Contents

Hardwood Silviculture Cooperative

Highlights of 2018

- Two more 27 year measurements were collected on the Type 2 installations (variable-density red alder plantation), bringing the total to 5 of the 25 installations with 27 year data.

- One more 22 year measurement was collected on the Type 2 installations, bringing the total to 23 of the 25 installations with 22 year data.

- 23 of the 25 Type 2 installations have had all treatments completed.

- One more 22 year measurement was collected on the Type 3 installations (red alder/Douglas-fir species mixtures), bringing the total to 6 of the 7 installations with 22 year data.

- Additional field data on tree taper was collected:
    - 15 trees from the 22 year-old Maxfield (DNR) Type 2 installation.

- The HSC and the Center for Intensive Planted-forest Silviculture (CIPS) updated RAP-ORGANON with additional, older tree data.

- The HSC participated in numerous continuing education and outreach events including: a DNR red alder silviculture workshop (Olympic Region), Clackamas Co. Tree School, Lane Co. Tree School, the WA Farm Forestry Association (WFFA) Forest Owners Field Day, Center for Intensive Planted-forest Silviculture (CIPS) Annual Meeting, and the Washington Hardwood Commission (WHC) Annual Symposium.

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 (*Pseudotsuga 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.

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).

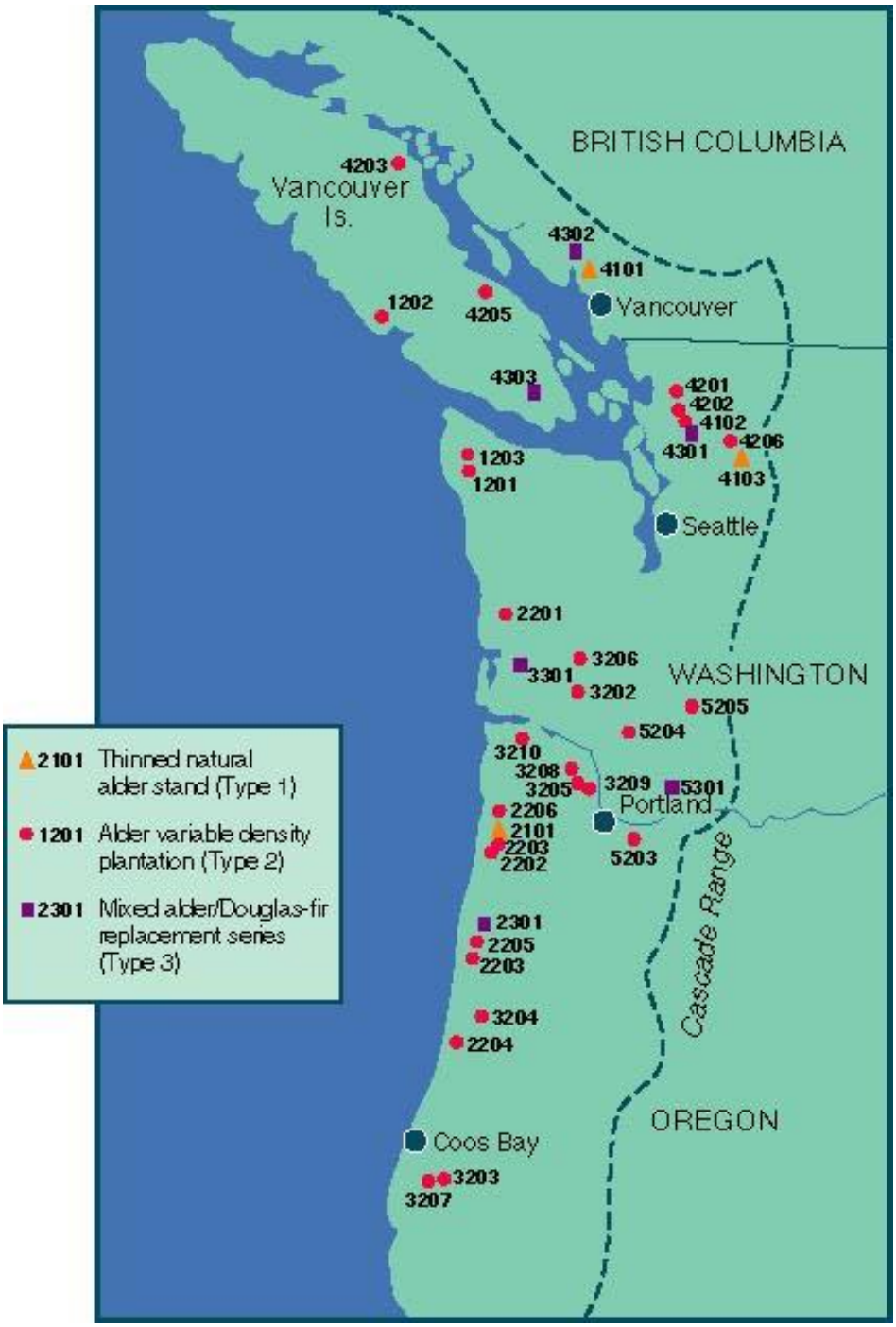

Figure 1. Location of installations for the Red Alder Stand Management Study.

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 approximately 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).

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

	Site Quality		
Region	Low SI50 :23-27 M SI20 :14-17 M	Medium SI50 :28-32 M SI20 :18-20 M	High 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

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.

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	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	2022	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
32nd yr Measure	2020	2021	2021	2021	2022	2022	2023	2023	2023	2023	2023	2024	2024

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	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	2002/17	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	2017	2010	NA	NA	2011	2009	2011	2010	2011	2010	NA
Prune Lift 4 22 ft	NA	NA	2017	2020	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
32nd yr Measure	2024	2025	2025	2025	2025	2025	2026	2026	2026	2027	2028	2028	2028

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

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
27th yr Measurement	2018	2020	2020	2020	2021	2022	2023
32nd yr Measurement	2023	2025	2025	2025	2026	2027	2028

The Winter 2017/18 measurements consisted of six installations requiring field work (Table 5). One site had the 22nd year measurement (Maxfield) and two sites had their 27th year measurement (LaPush, Pollard Alder). One Type 3 installation had its 22nd year measurement (Cedar Hebo). In addition to measurements, the Type 2 sites, Maxfield and Cape Mtn. LaPush had the fourth pruning lift and the 30ft HLC thin and fourth pruning lift, respectively. There were no orphaned sites requiring fieldwork so scheduling and completing these measurements went smoothly. Taper measurements on 15 trees were collected at the Maxfield site.

Table 5. Hardwood Silviculture Cooperative Field Activities, Fall 2017-Spring 2018

Type	Activity	Installation	Cooperator
Type 1	Completed		
Type 2	4th Pruning Lift	2204	SNF- Cape Mtn
		1203	DNR- Maxfield
	15-20ft HLC Thin	3207	BLM- Dora
	30ft HLC Thin	2204	SNF- Cape Mtn
	22yr Measure	1203	DNR- Maxfield
	27yr Measure	1201	DNR- LaPush
		2202	SNF- Pollard Alder
Type 3	22yr Measure	2302	SNF- Cedar Hebo

So, in the big picture:

- Twenty three of the twenty five Type 2 installations have had their 22nd year measurement.
- There are five Type 2 sites now having their 27th year measurement completed.
- Twenty three of the twenty five Type 2 installations have all treatments completed.
- Six of the seven Type 3 installations have had their 22nd year measurement.

This coming field season (Winter 2018/19) will be a busy year (Table 6). Five Type 2 installations (Pioneer Mtn., Sitkum, Keller-Grass, Shamu, and Thompson Cat) will have their 27th year measurement. Three Type 2 installations (Weebe Packin, Wrongway Ck., and Tongue Mtn.) will need their 22nd year measurement. Finally, one Type 3 installation (East Wilson) will have its 27th year measurement. There are no thinning or pruning treatments required. Unfortunately, three of the ten installations are "orphaned" making it difficult to get the measurements completed.

