Hardwood Silviculture Cooperative

2014 annual report

Contents

Highlights of 2014

Five more 22nd year measurements were collected on the Type 2 installations (variable-density red alder plantation), bringing the total to 11 of the 26 installations.

- The last three Type 2 installations had their 17th year measurements.
- 17 of the 26 Type 2 installations have had all the treatments completed.
- The regular measurement cycle of the four of the Type 1 installations has been completed. However, they are still providing additional research opportunities.
- Two Type 3 installations (mixed red alder/Douglas-fir plantation) had measurements completed this last year. Now all 7 installations have had had their 17th year measurements.
- More field data was collected investigating the potential stem form and volume effects resulting from thinning natural red alder stands. The data was collected from the HSC site #2101 (Battle Saddle), analyzed, and the preliminary results are included in this report.

Improvements continue on the interface designed for the red alder variant of ORGANON. This Excel program, created by the Center for Intensive Planted-forest Silviculture (CIPS) and the HSC, allows easier access to RAP-ORGANON and is fully of additional and useful features not included in the original model. This red alder Growth Simulator can be downloaded at: www.fsl.orst.edu/cips/Tools.htm.

Executive Summary 2014

The Hardwood Silviculture Cooperative (HSC) has spearheaded the effort to develop and provide information for foresters interested in red alder management for over 25 years. 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 went really well. Data collection and/or treatment application occurred on ten of the installations. Five Type 2 installations (pure red alder plantations) had the 22nd year measurement and three had the 17th year measurement. Lastly, one Type 3 installation (the red alder/Douglas-fir species mixtures) had the 17th year measurement and one had the 22nd year measurement.

In addition to the regularly scheduled 22nd year measurements, taper data (4 treatments by 3 trees/treatment) was collected for four of the five sites.

Gradual improvements are happening incrementally regarding the Center for Intensive Planted-forest Silviculture (CIPS) Red Alder Growth Simulator. These new features, along with a general description of this program is included in this report.

Furthermore, the HSC has analyzed the Type 1 taper data collected at last years' summer meeting. These data area follow-up to the data previously collected to assess the performance of the existing red alder volume/taper equation. Results are also included in this report.

The understanding and management of red alder has come a long way. More and more knowledge and more and more tools are being developed regarding the management of red alder, with the HSC and its members responsible for many of these developments. The vision, dedication, and continued support of the HSC members have made this possible.

Thank you members for your original vision, continued patience, and ongoing support,

Andrew Bluhm

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.

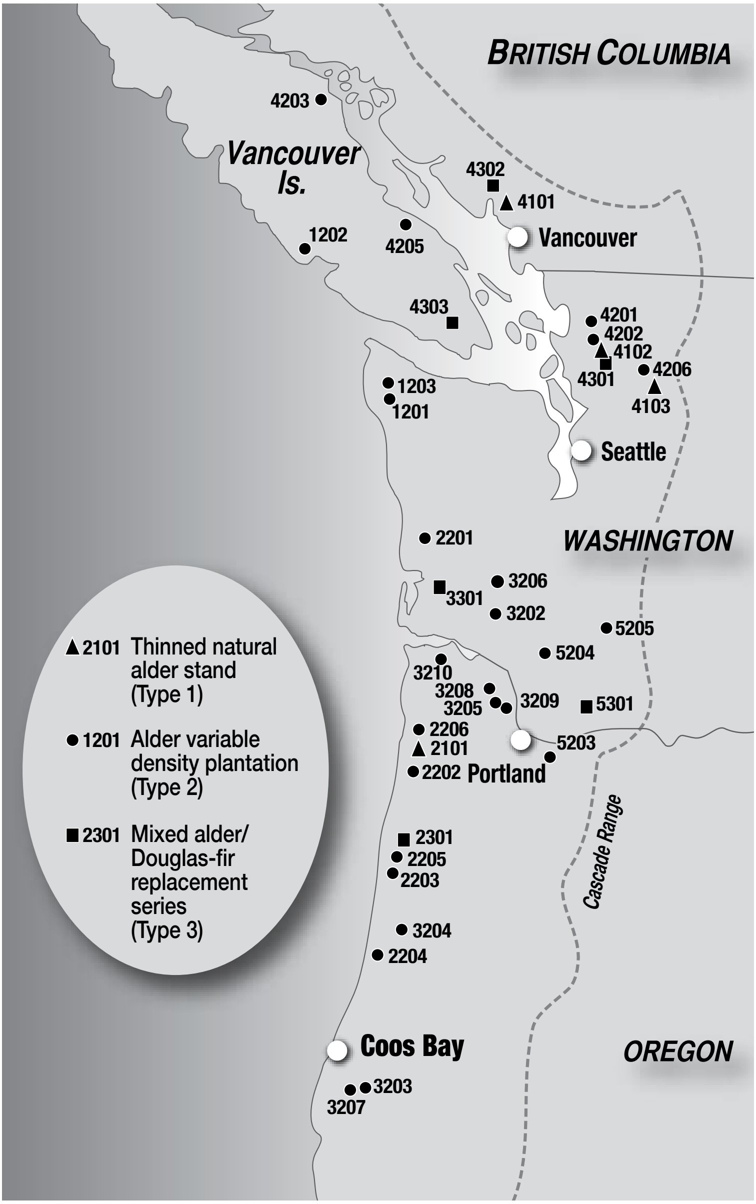


Figure1. Location of installations for the Red Alder Stand Management Study.

