Hardwood Silviculture Cooperative 2020 Annual Report

Contents

Hardwood Silviculture Cooperative

Highlights of 2020

- Port Angeles Hardwood and Cascade Hardwood have joined the HSC as new members.
- A red alder clone bank has been established with the top 20 clones from the WSU clonal alder program.
- A red alder clone field trial was established using clones from the WSU clonal alder program.
- Three more 27 year measurements were collected on the Type 2 installations (variable-density red alder plantation), bringing the total to 13 of the 25 installations with 27 year data.
- The HSC and the Center for Intensive Planted-forest Silviculture (CIPS) started another update of RAP-ORGANON.
- The HSC participated in numerous continuing education and outreach events including: Clackamas Co. Tree School, the WA Farm Forestry Association (WFFA) Forest Owners Field Day, 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 website 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 10 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).

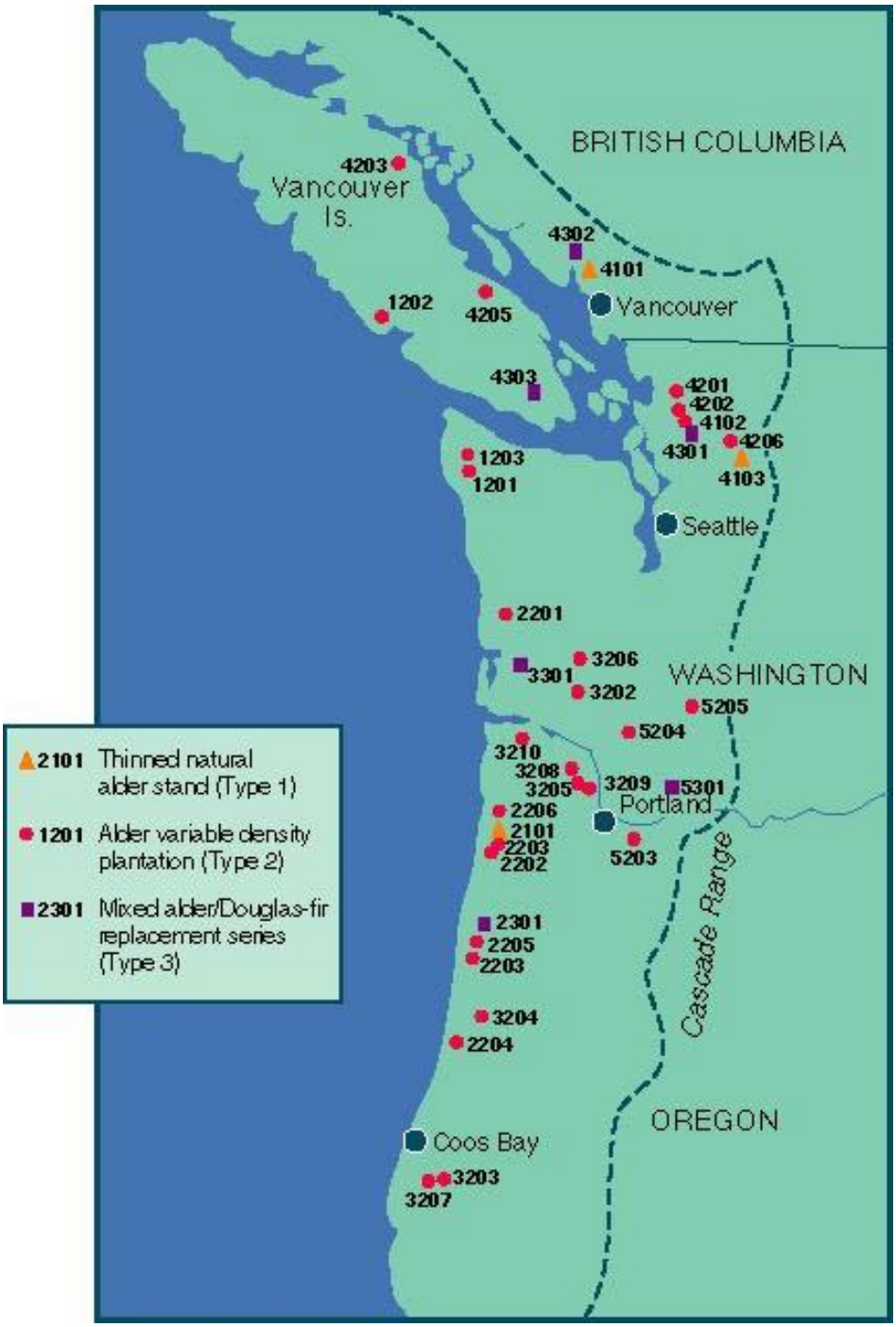

Figure 1. Location of installations for the Red Alder Stand Management Study.

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 completed activities.

TYPE 1	BCmin	SNF	DNR	MBSNF
Site Number	**4101**	**2101**	**4102**	**4103**
Site Name	**Sechelt**	**Battle Saddle**	**Janicki**	**Sauk River**
Plot Installation	1989	1990	1991	1994
1st yr Measurement	1989	1990	1991	1994
3rd yr Measurement	1992	1993	1994	1997
6th yr Measurement	1995	1996	1997	2000
9th yr Measurement	1998	1999	2000	2003
14th yr Measurement	2003	2004	2005	2008
19th yr Measurement	2008	2009	2010	2013

Table 4. Data Collection Schedule for Type 3 Installations. Shaded areas indicate completed activities.

Owner	BCmin	NWH	GYN	BCmin	DNR	SNF	GPNF
Site Number	**4302**	**2301**	**4301**	**4303**	**3301**	**2302**	**5301**
Site Name	**East Wilson**	**Monroe-Indian**	**Turner Creek**	**Holt Creek**	**Menlo**	**Cedar Hebo**	**Puget**
Year Planted	1992	1994	1994	1994	1995	1996	1997
1st yr Regen Survey	1992	1994	1994	1994	1995	1996	1997
2nd yr Regen Survey	1993	1995	1995	1995	1996	1997	1998
Plot Installation	1993	1995	1995	1995	1997	1998	1999
3rd yr Measurement	1994	1996	1996	1996	1997	1998	1999
6th yr Measurement	1997	1999	1999	1999	2000	2001	2002
9th yr Measurement	2000	2002	2002	2002	2003	2004	2005
12th yr Measurement	2003	2005	2005	2005	2006	2007	2008
17th yr Measurement	2008	2010	2010	2010	2011	2012	2013
22nd yr Measurement	2013	2015	2015	2015	2016	2017	2018
27th yr Measurement	2018	2020	2020	2020	2021	2022	2023
32nd yr Measurement	2023	2025	2025	2025	2026	2027	2028

Winter 2019/20 measurements occurred on three installations (Table 5). Blue Mtn (3206), Mohun Creek (4203), and Hemlock Creek (5204) had their 27th year measurement. No pruning or thinning treatments were required. Two of the installations (3206 and 5204) are orphaned sites, but the WA DNR graciously provided a crew to complete the measurements.

Table 5. Hardwood Silviculture Cooperative Field Activities, Fall 2019-Spring 2020

Type	Activity	Installation	Cooperator
Type 1		Completed	
Type 2	22yr Measure	Completed	
	27yr Measure	3206	WHC- Blue Mtn.
		4203	BCMIN- Mohun Creek
		5204	WHC- Hemlock Creek
Type 3		No Activities	

So, in the big picture:

- All twenty five Type 2 installations have now had their 22nd year measurement.
- Thirteen Type 2 sites have their 27th year measurement completed.
- Twenty three of the twenty five Type 2 installations have all treatments completed.
- All seven Type 3 installations have had their 22nd year measurement.
- One Type 3 installation has had its 27th year measurement.

This coming field season (Winter 2020/21) will be busy (Table 6). Five Type 2 installations (Lucky Creek, Cape Mtn, Siletz, Dora, and French Creek) will need their 27th year measurement. With the Siletz site requiring the last pruning lift. In addition, three Type 3 installations (Monroe-Indian, Turner Creek, and Holt Creek are due for their 27th year measurements.