Table 6. Hardwood Silviculture Cooperative Field Activities, Fall 2018-Spring 2019

Type	Activity	Installation	Cooperator
Type 1	Completed		
Type 2	22yr Measure	3208	ODF- Weebe Packin
		3210	OSU- Wrongway Ck.
		5205	GPNF- Tongue Mtn.
	27yr Measure	2203	ANE- Pioneer Mtn.
		3203	MEN- Sitkum
		3204	SNF- Keller-Grass
		3205	ODF- Shamu
		5203	BLM- Thompson Cat
Type 3	22yr Measure	5301	GPNF- Puget
	27yr Measure	4302	BCMIN- East Wilson

Current HSC Activities

Red Alder Taper Data Collection

Accurate stem taper equations are essential for characterizing stem form, tree volume, log sizes, and stand-level yields. As reported previously, the HSC-built taper equation for managed stands of red alder fit the data nicely. However, due to the young age of the plantations, the sampled trees were of pre-merchantable size (Table 7). Consequently, it is important to determine if this taper equation would accurately predict diameter inside bark (dib) and stem volume of larger, merchantable trees. With this in mind, the HSC has been collecting additional taper data. In the 2017-18 field season, the HSC collected data from fifteen trees from the 22 year-old Type 2 installation #1203, Maxfield. Cumulatively, the HSC has a very robust taper dataset spanning a wide range of sites and tree sizes (Table 8). This data will be used for periodic testing and updating of taper equations.

Table 7- Red alder taper equation (Bluhm et al. 2007) source data.

DBH	Height (ft)																	
(in)	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	Total
1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0
2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0
3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0
4	--	--	1	5	4	2	3	3	1	--	--	--	--	--	--	--	--	19
5	--	--	3	5	14	11	11	10	3	3	--	--	--	--	--	--	--	60
6	--	--	1	1	5	7	9	10	4	1	--	--	--	--	--	--	--	38
7	--	--	--	1	4	11	10	7	7	3	3	--	--	--	--	--	--	46
8	--	--	--	--	--	9	11	5	9	2	3	--	--	--	--	--	--	39
9	--	--	--	--	--	2	2	--	10	2	2	--	1	--	--	--	--	19
10	--	--	--	--	--	--	1	3	2	3	1	--	--	--	--	--	--	10
11	--	--	--	--	--	--	--	--	2	1	--	--	--	--	--	--	--	3
12	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0
13	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0
14	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0
15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0
16	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0
Total	0	0	5	12	27	42	47	38	38	15	9	0	1	0	0	0	0	234

Table 8- Red alder taper data, as of 2018.

DBH	Height (ft)																							
(in)	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120	125	Total
1	3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3
2	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1
3	--	1	2	1	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	5
4	--	--	--	2	5	4	2	3	3	1	--	--	--	--	--	--	--	--	--	--	--	--	--	20
5	--	--	--	3	5	16	12	12	11	4	5	1	--	--	--	--	--	--	--	--	--	--	--	69
6	--	--	--	3	1	6	8	9	11	4	3	2	2	--	--	--	--	--	--	--	--	--	--	49
7	--	--	--	1	2	5	11	10	7	8	4	5	1	1	--	--	--	--	--	--	--	--	--	55
8	--	--	--	--	1	--	9	12	7	10	4	13	2	--	--	--	--	--	--	--	--	--	--	58
9	--	--	--	--	--	1	2	2	1	13	15	8	2	4	--	--	--	--	--	--	--	--	--	48
10	--	--	--	--	--	--	--	1	3	5	8	7	6	2	3	--	--	--	--	--	--	--	--	35
11	--	--	--	--	--	--	--	--	--	2	12	6	10	4	3	1	1	--	--	--	--	--	--	39
12	--	--	--	--	--	--	--	--	--	1	1	6	5	5	1	2	--	--	--	--	--	--	--	21
13	--	--	--	--	--	--	--	--	--	--	--	2	7	6	2	1	--	--	--	--	--	--	--	18
14	--	--	--	--	--	--	--	--	--	--	1	4	4	1	3	--	--	--	--	--	--	--	--	13
15	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	2	--	--	--	--	--	1	1	5
16	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	1
17	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0
18	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	1
Total	3	1	3	10	15	32	44	49	43	48	53	54	39	25	12	6	1	0	0	0	0	1	2	441

Red Alder Species Mixture Soil Properties

Introduction

Red alder has long been known to affect soil properties in the Pacific Northwest. Numerous experiments have been established to determine the effect of red alder in mixed species stands (see references in Bormann *et al*. [1994] and Peterson *et al*. [1996]). In general, on nitrogen poor sites, adding a component of red alder to a conifer stand may result in greater whole stand productivity than in pure conifer sites. However, on nitrogen rich sites stand growth and conifer yield would be lower with the addition of red alder. Therefore, managing red alder in mixed species stands requires striking a balance between the facilitative, nutritional benefits and the competitive effects of red alder.

Ongoing trials to study the effects of red alder on stand dynamics and nitrogen availability are have been undertaken by the Hardwood Silviculture Cooperative (HSC) and the B.C. Ministry of Forests. The latter initiated long-term studies in the early 1990's to improve the understanding of both the competitive and facilitative effects of red alder when grown with conifers. These studies were established to document and demonstrate the effects of different amounts and spatial arrangements of red alder on tree growth and survival, stand dynamics, crown characteristics, and long-term site productivity. These studies had two components: 1) replacement series field experiments and 2) additive field experiments. See Thomas *et al*. (2005) for a description of the replacement series and additive study treatments.

Soils data have been collected for these research sites described in Table 9 but results have not been reported. Therefore, after receiving these soils data from George Harper with the B.C. Ministry of Forests, the HSC analyzed the following soil properties for the sites described in Table 11: total Carbon, Carbon/Nitrogen ratio, mineralizable nitrogen, and available Phosphorous. Based on the results found in the literature, expected patterns in these soil properties are:

1) Total Carbon increases with increasing red alder proportion or density
2) C:N decreases with increasing red alder proportion or density
3) Mineralizable Nitrogen increases with increasing red alder proportion or density
4) Available Phosphorous decreases with increasing red alder proportion or density.

The results of HSC's analysis was placed in this context.

Measurements

At each site, two nutrient pools-forest floor samples and soil samples- were taken at site establishment and again five years after establishment. Soil samples were collected from three depths (0-10cm, 10-20cm, and 20-40cm) from each seven or ten sample points per plot. Forest floor samples and soil samples were analyzed individually. Then, for simplicity sake, this report averages all forest floor and soil samples for each site/treatment combination. Percent relative change is used to help account for variation in beginning values for the various soil properties across the site/treatment matrix. Percent relative change is defined as: ((Final Soil Property Value-Initial Soil Property Value)/ Initial Soil Property Value)*100.

Table 9. Study site characteristics of the replacement and additive series experiments reported in Thomas, *et al*. (2005) and used in this study.

Installation	Study	Location	Subzone[1]	Slope (%) and position	Aspect	Elev (m)	Year Established	Soil Samples
Waterloo Creek	Additive	49º27'15"N, 124º51'00" W	CWHxm1	0-30%, middle	90	340	1992	Mineral Soil at 0 - 40cm depth & forest floor in years 1992 and 1997
Gough Creek	Additive	49º27'45"N, 123º37'45" W	CWHdm	10%, middle	270	425	1992	Mineral Soil at 0 - 40cm depth & forest floor in years 1992 and 1997
East Wilson Creek	Replace ment Series	49º27'30"N, 123º40'00" W	CWHdm	middle	180	280	1992	Mineral Soil at 0 - 40cm depth & forest floor in years 1993 and 1997
Holt Creek	Additive	48º45'20"N, 123º51'45" W	CWHxm	10%, elevated, gravelly, loamy sand textured terrace	20	**225**	1994	Mineral Soil at 0 - 40cm depth & forest floor in years 1995 and 1998
Holt Creek	Replace ment Series	48º45'20"N, 123º51'45" W	CWHxm	10%, elevated, gravelly, loamy sand textured terrace	20	**225**	1994	Mineral Soil at 0 - 40cm depth & forest floor in years 1995 and 1998

[1] CWHxm1=Coastal Western Hemlock Eastern Very Dry Maritime, CWHdm=Coastal Western Hemlock Dry Maritime zone, CWHxm=Costal Western Hemlock Very Dry Maritime. Zones are based on the Biogeoclimatic Ecosystem Classification.

Results

The changes in soil properties due to red alder appear dependent on site specific factors; mainly site productivity, but also on soil age, moisture, parent material, etc. The findings from this analysis are no different. For all four soil properties, site differences far outweighed, and possibly occluded treatment differences for both the replacement series and additive studies. The lack of replication within a site prevented the detection of statistical differences by treatment. Additional soil, geographic, and climatic factors may have assisted detecting overall trends based on the proportion or density of red alder. Furthermore, these soils data were collected only five years post-stand establishment- possibly too short of time to detect changes in soil properties. Fortunately, soils (and foliar) data have been collected on these sites more recently by Phil Comeau, University of Alberta, have been analyzed, and are in the process of being published.