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

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

Region	Site Quality: Low	Site Quality: Medium	Site Quality: High
	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.

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 2013/14 was a heavy field season regarding work load. Measurements and various treatments were completed on 10 of the 37 installations (see Table 5). Of important note, five of the ten sites are "orphaned" installations without personnel support for completing the measurements

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

TYPE 2	GYN	WHC	WHC	GYN	DNR	SNF	NWH	NWH	SNF	ODF	BLM	WHC	BCmin
Site Number	4201	2201	3202	4202	1201	2202	2203	3203	3204	3205	5203	3206	4203
Site Name	Humphrey	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	NA	NA	2002	2011	2008	2009	2004	NA	2007	2009	2007	2010
Prune Lift 4 22 ft	2001	NA	2002	2002	2018	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
27th yr Measure	2016	2017	2017	2017	2018	2018	2019	2019	2019	2019	2019	2020	

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

TYPE 2	WHC	BCmin	SNF	NWH	BLM	BCmin	SNF	BLM	DNR	DNR	ODF	OSU	GPNF
Site Number	5204	1202	2204	2205	3207	4205	2206	3209	4206	1203	3208	3210	5205
Site Name	Hemlock Ck.	Lucky Ck.	Cape Mtn.	Siletz	Dora	French Ck.	Mt. Gauldy	Scappoose	Darrington	Maxfield	Weebe	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
Prune Lift 2 12ft	NA	2006	2003	2003	NA	2003	2004	2004	2002	2005	2009	2006	NA
9th yr Measure	2002	2003	2003	2003	2003	2003	2004	2004	2004	2005	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	2012	2011	NA
Prune Lift 4 22 ft	NA	2021?	2021?	2016	NA	2016	2017	2010	2007	2018	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
27th yr Measure	2020	2021	2021	2021	2021	2021	2022	2022	2022	2023	2024	2024	2024

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

TYPE 1 Site Number	BCmin 4101	SNF 2101	DNR 4102	MBSNF 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	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

(Sitkum, Keller-Grass, Wrongway Ck, Tongue Mtn, and Puget). Completing measurements on these orphaned sites was extremely problematic to get completed and/or very time consuming.

Last year's work included:

- All scheduled measurements for Type 1 installations are completed.
- Eight Type 2 installations had fieldwork.
- Five sites- Pioneer Mtn (2203, ANE), Sitkum (3203, CAM), Keller-Grass (3204-SNF), Shamu (3205, ODF) and Thompson Cat (5203, BLM) had their 22nd year measurement. All treatments at these sites are complete.
- Three sites, Weebe Packin (3208, ODF), Wrongway Creek (3210, OSU), and Tongue Mtn (5205, GPNF) had their 17th year measurement. Two of the three sites (3208 and 3210) had the 4th and final pruning lift completed. Treatments are now complete on all three of these sites.
- Two Type 3 installation had fieldwork.
- Puget (5301, GPNF) had its 17th year measurement.
- East Wilson (4302, BCMIN) had its 22nd year measurement.
- 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 plot maintenance required. 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.

So, in the big picture:

- All scheduled measurements for the four Type 1 sites are completed.
- Eleven 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.

Table 5. Hardwood Silviculture Cooperative Field Activities, Winter 2013/14

Type	Activity	Installation	Cooperator
Type 1	Completed		
Type 2	15-20ft HLC Thin	5205	GPNF- Tongue Mtn (Dropped)
	4th Pruning Lift	3208	ODF- Weebe Packin
		3210	OSU- Wrongway Ck.
	17yr Measurement	3208	ODF- Weebe Packin
		3210	OSU- Wrongway Ck.
		5205	GPNF- Tongue Mtn.
	22yr Measurement	2203	ANE- Pioneer Mtn
		3203	CAM- Sitkum
		3204	SNF- Keller-Grass
		3205	ODF- Shamu
		5203	BLM- Thompson Cat
Type 3	17yr Measurement	5301	GPNF- Puget

- 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 year's fieldwork (Winter 2014/15) will have an unusually slight amount of fieldwork. Only three installations need measurements. Luckily, there are no "orphaned" installations (without personnel support for completing the measurements) this upcoming year. See Table 6 for the list of activities.

Fieldwork includes:

- Blue Mtn (3206, WHC), Mohun Ck (4203, BCMIN) and Hemlock Ck (5204, WHC) need their 22nd year measurement.

Table 6. 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	

CURRENT HSC ACTIVITIES

Thinned Natural Red Alder Stand Volume and Stem Form

Project Rationale/Objectives

As the HSC Type 1 stands are at rotation age and the Type 2 stands are approaching rotation age, it important to determine if the taper equation built from younger stands and used in ORGANON will accurately predict diameters along the profile of the tree and, thus, stem volume.