Table 6. Hardwood Silviculture Cooperative Field Activities, Fall 2019-Spring 2020

Type	Activity	Installation	Cooperator
Type 1		Completed	
Type 2	22yr Measure	Completed	
	4th Pruning Lift	2205	ANE- Siletz
	27yr Measure	1202	BCMIN- Lucky Creek
		2204	SNF- Cape Mtn
		2205	ANE- Siletz
		3207	BLM- Dora
		4205	BCMIN- French Creek
	32yr Measure	4201	GYN- Humphrey Hill
Type 3	27yr Measure	2301	ANE- Monroe- Indian
		4301	GYN- Turner Creek
		4303	BCMIN- Holt Creek

Current HSC Activities

Red Alder Clone Bank

The Hardwood Silviculture Cooperative, with assistance from the Washington Hardwoods Commission and Hancock Forest Management established a red alder clone bank, using material from Washington State University's tree improvement program. The clone bank would preserve the improved genetics developed by the program and provide a source of vegetative material and/or seed for further propagation.

Multiple locations were explored for the establishment of the clone bank including the J.E. Schroeder Seed Orchard (ODF), Webster Forest Nursery (WA DNR), Peavy Arboretum (OSU), the Travis Tyrrell Seed Orchard (BLM), and the Walter Horning Seed Orchard (BLM). The ODF Schroeder facility was chosen for several reasons: ODF has historically been an HSC cooperator and is a strong supporter of tree improvement and gene conservation, the location is fully integrated for tree improvement and has excellent facilities and knowledgeable staff, and the climate at the location is suitable for red alder.

Three ramets each from 20 production clones were planted with the possibility of adding more clones from the WSU program. Individual clones were planted at an 18' x 12' spacing with randomized planting spots (Figures 2 &3). Trees were planted in November 2019 and mortality (3 trees) was replaced in April 2020.

A clone bank to hold the genetic material safely is ideal for the long term storage of the selections. However, to keep plants for production (either vegetative or seed), regular maintenance such as pruning may be required. Future plans for the material will be determined by the HSC and may include producing seed for members and for progeny test sites.

Figure 2. Red alder clonal seedling and clone trial planted at the ODF J.E. Schroeder Seed Orchard.

Red Alder Clone Trial

History

Clonal forestry in eucalyptus, poplar and other hardwood species have shown tremendous strides in improving wood properties and shortening rotation times. In 1997, Weyerhaeuser Hardwoods (then Northwest Hardwoods) initiated a clonal red alder program with the goal of delivering a clonal red alder propagation system to NW Hardwoods by using selected superior field material. The red alder clones were selected for the best form, growth, and characteristics suited to processing. Clones were tested for disease, frost, and drought tolerance. In 2011 Weyerhaeuser sold the Hardwoods Division and gifted the Alder Program (under a variety of contractual obligations) to Washington State University Research Foundation (WSURF).

Initially, trees were selected (based on multiple criteria) from existing red alder plantations. Logs from these trees were brought to the lab and treated to initialize new growth. Then, cuttings were taken, rooted and become the parents for further testing. The parent plant is then topped and cuttings are taken from the branches.

These rooted cuttings were then placed out in replicated trials over multiple sites and years to assess the growth and tree form of the clones. Early results demonstrated significant gains in diameter (DBH) and height (HT) compared to unimproved (i.e. woods run) trees (Figure 3).

Clone	dbh gain	ht gain
clone 1	1.42	1.48
clone 2	1.34	1.16
clone 3	1.33	1.41
clone 4	1.33	1.18
clone 5	1.30	1.2
clone 6	1.29	1.19
clone 7	1.25	1.14
clone 8	1.24	1.39
clone 9	1.23	1.14
clone 10	1.23	1.14
clone 11	1.21	0.98
clone 12	1.19	1.16
clone 13	1.16	1
clone 14	1.16	1.36
clone 15	1.16	1.17
clone 16	1.13	1.21
clone 17	1.13	1.26
clone 18	1.12	1.2
clone 19	1.05	1.23
clone 20	1.04	1.33

top 10 clones	
dbh gain	ht gain
1.296	1.243

This means a 29.6% increase in DBH and a 24.3% increase in Height

top 20 clones	
dbh gain	ht gain
1.2155	1.2165

Figure 3. Early results of DBH and HT gain from the WSU red alder clone trials.

Objective

Although early trials indicate gains in growth, because of the contractual obligations, the specific clones and gain values are proprietary. Therefore, the objective of this study was to establish a clone trial on public land (OSU Blodgett tract) to compare the performance of red alder clones with a woods run control.

Clonal Material

The clones were produced by WSU as a continuation of the Weyerhaeuser Clonal Alder Program. In the original WeyCo program, clones were planted over a variety of sites, measured between age 5 &9, then ranked based on DBH gain, then height gain. Once clones displaying optimal gain were identified, other selection criteria (i.e. wood properties, disease tolerance, cold tolerance) were tested and assessed (Figure 4). In total, thirty-six (36) of the 648 clones were selected for production. WSU is currently providing clonal material for regional clone trials. Due to production and greenhouse constraints the actual number of available production clones varies from year to year.

Figure 4. Thirteen year old trees from a WSU clone trial.

Study Design

The trial was planted on April 3, 2020 in an unfenced area in the Newton Survivor harvest unit on the Blodgett Forest (46.065472°, -123.344099°). Elevation is 830’-1070’. Aspect is East to Southeast. Slopes are mild, ranging from flat to 20%. Soil type is Scaponia-Braun silt loam and estimated red alder site index (base age 50 years) is 92ft.

The Newton Survivor unit is ~21 acres (Figure 5) harvested in December 2018, and hand sprayed in the summer of 2019. Nine acres were planted in Douglas-fir in February 2020, leaving twelve acres available for red alder. Of that acreage, ~1 acre was designated for the trial and cleared of any slash piles (and subsequent burn piles), but the stumps and some slash will remain. The remaining acreage was an operational planting with a mixture of the red alder clones.

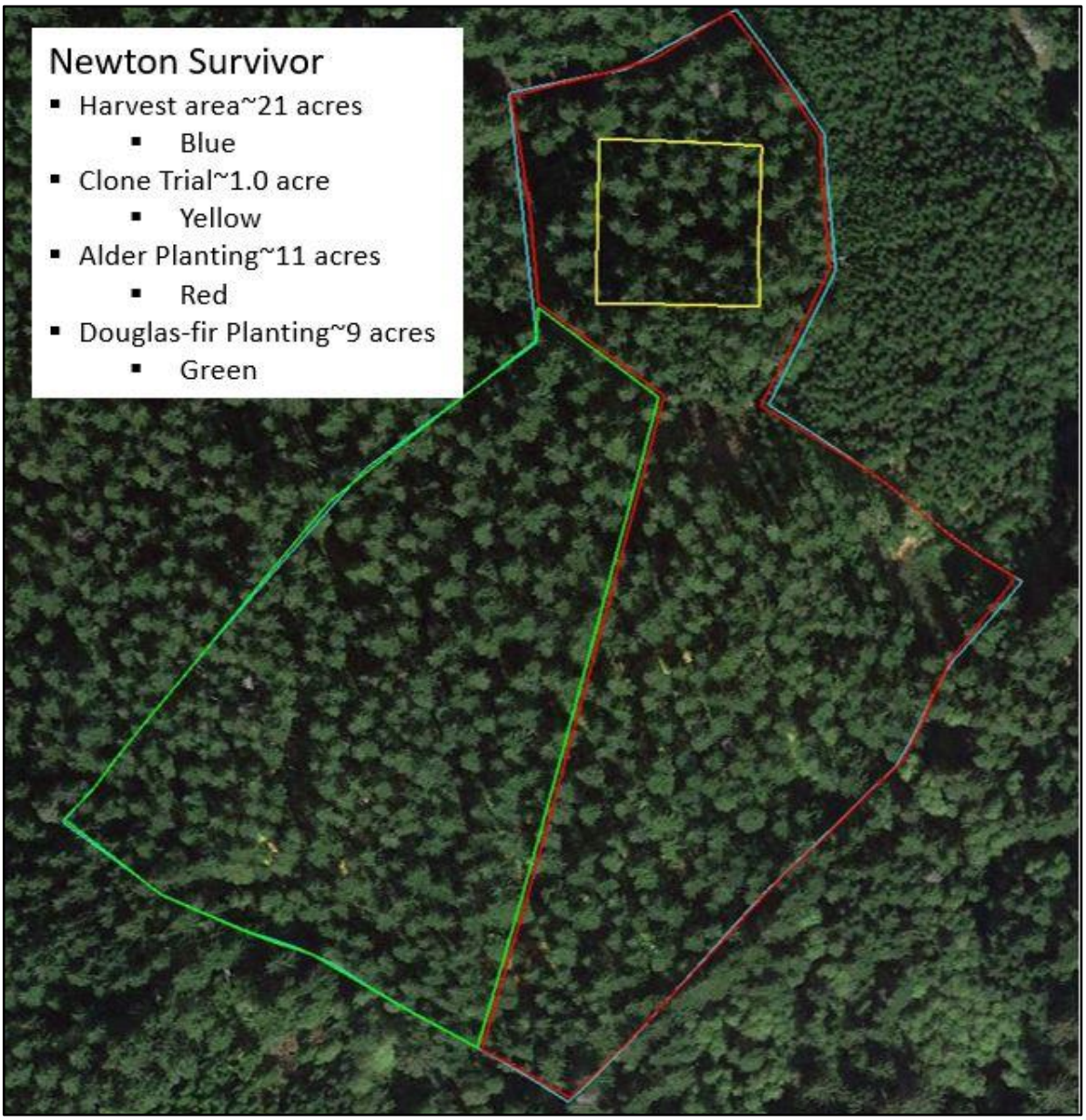

Figure 5. Planting layout of the Newton Survivor harvest unit.

