

Red Alder Management Tools

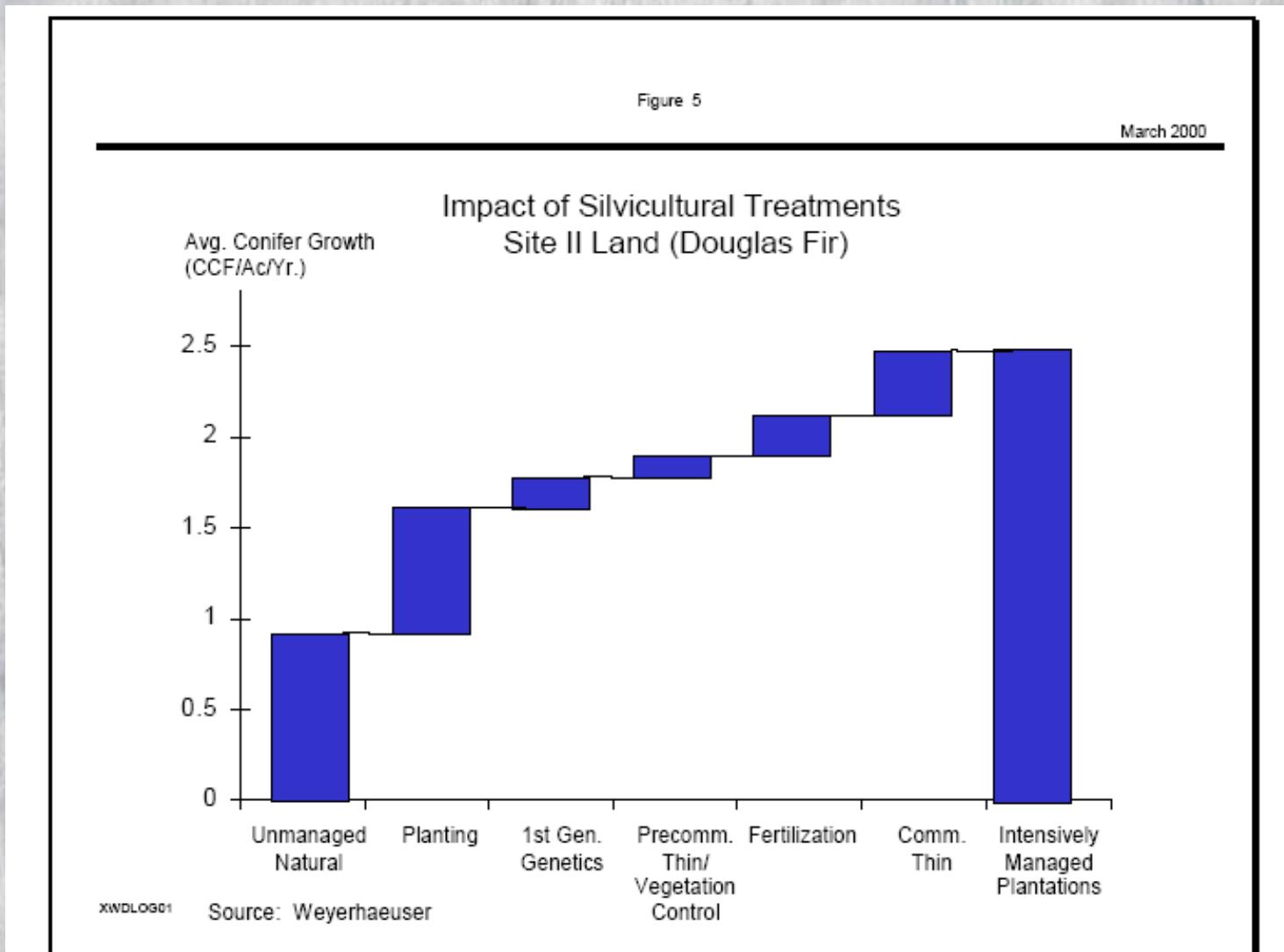
WHC Annual Symposium, June 14, 2018

Andrew Bluhm, Associate Program Director, HSC



Management Gains

- We know the benefits of intensive management for Douglas-fir. Outputs can be doubled! Same can be expected for red alder.



Management Gains

Yield expectations for managed red alder compared to natural stands

Management regime	Rotation length	Yield 30-foot average log length 5-inch plus	Percentage "high-value" sawlogs 8-inch plus
Intensive plantation management (speculative projections from 9-15 year old plantations)	25-30 years	13-17 mbf/acre	60-80%
Thinning existing alder patches (estimates from case studies)	30-40 years	10-15 mbf/acre	50-80%
Natural, unmanaged (based on empirical yields)	30-40 years	8-12 mbf/acre	10-30%

Red Alder Management Tools

Original (& still useful) Tools

- Site Index Equation
- Site Selection Tool
- Volume Tables
- Density Mgmt Diagram



Original (& still useful) Tools

- Site Index Equation

- Site index curves have been developed for natural stands of red alder using a base age of 50 years.

