



# Station Note

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## PRELIMINARY VOLUME TABLES FOR SMALL TREES IN NORTHERN IDAHO<sup>1</sup>

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The introduction of sawmills into northern Idaho which utilize small diameter logs has stimulated interest in trees of sizes formerly considered too small for lumber production. Most of the available volume tables do not include these lower diameter classes. Small-tree volume tables for Douglas-fir, western larch, lodgepole pine, grand fir, and a composite table for all species are presented.

The trees used to construct the tables were growing on medium sites near Athol, Idaho. Each tree was felled and the following information recorded: species, diameter inside and outside bark at the stump, diameter outside bark at breast height, diameter outside bark at every even 8-foot section and total height. On a subsample, diameter inside bark and outside bark were measured to the nearest tenth inch. This information and linear regression analysis was used to develop an equation to predict diameter inside bark at breast height and at even 8-foot sections for every tree.

Inside bark cubic foot volumes were computed using Smalian's formula ( $V = \frac{b + t}{2} L$  where V is cubic foot volume, b is basal area in square feet of the large end, t is the basal area in square feet of the small end and L is the length in feet). Board foot volumes were calculated by diagramming each 1-inch diameter class bolt into the maximum number of 2 x 2's, 2 x 3's or 2 x 4's

that could be recovered. Green lumber dimensions were determined from standards set by the Western Wood Products Association.<sup>3</sup>

Volume table construction was accomplished by regressing volume against diameter squared times height. An examination of the residual plots indicated unequal residual variances for the range of predicted volumes. Consequently, weighted least squares regression was used. For the cubic foot tables, the model  $V = a + bD^2H$  with weights of  $1/(D^2H)^2$  was used where a and b are coefficients, D is diameter breast height, and H is total height. The board foot tables were constructed using the model  $V = bD^2H$  and weights of  $1/D^2H$  where b, D, and H are as previously defined. Volumes presented are for total height above a 1 foot stump.

Users are cautioned that the tables are based upon relatively few trees from one geographic area in northern Idaho. These tables will be updated as additional information is available.

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<sup>3</sup> Western Wood Products Association. 1970. Grading Rules for Western Lumber. Portland, Oregon, p. 52.

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**Table 1. DOUGLAS-FIR (*Pseudotsuga menziesii* var. *glauca*)**

Cubic-foot Volume							Board-foot Volume								
DBH (inches)	TOTAL TREE HEIGHT IN FEET						Basis: trees	DBH (inches)	TOTAL TREE HEIGHT IN FEET						Basis: trees
	20	30	40	50	60	70			20	30	40	50	60	70	
2	0.30	0.37	0.45	0.53			2	0.67	1.01	1.35	1.68			2	
3	0.49	0.67	0.84	1.01			7	1.52	2.27	3.03	3.79			7	
4	0.76	1.07	1.38	1.69	2.00		10	2.70	4.04	5.39	6.74	8.09		10	
5	1.11	1.60	2.08	2.57	3.05		13	4.21	6.32	8.42	10.53	12.63		13	
6	1.54	2.24	2.94	3.64	4.33	5.03	15	6.06	9.10	12.13	15.16	18.19	21.23	15	
7		2.99	3.95	4.90	5.85	6.80	22		12.38	16.51	20.64	24.76	28.89	22	
8			5.11	6.35	7.60	8.84	13			21.56	26.95	32.34	37.74		
9			6.43	8.00	9.58	11.15	8			27.29	34.11	40.94	47.76		
10			7.91	9.85	11.79	13.73	1			33.69	42.12	50.54	58.96	1	
11				11.89	14.23	16.58	1				50.96	61.15	71.34	1	
12				14.12	16.91	19.71	0				60.65	72.78	84.90	0	

Derived from  $V = 0.141 + 0.001941D^2H$  ( $r^2 = .993$ )

Standard error of estimate = 0.0118

Derived from  $V = 0.008423D^3H$  ( $r^2 = .968$ )

Standard error of estimate = 0.2437

**Table 2. LODGEPOLE PINE (*Pinus contorta* var. *latifolia*)**

Cubic-foot Volume							Board-foot Volume								
DBH (inches)	TOTAL TREE HEIGHT IN FEET						Basis: trees	DBH (inches)	TOTAL TREE HEIGHT IN FEET						Basis: trees
	20	30	40	50	60	70			20	30	40	50	60	70	
2	1.00	1.08	1.16	1.24	1.32		0	2	0.82	1.24	1.65	2.06	2.47	0	
3	1.20	1.38	1.56	1.74	1.92	2.10	3	3	1.86	2.78	3.71	4.64	5.57	6.49	3
4	1.48	1.80	2.12	2.45	2.77	3.09	6	4	3.30	4.95	6.60	8.24	9.89	11.54	6
5	1.84	2.35	2.85	3.35	3.85	4.36	25	5	5.15	7.73	10.31	12.88	15.46	18.04	25
6	2.29	3.01	3.73	4.46	5.18	5.91	18	6	7.42	11.13	14.84	18.55	22.26	25.97	18
7	2.81	3.79	4.78	5.76	6.75	7.74	15	7	10.10	15.15	20.20	25.25	30.30	35.35	15
8	3.41	4.70	5.99	7.27	8.56	9.85	8	8	13.19	19.79	26.38	32.98	39.57	46.17	8
9		5.72	7.35	8.98	10.61	12.24	6	9		25.04	33.39	41.74	50.09	58.43	6
10		6.87	8.88	10.89	12.90	14.92	3	10		30.92	41.22	51.53	61.84	72.14	3
11			10.57	13.00	15.44	17.87	4	11			49.88	62.35	74.82	87.29	4
12			12.42	15.32	18.21	21.11	0	12			59.36	74.20	89.04	103.88	0