Both the operational and trial areas were planted on a 9 x 9' grid (537tpa), though this grid will be "less than perfect", because planting spots will be somewhat constrained by stumps and slash (Figure 6). Four sources of seedlings were used in this trial: 1) Eighteen clones from the WSU program and grown as PSB 615A plugs, 2) Woods run bare root seedlings from the Weyerhaeuser Aurora nursery, 3) Woods run 615 plugs grown by PRT Hubbard from the 041 seed source (SW WA), bought from WA DNR, and 4) an "Open pollinated" plugs (lot #249) from a WSU clone trial grown as plugs by the WSU program (hereafter known as "Clones", "WeyCo", "DNR", and "WSU")

Figure 6. Laying out the red alder clone trial. Note the heavy stump and slash coverage.

The study design was a randomized complete block design with four blocks (i.e. replications). Each block contained 21 treatments: 18 clones plus the three comparison sources (WeyCo, DNR, & WSU) included twice (to account for its expected higher inter-tree variation). A completely balanced design was preferred but not obtained (Table 7). Each treatment within each block is represented by an individual-tree plot, with planting locations randomly assigned. Each block had 144 planting spots- six individuals for each of the 18 clones, and 12 individuals for the three comparison sources. The trial was bordered by 5-tree row plots of randomly assigned 20 treatments (DNR source not included) all of which was surrounded by the operational planting. Figure 7 depicts the clone trial layout.

Table 7. Planting stock, map code and number of individuals planted in the red alder clone trial.

Clone	Code	Count	Caliper (mm)	Height (cm)
101	A	24	5.0	67.3
114	B	24	3.8	44.2
154	C	24	4.8	72.6
228	D	24	3.6	39.8
242	E	24	4.2	55.8
243	F	24	4.4	55.5
249	G	24	5.2	61.9
250	H	24	4.5	52.5
309	I	24	4.1	47.4
321	J	24	4.1	52.4
426	!K!	24	5.1	64.5
433	L	24	3.9	53.9
602	M	24	4.7	76.8
621	N	24	4.4	67.2
631	O	24	3.7	48.0
633	P	22	3.0	48.2
635	Q	24	4.8	65.1
639	R	24	5.6	96.8
DNR	T	55	4.6	44.1
WSU	S	47	4.1	38.6
Weyco	U	44	5.1	52.5
Total		576	4.4	55.8

	!K!	B	B	B	B	B	R	R	R	R	R	C	C	C	C	C	D	D	D	D	D	H	H	H	H	H
24	!K!	U	T	Q	T	Q	G	N	S	L	A	C	G	D	D	A	J	U	U	G	I	G	D	S	N	A
23	!K!	T	B	S	Q	T	F	A	E	L	C	S	O	I	A	N	B	T	L	T	S	N	T	U	U	A
22	!K!	T	J	H	Q	G	Q	C	U	P	N	N	R	T	A	T	R	H	T	F	A	S	J	F	N	A
21	!K!	!K!	L	D	S	P	F	R	A	J	H	B	J	!K!	L	U	B	J	U	U	S	E	H	Q	P	A
20	J	C	L	E	D	D	R	F	B	G	P	D	!K!	M	M	T	T	A	R	I	G	Q	Q	G	O	A
19	J	M	T	U	U	D	U	T	I	C	E	T	H	R	!K!	Q	F	U	M	O	F	S	S	H	!K!	P
18	J	B	N	O	U	E	S	D	R	F	N	!K!	S	C	R	U	B	H	I	S	J	M	O	H	O	P
17	J	E	S	T	B	F	L	G	F	H	E	B	I	E	P	T	T	O	O	T	!K!	H	G	I	P	P
16	J	T	!K!	T	O	U	J	A	U	H	I	Q	M	P	A	M	B	Q	!K!	F	T	C	R	L	E	P
15	N	L	A	R	S	!K!	R	U	O	I	M	G	H	!K!	S	J	E	T	E	E	U	D	S	B	C	P
14	N	S	J	U	I	U	M	S	P	I	N	P	T	I	L	D	N	S	C	L	F	U	R	D	T	E
13	N	O	C	M	!K!	A	S	J	O	S	M	U	P	Q	S	G	P	J	B	U	C	N	C	M	L	E
12	N	C	L	M	N	B	F	D	P	S	N	F	J	R	T	A	G	U	S	H	P	L	T	S	D	E
11	N	J	R	U	R	C	I	B	U	N	U	S	U	I	R	C	H	U	Q	Q	S	U	H	F	J	E
10	G	T	S	P	Q	B	S	S	J	U	E	O	N	O	N	P	S	G	U	G	R	H	M	D	E	E
9	G	R	I	H	I	F	A	H	B	G	J	U	R	R	L	F	R	S	Q	Q	P	U	S	F	M	L
8	G	Q	!K!	L	N	H	C	A	N	D	J	O	E	M	E	U	T	T	H	P	U	A	L	D	!K!	L
7	G	P	J	I	T	T	T	R	O	T	A	G	P	Q	I	A	S	U	I	C	H	D	I	N	Q	L
6	G	F	!K!	C	C	S	O	S	T	M	!K!	L	P	S	M	J	S	L	J	T	A	I	T	P	T	L
5	O	F	L	D	T	P	T	T	H	Q	M	G	T	L	T	G	G	F	C	C	E	!K!	A	J	N	L
4	O	G	U	E	Q	T	S	D	I	M	Q	S	H	U	C	T	B	!K!	R	O	N	F	B	F	O	U
3	O	A	E	S	T	T	L	H	!K!	B	L	!K!	S	E	A	J	T	B	M	I	S	N	T	N	!K!	U
2	O	G	I	M	R	A	!K!	D	B	S	C	A	T	B	E	U	O	O	E	B	O	D	B	U	J	U
1	O	E	M	O	G	T	O	T	D	F	E	Q	U	S	T	T	S	M	U	!K!	C	L	!K!	G	D	U
	M	M	M	M	M	Q	Q	Q	Q	Q	I	I	I	I	I	S	S	S	S	S	F	F	F	F	F	U
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	

Figure 7. The red alder clone trial experimental design. Each color (and letter) is an individual seedling of a particular clone or seedling source. There are 16 trees per block, 25 blocks, and a two tree wide woods run border.

Planned Data Collection

Immediately after planting, initial tree size (height and caliper) was measured on all 576 trees (not including the row plot borders). As seen in Table 7, mean caliper was 4.4mm (range 3.0mm to 5.6mm) and mean height was 55.8cm (range 38.6cm to 96.8cm). Grouping all clones together revealed small (but statistically significant) differences in caliper between the clone group and the comparison sources (Figure 8). The caliper of the WeyCo source was significantly greater than the caliper of the Clone group and the WSU source. Regarding height, the Clone group was taller than the DNR and the WSU source, and the WeyCo source was taller than the WSU source (Figure 9).