Bormann *et al*. (1994) succinctly expressed the problems and difficulties of identifying the controlling ecosystem processes or mechanisms to explain how alder can bring about changes in soil properties. They state “predicting effects of alder on long-term ecosystem

productivity for a specific site is difficult because the generality of mechanisms has not been evaluated." Despite its difficulties, interest in examining red alder species mixtures remains high across the region, hopefully providing more information on operational management of red alder species mixtures in the region.

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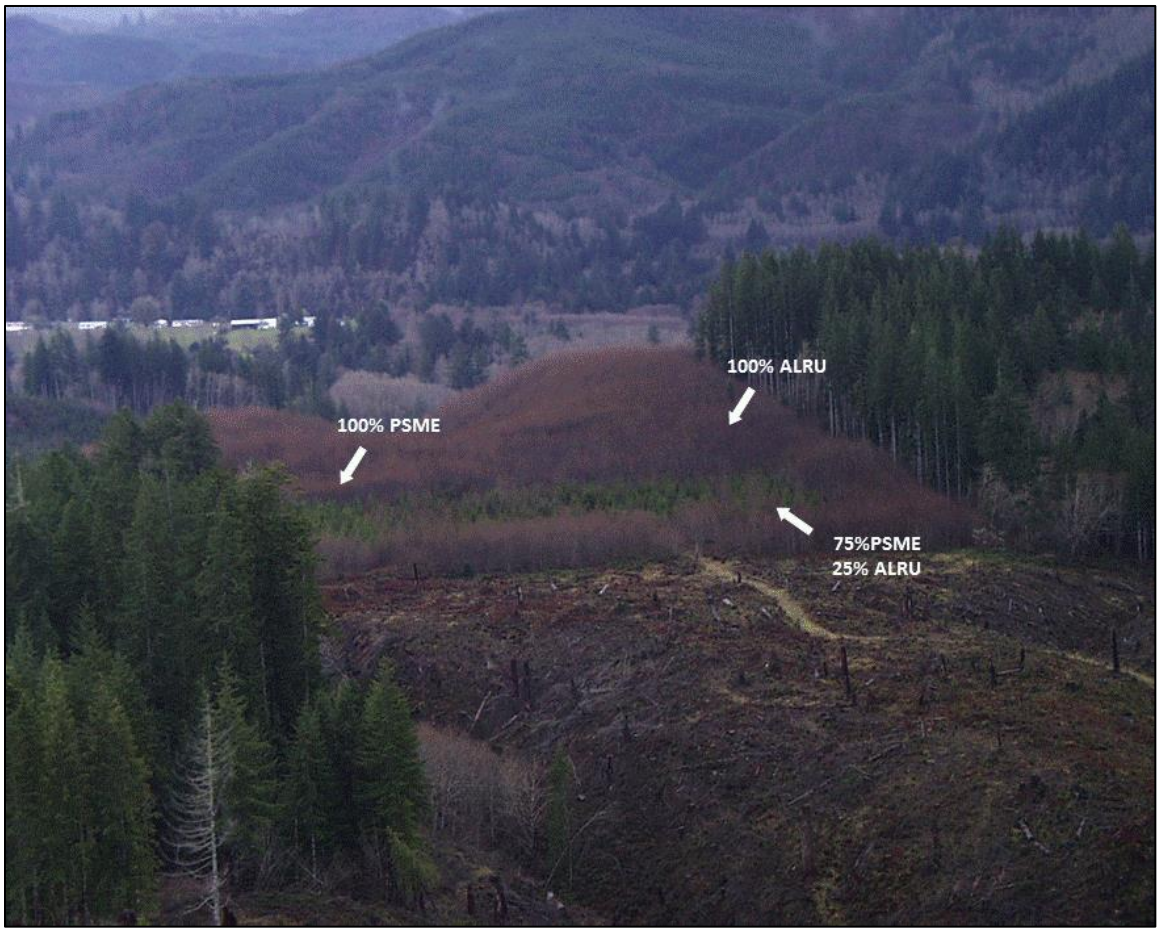

Research Results

Updates to the ORGANON Red Alder Plantation (RAP) Equations

Doug Mainwaring, David Hann, Andrew Bluhm, Doug Maguire, David Hibbs, and Glenn Ahrens

Introduction

When the red alder plantation version of ORGANON (RAP v1) was first produced in 2011, the oldest red alder plantations were 18 years total age. This initial version of the model was envisioned to provide suitably accurate extrapolations of trees and stands simulated out to 30 years, especially given the early peak of alder diameter and height growth. Because other alder growth models available at that time were based on measurements made in natural stands, use of planted tree data was considered a major improvement. Since that time, the Hardwood Silviculture Cooperative (HSC) has collected a significant amount of additional data, including thousands of observations of trees from thinned and unthinned plots with total age of 23 years and many additional observations from stands that have reached 28 years total age.

Comparison of model projections (using ORGANON-RAP v1) to measured plot data from the HSC network of plots revealed some inconsistencies, most notably significant underestimates of diameter in thinned stands, and overestimates of mortality in unthinned stands. Using the new data available since release of ORGANON-RAP v1, CIPS agreed to help refit the original equations using the existing model forms, or, if necessary with some simple alteration to existing equations.

This report provides a short description of the modeling dataset, provides results from refitting the equations, and compares goodness of fit between the new equations, the original equations, and the measured plot data.

Equations

Dataset

The dataset for this work came from 23 Weyerhaeuser installations containing 239 separate plots and nearly 143,000 measurements, and 25 HSC installation, containing 227 separate plots and nearly 223,000 separate measurements (Table 10). This dataset includes 70,000+ more measurements than the dataset used for the original RAP ORGANON fit. Most importantly, the new dataset completed measurements of all 18-year-old stands, 80% of 23-year-old stands, and approximately 10% of 28-year-old stands.

Table 10. Dataset analyzed for development of the original (v1) RAP ORGANON and the updated equations.

RAP-ORGANON Modeling Dataset		
Summary	RAP v1	RAP v1.1
Total number of locations	48	48
Total number of plots	466	466
Number of plots by stand age:		
2	10	10
3	408	408
4	21	21
5	56	56
6	343	343
7	53	53
8	18	18
9	209	209
10	84	84
11	111	111
12	229	229
13	86	86
14	100	100
15	38	81
16	10	20
17	86	227
19		2
20		2
22		174
27		26
Total number of measurements	295,118	365,526

Height growth

Height growth was modeled as a function of potential height growth as represented by the top height or site tree component of the stand. For this purpose, the Weiskittel *et al*. (2009) site index equation was used to derive growth effective age based on the current estimate of site index (SI20; height at 20 years), current height of the tree (GEA1), and expected annual top height growth for that growth effective age was then computed as the potential height growth implied by the initial height (H1) and the expected future height (H2) assuming the tree was a member of the top height component:

[1a] $PHG = H2 - H1$

[1b] $H2 = (\mathrm{SI20}/(\exp(-4.481266 * (20^{-0.658884} - (\mathrm{GEA1} + 1)^{-0.658884}))))$

[1c] $H1 = (\mathrm{SI20}/(\exp(-4.481266 * (20^{-0.658884} - (\mathrm{GEA1})^{-0.658884}))))$
[1d] $GEA1 = (-((\ln(\mathrm{SI20}/\mathrm{HT})/(-4.481266)) - 20^{-0.658884}))^{-1.5177178}$

Height increment for each tree was then estimated by modifying the dominant height growth by accounting for relative dominance using the following equation:

[2] $Htgr = (PHG \cdot a_0 \cdot (exp(a_1 + a_2 \cdot CCH) + (\exp(a_3 \cdot CCH^{0.5}) - \exp(a_1 + a_2 \cdot CCH)) \cdot exp(-(1 - CR)^2)))$

where Htgr was predicted annual height increment (ft), CCH was crown closure at the height of the subject tree (expressed as a percentage), CR was crown ratio (expressed as a proportion), and a_0- a_3 were parameters estimated from the data (Table 11).

DBH growth

DBH growth was modeled with a function that potentially peaked over initial DBH. Similarly, variables representing the effects of stand density, relative social position, and site quality were included as predictors, specifically stand-level basal area, basal area in larger trees, crown ratio, and 20-yr site index (Weiskittel *et al*. 2009). The following model was identified as the best predictor of diameter growth:

[3] $DG = exp(b_0 + b_1 \cdot ln(DBH + 1) + b_2 \cdot DBH + b_3 \cdot \ln\left(\frac{CR+0.2}{1.2}\right) + b_4 \cdot ln(SI_{20} - 4.5) + b_5 \cdot \left(\frac{BAL}{log(DBH+1)}\right) + exp(b_6 \cdot BA^{0.5}))$

where DG was predicted annual diameter growth (inches), DBH was initial diameter at breast height (inches), SI_{20} was the plot-level site index (ft at 20 yrs; Weiskittel *et al*. 2009), BAL was basal area in larger trees (ft^2/ac), BA was stand level basal area (ft^2/ac), b_0-b_6 were parameters estimated from the data (Table 11), and all other variables were defined above.