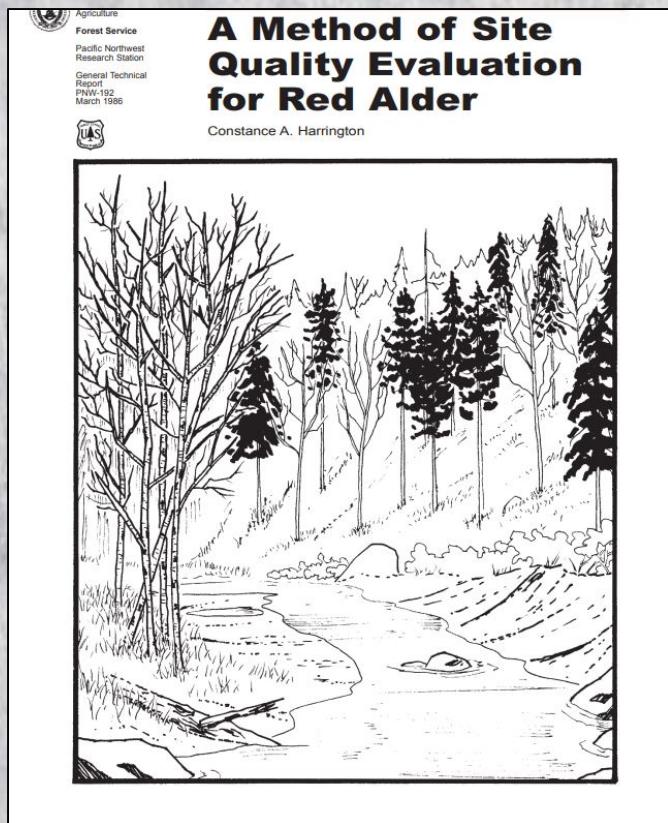
		Red Alder Site Index SI_{50} by Age and Height - ages 5-20 years from seed Find SI in the table using ave. height of dominant trees in left column, age in top row																		
height	age	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20			
10	59																			
12	69	62																		
14	75	69	62																	
16	82	72	66	62	59															
18	89	79	72	66	62	59														
20	92	85	75	72	66	62	59													
22	98	89	82	75	72	66	62	62	59											
24	102	92	85	79	75	72	69	66	62	59										
26	108	98	89	82	79	75	72	69	66	62	59									
28	112	102	92	89	82	79	75	72	69	66	62	62	59							
30	115	105	98	92	85	82	79	75	72	69	66	62	62	59						
32	118	108	102	95	89	85	79	75	75	75	72	69	66	66	62	62	59			
34	121	112	105	98	92	89	82	79	75	75	72	69	66	66	62	62	62			
36	125	115	108	102	95	92	85	82	79	75	75	72	69	69	66	66	66			
38	128	118	112	105	98	92	89	85	82	79	75	75	72	69	69	66	66			
40		121	112	105	102	95	92	89	85	82	79	75	75	72	72	72	69			
42		125	118	112	105	98	95	92	89	85	82	82	79	75	75	72				
44		128	121	112	108	102	98	95	92	89	85	82	82	79	75	75				
46			121	115	112	105	102	98	92	92	89	85	82	82	79	75				
48			125	118	112	108	102	98	95	92	89	89	85	82	82	79				
50			128	121	115	108	105	102	98	95	92	89	89	85	85	82	82			
52				125	118	112	108	105	102	98	95	92	89	89	85	82	82			
54				125	118	115	112	105	102	98	95	95	92	89	89	85	82			
56				128	121	118	112	108	105	102	98	95	95	92	89	89	89			
58					125	118	115	112	108	105	102	98	95	92	92	92	89			
60						125	121	118	112	108	105	102	102	98	95	92	92			
62						128	125	118	115	112	108	105	102	98	98	95	92			
64							125	121	118	112	108	108	105	102	98	98	95			
66							128	125	118	115	112	108	108	105	102	98	98			
68								125	121	118	115	112	108	105	105	102	98			
70								128	125	121	118	115	112	108	105	105	102			
72								128	125	121	118	115	112	112	108	105	105			
74									128	125	121	118	115	112	108	108	105			
76										128	125	121	118	118	115	112	108	108		
78											128	125	121	118	115	115	112	108		
80												128	125	121	121	118	115	112		
82													128	125	121	118	118	115		
84														128	128	125	121	118	118	
86															128	125	121	121	118	
88																128	125	121	121	118
90																	128	128	125	121

Calculated from equations of Harrington and Curtis 1986,
converted to 50-year base by Thrower and Nussbaum 1991

Original (& still useful) Tools

■ Site Selection Tool

- The most common way of determining site index (base age of 50 years) uses the soil-site method developed by Harrington (1986).



Site evaluations for red alder					
Soil-site factors					
1	2	3	4	5	6
Geographic and topographic position	Soil moisture and aeration during the growing season	Soil fertility and physical condition	Soil-site property	Score for this site	Soil-site property
Elevation	Internal drainage	Parent material			
Physiographic position	Texture	pH			
Aspect and slope	Soil depth	Organic matter			
Precipitation	Rock and gravel	Bulk density			
Special hazards	content				
	Depth to water table				
Total for factor 1 =	Total for factor 2 =	Total for factor 3 =			
Total for all factors = _____.					
SI ₅₀ = _____ m.					

