7	13.6	12.1	-11.0	13.0	11.8	-8.2	20.9	18.3	-13.0	16.9	14.3	-14.7

[1] DIB at 17.3ft/DOB at 4.5ft (DBH)
[2] DIB at 32.0ft/DOB at 4.5ft (DBH)
[3] (ft) To a 5in DOB
[4] 0.5ft stump height to a 5in DOB top
[5] One 31.5ft log above a 0.5ft stump height.

Validation of RAP-ORGANON: Preliminary Results

Rationale

In 2011, the HSC completed the development, and released to the public, a variant of ORGANON for red alder plantations called RAP-ORGANON (hereafter referred to as RAP). This version is the first red alder growth and yield model that specifically models the behavior of managed red alder plantations. Data used to create the model came from the HSC Type 2 installations and complementary data from Weyerhaeuser's red alder research network. This data base comprised 53 research sites, each planted in blocks across a broad range of initial densities with later thinning treatments imposed on plots within blocks. Measurements on individually tagged trees started at plantation age 3 (total age 4) and were remeasured on 3 to 5 year intervals. Maximum stand age of the measurements extended up to 17 years for the oldest plantations.

These plantations, as part of the HSC long-term research network, have been continually remeasured since the creation of the model- providing additional data and data from older (generally larger) trees. Table 10 compares HSC data that went into the creation of RAP and data that currently exists (through the 2014 growing season). As shown in the highlighted text, the number of plantations with 17 year old data has increased substantially and where no data existed before, there are now 14 plantations with 22 year old data.

Objectives

How well does RAP predict tree and stand characteristics for these older data (plantations)? Or, put another way, the "new" data was used to "validate" model pre-

Table 10. HSC data used in construction of RAP-ORGANON (Modeling Data) and data collected through the 2014 growing season (Current Data), by site, plot, and stand age. Bold text highlights data collected since model completion.

		Modeling Data		Current Data	
Total Number of Sites		22		22	
Total Number of Plots		210		210	
Total Number of Trees		46,832		~47,000	
Number of Plots (Sites) by Stand Age:					
	3	188	(22)	188	(22)
	4	2	(1)	2	(1)
	5	46	(13)	46	(13)
	6	162	(22)	162	(22)
	7	5	(1)	5	(1)
	8	18	(5)	18	(5)
	9	177	(22)	177	(22)
	10	6	(2)	6	(2)
	11	4	(2)	4	(2)
	12	195	(22)	195	(22)
	14	4	(2)	4	(2)
	15	4	(1)	**3**	**(13)**
	17	86	(9)	**227**	**(24)**
	19	0		**2**	**(1)**
	20	0		**2**	**(1)**
	22	0		**117**	**(13)**

dictions. The "new" data is this older data collected from 11 HSC plantations spanning a wide range of geographic locations and site qualities. Therefore, to test model predictions, individual tree data from age 3 was projected or "grown" in RAP to an age of 22 (i.e. predicted) and those projections were then compared to the data collected at age 22 (i.e. actual or observed). Due to the great number of potential methods, treatments and comparisons, reduced and simplified results are presented here. The full set of results can be obtained by contacting the HSC. Comparisons between predicted and observed values were made for the 11 plantations for the following two treatments most similar to operational forestry:

- 525tpa Control
- 525tpa Thin when live crown approaches 20ft (about age 9)

Comparisons were done for the following 5 tree or stand variables:

- Trees per acre (TPA; stems/acre)

- Quadratic mean diameter (DBH; inches)
- Height of the largest 100 trees/acre (H100; feet)
- Stand basal area (BA; ft^2/acre)
- Merchantable stand volume (VOL; ft^3/acre; 6in stump, 4in top diameter)

The predicted vs. observed values for these 10 comparisons (2 treatments by 5 variables) are presented by increasing site productivity (using 20 year base age site index from Weiskittel, et.al. 2006). Mean relative bias ((Predicted value-Observed value)/Observed value) across sites was calculated.