The following three objectives were investigated:

1. How well does the taper/volume equation developed from plantation grown trees, predict diameter at multiple points along the tree stem?
2. Did thinning affect stem form/shape?
3. How well does the taper equation predict individual tree merchantable volume?

Previous Results

Last year, the HSC analyzed the taper data collected on the 33-year-old Type 1 installation (4102, Janicki). 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.
- Thinning did affect stem shape. Plot tree DBHs and CRs, were smallest for the unthinned treatment and increased with thinning intensity. Plot tree HLCs, and HTs, were the opposite; these values were greatest for the unthinned treatment and decreased with thinning intensity.
- Log form, as expressed by form quotients (Girard form class, Olney form class, and form factor) did not differ substantially across 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%.

Current Results

Site Characteristics

To determine how well the taper equation would predict DIBs (and volume) on another site, the HSC sampled Battle Saddle (2101, SNF), another Type 1 site. This site, located in the OR Coast Range, about ten miles Southeast of Tillamook, OR (T3S R9W Sec 12; N45^0 19.405 W123^0 44.538) regenerated naturally in 1975 following a harvest in 1973. Site index (base age 20 years) was estimated at 54ft based on height/age pairs using Harrington and Curtis' site index equation and 82ft based on soil/site characteristics using the red alder site evaluation method of Harrington. Elevation is 1680ft, slope is 60%, aspect is West, and the soil is a well-drained gravelly loam. Thinning was done in 1990 (age 14). At the time of thinning, stand density averaged 1220 trees/acre. Three treatment plots (unthinned, thin to 230tpa and thin to 525tpa) were established.

Methods, sampling procedure and measurements.

The methods, sampling procedure and plot and taper measurements were consistent with those followed for the previous site. Details can be found in the HSC 2013 Annual Report.

Specifically, approximately ten trees per treatment 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). The observed mean, minimum, and maximum DIBs for the measurement points are presented in Table 8.

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

Individual tree observed DIB vs. predicted DIB values, by treatment, for measurement points 0.5ft, 32.0ft and HLC are shown in Figures 2a through c, 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

Table 7--Tree and sample characteristics, by treatment.

Treatment	Thin to 230 tpa	Thin to 525tpa	Unthinned/Control
Density (tpa)	244	352	448
Sample size (#)			
Trees	14	13	7
Stem Diameters	88	79	42
Stem DIB (in)			
Minimum	3.6	3.3	2.9
Mean	10.5	10.0	9.3
Maximum	19.5	15.8	15.9
Tree DBH (in)			
Minimum	8.4	7.7	6.3
Mean	11.5	11.1	10.3
Maximum	14.1	13.8	12.9
Tree height (ft)			
Minimum	66.9	67.6	69.5
Mean	74.5	74.5	76.4
Maximum	85.0	81.4	81.7
Tree Height to Live Crown (ft)			
Minimum	39.7	37.4	52.5
Mean	47.6	44.9	56.8
Maximum	56.8	51.2	59.0

Table 8--Taper tree observed diameter inner bark (DIB) values by measurement point and treatment.

Treatment Density (tpa)	Thin to 230 tpa 244	Thin to 525tpa 352	Unthinned/Control 448
Sample size (#)	14.0	13.0	7.0
0.5ft (in)			
Minimum	10.2	9.4	7.2
Mean	14.4	13.5	13.3
Maximum	19.5	15.9	18.2
2.2ft (in)			
Minimum	9.0	8.1	6.6
Mean	12.5	11.7	10.9
Maximum	15.7	14.2	13.4
4.5ft (in)			
Minimum	8.4	7.7	6.3
Mean	11.6	11.1	10.3
Maximum	14.1	13.8	12.9
17.3ft (in)			
Minimum	6.8	6.5	5.5
Mean	10.1	9.8	9.2
Maximum	13.2	11.6	11.0
32.0ft (in)			
Minimum	5.7	5.0	4.6
Mean	8.4	8.0	7.8
Maximum	10.4	10.0	9.2
Height to live Crown (in)			
Minimum	3.6	3.3	2.9
Mean	6.1	6.4	4.5
Maximum	8.8	8.7	9.8

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 of the base of the trunk. No strong pattern of over- or under-prediction was evident. At heights of 2.2ft, 4.5ft, and 17.3ft, the predicted DIBs closely match the observed values (data not shown). This is mainly a function of the form taper equation itself. In Figure 2b (32.0ft), DIB predictions are closely disturbed along the 1:1 line, both above and below the line. 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 observed (measured) DIB and predicted (calculated from the taper equation) DIB was used to determine how well the taper equation fit these sample trees.

The mean and maximum bias, by measurement point and treatment is shown in Table 9. Mean bias was 0.5in or less (both positive and negative) for all but one of the measurement point/treatment combinations.

Maximum bias (either positive or negative) was greater at the tree base and at HLC than along the stem. Absolute bias has practical implications concerning the estimation of log scaling diameter. The maximum bias estimates for the 32.0ft measurement point (a common small end log position) was always positive (under-predicted) for all treatment and ranged from 0.4in to 1.1in.