Original (& still useful) Tools

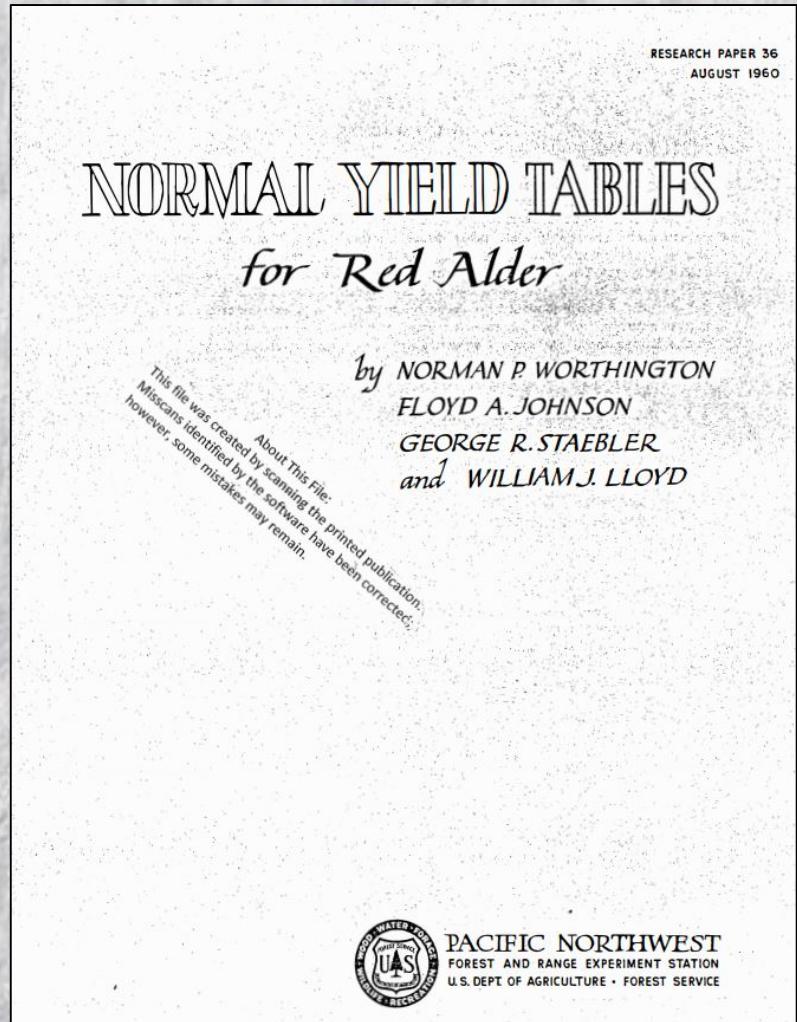
■ Site Selection Tool

- Soils data can be most readily found at the NRCS website

The screenshot shows the homepage of the Web Soil Survey. At the top, there's a navigation bar with links for Contact Us, Subscribe, Archived Soil Surveys, Soil Survey Status, Glossary, Preferences, Link, Logout, and Help. There are also icons for soil samples and a magnifying glass. Below the navigation bar, there are several buttons: Area of Interest (AOI), Soil Map, Soil Data Explorer, Download Soils Data, and Shopping Cart (Free). A sidebar on the left contains a 'Search' dropdown and a 'Area of Interest' dropdown. Under 'Area of Interest', there are options for Import AOI, Address, State and County, Soil Survey Area, Latitude and Longitude, PLSS (Section, Township, Range), Bureau of Land Management, Department of Defense, Forest Service, National Park Service, and Hydrologic Unit. To the right is the 'Area of Interest Interactive Map'. The map shows a satellite view of the Portland, Oregon, area, including parts of Washington state to the west. It highlights several counties: Yamhill, Polk, Marion, Clackamas, Multnomah, and Hood River. Major rivers like the Willamette and Columbia are visible. Roads are shown in yellow, and towns like Portland, Salem, and Clackamas are labeled. A red polygon outlines a specific area of interest. A legend at the top of the map area includes icons for search, zoom, and various map controls. Below the map is a scale bar indicating 0 to 20 miles.