Methods

The data in this analysis came from 11 plantations of pure red alder in western Oregon (OR) and western Washington (WA) (see Figure 1). The climate is maritime and characterized by wet, mild winters, and cool, dry summers. Soil types included silty loams, clay loams, gravelly loams, and cobbly loams. Elevation ranged from 300ft to 1150ft, slopes ranged from 5% to 35%, and annual precipitation ranged from 45in to 130in.

Plantations were established on previously harvested sites of at least 15 acres and reasonably uniform ground conditions. Site preparation methods were the standard operating methods for the region at the time and included normal competition reduction practices. Climatic (annual and growing season precipitation, length of growing season) and soils information was determined and site index was estimated using the soil-site method of Harrington (1986). Using this method, mean site index (base age 50 years) was 98ft.

Sites were planted between 1989 and 1992. At each site, blocks of local red alder nursery stock (inoculated with *Frankia* spp.) were planted to target densities of 100, 230, 525, and 1200 trees per acre (tpa). Planting blocks were randomly assigned and within each planting block, control plots and various thinning and pruning treatment plots were randomly assigned. Treatment plots were 1.25 acres and contained a 0.3 acre measurement plot. Treatment activities and data collection are administered by the HSC. A full description of site locations, plot layouts, treatments, etc. can be found at http://hsc.forestry.oregonstate.edu/.

At age 3, 6, 9, 12, 17, and 22 data was collected on permanently tagged individual trees. Stem diameter at 4.5ft (DBH) was recorded for every tree and height was measured on a subsample of 40 trees that included the 10 trees of smallest diameter the 10 of largest diameter, and 20 mid-range trees (based on diameter). Mean tree diameter was calculated as quadratic mean diameter.

Results from only two treatments are presented here; treatments thought to most closely mirror operational forestry in the region. The first treatment is the 525tpa control (unthinned) treatment and the second treatment is thinning a 525tpa plot when the average HLC was between 15ft and 20ft (occurring at or around age 9) to a target density of 230tpa. Actual planting densities and residual thinning densities, by site are found in Table 11.

Model Input

Model projections were run using the Red Alder Growth Simulator (RAGS), an Excel-based interface for (the DOS-based) RAP. But first, test runs were made using both programs to deter-

Table 11. RAP-ORGANON preliminary validation site by treatment data matrix.

Site #	Site Name	SI20 (ft)	525tpa Control	525tpa Thin	
			Tpa	Age	Tpa
1201	LaPush	53.8	591	NA	NA
4202	Clear Lake	60.4	674	NA	NA
2203	Pioneer Mtn.	60.8	476	8	270
2202	Pollard Alder	61.4	584	12	192
5203	Thompson Cat	62.4	653	8	198
3204	Keller Grass	63.2	560	9	237
3205	Shamu	68.0	611	8	234
5204	Hemlock Ck.	68.5	594	9	230
3203	Sitkum	74.4	596	9	225
4201	Humphrey Hill	75.3	713	NA	NA
3202	Ryderwood	78.9	617	9	237
Mean	------	66.0	614	8.7	230
n	------		11	8	

mine if projections were consistent between the Excel-based RAGS and DOS-based RAP. This test used the first set of collected data (age 3) projected to age 22 for the 525tpa control plot for the same 11 sites used here. The variables assessed were the same 5 listed above (TPA, DBH, H100, BA, and VOL). In addition, to assess the performance of the taper equation, merchantable board foot volume (BFVOL) was compared.

Both programs require the same following inputs. Site index (base age 20) was calculated using 17 year data from the 230tpa, 525tpa, and 1200tpa control plots (see Table 11), breast height age was 21 years, age from seed was 23 years and the thinning type was a user thin since the individual tag numbers of the removed trees were known. For this analysis, merchandising and economic specifications were not applicable.