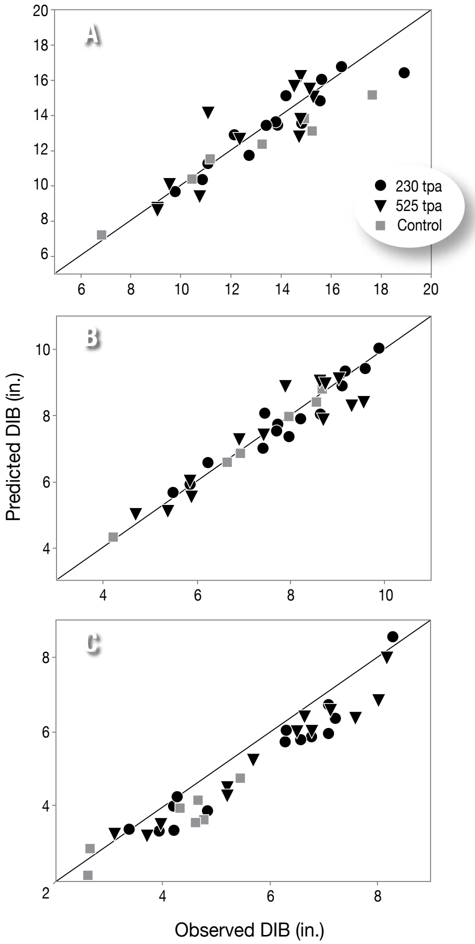


Figure 2. Observed vs. predicted diameter inner bark (DIB) for the (A) 0.5ft., (B) 32.0ft., and (C) height to live crown (HLC) measurement point, by treatment.

Table 9--Mean and maximum DIB bias by treatment and measurement point (MP).

MP	Thin to 230tpa			Thin to 525tpa			Unthinned/Control		
	Obs DIB (in)	Mean Bias (in)	Max Bias (in)	Obs DIB (in)	Mean Bias (in)	Max Bias (in)	Obs DIB (in)	Mean Bias (in)	Max Bias (in)
0.5ft	13.8	0.3	1.3	12.7	-0.2	-3.2	12.8	0.9	2.5
2.2ft	11.6	-0.3	0.6	11.2	-0.2	-0.9	10.4	-0.2	-0.6
4.5ft	11.1	-0.1	0.0	10.6	0.0	-0.2	9.8	-0.1	-0.2
17.3ft	9.6	-0.1	0.9	9.1	-0.2	-1.7	8.7	0.0	1.0
32ft	7.9	0.1	0.6	7.5	0.0	1.1	7.3	0.1	0.4
HLC[1]	5.7	0.5	1.1	6.0	0.5	1.2	4.1	0.5	1.1

[1] See Table 7 For mean values by treatment.

Relative bias ((observed DIB-predicted DIB) /observed DIB) is a way to assess the taper equation performance as a function of the DIB measurement. Although some individual measurement points displayed large bias (up to ~20%), mean relative bias was very small, around 2% or less. No general patterns regarding over- or under-predictions were observed except for the HLC measurement point where mean relative bias was 9% and almost always positive (under-predicted).

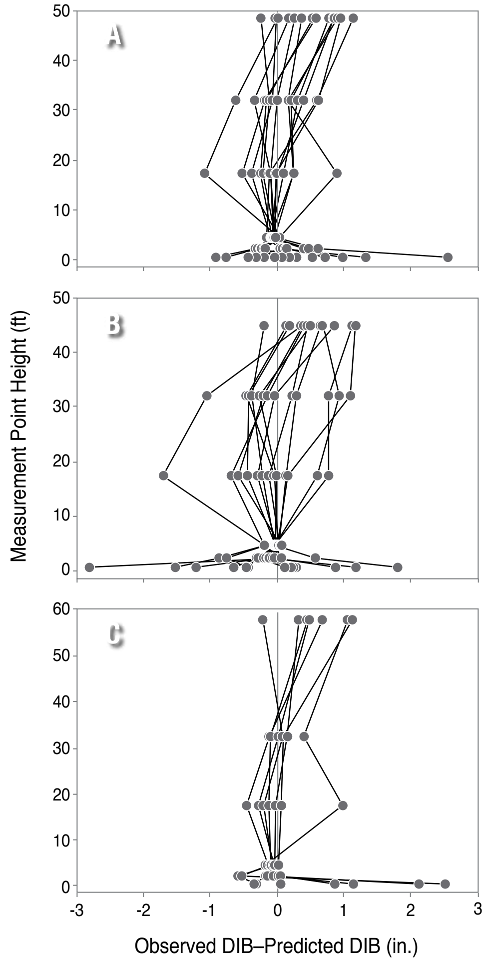
Graphical illustrations of measurement point bias by individual tree and treatment are presented in Figure 3.

These preliminary results indicate that the taper equation predicts DIBs along the stem very well and generally unbiased. Furthermore, the taper equation seemed to do equally well predicting DIBs for thinned treatments as well as unthinned treatments.

Objective 2: Did thinning affect stem form/shape?