Derived from  $V = 0.838 + 0.002011D^2H$  ( $r^2 = .932$ )

Standard error of estimate = .0967

Derived from  $V = 0.01031D^3H$  ( $r^2 = .944$ )

Standard error of estimate = 0.5439

**Table 3. WESTERN LARCH (*Larix occidentalis*)**

Cubic-foot Volume						Board-foot Volume									
DBH (inches)	TOTAL TREE HEIGHT IN FEET					Basis: trees	DBH (inches)	TOTAL TREE HEIGHT IN FEET					Basis: trees		
	30	40	50	60	70			80	30	40	50	60		70	80
2	0.41	0.49	0.57			0	2	1.01	1.35	1.68			0		
3	0.71	0.88	1.06	1.24		1	3	2.27	3.03	3.79	4.55		1		
4	1.12	1.43	1.75	2.06		4	4	4.04	5.39	6.74	8.08		4		
5	1.65	2.14	2.63	3.12	3.61	4	5	6.32	8.42	10.53	12.63	14.74	4		
6	2.30	3.00	3.71	4.41	5.12	9	6	9.09	12.13	15.16	18.19	21.22	9		
7	3.06	4.02	4.98	5.94	6.90	7.86	5	7	12.38	16.51	20.63	24.76	28.88	33.01	5
8		5.20	6.45	7.71	8.96	10.21	5	8		21.56	26.95	32.34	37.73	43.12	5
9			8.12	9.70	11.29	12.88	3	9			34.11	40.93	47.75	54.57	3
10			9.98	11.94	13.90	15.86	0	10			42.11	50.53	58.95	67.37	0
11				14.41	16.78	19.15	1	11				61.14	71.33	81.52	1
12				17.11	19.94	22.76	1	12				72.76	84.88	97.01	1

Derived from  $V = 0.179 + 0.001960D^2H$  ( $r^2 = .992$ )

Standard error of estimate = 0.0357

Derived from  $V = 0.008421D^3H$  ( $r^2 = .966$ )

Standard error of estimate = 0.6289

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Table 4. GRAND FIR (*Abies grandis*)

DBH (inches)	Cubic-foot Volume						Basis: trees	DBH (inches)	Board-foot Volume						Basis: trees
	TOTAL TREE HEIGHT IN FEET								TOTAL TREE HEIGHT IN FEET						
	20	30	40	50	60	70		20	30	40	50	60	70		
4	1.09	1.44	1.78	2.13	2.47		0	4	3.05	4.57	6.09	7.62	9.14		
5	1.48	2.02	2.56	3.10	3.64	4.18	5	4.76	7.14	9.52	11.90	14.28	16.67	1	
6	1.95	2.73	3.51	4.29	5.06	5.84	1	6	6.86	10.29	13.71	17.14	20.57	24.00	
7	2.52	3.57	4.63	5.69	6.75	7.80	5	7	9.33	14.00	18.67	23.33	28.00	32.66	
8		4.54	5.93	7.31	8.69	10.07	7	8		18.28	24.38	30.47	36.57	42.66	
9			7.39	9.14	10.89	12.64	1	9			30.86	38.57	46.28	54.00	
10				11.19	13.35	15.51	0	10				47.62	57.14	66.66	

Derived from  $V = 0.400 + 0.002159D^2H$  ( $r^2 = .996$ )  
 Standard error of estimate = 0.0720

Derived from  $V = 0.009523D^2H$  ( $r^2 = .983$ )  
 Standard error of estimate = 0.7170

Table 5. ALL SPECIES

DBH (inches)	Cubic-foot Volume							Basis: trees	DBH (inches)	Board-foot Volume							Basis: trees
	TOTAL TREE HEIGHT IN FEET									TOTAL TREE HEIGHT IN FEET							
	20	30	40	50	60	70	80		20	30	40	50	60	70	80		
2	0.34	0.43	0.51	0.60	0.69			2	0.74	1.11	1.48	1.85	2.22				
3	0.56	0.75	0.94	1.14	1.33			11	1.66	2.50	3.33	4.16	4.99				
4	0.86	1.20	1.54	1.89	2.23			20	2.96	4.44	5.92	7.40	8.88				
5	1.24	1.78	2.32	2.85	3.39	3.93		47	4.62	6.94	9.25	11.56	13.87	16.18			
6	1.72	2.49	3.26	4.03	4.80	5.58	8.58	40	6.66	9.99	13.32	16.65	19.98	23.31			
7		3.32	4.38	5.43	6.48	7.53		47		13.59	18.13	22.66	27.19	31.72	36.25		
8			5.66	7.04	8.41	9.78	11.15	33			23.68	29.59	35.51	41.43	47.35		
9			7.12	8.86	10.60	12.33	14.07	18			29.96	37.46	44.95	52.44	59.93		
10			8.75	10.90	13.04	15.19	17.33	4			36.99	46.24	55.49	64.74	73.99		
11				13.15	15.75	18.34	20.94	6				55.95	67.14	78.33	89.52		
12				15.62	18.71	21.79	24.88	1				66.59	79.90	93.22	106.54		

Derived from  $V = 0.171 + 0.002145D^2H$  ( $r^2 = .946$ )  
 Standard error of estimate = 0.0305

Derived from  $V = 0.009248 D^2H$  ( $r^2 = .948$ )  
 Standard error of estimate = 0.2597