Results

Results from the comparison between RAGS and RAP, though not identical (which, in theory, should be), were very similar (data not shown). The mean relative bias (RAGS="Predicted" and RAP="Observed) for each variable was as follows:

- TPA: -2.7%
- DBH: -0.8%
- H100: -0.3%
- BA: -0.8%

- VOL: -0.6%
- BFVOL: 0.7%

Results from the comparison between RAP projections (predicted) and measured values (observed) are the following:

- Trees Per Acre (TPA), Figure 4
  - Control- Generally, RAP under-predicted TPA for 8 of the 11 control plots. Relative bias was -6.1%.
  - Thin- RAP accurately predicted TPA for the thinned plots as reflected in a relative bias value of 0.6%.
- Diameter Breast Height (DBH), Figure 5
  - Control- RAP under-predicted DBH for 7 of the 11 control plots. Model predictions were accurate (relative bias was -2.0%) but not very precise.
  - Thin- RAP consistently and substantially under predicted DBH for all thinned plots. Relative bias was -8.9%.
- Tree Height (H100), Figure 6
  - Control- RAP consistently under-predicted H100. Relative biases were always negative with a mean value of -6.8%.
  - Thin- With one exception, RAP under-predicted H100 for the thinned plots. Relative bias was -5.5%.
- Stand Basal Area (BA), Figure 7
  - Control- RAP under-predicted BA for all but 2 control plots. Model predictions were sometimes very inaccurate. Relative bias was -9.9%.
  - Thin- Mainly as a result of the consistent under predictions in DBH, BA was consistently and substantially under-predicted for the thinned plots. Relative bias was -16.2%.

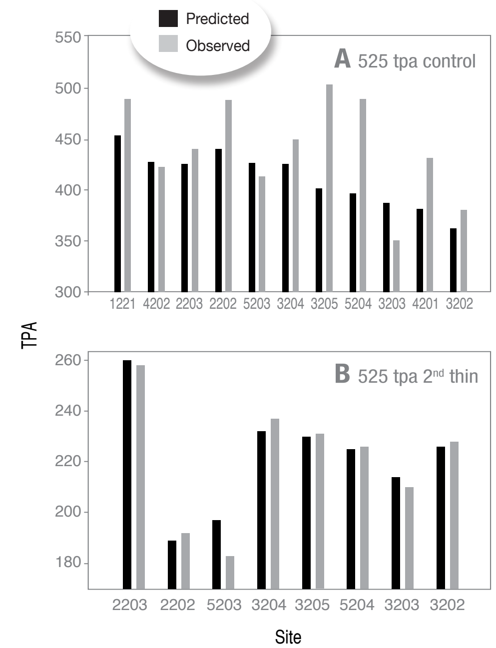


Figure 4. Trees per Acre- 22 year predicted TPA vs. observed TPA, by site for the a) 525tpa control and b) 525tpa 2nd thin.

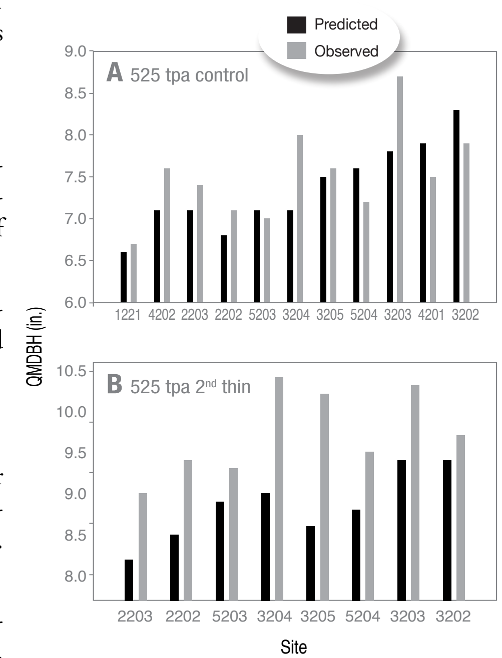


Figure 5. Diameter Breast Height- 22 year predicted DBH vs. observed DBH, by site for the a) 525tpa control and b) 525tpa 2nd thin.