Mortality

Parameters for an equation to predict the probability of mortality were annualized with a compound interest formula that was implemented iteratively (Flewelling and Monserud 2002). Predictor variables were set equal to their value at the beginning of the measurement period for each iteration. The iterative estimation process was run in SAS PROC NLIN and was allowed to continue until further changes in the parameter estimates resulted in no significant improvement in minimization of the negative log likelihood. The fitted model took the following form:

[4] PM=exp(Y)/(1+exp(Y))

[5] $Y = (d_0 + d_1 \cdot \mathrm{DBH} + d_2 \cdot \mathrm{CR} + d_3 \cdot \mathrm{BAL} + d_4 \cdot SI_{20})$

where PM was predicted annual probability of mortality, d_0-d_4 were parameters estimated from the data (Table 11), and all other variables were defined above.

Alternative models were assessed by comparing actual mortality rates to predicted rates in systematic subclasses of each of the independent variables. Final model selection was based both on the minimization of difference between actual and predicted mortality, as well as the interactive behavior of the mortality equation with the diameter growth and height growth equations as a prediction system.

Height to crown base

A static equation was constructed to update height to crown base over successive growth periods. The model was fitted using data from only those trees measured for both total height and height to crown base. Separate equations were fitted for undamaged trees and the set of all undamaged and damaged trees. The final model for undamaged trees was as follows:

[6] $HCB = (HT - 2) / (X + 2)$

With

[7] $X = (1 + exp(e_0 + e_1 \cdot HT + e_2 \cdot CCFL + e_3 \cdot ln(BA + 0.00001) + e_4 \cdot (DBH / HT) + e_5 \cdot ln(SI_{20} - 4.5)))$

where HCB was predicted height to live crown base (ft), CCFL was crown competition factor in trees larger than the subject tree, e_0-e_5 were parameters estimated from the data (Table 11), and all other variables were defined above.

Diameter growth thinning modifier

Modifying equations are used within ORGANON to adjust individual tree growth in thinned stands to account for the differences in growth between what the standard equations would predict for their changed status and what the measurements indicate. Following the procedures outlined for the production of such equations for the SMC variant of ORGANON (Hann *et al*. 2003), multipliers were developed to estimate the effects of thinning on both diameter and height growth.

The direct effect of thinning on red alder diameter growth was modeled as a function of thinning intensity, years since thinning, and canopy position of the residual tree in the stand:

[8] DBH_{mod}=1+ $(f_1 \cdot PREM) \cdot \exp(f_2 \cdot YST^2 + \exp(f_3/(\mathrm{BAL}+0.01)))$

where DBH_{mod} is the predicted multiplier, *PREM* is the proportion of basal area removed ($0<PREM<1$), *YST* is years since thinning, parameters f_1-f_3 were estimated from data and all other variables were defined previously (Table 11).

Height growth thinning modifier

The direct effect of thinning on height growth was modeled as a function of thinning intensity and time since thinning:

[9] Ht_{mod}=1+ $(g_1 \cdot PREM^{g_2}) \cdot \exp(g_3 \cdot YST))$

where Ht_{mod} is the predicted multiplier, $g_1 - g_3$ were parameters estimated from the data, and all other variables are defined previously (Table 11).

Table 11. Parameter estimates for equations predicting red alder height growth, diameter growth, probability of mortality, height to crown base, and dbh and height thinning modifiers.

Response	Parameter	Estimate	SE
Ht growth MSE=15.1736	a_0	1.095805	0.00744
	a_1	-0.28657	0.1024
	a_2	-0.25017	0.0483
	a_3	-0.06925	0.00186
DBH growth MSE=10.8847	b_0	-4.90337	0.0318
	b_1	0.34662	0.0141
	b_2	-0.0959	0.00304
	b_3	0.736765	0.0110
	b_4	1.197856	0.00764
	b_5	-0.0216	0.000208
	b_6	-0.07894	0.00164
Mortality MSE=0.0426	d_0	-2.2837	0.0652
	d_1	-0.9666	0.00903
	d_2	-4.5170	0.0870
	d_3	0.0128	0.000472
	d_4	0.0465	0.000858
Height to crown base MSE=14.4448	e_0	5.4749	0.0307
	e_1	-0.00994	0.000210
	e_2	-0.00102	0.000019
	e_3	-1.5594	0.00752
	e_4	7.5235	0.0853
	e_5	0.0222	0.000242
Dbh thinning modifier MSE=2.9931	f_1	0.5172	0.0504
	f_2	-0.00891	0.00158
	f_3	-20.9030	7.5946
Height thinning modifier MSE=1.4849	g_1	-0.6658	0.1052
	g_2	1.9056	0.3614
	g_3	-0.6717	0.1592

Results and Discussion

The equation forms were similar to those fitted for the original RAP version (RAP v1) of ORGANON, though the height increment equation used a reduced form of the original equation. The greatest result of this second round of equation refinement was the change in the diameter growth thinning modifier equation. The original effort found no significant additional effect of thinning on diameter growth, though comparisons of thinned plots to model simulations found significant underestimation of diameter growth. With additional time since thinning and many more measurements, a diameter growth thinning modifier could be justified and verified that thinning did result in a positive boost to diameter growth above that predicted by density reduction in the equation for untreated stands (Fig. 2). The height growth modifier predicted a slightly lower negative impact of thinning on height growth relative to the original equation in RAP v1 (Fig. 2).

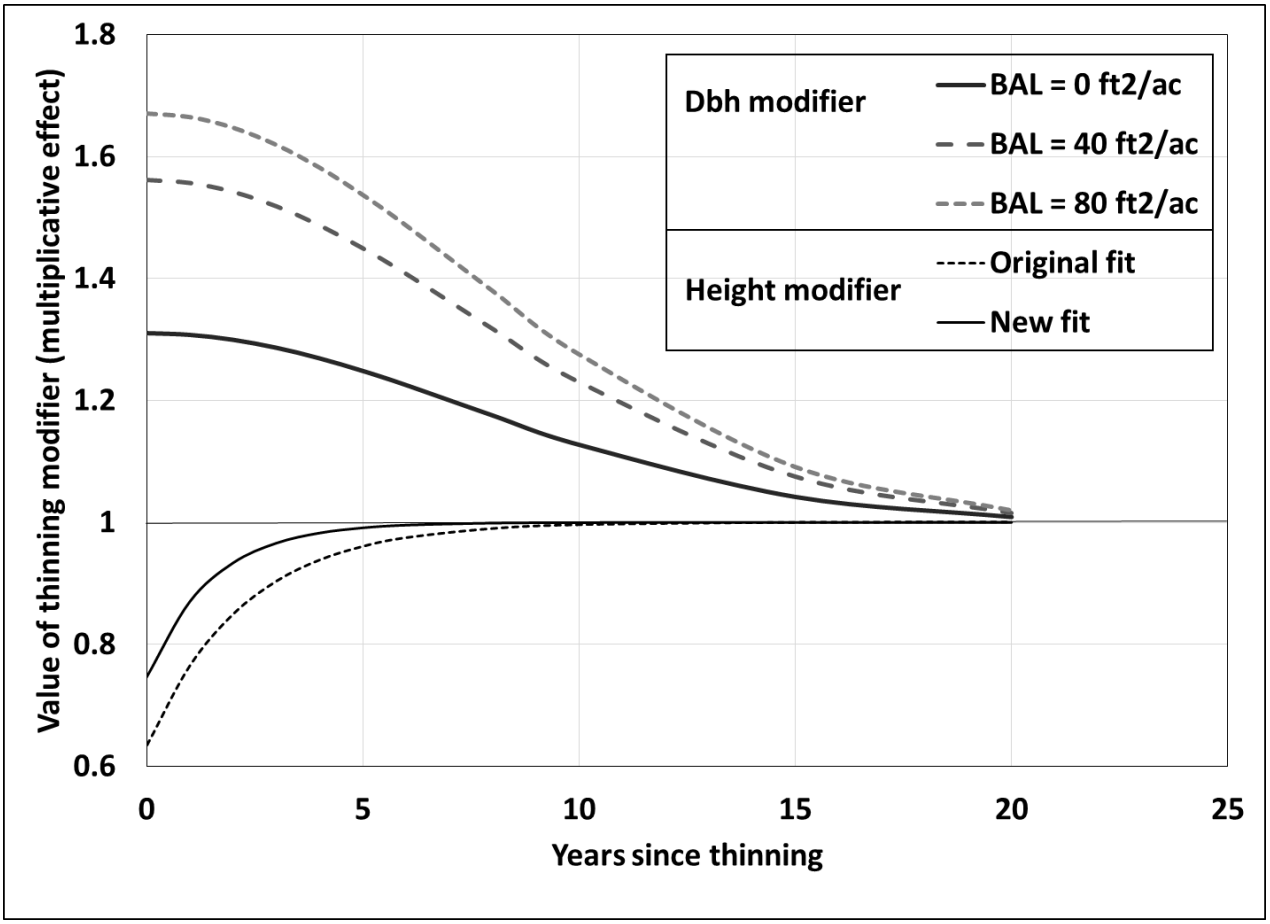

Figure 2. Modifiers for direct thinning effects on DBH and Height growth of red alder in RAP v1 and v1.1, under thinning intensity that removes 60% of the basal area (PREM=0.60).