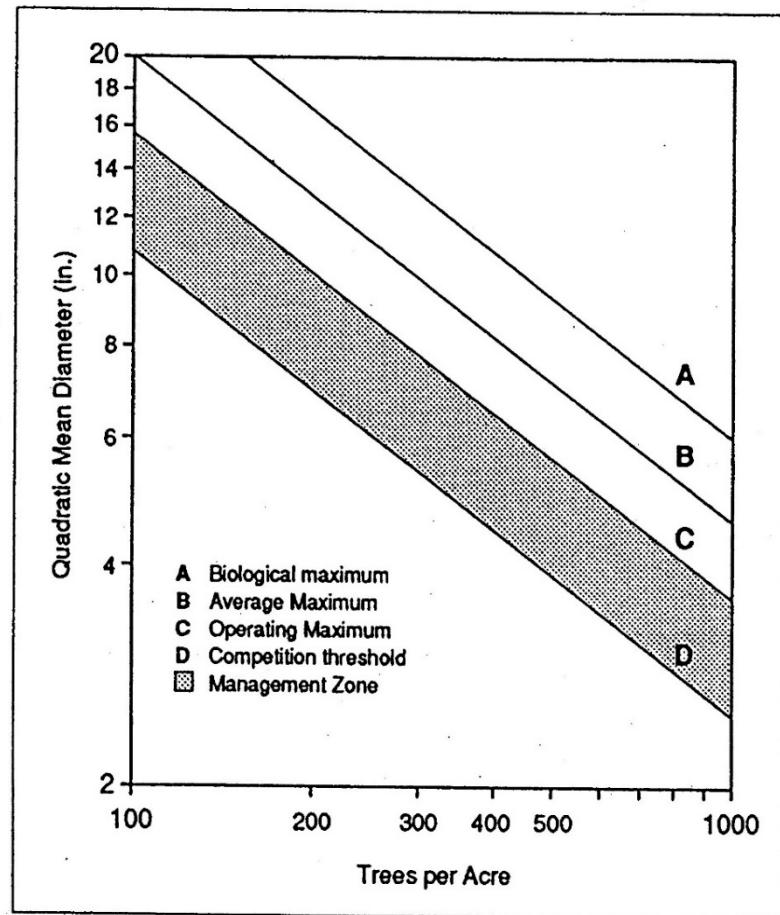
Original (& still useful) Tools

- Volume Tables/Equations
- **Chambers. 1983.** Empirical yield tables for predominantly alder stands in western Washington.
- **Worthington, et al. 1960.** Normal yield tables for red alder.
- **Curtis, et al. 1968.** Volume and taper tables for red alder.
- **Johnson, et al. 1949.** Volume tables for red alder.
- **Browne. 1962.** Standard cubic-foot volume tables for the commercial species of British Columbia
- **Skinner. 1959.** Cubic volume tables for red alder and Sitka spruce.
- **Kozak. 1988.** A variable-exponent taper equation.



Original (& still useful) Tools

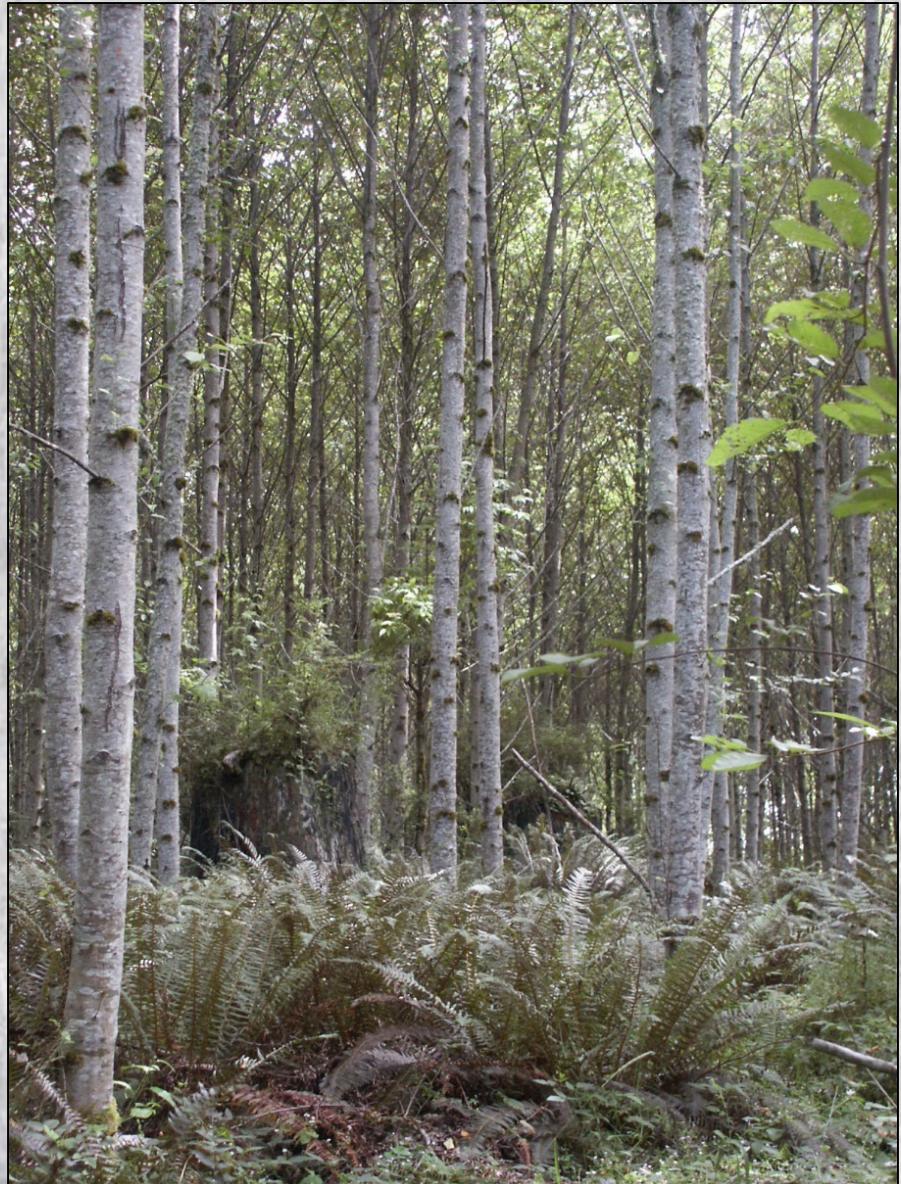
- Density Management Guide for Red Alder (Puettmann et al. 1993)
- Density Mgmt Diagram
 - Defines relationship between growing space and tree size
 - Very useful tool for making decisions regarding stand density (i.e. thinning)