- Total Stand Volume (VOL), Figure 8
    - Control- VOL was under-predicted for all but one control plot. Individual relative bias values ranged from 3.4% to -28.9% with a mean relative bias of -15.0%.
    - Thin- RAP consistently and substantially under-predicted VOL for the thinned plots. Relative bias ranged from -2.9% to -36.8% (mean -20.8%).

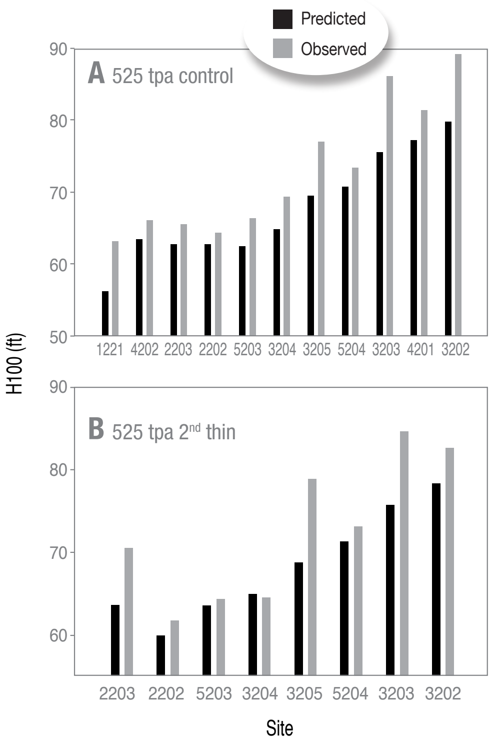


Figure 6. Crop Tree Height- 22 year predicted H100 vs. observed H100, by site for the a) 525tpa control and b) 525tpa 2nd thin.

Conclusion

Using the data and procedures outlined above, the existing red alder growth and yield model (RAP-ORGANON) consistently under-predicted TPA, DBH, H100, BA, and VOL for both the 525tpa Control and the 525tpa Thin treatments. Generally, the predictions were better for the control treatment versus the thinned treatment. These individual under-predictions combined and culminated in under-predictions of -15.0% and -20.8% for VOL for the control and thinned treatments, respectively. These results are preliminary and not a "true validation" thoroughly performed by a professional modeler. RAP growth and yield model predictions are the result of complex, interacting equations, so the identification and possible solutions are unknown at this time. Be that as it may, these under predictions warrant the recognition by RAP users and require further investigation.

This emphasizes the need for HSC to investigate the technical modeling approach and the optimal timing for new work to update the growth and yield model for managed alder using additional data from older stands.

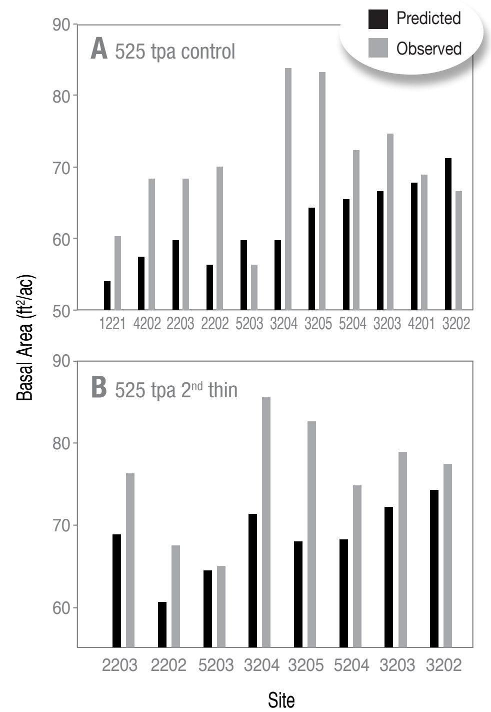


Figure 7. Basal Area- 22 year predicted BA vs. observed BA, by site for the a) 525tpa control and b) 525tpa 2nd thin.