Using the most recently collected plot data (19 years post-thinning, 33 years total age), thinning did seem to affect the shape of the stem. As seen in Table 10, the mean DBH was smallest for the unthinned treatment and increased with thinning intensity. For total HT and HLC, the 230tpa thin had significantly smaller values. Crown ratios were smallest for the unthinned treatment as compared to either thinning treatment.

Figure 3. Diameter inner bark (DIB) bias (observed DIB– predicted DIB) for the (A) thin to 230tpa treatment (n=14), (B) thin to 525tpa treatment (n=13), and (C) unthinned treatment (n=7).



Combining various diameter and height measurements is a useful way to express tree form and thus, log form. Three form quotients were used in this analysis:

1. Girard form class (GFC)- ratio of diameter inner bark (DIB) at 17.3ft to the diameter outer bark (DOB) at breast height (4.5ft)
2. Olney form class (OFC)- ratio of diameter inner bark (DIB) at 32.0ft to the diameter outer bark (DOB) at breast height (4.5ft)

Table 10--Tree characteristics (DBH, Total Height, Height to Live Crown, and Crown Ratio) by treatment.

Treatment	Thin to 100tpa	Thin to 230tpa	Unthinned
Density (tpa)	244	352	444
DBH (in)			
Minimum	3.7	5.2	4.7
Mean	9.6a	8.8b	7.9c
Maximum	13.8	13.3	12.9
Total Height (ft)			
Minimum	43.9	40.2	45.1
Mean	66.1a	56.0b	63.7a
Maximum	86.2	72.5	81.1
Height to Live Crown (ft)			
Minimum	34.4	29.0	35.6
Mean	47.7a	37.4b	50.4a
Maximum	68.9	52.1	61.0
Crown Ratio			
Minimum	0.08	0.10	0.05
Mean	0.27a	0.31a	0.18b
Maximum	0.52	0.59	0.37

3. Form factor (FF)- ratio of the volume of the tree to the volume of a cylinder having the same length and cross section (basal area at 4.5ft)

As seen in Table 11, the observed form quotients only differed slightly across treatments, indicating that thinning did not affect these measures of stem/log form.

Objective 3: How well does the taper equation predict log and tree volume?

The observed, predicted, and relative bias estimates of the abovementioned form quotients are also shown in Table 11. Observed and predicted GFC were very similar and did not differ across treatments (ranging from 0.83 to 0.84). Thus, relative bias was very small; ranging from -2.4% for the 525tpa Thin to 1.6% for the 230tpa Thin. Moving up the stem to

32ft, observed OFC was similar across treatment (ranging from 0.68 to 0.70) and predicted OFC values were less than 1.0% different than observed values. Form factor varied little across treatments (mean=0.40).

Because every sampled tree had DIB measurements at 0.5ft and 32.0ft, those values were used to test how well the taper equation predicted individual log volumes. To simplify matters, the volume of that 31.5ft length was calculated as a single log. As seen in Table 11, observed cubic foot volume was smallest for the unthinned trees and increased with thinning intensity (ranging from 14.2ft^3 to 17.5ft^3). Predicted volume values were all within 1.0% of observed volumes.

Table 11--Girard form class, Olney form clas, form factor, and volume (ft^3) by treatment.

MP	Thin to 230tpa			Thin to 525tpa			Unthinned/Control		
	Observed	Predicted	Bias (%)	Observed	Predicted	Bias (%)	Observed	Predicted	Bias (%)
Girard Form Class[1]	0.83	0.84	-1.6	0.82	0.84	-2.4	0.84	0.85	-0.4
Olney Form Class[2]	0.68	0.68	0.50	0.68	0.68	-0.2	0.70	0.70	0.7
Form Factor[3]	0.40	--	--	0.40	--	--	0.41	--	--
Volume[4]	17.5	17.3	0.6	16.1	16.1	-1.0	14.2	14.1	0.3

[1] DIB at 17.3ft/DOB at 4.5ft (DBH)
[2] DIB at 32.0ft/DOB at 4.5ft (DBH)
[3] Total stem volume (inside bark)/a cylinder with equal diameter and height
[4] One 31.5ft log above a 0.5ft stump height.

Conclusion

These results indicate that the taper equation developed from plantation-grown red alder did an outstanding job predicting DIBs from larger trees of natural origin. These results are in contrast to the previously reported results using the HSC Type 1 Site #4101. For that site, the taper equation consistently under predicted DIBs and log volume (ranging from 10% to 20%). For this site, relative bias was very small and well within the acceptable range for DIBs, form quotients, and log volume.

CIPS Red Alder Growth Simulator

The interface created by the Center for Intensive Planted-forest Silviculture (CIPS) at OSU for the ORGANON growth and yield model is an extremely useful tool for predicting the effects of management on red alder plantations.

Last years' HSC Annual Report detailed the functioning of the interface, which included:

- Installing the program
- Setting up for projections/runs
- Worksheet features
- Treatment Scenarios
- Tree, volume and economic output

However, this tool is still a work in progress. There have recently been a few new changes to the simulator:

- The 'Stand info' worksheet has been redesigned to make it even more intuitive and user-friendly.
- On the "Treatments" worksheet, one can now to a thinning based on relative density. Furthermore, relative density is now outputted on the "Projection" worksheet.
- In response to suggestions from reviewers, there is now a new worksheet titled "Comparison with Control" which will superimpose the managed run over the control (or "unmanaged" run) for volume yield and present net worth.
- On the "Economics" worksheet, present net worth (PNW) now incorporates a weighted average of log size proportions.