Density Management Diagram for red alder

New (or future) Tools

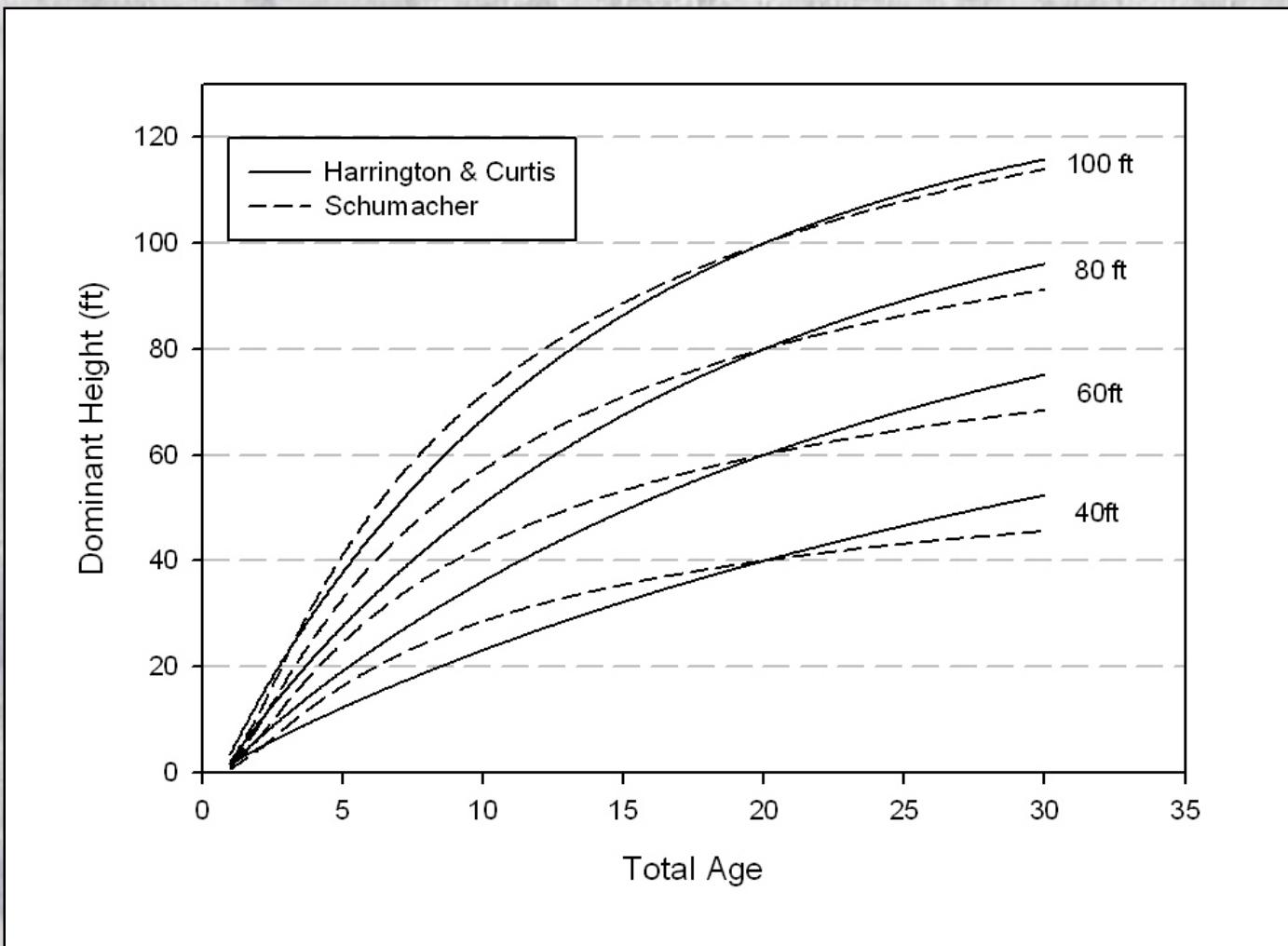
- Site Index Equation
- Site Selection Tool
- Volume/Taper Equation
- Growth & Yield Model
- Volume Tables



New (or future) Tools

- Site Index Equation

Weiskittel, et al. 2009. Modeling top height growth of red alder plantations.