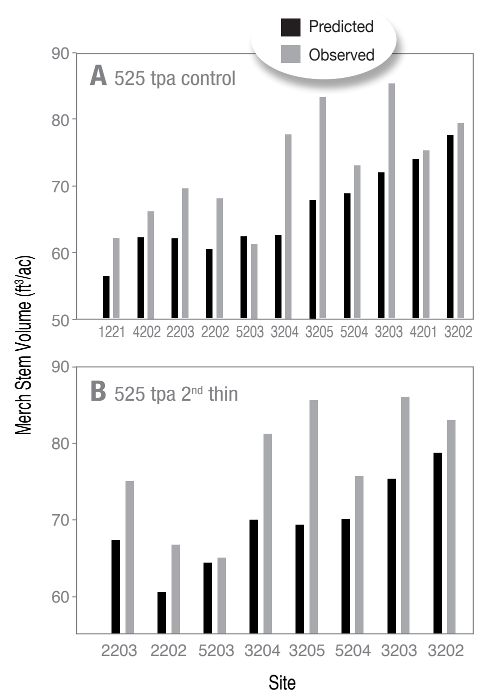


Figure 8. Merchantable Volume- 22 year predicted VOL vs. observed VOL, by site for the a) 525tpa control and b) 525tpa 2nd thin.

Outreach and Education

Forest Owner Field Day

This workshop, sponsored by Washington State University Extension was held in Salkum, WA August 9, 2014. This educational event provided practical “how-to” information to a wide array of forest owners. For the fourth year running, Andrew Bluhm taught the “Basics of Red Alder Management” and the “Advanced Hardwood Management” courses.

Society of American Foresters National Convention 2014

Glenn Ahrens presented a poster Decision Tools for Selecting Red Alder and Douglas-fir Silvicultural Regimes at the Society of American Foresters National Convention, Salt Lake City, UT, October 8-11, 2014. The poster compared projected outcomes for plantation management regimes for red alder and Douglas-fir under a range of economic and environmental conditions. Outcomes were projected using the CIPS ORGANON Red Alder Plantation growth model and the CIPS ORGANON Stand Management Cooperative growth model for Douglas-fir.

Direction for 2016

As always, the specific goals for 2016 are both continuations of our long-term objectives and new projects:

- Continue efforts to recruit new members.
- Continue HSC treatments, measurements and data tasks.
- Continue adding content and updating the HSC website.
- Continue efforts in outreach and education.
- Continue working with and analyzing the HSC data.
- Continue growth and yield modeling efforts; testing RAP-ORGANON outputs/predictions; investigating the technical modelling approach and the optimal timing for updating the growth and yield model for managed alder using additional data from older stands.

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 Summer Management Committee Meeting Minutes

Tues August 5, 2014:

Attendees: Andrew Bluhm, David Hibbs, Glenn Ahrens- OSU; Scott McLeod, Brian Morris- WA DNR; Jeanette Griese- Bureau of Land Management; John Walter- Stimson Lumber Company; Robert Deal- USFS PNW Research Station; Steven Perakis- USGS.

Please refer to the associated handouts for further information.

We started the meeting at 9:00 AM at the Benton County Extension office in Corvallis, OR with the morning session being indoors and after lunch, visiting a HSC Type 2 installation outside Toledo, OR.

The morning session started with Dave Hibbs introducing the proposed new HSC program leader, Glenn Ahrens. As many are aware, Dave is retiring and Glenn has a long history with red alder and with the HSC. According to Dave, "Glenn has a long history with the HSC so is known to most of you. He was in Andy's role in the Coop's early days, establishing many of our installations and measuring them all. Glenn has kept his hand in alder since then, participating in some HSC events, giving presentations on alder at many workshops, and working with non-Coop data sets to answer alder management questions not being addressed by the HSC. He is currently an OSU Extension agent based in Oregon City."