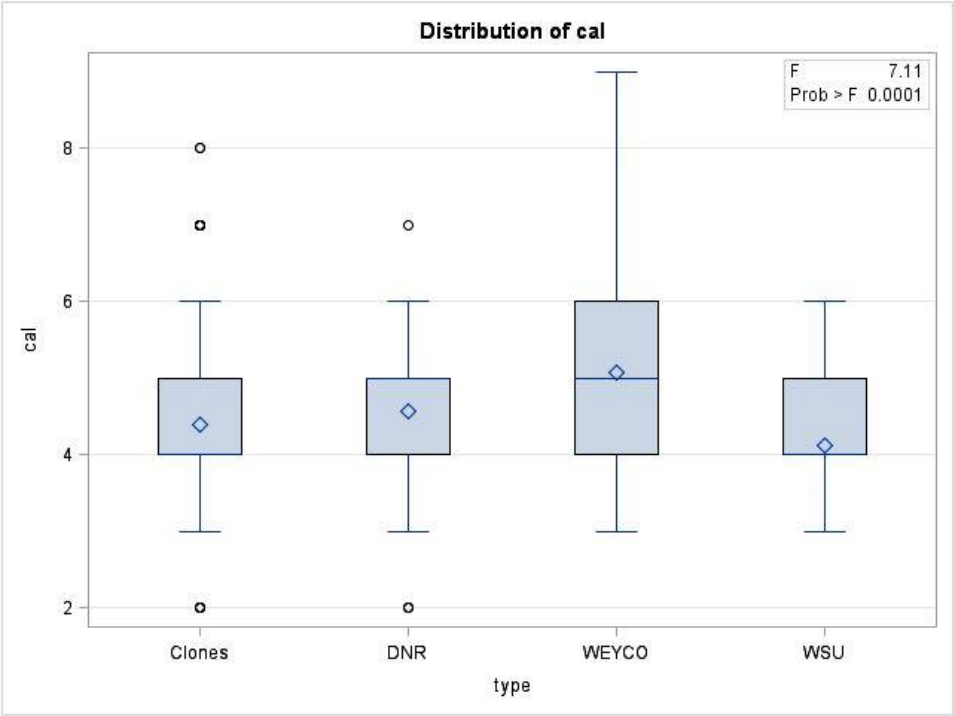

Figure 8. Initial (year 0) caliper (mm) by seedling type.

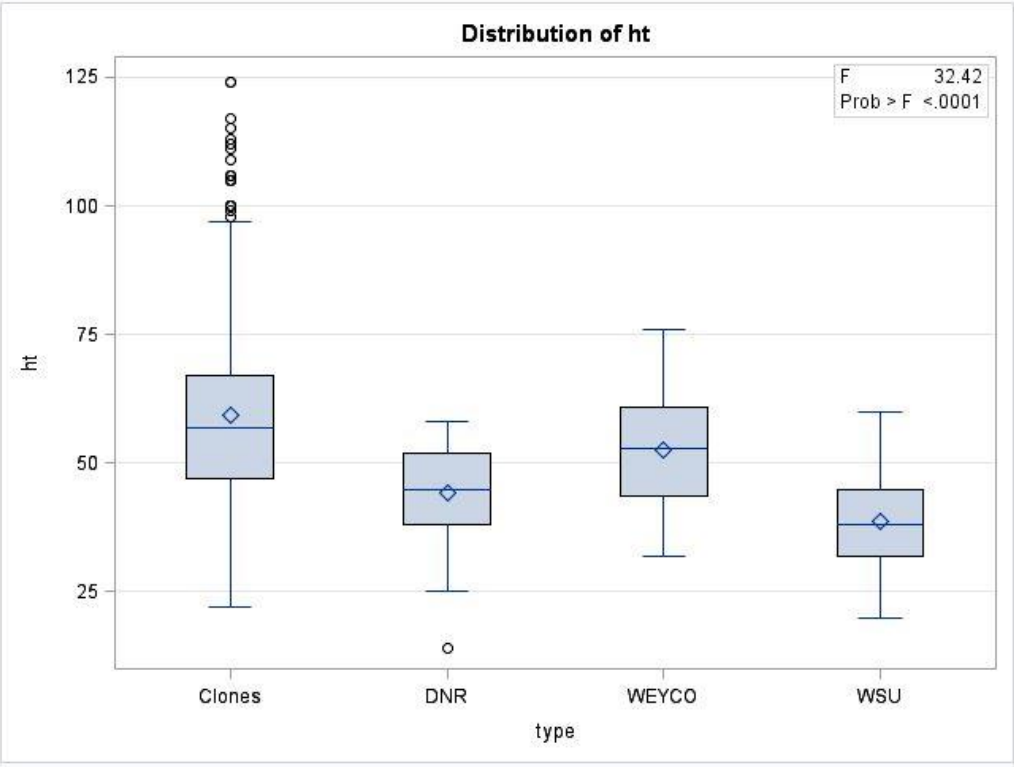

Figure 9. Initial (year 0) height (cm) by seedling type.

Starting in year 1 (Fall/Winter 2021/22), all trees will be tagged with sequentially numbered aluminum tags placed on a wire pin on the south side of the tree. Tree #1 is located in the SW corner of the test site, with tags progressing North and going in a serpentine fashion. Tree size and survival measurements will be made in years 1, 2, 3 with the measurement interval after year three to be determined.

Updates to the ORGANON Red Alder Plantation (RAP) Equations

As described in the HSC 2019 Annual Report, CIPS (Center for Intensive Planted-forest Silviculture) allied with the HSC to refit some of the equations used in the original version of RAP-ORGANON). The refit equations, when reinserted into the growth model seemed to provide better predictions of growth and yield of red alder plantations (Figure 10). But before this updated model could be released to the public, a more thorough analysis by David Hann, the model's author, was required.

As of the publication of this report, this effort has completed the refitting of all equations except the diameter and height growth responses to thinning. We anticipate the public release of the updated model sometime in 2020.

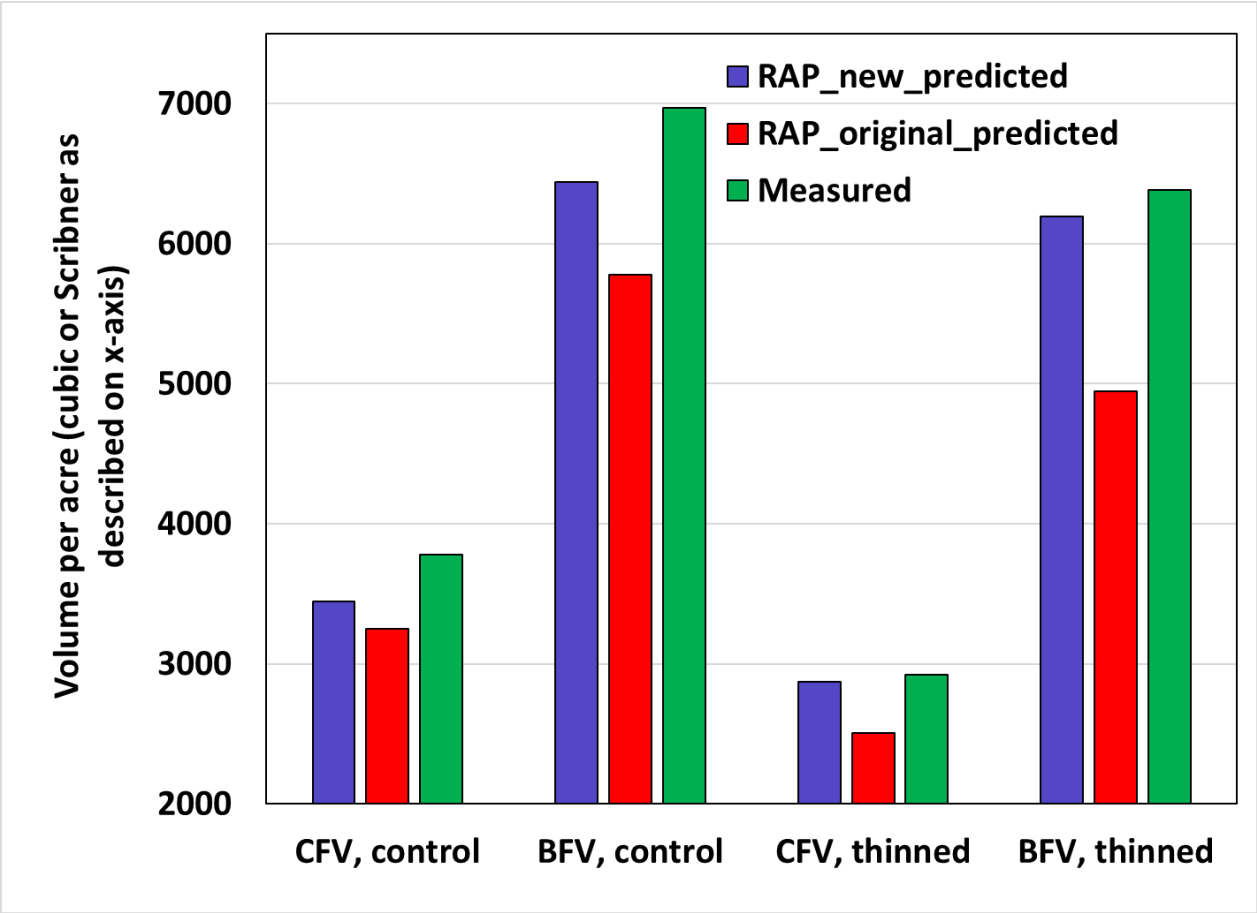

Figure 10. Predicted (using original and new RAP-ORGANON equations) and measured standing cubic and Scribner volume per acre on all HSC Type 2 plots combined.