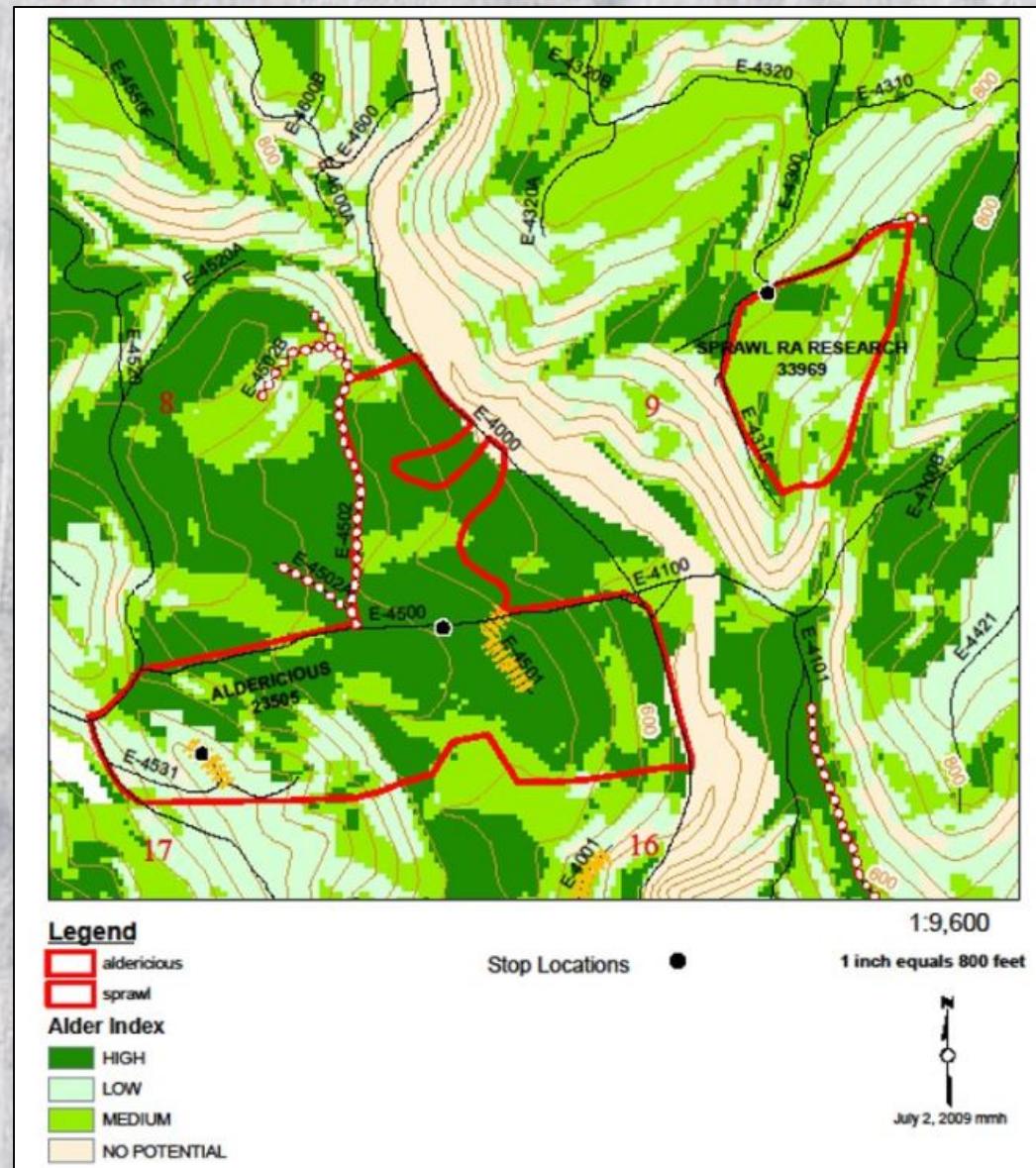


New (or future) Tools

- #### ■ Site Selection Too

- Developed by DNR
 - Uses NRCS
 - PRISM
 - LiDAR/DEM

- Available Western WA & OR



New (or future) Tools

- Volume/Taper Equation

Bluhm, et al. 2007. Taper Equation and Volume Tables for Plantation-Grown Red Alder.



USDA

United States Department of Agriculture
Forest Service
Pacific Northwest Research Station
General Technical Report PNW-GTR-735
October 2007

Taper Equation and Volume Tables for Plantation-Grown Red Alder

Andrew A. Bluhm, Sean M. Garber, and David E. Hibbs

New (or future) Tools

- Volume/Taper Equation

DBH (in)	HT																					Total		
	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120	125	
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

New (or future) Tools

- Growth & Yield Model

- RAP-ORGANON
- Red Alder Growth Simulator
 - CIPS and the HSC, developed a user-friendly interface for RAP-ORGANON using Excel.
 - This program can simulate stand and tree growth under different treatment scenarios (i.e. thinning).
 - “Runs” are controlled by user-specified tree lists, stand information (site index, age and planting density), rotation length and treatment types, merchandising specifications (top diameter, log lengths, trim, etc.), and economic specifications (interest rate, incurred costs and log prices).
 - Output contains tree, stand, and economic data.
- Site Index Calculator:
 - Site indices (base age 20 years) can be calculated based on height-age pairs.
- Site Index Converter:
 - Site indices based on height age pairs (base age 20 years) can be converted to site indices based on the site quality evaluation method (base age 50 years), and vice versa.
- Site Quality Calculator:
 - Predicting site quality on sites where the species of interest is not growing is a useful tool for forest managers. Thus, a built-in calculator for Harrington's (1986) “Method of Site Quality Evaluation for Red Alder” is included.
- Economic Analysis
 - Present net value (PNV) of any treatment scenario can be produced based on age, yield, costs interest rate and inflation rate.