The original equations and the updated equations were used to project initial three-year-old trees from 21 sites that had been measured at (total) age 23 to test performance of the growth projection system over this 19 year period. At each site, the following treatments were used:

- Control plots:
  - 230tpa, 525tpa, 1200tpa
- Thinned plots:
  - Thin 525tpa at age 6 to ~230tpa
  - Thin 1200tpa at age 6 to ~230tpa
  - Thin 525tpa at age 9 to ~230tpa
  - Thin 1200tpa at age 9 to ~230tpa
  - Thin 1200tpa at age 9 to ~100tpa

The following stand variables were compared:

- TPA
- QMDBH
- H40
- CFV

The following suite of graphs all show the relationship of “% Bias” " [(predicted-observed)/observed] and one of the five stand variables by model version and treatment. Control treatments are illustrated in Figures 3 through 6 and the Thin at age 9 treatments are illustrated in Figures 7 through 10 (Thin at age 6 graphs are not presented). Each point on the graph is an individual treatment (plot) value. Points are above the “zero line” indicate that the model is overpredicting the variable and points under the line indicate the model was underpredicting the variable.

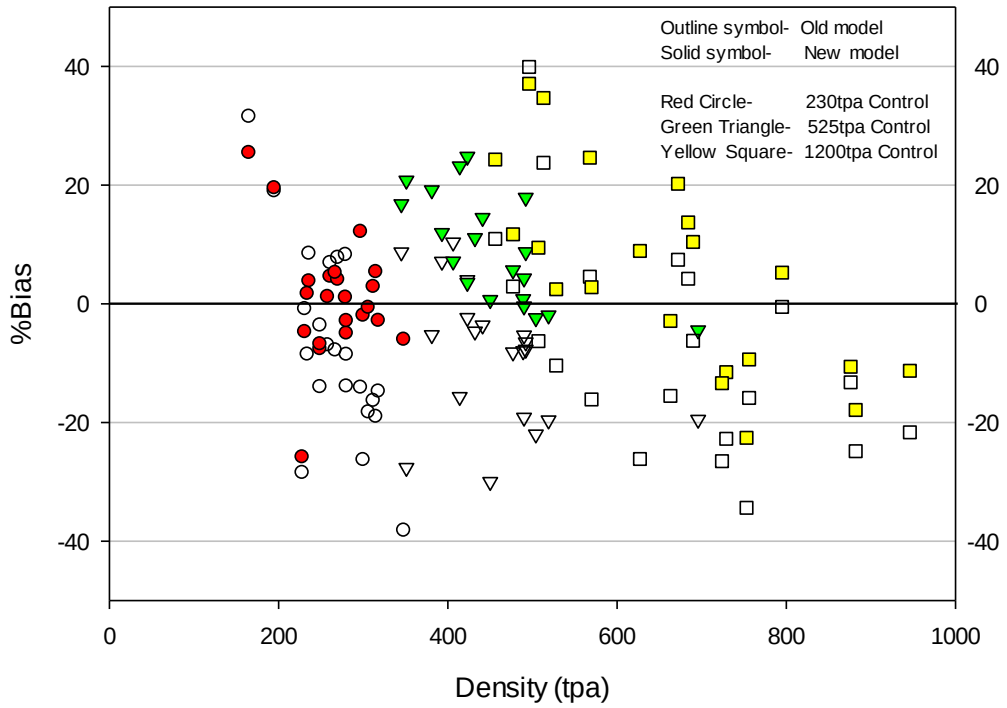

Figure 3. Control plot density (tpa) bias (%) by planting density and model version.

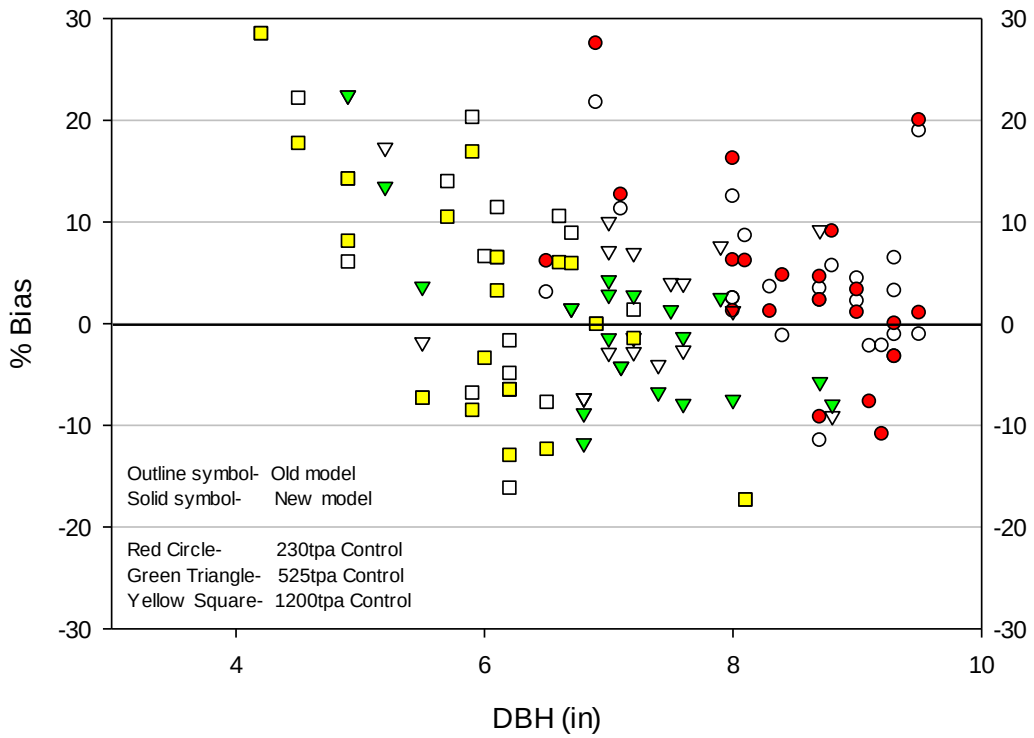

Figure 4. Control plot DBH (in) bias (%) by planting density and model version.

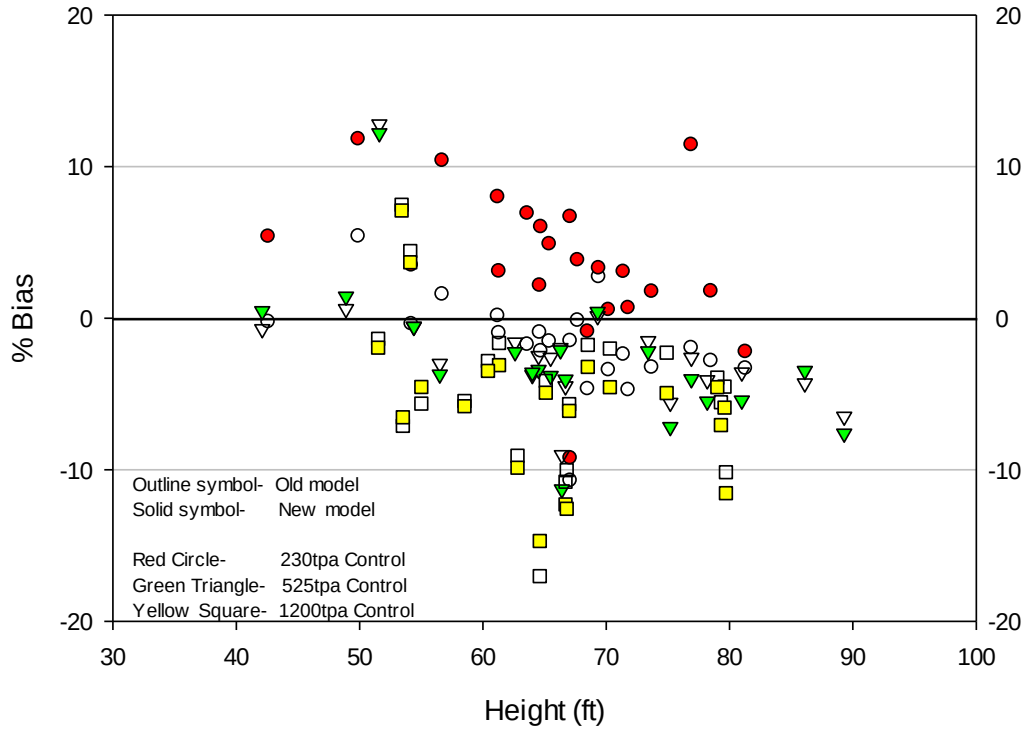

Figure 5. Control plot H40 (ft) bias (%) by planting density and model version.