Red Alder Yield Tables

The goal of the HSC is to improve the understanding, management, and production of red alder and specifically to understand of the effects of stand density management on red alder growth and yield. Then to take this knowledge and to 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 a new variant of ORGANON for red alder plantations (RAP-ORGANON). The database used to develop this model was the most comprehensive ever gathered in the region comprising 53 research sites. The oldest plantations were 18 years old. This version of ORGANON (RAP) was the first red alder growth and yield model what specifically modelled the behavior of red alder plantations. 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.

The first modeling dataset was deficient in old trees/stands. This deficiency resulted in an unknown amount of error in model projections. However, additional, older data is now available. There is currently a large amount of 22 and 27 year-old data. This additional data offers potential for the improvement or creation of stand tables to project yield from managed, even-aged, pure alder stands across the range of site productivity for a series of likely plantation management scenarios. These yield tables would be a welcome new tool for forest managers.

The HSC is looking for extra help from cooperators or collaborators to help achieve this goal. Currently, the HSC is consulting with the Washington Hardwood Commission and has developed a preliminary methodology for developing stand tables based on the original version of RAP-ORGANON. This methodology was as follows:

1) HSC Type 2 sites were classified into three productivity classes- high, medium, and low.
2) Seventeen or 22 year-old) data from three sites from each productivity class was selected.
3) After deciding on merchantability standards ((30 ft target log length, 5-inch min. top, 8-inch trim), the original version of RAP-ORGANON was used to generate Scribner volume estimates in 5 year intervals for the following three treatments: plant at 250tpa, plant at 525tpa, and plant at 525tpa and PCT to 230tpa at age 7.

Preliminary findings include:

- Volume estimates on Medium to High Productivity sites are 25% to 50% higher than "normal yield" from natural stands (Chambers, C.J. 1983. Empirical yield tables for predominantly alder stands in western Washington. 4th print. DNR Rep. 31. Olympia, WA: Washington State Dept. of Natural Resources).
- Thinning increases yield of larger log sizes (>8 inch scaling dia), but it reduces total yield somewhat (>5 inch dia).
- Thinning has a greater impact on medium productivity sites compared to high productivity sites.

Once the updated growth model is available, the HSC is intent on publishing a suite of red alder stand volume tables. Until then, however, the HSC would like further input from regional foresters as to what information should be presented and how the stand tables would be structured.

Red Alder Lumber Recovery Study

Introduction

With the increasing reliance on short-rotation plantation forestry, log sizes continue to decline. Research has previously shown that Douglas-fir trees harvested at younger ages do not produce the same log and lumber grade yields as those harvested from older stands (Barbour & Parry 2001, Weiskittel et al 2006). However, only a limited amount of research has been done on the influence of intensive management activities such as vegetation control, precommercial thinning, and fertilizer application on wood quality characteristics (Sonne et al. 2004; Gartner 2005) with no existing studies on red alder. It has been shown that silvicultural activities associated with sort-rotation plantation management increases juvenile wood content and knot size (Fahey et al. 1991; Gartner 2005). However, gains in lumber yield may possibly outweigh any negative consequences for log or product quality (Sonne et al. 2004). Some important individual tree attributes that are sensitive to stand condition and influence lumber quality are stem form (i.e. taper), proportion of juvenile wood, and branching characteristics (number and size). This study will test the influence of intensive management on red alder log quality.

Very few, if any red alder plantations have been commercially harvested. In addition, managed plantations (of all species) differ in rotation ages, harvest volume, lumber recovery, etc. from natural, unmanaged plantations. Therefore, given that many red alder plantations are approaching harvest, the HSC and Cascade Hardwood Group have initiated a project to obtain information relative to the recoverable volumes and grade yields of lumber from managed stands of red alder in the Pacific Northwest. Cascade Hardwood Group is an ideal cooperator since they have undertaken numerous mill/lumber recovery studies. Currently, there is no information available on the volume, grade recovery, and product value of logs from managed stands of red alder.

Objectives

The goal of this study is to provide valuable information for land managers and for mill owners on the recoverable volumes and grade yields of lumber from managed plantations of red alder. The specific objectives of this project are:

1) Describe characteristics of trees and logs from red alder plantations with various silvicultural regimes (varying planting density, pruning, and precommercial thinning).
2) Estimate total lumber volume recovery rates, grade recovery percentages, overrun percentage, cubic recovery ratio (CRR) and lumber recovery factor (LRF) for the different silvicultural treatments.
3) Compare estimates of lumber recovery variables for managed stands with "woods-run" or industry averages for unmanaged, natural stands).
4) Assess the applicability of current red alder log grades and buyer specifications for use on logs from managed stands. How well do log grades/log buyer specs predict lumber recovery for alder logs from managed stands?

Previous Volume and Yield Estimates

In contrast to softwood species, few studies have been conducted on product (or lumber) recovery from western hardwood species. The only available information on growth and volume characteristics for red alder is based on material from unmanaged, natural stands. Volume tables have been developed based on Scribner and International log rules and cubic volume (Chambers 1986, Johnson et al. 1949, Worthington et al. 1960). This study should provide accurate volume information as it pertains to silvicultural treatments (i.e. management regimes).

Previous recovery studies do exist from unmanaged, natural stands of red alder. Pfeiffer and Wollin (1954) conducted a recovery study based on data from 472 red alder logs harvested in Oregon. The logs processed in this study were 8 feet long with top diameters ranging from 10 to 24 inches dbh. Plank et al. (1990) conducted a study based on a sample of 159 red alder trees in the coastal range of northwest Oregon. These trees ranged in size from 12 to 28 inches dbh and were from 49 to 116 feet tall. Average age was 66 years with individual stems varying from 31 to 102 years. The LRF (ratio of board feet of lumber tally per net cubic foot of log input) for logs in the 9-inch-and-larger diameter class ranged from 4.3 to 4.4 board feet. Regression equations were developed to calculate grade recovery (percentage of recovery values) as a function of log diameters. In this study, it was estimated that recovery of the two highest grades of lumber (Select and No. 1 Shop) increased from 4 percent for 7-inch logs to 88 percent for 23-inch logs. Plank and Willits (1994) also conducted a second study using 153 red alder trees that were harvested from Northwest Washington. These trees were slightly younger, but of a similar diameter range. Slightly higher grade recovery values were obtained in the Washington study. More recently, Brackley et al (2009) quantified the recovery of lumber from a 46 year-old natural stand of red alder from Southeast Alaska. The study compared red alder in southeast Alaska to other regions of the Pacific Northwest and provided information useful for inventory, forest management, and appraisal purposes. The study specifically provided information on the characteristics of trees and logs, compared volume and grade recovery with yields from other studies and compared overrun percentage, cubic recovery ratio (CRR) and lumber recovery factor (LRF) from the Alaska material with reported values from other regions. They determined that there were no significant differences in material between that log resource and other regions in the Pacific Northwest. As can be seen from these studies, the trees used were much older and larger than trees (i.e. logs) expected to be produced from short-rotation, managed plantations.

Site Selection

Two sites are potential candidates for this study. Both are in NW Washington, owned by Swaner Hardwoods and managed by Goodyear-Nelson. These sites are two of the first HSC Type II installations established. The first, Humphrey Hill (#4201) was established in 1989 and the second, Clear Lake Hill (#4202) was established in 1990. Table 8 describes the site characteristics.

Table 8. Characteristics for the candidate sites to be used in this study.

Site Name	Humphrey Hill	Clear Lake Hill
Establishment date	1989	1990
Latitude	48.58	48.47
Longitidue	122.18	123.03
Elev (ft)	400	500
Slope (%)	5	35
SI(50) (ft)[a]	115	105
SI(20) (ft)[b]	75	65

[a]Calculated pre-establishment using the Site Selection Method from Harrington (1986)
[b]Calculated from control treatment tree top heights using the equation in Weiskittel et al (2009)

Each site is composed of 10 different silvicultural treatments of approximately one acre each (Figures 11 & 12). Within each silvicultural treatment is a 1/3 acre measurement plot where diameter, height, and height to live crown has been measured for individually tagged trees at least seven times up to age 27.