Dave provided a nice overview of the HSC- its history, objectives, accomplishments, future direction, etc.

The first presentation of the day was given by Steve Perakis, a research scientist with the USGS, and a frequent collaborator with the HSC. His presentation was titled "Legacy effects of red alder on soil nutrients in the Oregon Coast Range". This presentation, focusing heavily on chemistry, nonetheless, was extremely interesting and though-provoking. His main point was that red alder has long-lasting and extremely beneficial nutritive effects for plant growth. Key points include (but are no way limited to):

- Most minerals plants require from the soil are derived from bedrock, except Nitrogen.
- Nitrogen is added to the soil only by atmospheric deposition, microbial or epiphytic N-fixers, or red alder
- Nitrogen fixation rates by red alder are orders of magnitude greater than all others combines.
- This "legacy" Nitrogen persists in soils for centuries to millennia.
- Nitrogen added to the soil by red alder is because red alder fixes more Nitrogen than it needs and the rest escapes (leaks) into the soil.

- Combining the repeated presence of red alder on the landscape with the fire return yields estimates that red alder adds +10,000kg/ha/fire of Nitrogen.
- The forests of the OR Coast Range have more Ecosystem Nitrogen than any other temperate forests worldwide, up to 2 to 3 times as much.
- These Nitrogen rich soils grow Nitrogen rich conifers.
- Nitrogen in the soil goes through nitrification which is where ammonium is converted to nitrites (and Hydrogen ions) and is a critical soil process.
- Accumulated soil Nitrogen produces nitrates when nitrification rates exceed Nitrogen uptake (by Douglas-fir, for example).
- Therefore, high Nitrogen forests can leach nitrate, can lead to soil acidification (due to the Hydrogen ions), and deplete base cations (Ca, Mg, Na, K) in the soil.
- Effects of the latter include reduced foliar concentrations in Douglas-fir of only Ca and the loss of Ca and Mg from the soil.
- Legacy Nitrogen fixation increases soil organic phosphorous.
- Bedrock type (basalt vs. sedimentary) has a minor effect on soil fertility but interacts with legacy Nitrogen to determine long-term nutrient sources.

An electronic copy of Steve's presentation is included in the meeting minutes.

Andrew Bluhm then followed with a presentation titled "HSC Red Alder Upper Stem Measurement Project". This analysis, a continuation of the analysis he did last year used upper stem diameter measurements to see if thinning affected taper.

The previous analysis looked at how well the taper equation predicted DIB and thus volume for a thinned natural alder stand. Results indicated that the taper equation did a poor job for this site:

- The taper equation consistently under predicted DIBs, especially as one moved up the bole.
- Taper equation seemed to do a slightly better job predicting DIBs and heights for the unthinned treatment as compared to the thinned treatments.
- Predicted volumes were less than the observed volumes, sometimes significantly.

Because of this result, it was decided to repeat the analysis on another HSC Type 1 installation #2101 (Battle Saddle), collected in the summer of 2013. This stand was 33 years old and was thinned at age 14. Results include:

- Predicted DIBs closely match the observed values at every measurement point until reaching the HLC (under-prediction of DIB).

- No observable/significant differences in observed vs. predicted DIBs by treatment.
- Mean bias was 0.5in or less (both positive and negative) for all measurement point/treatment combinations.
- Maximum bias estimates for the 32.0ft measurement point was always under-predicted, but small (range 0.4in to 1.1in).
- Mean relative bias was very small, around 2% or less.

An electronic copy of this presentation is included in the meeting minutes.

Therefore, conflicting results were produced: the taper equation grossly under-predicted DIBs and volumes for Janicki, but did an excellent job predicting DIBs and volumes for Battle Saddle. In light of this, the group agreed that it was important to keep collecting more taper data to eventually update/correct the existing equation. This additional data could be collected from:

- The other 2 Type 1 sites
- From the buffers of some of the older Type 2 sites
- An 'old' DNR alder plantation near Abernathy Creek, WA

Andrew then presented the group with updates regarding the RAP-ORGANON Excel Interface.