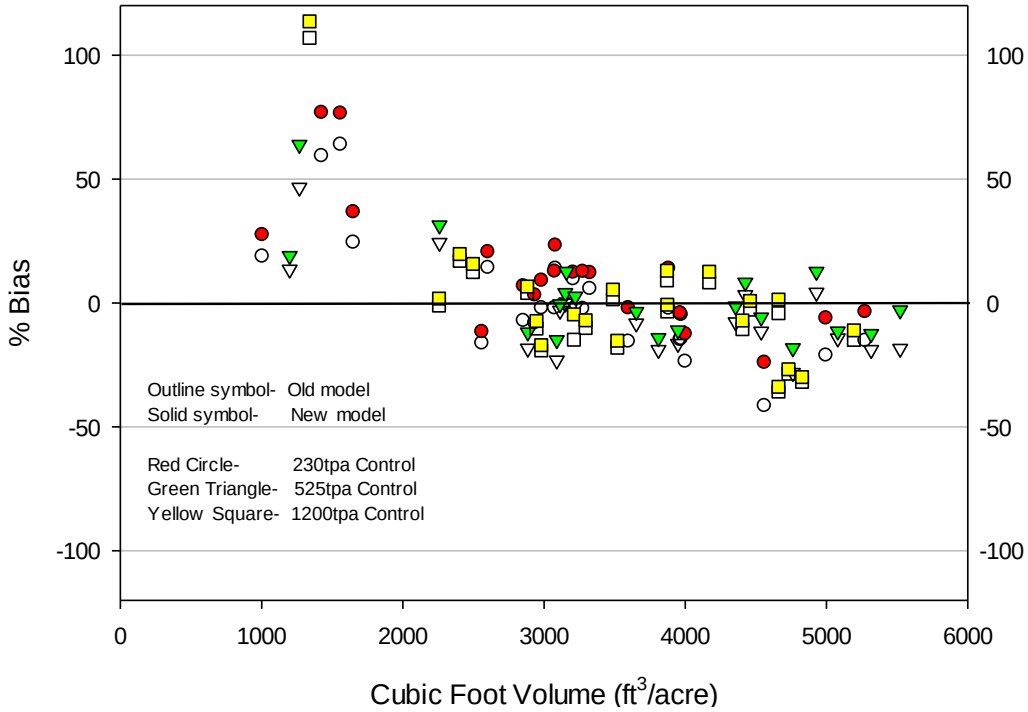

Figure 6. Control plot volume (ft^3/acre) bias (%) by planting density and model version.

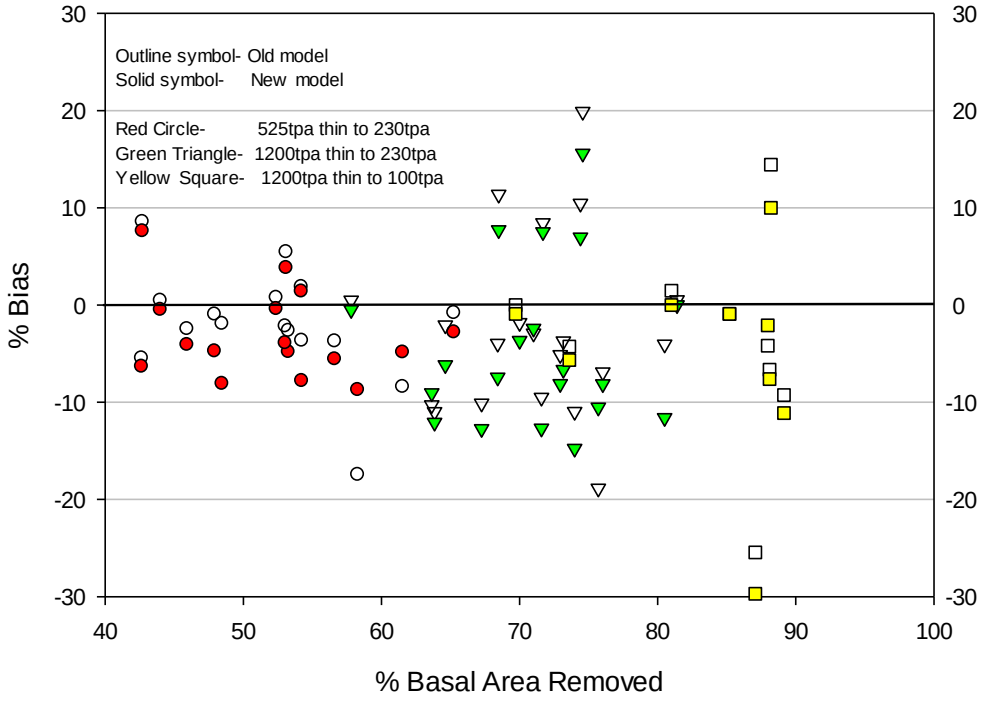

Figure 7. Thinning treatment density (tpa) bias (%) by % BA removed and model version.

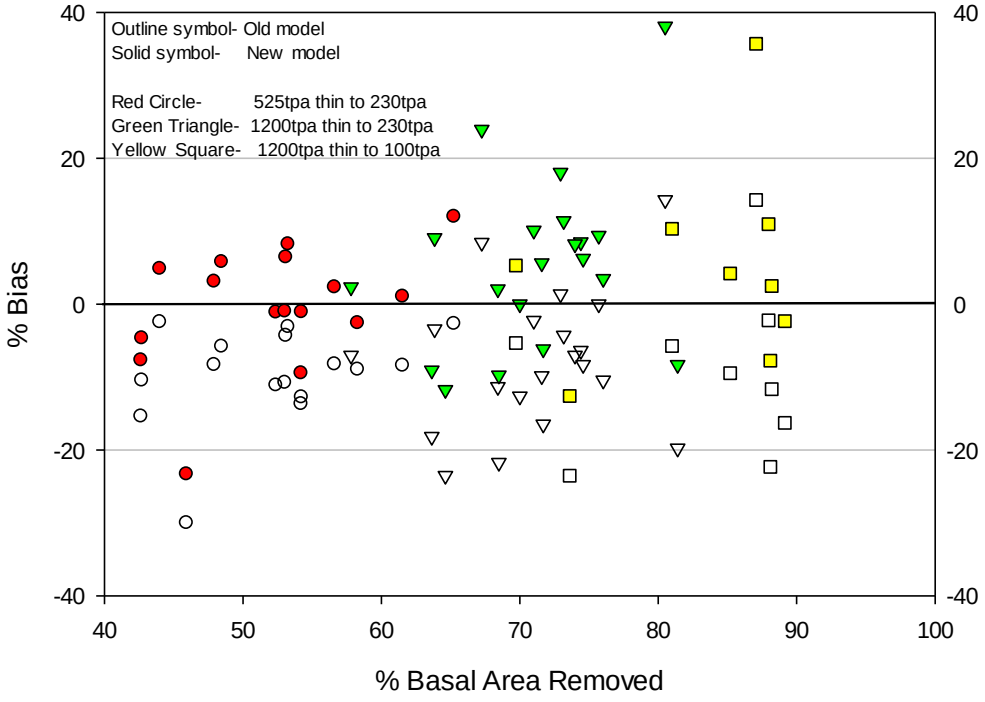

Figure 8. Thinning treatment DBH (in) bias (%) by % BA removed and model version.