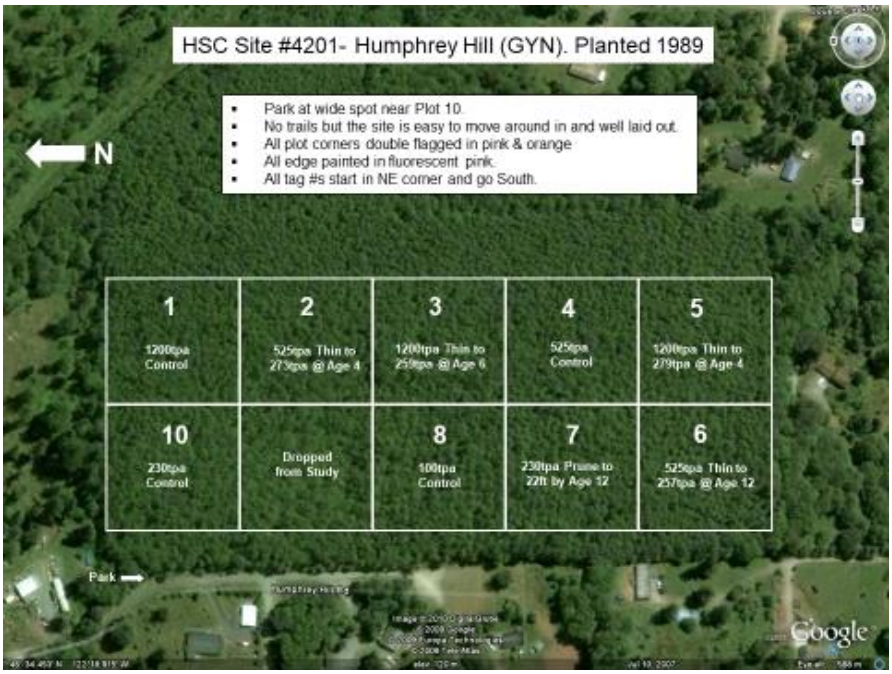

Figure 11. Site map for Humphrey Hill showing silvicultural treatments.

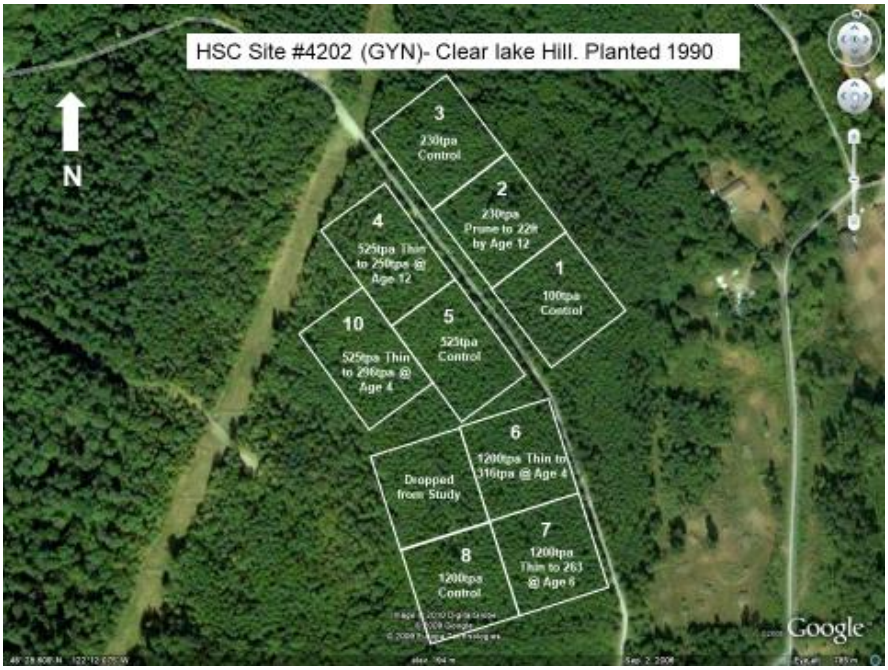

Figure 12. Site map for Clear Lake Hill showing silvicultural treatments.

Timing

The proposed timing of this study is during the Fall 2020/Spring 2021 winter after Humphrey Hill has had its 32-year measurements and when the harvesting plan has been approved by Swaner Hardwoods. It has been proposed that only one site will be used in this study. Then, if there is interest, the other site could be sampled in the future.

Harvest and Logging Plan

The sale of the timber and all associated logging, trucking and milling costs will be negotiated between the HSC, Cascade Hardwood, and Swaner Hardwoods. Harvesting will be done using ground-based equipment with the specific logistics determined by Cascade Hardwood staff and conveyed to the logging contractor. Likewise, the log tracking methods will be determined by Cascade Hardwoods.

Log Selection

The number of trees from each treatment that will be selected for this study will be determined by HSC and Cascade Hardwood staff. Options for tree selection include by treatment plot, by measurement plot, or by individually tagged trees. The number of logs used in this study will also be determined by the bucking methods used. Two options currently being considered are 1) landowner preferred- 20ft lengths, or 2) mill preferred length for butt log then cut to a 5 or 6 inch small-end diameter. The delivered logs will be unloaded and placed on bunk logs in the wood yard at the Cascade Hardwood Group mill in Chehalis, WA. All logs (either long- or short-logs) will be scaled according to the methods used by Cascade Hardwood. Additional scaling methods could include:

- Cubic content using the National forest cubic scaling handbook (USDA FS 1991).
- Stem analysis methods where diameter outside bark will be taken at multiple locations along the log (locations TBD). Volume would then be calculated for each section and total stem volume would be based on the sum of the section volumes. The bark thickness equation from

Bluhm et al (2007) will be used to convert outside bark measurements to bark-free measurements.

Once the long-length sections are scaled and measured, all material will be bucked into mill-length logs. In accordance with current industry practices, the logs will be cut into 10- and 12-foot lengths for sawing. The short logs will be scaled and graded in accordance with the above-cited scaling procedures to obtain estimates of both board foot volume (Scribner C) and USDA Forest Service cubic foot values. All short logs will be assigned numbers using a coding system that allows identification of the long log of origin and position (butt, middle, top) within the long log.

Log and Lumber Processing and Lumber Grading

The critical aspects of log and lumber processing and lumber grading will be handled by the experts at Cascade Hardwood.

Deliverables

Stand and tree mensuration data, by treatment, will be determined by current HSC data and by a standard timber cruise. Metrics may include:

- Trees per acre
- Basal Area
- Total Cubic foot volume
- Tree dbh
- Tree Height
- Tree Height to Live Crown (or Crown Ratio)
- Height to Merchantable Top
- Individual Tree Merchantable Cubic Foot Volume

Furthermore, this study would be an excellent opportunity to collect taper data on merchantable-sized trees, branches, and tree crown widths. The taper data would improve RAP-ORGANONs volume estimation routine, the branch data might be important since red alder lumber grade is based primarily on the presence of knots and the crown width data, although having little relation to this study, is an important variable in RAP-ORGANON model but very hard to come by.

In addition, merchantable board foot volume by log diameter class and treatment will projected using the HSC data and RAP-ORGANON. These estimates can then be compared with gross volume estimates from cruise data. Figure 13 is an example of projected volume estimates by log diameter class, treatment, and site.