New (or future) Tools

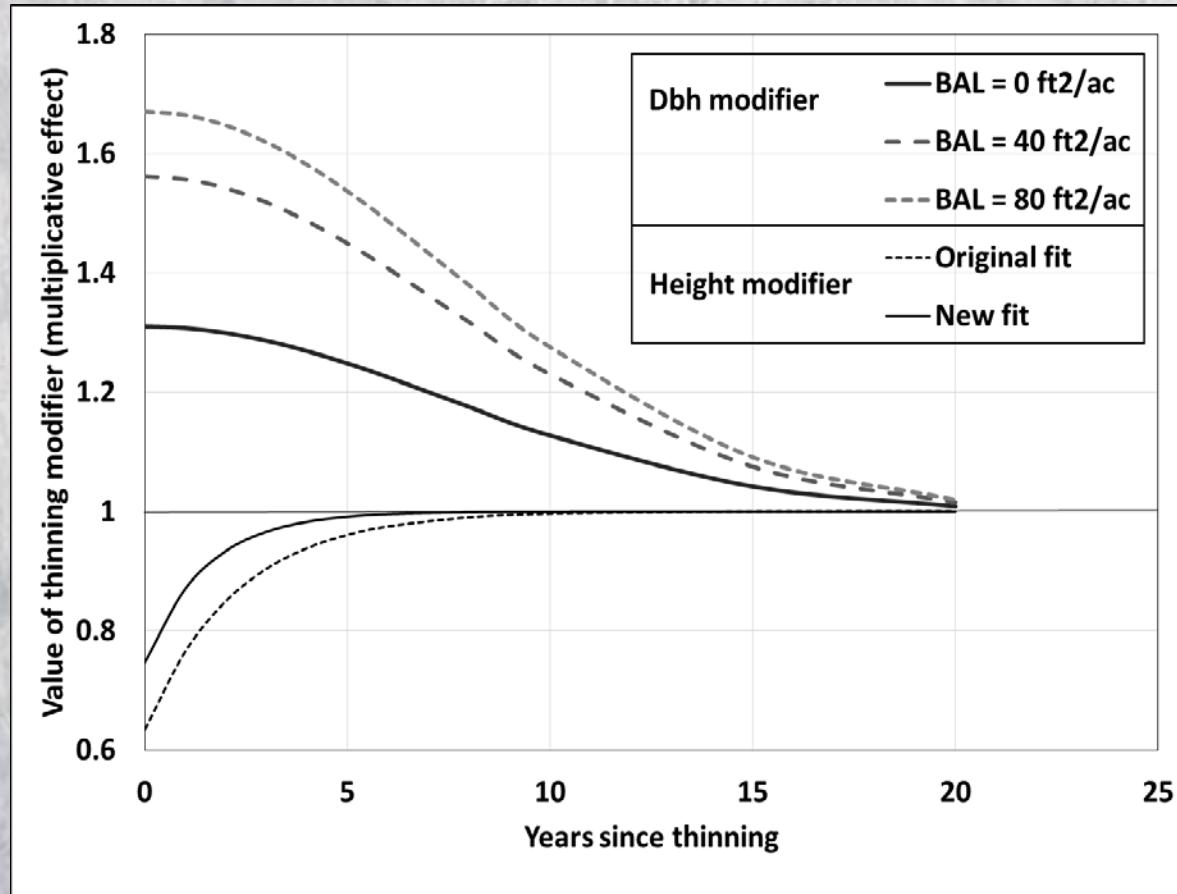
- Growth & Yield Model Update

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

New (or future) Tools

- Growth & Yield Model Update

- Refit RAP-ORGANON Growth Equations

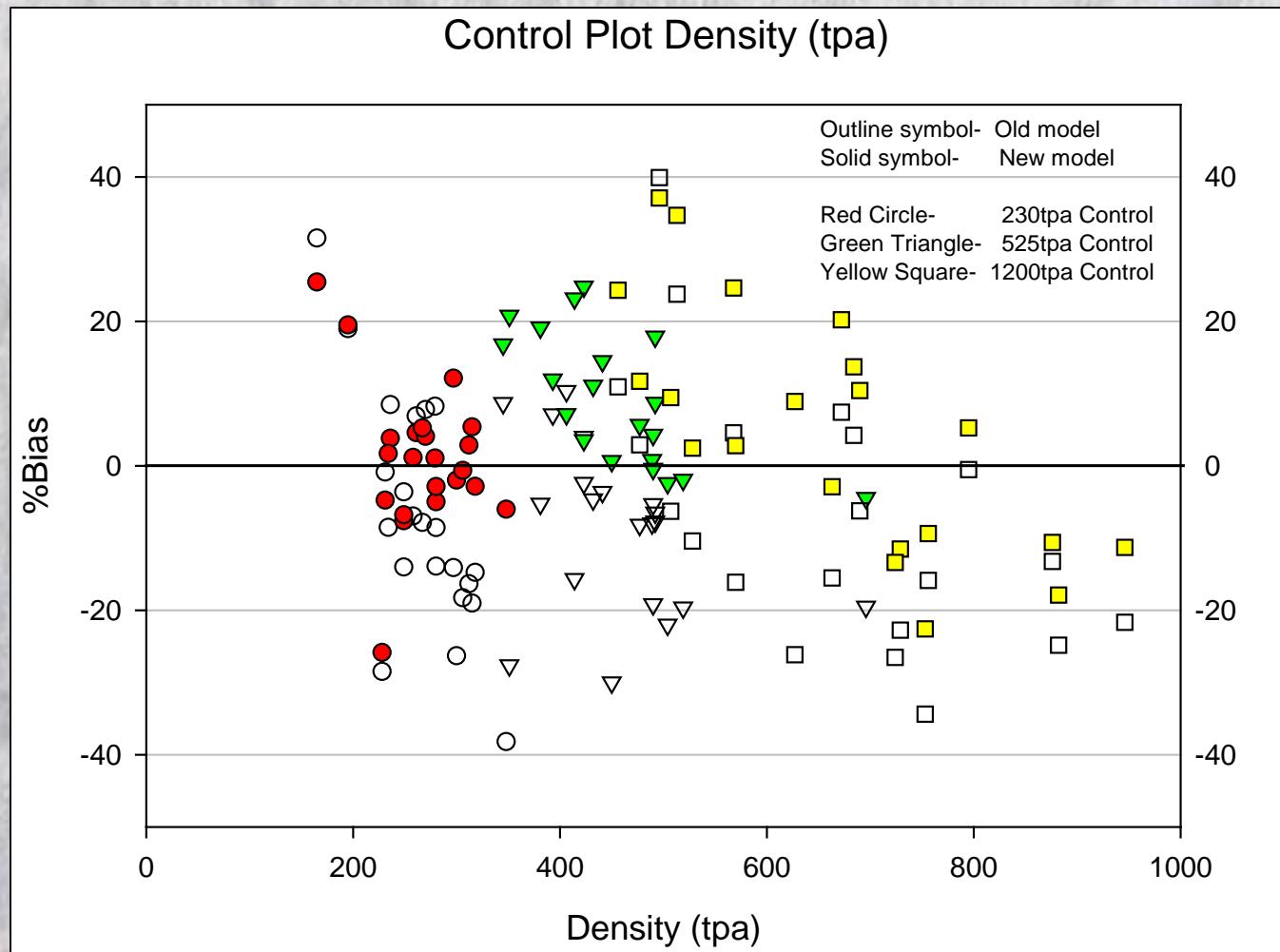


Modifiers for direct thinning effects on DBH and Height growth of red alder in RAP v1 and v1.1, under thinning intensity that removes 60% of the basal area (PREM=0.60).

New (or future) Tools

- Growth & Yield Model Update

- See how well this “updated” model predicts measured data



New (or future) Tools

- Growth & Yield Model Update
 - See how well this “updated” model predicts 22 year data

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

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).

New (or future) Tools

- Growth & Yield Model

- See how well this "updated" model predicts 22 year data

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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).

New (or future) Tools

Volume Tables