Both the CIPS Growth Simulator for Douglas-fir, and the CIPS Red Alder Growth Simulator and their associated instructions are available for download at www.fsl.orst.edu/cips/Tools.htm. Any questions/comments/problems encountered with the simulator, or any assistance with the installation or use of the simulator can be directed to Andrew Bluhm.

ACCOMPLISHMENTS OF 2014

In addition to performing the necessary HSC tasks, Andrew was invited to speak at one meeting this past year.

FOREST OWNER FIELD DAY

This conference, sponsored by Washington State University Extension was held in Forks, WA August 24, 2013. This educational event provided practical "how-to" information to a wide array of forest owners. For the third year running, Andrew taught the "Advanced hardwood Management" course.

DIRECTION FOR 2015

As always, the specific goals for 2015 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; primarily to update and test the CIPS Red Alder Growth Simulator and 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 Summer Management Committee Meeting Minutes- July 9-10, 2013

Tues July 9, 2013:

Attendees: Andrew Bluhm, David Hibbs- OSU; Florian Deisenhofer- Hancock Forest Management; Scott McLeod- WA DNR; Jeanette Griese- Bureau of Land Management; Wayne Patterson- Siuslaw National Forest.

- Please refer to the associated handouts for further information.

We started the meeting at 9:00 AM at the Hebo Ranger Station, Siuslaw National Forest, Hebo, OR with the morning session being indoors and after lunch, visiting a nearby HSC Type 1 installation.

The morning session started with a presentation by Andrew titled "HSC/DNR Red Alder Upper Stem Measurement Project". This analysis used upper stem diameter measurements to see if thinning affected taper. The measurements came from the HSC Type 1 installation #4102 (Janicki), just prior to harvest (fall of 2010). The stand was 33 years old and was thinned at age 14. The study objectives were varied and many. Presented were the results from the following six objectives:

How well did the taper/volume equation developed from plantation grown trees, predict diameter at multiple points along the tree stem?

- Taper equation predicted DIBs below the live crown well
- Taper equation consistently over predicted DIBs within the crown
- Taper equation seemed to do a slightly better job predicting DIBs and heights for the unthinned treatment as compared to the thinned treatments

Did thinning affect tree form?

- Using taper trees (n=26), mean observed DIBs across treatments were smallest for the unthinned treatment and increased with thinning intensity for all measurement points
    - Not statistically significant nor consistent
- Using plot trees (n=107), there were statistically significant and consistent effects of thinning:
    - DBHs and CRs, were smallest for the unthinned treatment and increased with thinning intensity.
    - HLCs, and HTs, were greatest for the unthinned treatment and decreased with thinning intensity.

Did thinning affect stem shape?

- Form quotients did not differ substantially across treatments, indicating that thinning did not affect these measures
    - Girard form class (GFC) & Olney form class (OFC) were very similar across treatments
    - GFC- very little bias (0 to 2%)
    - OFC- greater bias (11 to 15%)
    - Form factor- no difference

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

- Observed ft^3 volume:
  - Smallest for the unthinned trees and increased with thinning intensity
  - Predicted volumes were less than the observed volumes
  - Relative bias was less for the unthinned trees and increased with thinning intensity

How did the DNR cruise estimates of individual tree volume (ft^3) compare to the HSC taper estimates?

- DNR ITV estimates were consistently less than HSC estimates for both taper sample trees and plot sample trees.
- Better ITV estimates for Unthinned/control than for the thinned treatments:
  - 100tpa Thin=7%
  - 230tpa Thin=8%
  - Unthinned=1%
- But remember that the HSC Taper estimates were less than the observed values:
  - 100tpa Thin=20%
  - 230tpa Thin=16%
  - Unthinned=13%
- Overall there is a general pattern- there's more wood out there than either the HSC or DNR estimates (26 taper sample trees [32ft log], 107 plot trees [40ft log])

How did the DNR cruise estimates of merchantable volume (bdft/acre) compare to the HSC/ORGANON estimates? What were the financial implications?

- DNR volume estimates were less than HSC estimates for the thinned treatments but greater for the unthinned treatment:
  - HSC Volume: 230tpa>=Unthinned>>100tpa

    - DNR Volume: Unthinned>230tpa>100tpa
- Revenue estimates were likewise different:
    - HSC Revenue: 230tpa>Unthinned>100tpa
    - DNR Volume: Unthinned>230tpa>100tpa

The group then discussed whether or not it was important to keep collecting more taper data to update/correct the existing equation. And if so, what sites/trees to use.

Before more decisions are made, it was thought that Andrew should analyze the data that was going to be collected from Battle Saddle to see if the under predictions from the taper equation manifested themselves it this site. If not, more discussion will be needed. If so, it was identified that more 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 'Stand Info' worksheet which now includes all of the economic specifications as well as user input log prices. The latter is a much needed improvement over the previous versions which just used a 'camp run' price.
- A new 'Treatment' worksheet that allows the user to compare any run treatment scenario against a "control" or "untreated" treatment.
- A new 'Comparison with Control' worksheet that graphs out

the projected treatment versus the untrated stand for present net worth and MBF/acre.