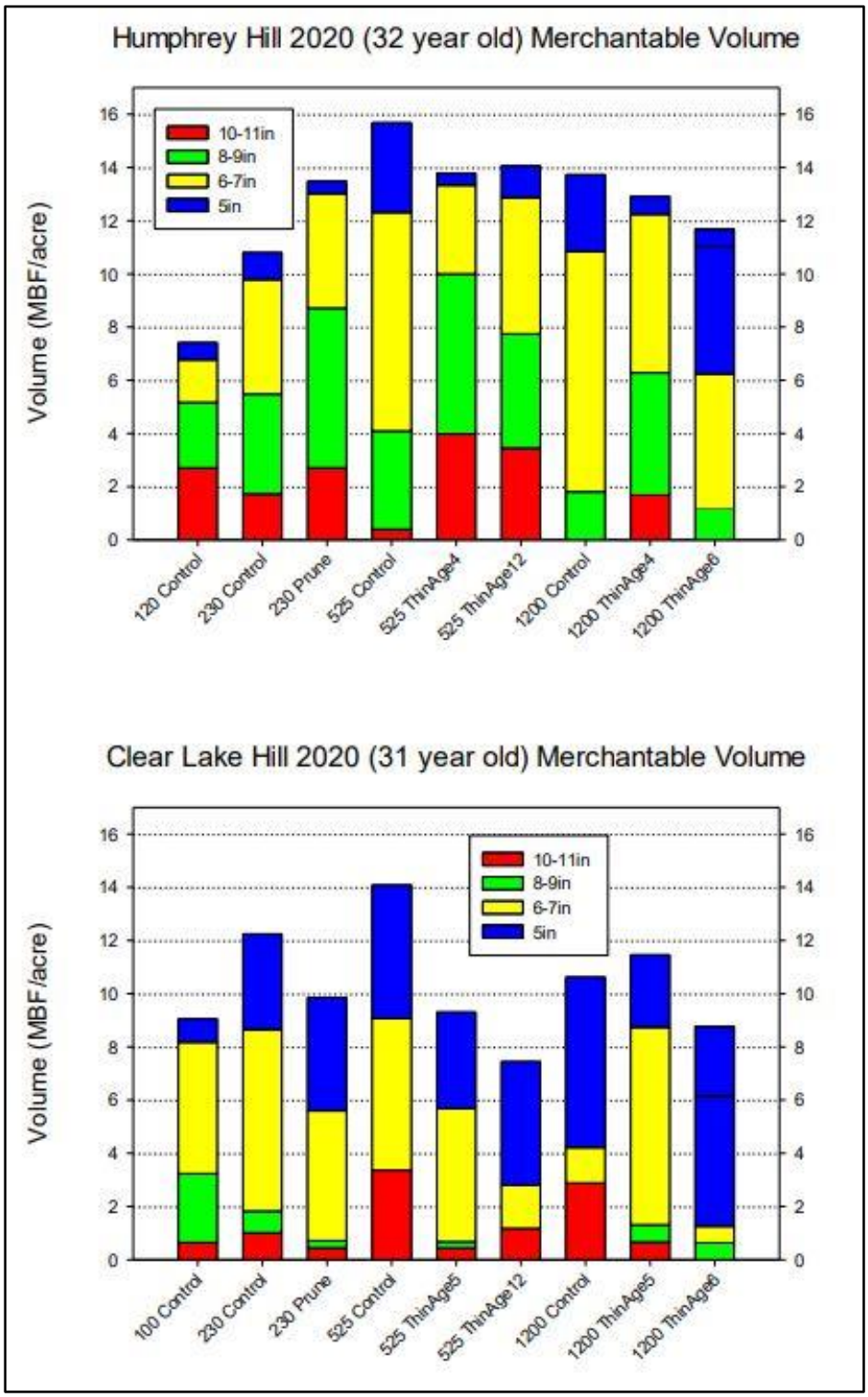

Figure 13. Projected volumes by treatment and log diameter class for a) Humphrey Hill, and b) Clear Lake Hill.

Log Sample Measurements

Stem characteristics by treatment and log diameter class will be determined. Characteristics from long logs may include:

- Number of samples
- Stem length
- Top diameter
- Gross and net scale Scribner C
- Gross and net cubic scale volume
- Gross cubic volume from the stem analysis measurements
- Weight

Characteristics from short logs may include:

- Short logs per stem
- Gross and net scale Scribner C
- Gross and net cubic scale volume

Lumber yield and quality would be calculated for each silvicultural treatment, summarized and used to calculate:

- Total lumber volume
- Cubic lumber recovery (ratio of recovered lumber volume to actual log volume)
- Lumber recovery factor
- Volume weighted grade average
- Estimated value based on current prices.

Lumber Volume and Grade Recovery by Tree, Long and Short Log Lengths would be summarized for each silvicultural treatment. The basic characteristics and resulting tally of lumber by grade for each log diameter class would be reported. These characteristics may include:

- Board feet by grade and scaling diameter
- Lumber recovery by grade and scaling diameter
- Percent grade for each scaling class
- Overrun of net log scale
- Cubic recovery ratio (CRR)
- Lumber recovery factor (LRF)
- Average recovery ($) by gross scale class
- Value lumber tally from log
- Value/mbf of tally from log

Comparison of Yields With Natural Stands

Recognizing the differences that exist between sample characteristics, production systems, products, and applied grading rules, the lumber recover results from this study (e.g. CRR and LRF) will be compared to the results of previous studies from unmanaged, natural red alder stands. This study would provide information that can be used for inventory, forest management, and appraisal purposes and provide information for mill owners and entrepreneurs interested in producing lumber products.

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Outreach and Education

Washington Hardwoods Commission 2019 Annual Symposium

Glenn Ahrens, director of the HSC, was invited to present on "OSU Hardwood Silviculture Cooperative Update at the WHC 2019 Annual Symposium on June 13, 2019 in Kelso, WA. Glenn gave an overview of the HSC including:

- History
- Cooperators
- Research Objectives
- Outreach Activities
- Current and Future Projects

Doug Mainwaring, with the Center for Intensive Plantation Silviculture (CIPS) was also invited to present on "RAP-ORGANON: The Particulars and Performance of the 2019 Updates". Equations within the RAP-ORGANON growth model have been updated using the latest measurements from the HSC plot network. He described the details of the updates and its validation with an independent data set.

The presentations can be found at:
http://www.wahardwoodscomm.com/2019_AnnualSym.html

WA Family Forest Field Day

This workshop, sponsored annually by Washington State University Extension was held in McCleary, WA August 24, 2019. 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. Andrew Bluhm, Associate Director of the HSC taught "Hardwood Management".

Long-Term Ecosystem Productivity Field Visit

The Long-Term Ecosystem Productivity project (LTEP), currently directed by Bernard Bormann (Professor in the College of Environment UW and Director of the Olympic Natural Resources Center) led a field trip to the Mount Hebo Old-Growth Restoration Study on August 27th, 2019. This study was installed to address specific concerns of the Northwest Forest Plan, namely how to grow old-growth from existing plantations and produce timber products. The Oregon Coast range has been managed intensively for timber production for many years. The results have been densely stocked young plantations lacking structure, snags, down dead wood, and diversity. On the Siuslaw National Forest, managers and scientists are exploring ways to achieve healthy ecosystems in second growth plantations 30 to 50 years old through thinning. The Thinning Diversity Study has been established there in which four levels of thinning were installed in study areas. Additional species were experimentally planted including: western hemlock, western redcedar, red alder, Sitka spruce, grand fir, and bigleaf maple in addition to Douglas-fir. The thinning trials are monitoring how different

densities of overstory trees effect the development of old-growth characteristics.

Andrew Bluhm was invited to provide insights into the role that hardwoods (especially red alder) would play in achieving healthy ecosystems and producing timber products.

Figure 14. Red alder planted under a thinned overstory of Douglas-fir at the LTEP Mount Hebo Old-Growth Restoration Study.

Direction for 2021

The HSC goals for 2021 are the continuation of our long-term objectives and new projects:

Long-term:

- 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.

Short-term

- Complete the development of the GIS based red alder site selection tool.
- Complete and test the updated version of RAP-ORGANON.
- Complete the creation of red alder stand tables from the updated RAP-ORGANON growth and yield model.
- Develop a strategy for, and maintain the red alder clone bank and develop a .
- Continue measurements on the red alder clone trial.

HSC 2019 Committee Meeting Minutes
July 18, 2019 Chehalis, WA

Business Meeting

Attendees: Andrew Bluhm, Glenn Ahrens- OSU; Calvin Ohlson-Kiehn- WA DNR; Florian Deisenhofer, Cesar Carrion Guidotti, Randy Roeh- Hancock; Joe Monks- Washington Hardwood Commission/NW Hardwoods; Bob Deal- PNW Research Station; Darrel Alvord, Ken Jones, Alan Brunstad- Cascade Hardwoods; Randy Bartelt, Ron Hurn- Port Angeles Hardwood; James Donahey- Gifford Pinchot National Forest; George McFadden, Kenny Ruzicka, Jacob Attebery, Katie Benedek- Bureau of Land Management

The meeting started at 9:00 AM at the Ribeye restaurant in Chehalis, WA office with a welcome from the HSC program leader, Glenn Ahrens. After introductions, Glenn welcomed the new members to the HSC- Cascade Hardwoods and Port Angeles Hardwood. Following that, Andrew Bluhm 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 2018/19) was a busy year.

- 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.
- 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 were "orphaned" making it difficult to get the measurements completed.

Next year (Winter 2019/20) will be a very light year.

- Three Type 2 installations (Blue Mtn., Mohun Creek, and Hemlock Creek) will need their 27th year measurement.
- There are no thinning or pruning treatments required.
- Unfortunately, two (Blue Mtn. and Hemlock Creek) of the three installations are "orphaned" since the Washington Hardwoods Commission (WHC) will not support the measurements.