As mentioned previously, a user-friendly Excel interface for using the RAP ORGANON growth model has been developed at Oregon State University by the Center for Intensive Planted-forest Silviculture (CIPS). Originally developed for Douglas-fir, a version was developed for RAP ORGANON and a copy of the program (as well as user instructions) can be obtained at the CIPS website (www.fsl.orst.edu/cips). Andrew then demonstrated how the interface works using plot data from one of the HSC sites. If interested in using this growth simulator, please see the CIPS website or contact Andrew directly. New features include:

- A new 'Treatment' worksheet that allows the user to compare any run treatment scenario against a "control" or "untreated" treatment, both in tabular as well as graphical form.
- Internal rate of return (IRR) in addition to net present value (NPV) was included in the output.

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. Please see the associated handouts.

Winter 2013/14 had an unusually large amount of fieldwork. A total of 10 installations need either a measurement or a treatment. Fieldwork includes:

- Nine Type 2 installations needed fieldwork.
- A whopping five installations- Pioneer Mtn (2203, ANE), Sitkum (3203, CAM), Keller-Grass (3204, SNF), Shamu (3205, ODF) and Thompson Cat (5203, BLM) needed their 22nd year measurement.
- Three installations- Weebe Packin (3208, ODF), Wrongway Creek (3210, OSU), and Tongue Mtn (5205, GPNF) needed their 17th year measurement. In addition these installations need either the 4th and final pruning lift (Weebe Packin and Wrongway Creek) or their 1-20ft HLC thin (Tongue Mtn.)
- One installation- French Creek (4205, BCMin) needed its 4th pruning lift (to 22ft).
- One Type 3 installation needed fieldwork.
- Puget (5301, GPNF) needed its 17th year measurement

Of important note, there were four "orphaned" installations without personnel support for completing the measurements (Tongue Mtn, Wrongway Creek, Sitkum, and Puget). Completing measurements on these orphaned sites was extremely problematic to get completed.

This coming field season (Winter 2014/15) will have very little fieldwork- less than the HSC had had in over a decade. Only 3 installations need a measurement. Fieldwork includes:

- Three installations- Blue Mtn (3206, WHC), Hemlock Creek (5204, WHC), and Mohun Creek (4203, BCMIN) needed their 22nd year measurement.

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

To help planning, there will be a lot of (more than average) fieldwork two years from now (Winter 2015/16).

Next, the topic turned to the HSC budget. Fortunately, dues received in FY 2014 exceeded expectations. This will allow the HSC enough income to repeatedly fund Andrew for 0.3 FTE and allowing a significant amount of carryover. For FY 2015, uncertainty exists in the level of funding, but dues and thus revenue seems to remain relatively constant. Please see the associated handouts for the specifics on the budget and future directions.

After lunch, the group went to conduct upper stem measurements on the HSC Type 2 installation "Pioneer Mtn" (2203). This was a 23 year old plantation that just had its last measurement the year before as well as some taper measurements completed. We were there to add additional trees as well as trees from an additional treatment to the growing taper database. A couple days beforehand, Dave and Andrew felled 7 trees and with everyone's help, we completed the measurements.

In addition, Andrew took the last years measurements and completed a report summarizing the DBH, height, and volumes through age 22 and forecasted to age 30 (volume only).

Please see the associated handout.

Wed August 6, 2014:

Attendees: Andrew Bluhm, David Hibbs, Glenn Ahrens- OSU; Brian Morris- WA DNR; John Walter- Stimson Lumber Company; Robert Deal- USFS PNW Research Station.

Please refer to the associated handout for further information.