- A tool to convert from a 50 year base age site index to a 20 year base age.

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 2012/13 was a somewhat light field season regarding work load. Measurements and various treatments were completed on 6 of the 37 installations. Last year's work included:

- One Type 1 installations had fieldwork.
- Sauk River (4103, MBSNF) had its 19th year post-thinning measurement. This was the last of the four Type 1 sites to have the 19th year post-thinning measurement. This was the last scheduled measurement for the Type 1 sites since two of the four sites, Janicki (4102, DNR) and Battle Saddle (2101, SNF), have or will have been logged before the next measurement, reducing the number of sites to two and thus compromising the integrity of the study design. Therefore, the 22nd year post-thinning measurement scheduled for this winter at Sechelt (4101, BCMin) was dropped.
- Four Type 2 installations had fieldwork.
- Two sites- Pollard Alder (2202, SNF) and LaPush (1201, DNR) had their 22nd year measurement. All treatments at Pollard Alder are complete. LaPush has its 4th and final pruning lift remaining.
- One site, Maxfield (1203, DNR) had its 17th year measurement. This site has only its 4th and final pruning lift remaining.
- One site, Cape Mtn. (2204, SNF) had its 3rd pruning lift completed.
- One Type 3 installation had fieldwork.
- Cedar Hebo (2302, SNF) had its 17th year measurement.
- In addition to the measurements and treatments completed above, there was substantial plot maintenance required including: replacing measurement plot corner markers, retagging trees that out-

grew the zipties, refreshing or establishing DBH paint lines, and rouging out invading conifers and/or hardwoods.

This coming year's fieldwork (Winter 2013/14) will have an unusually large amount of fieldwork. A total of 10 installations need either a measurement or a treatment. Fieldwork includes:

- Nine Type 2 installations need fieldwork.
- A whopping five installations- Pioneer Mtn (2203, ANE), Sitkum (3203, CAM), Keller-Grass (3204, SNF), Shamu (3205, ODF) and Thompson Cat (5203, BLM) need their 22nd year measurement.
- Three installations- Weebe Packin (3208, ODF), Wrongway Creek (3210, OSU), and Tongue Mtn (5205, GPNF) needs 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) needs its 4th pruning lift (to 22ft).
- One Type 3 installation needs fieldwork.
- Puget (5301, GPNF) needs its 17th year measurement

Of important note, there are four "orphaned" installations without personnel support for completing the measurements (Tongue Mtn, Wrongway Creek, Sitkum, and Puget). In addition, fieldwork on one of the sites formerly the responsibility of Forest Capital (Pioneer Mtn) , which is now Hancock Forest Management, needs to get completed. Completing measurements on these orphaned sites is extremely problematic to get completed and will require discussions and solutions among and from the HSC members.

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

Next, the topic turned to the HSC budget. Just like in the last few years, dues received in FY 2013 were about expected and consistent with dues from the past few years. This allowed the HSC enough income to fund Andrew for only 4 months at 0.8 FTE. For FY 2014, uncertainty exists in the level of funding, but dues and thus revenue seems to remain 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 1 installation "Battle Saddle" (2101). This was a 37 year old stand that was planted with Douglas-fir in 1975 but was overtaken by red alder. The stand was thinned in in 1990 (age 14). Site index was estimated to be 82ft (Harrington, 50 year base) or 52ft (Harrington and Curtis, base age 20 years).

The week before, Dave and Andrew felled and measured 7 trees in the control plot and felled 10 trees each in the thin to 230tpa and the thin to 525tpa treatments. With everyone's help, we measured all 20 trees but decided to come out the next day and fall and measure additional trees.

Wed July 10, 2013:

We returned to Battle Saddle and felled and measured 7 additional trees. By lunchtime we had made it over to the HSC Type 2 installation- Pollard Alder (#2202). This was planted in 1991 and just had its 22nd year measurement this past winter. At the time of planting, site index was estimated to be 78ft (base age 50 years, based on height/age pairs from the surrounding stand) and 108ft (base age 50 years, based on Harringtons soil/site method). Using recent height age pairs, it is estimated at 70ft (Weiskittel, base age 20 years). Discussion topics included the following (but please see the associated handouts for more information):

- Compared with the other 22 year old HSC Type 2 sites, Pollard alder is average or slightly below average in control plot DBH and HT.
- When compared to the corresponding control (unpruned) plot, pruning had no effect on DBH and HT. Projected out to 30 years old, no effect on MBF/acre or $/acre.
- When tree data from the prune plot just prior to the first pruning lift was grown in ORGANON out to 30 years, the actual/prune volume as greater than the projected/ unpruned volume.
- Using control plot data:
    - Mean plot QMDBH ranged from 6in to 9in, with the corre-

sponding decrease in DBH with increasing planting density.