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 fiscal year 2019 were $38,500, down considerably from the dues received the year before.
- Actual FY2019 costs (with the exception of increased travel costs) were in line with what was projected for FY2019.
- Andrew's time remained at 0.40FTE.

- The HSC will be carrying appx. $12,000 into FY2020.
- Starting in 2020, the HSC will be having two new dues-paying members- Cascade Hardwoods and Port Angeles Hardwoods.
- But because of the increased operating costs and increased overhead, Andrews's time is projected to decrease to 0.35FTE in FY 2020.

Andrew then gave a summary of the latest refitting of the RAP-ORGANON growth and yield model. For a full summary, please see the HSC 2019 annual report. Key points were:

- When the original alder plantation version of ORGANON (RAP1) was first produced in 2011, the oldest measured data from alder plantations were 18 years total age.
- Comparison of model projections (using RAP1) to measured plot data from the HSC network found some inconsistencies, most notably significant underestimates of diameter in thinned stands, and overestimates of mortality in unthinned stands.
- A refit of updated, older datasets was done by CIPS (Center for Intensive Planted-forest Silviculture) allied with the HSC.
- The new dataset included over 70,000 more measurements than the dataset used for RAP1 fit.
- Thinning modifiers were based on nearly 200 plots subjected to thinning, with remeasurements ensuring that more than 50 plots had at least 10 years of growth since thinning and 15 had 15 or more years of growth response.
- The Weiskittel et al. (2009) site index equation was refitted to derive growth effective age based on the current estimate of site index and the current height of the tree.
- The diameter growth equation was the same as that used for the original model.
- Only minor changes were made to the mortality equation, height to crown base equation, and the thinning modifier for height increment.
- The greatest changes were those to the height increment equation and the thinning modifier for diameter growth.
- The new height growth modifier predicted a negative impact of thinning on height growth similar to the original equation.
- The original effort to predict the direct effect of thinning, undertaken with much less time since thinning, found no significant direct effect of thinning on diameter growth. With additional time since thinning and many more measurements, a diameter growth thinning modifier verified that thinning did result in a significant and positive direct effect on diameter growth.
- On the stand level, the new equations underpredicted standing trees per acre, basal area and stand volume on both control and thinned plots, though the new fits are an improvement relative to the original equations. Importantly, given the identified shortcoming in the predicted diameter increment response to thinning, the difference between the measured values and the predicted values on thinned plots are greatly diminished using the new equations, with average standing Scribner volume underestimated by 7.6 and 3.0% on control and thinned plots with the new equations, versus 17.2 and 22.5% with the original equations, respectively.

Glenn then discussed the ongoing effort to produce alder plantation growth and yield tables. These yield tables would be generated with predictions from the updated growth model. Glenn and the audience voiced the following comments and questions:

- Is the HSC wanting to produce just a set of growth and yield tables or take it a step further by producing a management guide for alder?
- Would the growth and yield tables include economic variables?

- Technical assistance is needed from the HSC members to define the parameters of the tables and included variables.

The next topic, alder genetics, was presented by Andrew. This general topic was broken down into three components- the WSU alder clonal seedling program, an alder clone bank, and an alder clone trial.

WSU clonal seedling program:

- Clonal forestry in eucalyptus, poplar and other hardwood species have shown tremendous strides in improving wood properties and shortening rotation times. Therefore, an alder clonal program would allow for the production of large numbers of plants that have been selected to exhibit specific wood characteristics coupled to improved growth.
- In 1997, Weyerhaeuser initiated a clonal alder program. The alder clones were selected for the best form, growth, and characteristics suited to processing. Clones were tested for disease, frost, and drought tolerance.
- In 2011 Weyerhaeuser gifted the Alder Program (under a variety of contractual obligations) to Washington State University Research Foundation (WSURF).
- Initially, trees were selected (based on multiple criteria) from existing alder plantations. Branches from these trees were brought to the lab and treated to initialize new growth. Then, cuttings were taken, rooted and become the parents for further testing.
- These rooted cuttings were then placed out in replicated trials over multiple sites and years to assess the growth and tree form of the clones. Early results demonstrated significant gains in diameter and height compared to unimproved trees.
- In total, thirty-six (36) of the 648 clones were selected for production.
- The gain (from the top 20 clones) has been shown to be:
    - DBH=1.2155
    - HT=1.2165
- WSU has the objective to produce seedlings for sale to the general public. The expected availability is as follows:
    - 15K available for fall 2020
    - 80-100K available for spring 2020
    - 120K available for 2021
    - 200K available for 2022
- Seedling costs are yet undetermined.
- In addition to seedlings, WSU is expecting to produce improved seed also available to the public. The expected availability is not yet known but expectations are for 2020 production.

Clone bank (for a full description please see the 2019 HSC Annual Report):

- The HSC, WHC, and Hancock Forest Management launched an effort to establish an alder clone bank, using material from WSU's tree improvement program.
- Multiple locations were explored for the establishment of the clone bank including the J.E. Schroeder Seed Orchard (ODF), Webster Forest Nursery (WA DNR), Peavy Arboretum (OSU), the Travis Tyrrell Seed Orchard (BLM), and the Walter Horning Seed Orchard (BLM). The ODF Schroeder facility was chosen for several reasons: ODF has historically been an HSC cooperator and is a strong supporter of tree improvement and gene conservation, the location is fully integrated for tree improvement and has excellent facilities and knowledgeable staff, and the climate at the location is suitable for alder.

- The clone bank would preserve the improved genetics developed by the program and provide a source of vegetative material and/or seed for further propagation. A clone bank to hold the genetic material safely is ideal for the long term storage of the selections. The exact number of clones (~20), raments per clone (~3-6), spacing (~10' x 10'), and the establishment (~$5,000/acre) and maintenance (~$700/acre) costs, and funding sources are currently being determined.

Clone trial (for a full description please see the 2019 HSC Annual Report):

- Although early trials indicate gains in growth, because of the contractual obligations, the specific clones and gain values are proprietary. Therefore, the objective of this study is to establish a clone trial on public land to compare the performance of alder clones on the OSU Blodgett tract, plus a woods run control.
- The trial will be planted in April 2020 in an unfenced area on the OSU Blodgett Forest. The area (~1.1 acres) will have been cleared of any slash piles.
- The clones will be rooted cuttings and grown in PSB 615A plugs. The woods run trees will be grown by PRT Hubbard from the 041 seed source (SW WA), bought from WA DNR. Seedlings are PSB 615A plugs.
- The BLM offered to provide personnel to help bag and tag the seedlings.
- The study design is a randomized complete block design with the number of blocks determined by the number of clones to be tested and the availability of material (ideally 25 blocks). Each block will contain 16 treatments: 14 clones plus a woods run control included twice (to account for its expected higher inter-tree variation).
- Each treatment within each block is represented by an individual-tree plot, with planting locations randomly assigned. The trial will be surrounded by a minimum of two border rows of woods run control trees. All test trees, not including border trees, will be tagged with sequentially numbered aluminum tags.
- Initial tree size will be measured on either a) a subset of trees prior to planting, or b) all trees immediately after planting. Survival will be measured in year age 1 and 2. Tree size (height and diameter measurements) will likely be made in year 3, 6, 9, 12, and 17.

Brian Kyle (Northwest Hardwoods Canada) brought to the attention of the group that there is an alder improvement program out of British Columbia, specifically an improved seed orchard run by the BC Ministry. With help from Brian, Andrew will pursue gathering information from that program to help guide the HSC's work with alder genetics.

Mill study

Conducting a mill study on plantation-grown alder has always been a long-term goal of the HSC. Now with many HSC plantations reaching merchantability and two mills joining the HSC, members think it is time to start planning a mill study. It was decided to form a subcommittee to pursue this topic. Both Cascade Hardwoods and Port Angeles Hardwoods volunteered for this role.

<u>Field Tour</u>

The afternoon was spent touring the Cascade Hardwood log yard and mill. Unfortunately, cottonwood was being milled that day but much was learned about alder log quality, mill productivity, and alder markets. Many thanks go out to Darrell Alvord and others from Cascade Hardwood.

HSC Financial Support 2020

Cooperator	Support
BC Ministry of Forests	$8,500
Bureau of Land Management	$8,500
Cascade hardwood LLC	$8,500
Goodyear-Nelson Hardwood Lumber Company	$4,500
Hancock Natural Resource Group	$8,500
Oregon Department of Forestry	------
Port Angeles Hardwood	$8,500
Siuslaw National Forest	------
Washington Department of Natural Resources	$8,500
Washington Hardwood Commission	------
Subtotal	$55,500
Oregon State University	$15,905
Total	$71,405