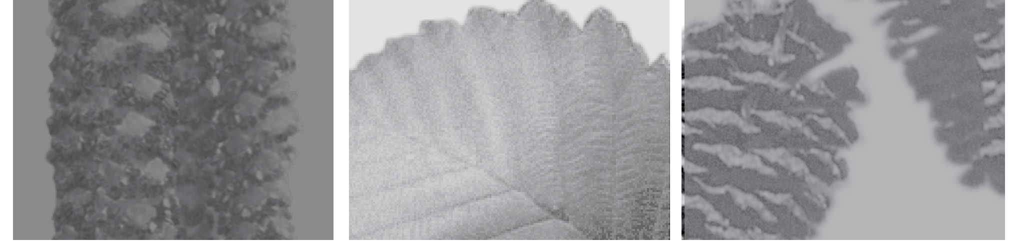
We started the meeting at 8:00 AM at the Benton County Extension office in Corvallis, OR where we drove to visit the HSC Type 3 installation (#2301) outside Siletz, OR.

This site is one of the seven red alder Douglas-fir mixed-species replacement experiments. The site was used as a forum to continue the discussion of the Type 3 results included in the HSC 2012 Annual Report and presented at the Summer 2012 meeting. This site, planted in 1994, does not have all 5 treatments- the 50% red alder plot was lost long ago due to road construction, and the 25% red alder plat had all of its alder rogued out recently, for reasons unknown. Using 17 year old data for the following three treatments; 0% red alder, 11% red alder, and 20% red alder, the performance of this one installation was placed in the context of the following question:

Is there any benefit of adding a little red alder into a Douglas-fir plantation?

- DBH: Through age 17, there was a slight reduction of Douglas-fir DBH for the 20% red alder mixture. DBH was reduced by 1in, or 12%. No reductions were observed for the 10% red alder treatment.
- HT: There were no reductions in Douglas-fir height for either mixed-red alder treatment.
- 17 year Volume (ft^3/acre): Total cfvol (both red alder and Douglas-fir) for the 20% red alder treatment was lower than for the other two treatments. Total cfvol (both red alder and Douglas-fir) for the 10% red alder treatment was greater than for the pure Douglas-fir. This was the result of the red alder volume being additive to the equivalent Douglas-fir volumes.
- Projected Volume (bdft/acre)- No red alder market value: At age 47, projected total bdftvol for the pure Douglas-fir treatment was 55.1MBF, higher than volumes in the mixed-species treatments. The 10% red alder treatment had 51.9MBF (6% reduction) and the 20% red alder treatment had 50.2MBF (9% reduction). Assuming that the red alder had no market value, the question was would have it been cost effective, at any time, to incur the cost of removing the red alder?
- Projected Volume (bdft/acre)- Red alder: The next question was suppose the red alder was removed at age 20 (as happened here). What red alder volume would have been lost by age 47? Running the red alder through RAP ORGANON, approximately 3.5MBF of merchantable volume was lost.
- Projected Volume (bdft/acre)- Douglas-fir: The next question was given that the red alder was removed here at age 20, what effect (if any) will that have on the growth of the remaining Douglas-fir? By running the Douglas-fir through SMC ORGANON, by reducing the density of a pure Douglas-fir stand at age 20 by the number of red alder removed, by age 47 the stand would yield 49.1MBF.
- Projected Volume (bdft/acre)- Total: The final question was, given these assumptions and model limitations, what would the total volume of a 20% red alder treatment be a t age 47? Adding 3.5MBF to 49.1MBF results in 52.6MBF. This is a 4.5% reduction in projected volumes of a pure Douglas-fir plantation.

Finally, there was general consensus that there will not be a winter work party this coming field season.



Appendix 3
Financial Support Received in 2014-2015

Cooperator	Support
BC Ministry of Forests	$8,500
Bureau of Land Management	$8,500
Goodyear-Nelson Hardwood Lumber Company	$4,500
Hancock Forest Management	$8,500
Oregon Department of Forestry	$8,500
Siuslaw National Forest	------
Washington Department of Natural Resources	$8,500
Washington Hardwood Commission	$5,500
Subtotal	$52,500
Oregon State University	$18,100
Total	$70,600

http://hsc.forestry.oregonstate.edu/