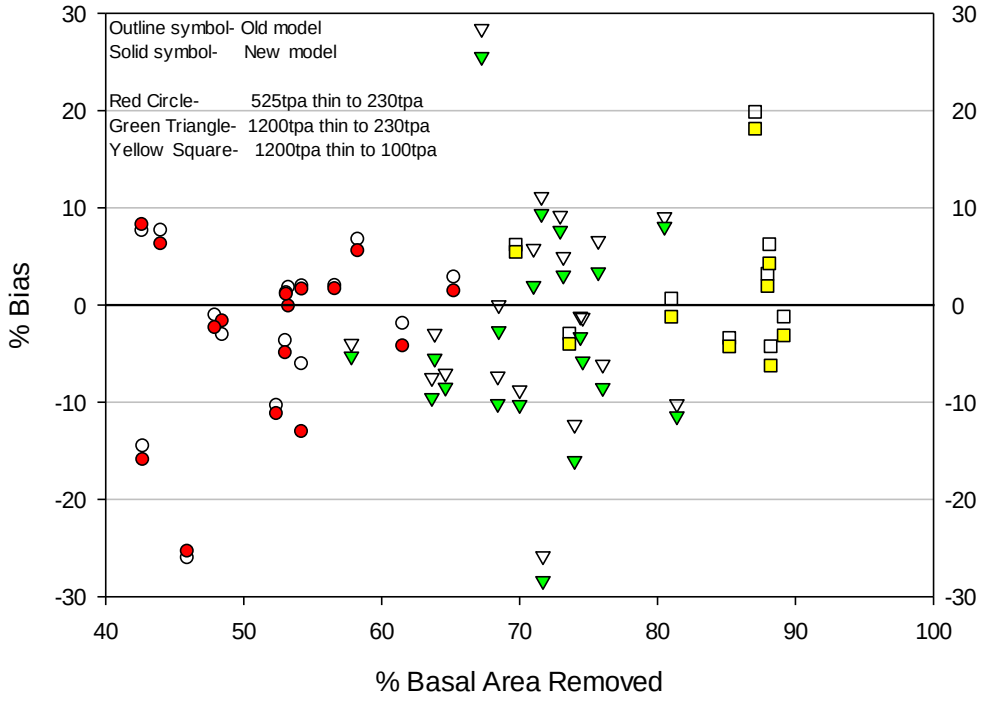

Figure 9. Thinning treatment H40 (ft) bias (%) by % BA removed and model version.

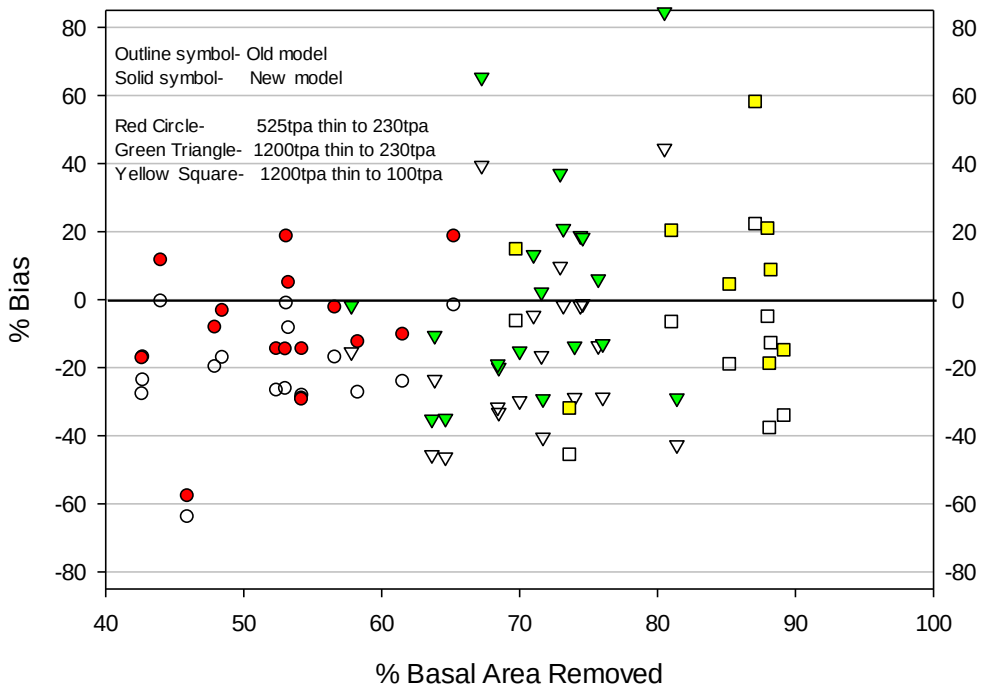

Figure 10. Thinning treatment volume (ft^3/acre) bias (%) by % BA removed and model version.

Table 12 shows that mortality was predicted to be lower than in RAP v1, except for plots receiving late thinnings. Most plot types exhibited reduced DBH bias after 20 years of growth projection, and the absolute value of bias in standing cubic volume was educed for most plots, though not for plots under the lowest density management regime (Table 10). While overall bias in cubic volume was lower, plot volume was generally overpredicted with the new equations, while it was underpredicted with the original equations (Table 12).

Bias in dominant height predictions after 20 years of projections was generally greater with the new equations, and dominant height was generally underpredicted with both sets of equations. Recognizing that dominant height growth and therefore growth potential of all trees relies on the site index equations, high variability in estimated site index for a given plot when using height-age pairs from different growth periods suggests that the site index equations (Weiskittel *et al*. 2009) may not be adequately describing the height growth trajectory.

Table 12. Percent "bias" [(predicted-observed)/observed] resulting from application of the first version (v1) of RAP-ORGANON and the version with the refitted 2018 equations (v1.1).

Treatment	TPA		DBH		H40		CFV	
	Old	New	Old	New	Old	New	Old	New
230tpa Control	-7.2	1.0	4.2	4.1	-1.7	3.8	1.1	12.5
525tpa Control	-8.8	9.1	2.5	-0.5	-2.2	-2.8	-4.9	2.3
1200tpa Control	-7.0	5.1	4.0	1.7	-4.7	-5.6	-2.2	1.5
525tpa PCT to 230tpa @ Age 6	3.3	1.9	-4.7	5.7	-3.2	-3.7	-8.6	8.4
525tpa PCT to 230tpa @ Age 9	-2.0	-3.1	-9.8	-0.4	-2.2	-3.3	-21.4	-9.2
1200tpa PCT to 230tpa @ Age 6	4.5	2.9	-5.1	8.2	-5.8	-7.3	-9.3	10.5
1200tpa PCT to 230tpa @ Age 9	-2.5	-4.4	-7.9	5.6	-1.0	-3.3	-15.6	2.2

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Weiskittel, A.R., Hann, D.W., Hibbs, D.E., Lam, T.Y. and Bluhm, A.A. 2009. Modeling top height growth of red alder plantations. For. Ecol. Man. 258:323-331.

Outreach and Education

Family Forest Field Day

This workshop, sponsored by Washington State University Extension was held in Oakville, WA August 19, 2017. This educational event provided practical "how-to" information to a wide array of forest owners. This event included classes and activities led by experts in forest health, wildlife habitat, soils, fire protection, timber and non-timber forest products. Glenn Ahrens, director of the HSC taught "Red Alder Management" (two sessions, 48 people total) and "Advanced Hardwood Management" (two sessions, 30 people total).

Managing Red Alder Workshop

On October 6 & 7, 2017, Washington State University Extension had a two day educational workshop for property owners in Arlington, WA. This event took a comprehensive look at both the challenges and opportunities that red alder presents to landowners. Topics focused on management options for different property sizes and different property uses and how to provide for long-term health, habitat, and water quality in the process. Glenn Ahrens, gave two presentations (Alder Ecology" and "Alder Management Options" and provided expert knowledge during the field tour.

DNR IMF Red Alder Workshop

Matt Perry, Intensive Management Forester for the DNR Olympic Region, organized and hosted a training workshop for DNR employees interested in red alder management on May 16 & 17, 2017 in Forks, WA. Andrew Bluhm started the day with a presentation on current knowledge of red alder management. We then went on a tour of HSC Type II site #1201 (LaPush) where Andrew discussed effects of density management on growth & yield and provided economic comparisons between various red alder and Douglas-fir management scenarios. The following stop looked at, and discussed options foresters have when Douglas-fir plantations experience significant red alder ingrowth.