- WHC and the HSC are developing a suite of user-friendly volume tables for managed red alder.
- These tables should have the capacity to predict volume by:
 - Cubic feet & board feet
 - Site quality
 - Age
 - Unthinned & thinned
 - Merchandising specifications (i.e. log length & top diameter)

Age (years)	Site index (feet)						
	60	70	80	90	100	110	120
	Board feet						
20	--	--	--	100	1,200	2,400	3,500
25	--	200	1,800	3,500	5,200	6,900	8,800
30	300	2,400	4,600	6,800	9,200	11,700	14,300
35	1,800	4,500	7,300	10,300	13,400	16,600	20,000
40	3,200	6,500	10,000	13,700	17,600	21,700	26,000
45	4,500	8,400	12,700	17,100	21,900	26,900	32,100
50	5,600	10,300	15,300	20,600	26,200	32,100	38,400
55	6,600	12,000	17,800	24,000	30,500	37,500	44,800
60	7,500	13,600	20,200	27,300	34,900	42,900	51,700
65	8,200	15,100	22,500	30,600	39,200	48,100	56,800
70	8,700	16,400	24,700	33,800	42,800	52,100	61,900
75	--	17,500	26,800	36,100	45,700	55,900	66,800
80	--	--	28,100	37,800	48,300	59,600	71,600

Red Alder Management Tools

- Summary: “We've come a long way, baby”