  - Mean plot HT ranged from 46ft to 56ft, with no significant/substantial treatment differences.
  - Regarding relative density, the 1030tpa exceeded 0.45 (the operating maximum, or upper limit of the 'management zone') at age 8. The 575tpa plot entered the management zone (RD=0.25) at age 7 and exceeded the management zone by age 12. The 240tpa plot entered the management zone at age 12 and is just leaving the management zone at age 22.

- Comparing thinning responses for the 575tpa planting density treatments (control/unthinned, thin to 230tpa at age 5, thin to 230tpa at age 12, thin to 230tpa at age 17):
  - Thinning increased DBH from 7in to about 9in for all 3 thinning treatments.
  - Thinning increased HT from about 50ft to about 55ft-65ft.
  - The thin at age 5 was well below the lower limit of the management zone. The thin at age 8 occurred just as the plot was reaching the upper limit of the management zone and the thin at age 17 occurred well beyond the operating maximum and close to the average maximum (i.e. self-thinning line).

- When projected (ie. grown in ORGANON) to stand age 30years, using 20ft logs, to a 5in top, and current log prices for NW OR:
  - The 575tpa control plot had 12.7MBF/acre followed closely by the 1030tpa (11.4MBF/acre) and the 240tpa (10.1MBF/acre). The 110tpa plot only had 6.8MBF/acre.
  - The 575tpa control plot thus had the greatest gross revenue, at $6,052/acre followed closely by the 240tpa ($5,555/acre) and the 1030tpa ($5,204/acre). The 110tpa plot only yielded $4,024/acre.
  - For the 575tpa thinned plots, the control plot had slightly more volume than the thinned plots (7.5%, 16.6%, and 17.1%, respectively).
  - Regarding gross revenue, the first thinning (at age 5) yield-

ed $6,278/acre, slightly higher than the control plot ($6,052/acre). The thin at age 12 had ($5,822/acre) followed by the thin at age 17 ($5,578/acre).

In addition to the specific growth and yield results, Andrew also used data from this site to check ORGANON projections against the actual measured data from this site. These results are a continuation/addition to the results presented at the HSC Summer 2011 meeting. The results from the previous analysis suggested that RAP-ORGANON over predicted mortality and under predicted DBH growth, especially DBH growth following thinning; the end result being that RAP-ORGANON under estimated final yield. Please see the associated handouts for the complete results.

To check mortality results, I compared the actual HSC density (tpa) data (at plantation age 22 years old) to the RAP-ORGANON predictions when I "grew" 3 year old control plot data out to the same age.

The data indicates that RAP-ORGANON does indeed over predicted mortality, especially at high densities.

To check DBH growth/response, I used four thinning treatments:

- Plant to appx. 1030tpa, thin at age 5 to appx. 230tpa
- Plant to appx. 575tpa, thin at age 5 to appx. 230tpa
- Plant to appx. 1030tpa, thin at age 8 to appx. 230tpa
- Plant to appx. 575tpa, thin at age 12 to appx. 230tpa

Two comparisons were made:

- Observed vs. Predicted DBH response following thinning. To accomplish this, I compared the actual plot data collected at age 22 to RAP-ORGANONs predictions at age 22 by using the plot data at the time of the thinning (ages 5, 8, and 12, for the three treatments), removing the same individual trees that were actually cut (by using the "User thin" option in RAP-ORGANON, then "growing out" the trees to age 22. This DBH difference (if any) is what I refer to "Thinning DBH response".
- Observed vs. Predicted DBH growth/response if the plot was not thinned. Because I cannot "unthin" a plot, I grew out the 575tpa control plot data starting at the time of thinning (i.e. 'Observed')

and compared that to the RAP-ORGANON projection of by running the "unthinned" plot data. This DBH difference (if any) is what I refer to "Control DBH response".

The total 'Treatment Response' = (Predicted Thinning Response – Predicted Control Response) / (Observed Thinning Response - Observed Control Response).

Negative values indicate an under prediction by RAP-ORGANON while positive values indicate an over prediction by RAP-ORGANON.

RAP-ORGANON always under predicted the DBH of the thinned trees, and 3 of the 4 times over predicted the DBH of the control trees.

The total treatment response was always negative, with the two later thinning treatments having the observed treatment response more than double that of the predicted treatment response (values >100%).

The results presented here agree with the results already presented for three other HSC Type 2 sites (#4201, # 3202, and #3203); mainly that RAP-ORGANON over predicts mortality, slightly over predicts control (unthinned) tree DBH, and under predicts thinned tree DBH: the end result being an under prediction of stand-level volume. The magnitude of the difference is not entirely obvious and has yet to be quantified. The group agreed that further investigation/testing is desired.

As a reminder, there was general consensus that a winter work party was desirable considering the large number of orphaned sites. Potential dates and specific sites are still to be determined. Andrew will contact committee members to try to choose dates and locations. If you have any preference as to the dates, please contact the HSC.

APPENDIX 3

Financial Support Received in 2013-2014

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		------
Trillium Corporation		------
Washington Department of Natural Resources		$8,500
Washington Hardwood Commission		------
	Subtotal	$47,000
Forestry Research Laboratory		$19,800
	Total	$66,800