Lane Tree School

On June 2, 2018, OSU Extension Service put on the Lane County Tree School in Pleasant Hill, OR. This one day mini-college was for family forestland owner, forester, loggers, arborists, teachers and the general public. This event offered 28 classes covering key topics to support successful management of diverse woodlands. Andrew Bluhm taught the class "Red Alder Management: Silviculture to Marketing" to a small but inquisitive audience. He discussed why or why not to grow red alder, presented probable management or non-management scenarios and finished with topics about harvesting and marketing red alder.

Direction for 2019

The HSC goals for 2019 are both the continuation of our long-term objectives and new topics and 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 assisting HSC members with their specific red alder management needs and projects.
- Create user-friendly, red alder stand tables from the updated RAP-ORGANON growth and yield model.

Appendix 1- HSC 2017 Committee Meeting Minutes

Wednesday July 12, 2017:

Attendees: Andrew Bluhm, Glenn Ahrens- OSU; Brian Morris- WA DNR; Carlos Gantz- Greenwood Resources /Washington Hardwood Commission; James Kirkpatrick- Bureau of Land Management

The meeting started at 8:00 AM at the Clatskanie River Inn in Clatskanie, OR with a welcome from the HSC program leader, Glenn Ahrens. After welcomes, Glenn gave an update on the current HSC effort of updating the red alder growth and yield model. The following is a summary of the effort:

- Background
  - The goal of the HSC is to improve the understanding, management, and production of red alder.
  - To take this knowledge and create red alder growth and yield tools for forecasting future yields of managed red alder stands.
  - The first major step was back in 2010 with the development of RAP-ORGANON. This was the first red alder growth and yield model that specifically modelled the behavior of plantations.
    - The database used to develop this model was the most comprehensive ever gathered in the region- comprising 53 research sites.
    - The oldest plantations were 17 years old.
  - Then in an effort to make the model more user friendly, the HSC and the Center for Intensively Plantation Silviculture (CIPS) created an Excel-based platform to run RAP-ORGANON.

- Rationale
  - The modeling dataset was deficient in old trees/stands, resulting in an unknown amount of error in model projections.
  - Ideally, a modeling dataset should cover the entire range of desired projections.
  - An official model validation performed by David Hann indicated that other than the mortality equation, the model performs well when projecting stand-level attributes over time.
  - However, using more recent data, the HSC evaluated model predictions for:
    - Trees per acre
    - DBH
    - Basal Area
    - Height of the largest 100tpa
    - Cubic foot volume.
  - In brief, the results indicate that RAP-ORGANON consistently under predicts these five stand variables.

- Improvement Possibilities
  - With the continued collection of data from HSC sites, additional data from older stands is now available.

- There is currently a large amount of 22 year-old data and some 27 year-old data. This offers potential for the improvement through updating existing red alder management tools as well as the development of new tools. Options include, but are not limited to the following:
    - Improve the predictive ability of RAP-ORGANON by refitting the appropriate equations by including all new data.
    - Using the modeling dataset, develop stand tables to project managed, even-aged, pure species stands. These stand tables would be a welcomed new tool for forest managers.
- The HSC is exploring the options to update and improve growth and yield projection tools with extra help from cooperators or collaborators.
    - Greenwood Resources: We are working with Carlos Gantz (also a member of the WHC) to explore the feasibility of using the HSC dataset to develop new stand tables.
    - CIPS: We are working with Doug Maguire and Doug Mainwaring to develop an approach to re-fit the growth model equations with an updated dataset that we can then re-apply with periodic updates without having to undertake a big new contract project each time.
- The HSC has already prepared the data and sent a limited dataset to both groups.

Next was a presentation given by Andrew Bluhm titled "Effect of Species Mixtures on Growth and Yield of Red Alder and Western Redcedar". This presentation was based on the report presented in The HSC 2017 Annual Report. Please see the annual report for the full results. A summary of the results are as follows:

- Introduction
    - The relationships among tree mortality, tree size (DBH, Height, cubic foot volume), and stand yield in planted red alder and western redcedar species mixtures were explored at a modified replacement series at a 26 year-old site growing on abandoned agricultural land near Mt Vernon, Washington.
    - This study is the only one in the USA and the oldest of its kind in existence.
    - Treatments included four species proportions (100% red alder, 25% red alder/75% redcedar, 50% red alder/50% recedar, 100% redcedar) planted at 680tpa (8' x 8' spacing). An additional treatment of pure red alder was planted at 170tpa (16' x 16' spacing) was also included.
    - Redcedar was planted in 1990 and the red alder planting was delayed for seven years (1997 and interplanting in 1998).
    - However, due to early seedling mortality from *Septoria alnifolia*, four of the 13 treatment plots failed and the only pure red alder treatment plot was compromised.

- Results
    - By 2016, redcedar had much higher survival than red alder.
    - The survival of both species was greater in the mixtures than in the pure species treatments.
    - Red alder DBH and height was greatest at the lowest densities of red alder and was independent of the mixed or pure treatments.

    - Redcedar DBH and height were reduced when grown in species mixtures compared to pure species treatments (19% and 10%, respectively).
    - Red alder individual tree cubic foot volume was greatest at the lowest densities and redcedar individual tree volume was greatest in the pure species treatment.
    - Total merchantable stem volume was greatest in the treatments that contained a redcedar component, whether pure or mixed species. Volume in the pure red alder treatments was less than half of that of the treatments that contained redcedar.
    - In the mixed species treatments, relative yield (RY) of the red alder was >1 (indicating growth enhancement) whereas for redcedar RY was <1 (indicating a growth penalty).
    - Relative land output (RLO) for the mixed species treatments was <1, indicating a substantial increase in per acre productivity as measured by merchantable volume.

- Conclusion
    - These positive yield improvements over the pure species treatments were observed mainly as the result of increased survival of both species, increased volume of red alder in the mixed species treatment, and shade tolerance of the redcedar allowing the development of a distinct stratified (two-storied) stand structure.
    - These results demonstrate that there is potential for mixedwood management and that forest managers should consider species mixtures as a means to enhance productivity, yield, and other management objectives.

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

Last year (Winter 2016/17) had fieldwork on a total of six sites:

- Two Type II installations- Clear Lake Hill (4202, GYN) and Ryderwood (3202, WHC) had the 27th year measurement.
- Three Type II installations- Mt. Gauldy (2206, SNF), Scappoose (3209, BLM), and Darrington (4206, WADNR) had the 22nd year measurement.
- Of these installations there was one pruning treatment (Mt. Gauldy).
- One Type III installation- Menlo (3301, WADNR) had the 17th year measurement.

This coming field season (Winter 2017/18) will be a busy year.

- Two more of the oldest HSC sites (LaPush and Pollard Alder) will have their 27th year measurement.
- One Type 2 installation (Maxfield) and one Type 3 installation (Cedar Hebo) will need their 22nd year measurement.
- In addition to the above measurements, two installations will require thinning (Dora and Cape Mtn.) and three installations are due for the 4th and final pruning lift (LaPush, Cape Mtn., and Maxfield).
- There are no orphaned sites due for measurement or treatment.

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

Next, Andrew presented the HSC budget. Please see the handouts included in the meeting folder. Highlights included:

- Dues received in 2017 were $58,500, up $11,000 from the year before.
- Actual costs (with the exception of Andrew's cost) were in line with what was projected.
- With the increase dues, Andrew's time was increased in 2017 from 0.30FTE to 0.35FTE.
- Starting in 2018, ODF will no longer be a dues paying member.
- Because the HSC currently has a significant carryover, Andrews's time will remain at 0.35FTE.

After lunch, the grouped toured Greenwood Resources Tree Improvement Center in Westport, OR. Here, Kathy Haiby led the group through their greenhouses to view and discuss alder and poplar propagation. Carlos Gantz then walked the group through field trials that included:

- *P. trichocarpa* top line trial – Selection for ease of sugar release
- *P. trichocarpa* common age (2013) trial
- *P. maximowicizii* breeding orchards
- Seedling availability

The final stop was a visit to Greenwood Resources Lower Columbia Tree Farm out of Clatskanie, OR. Here, Carlos Gantz then walked the group:

- Hybrid poplar 1428; Stand 02-750; harvest age stand
- Recent hybrid poplar plantation; Stand 02-180; 4 years old; verification trial
- Red alder clonal trial; Stand 02-185

Appendix 2- HSC Financial Support 2018

Cooperator	Support
BC Ministry of Forests	$8,500
Bureau of Land Management	$17,072
Goodyear-Nelson Hardwood Lumber Company	$4,500
Hancock Natural Resource Group	$8,500
Oregon Department of Forestry	$8,500
Siuslaw National Forest	------
Washington Department of Natural Resources	$8,500
Washington Hardwood Commission	------
Subtotal	$55,572
Oregon State University	$18,550
Total	$74,122