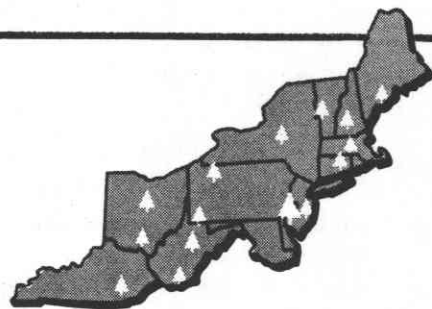


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CUBIC-FOOT TREE VOLUMES AND PRODUCT RECOVERIES FOR EASTERN REDCEDAR IN THE OZARKS

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Abstract. Tree volume tables and equations for eastern redcedar are presented for gross volume, cant volume, and volume of sawmill residue. These volumes, when multiplied by the average value per cubic foot of cants and residue, provide a way to estimate tree value.

Eastern redcedar, though not a major component of Missouri's forests, is a commercial species (Spencer and Essex 1976). The USDA Forest Service appraises redcedar during timber sales, and many small sawmills purchase the timber for the production of cants, which are later resawn into lumber.

This report contains gross volume and product recoveries for eastern redcedar. These can be used to appraise the value of a stand of cedar.

FIELD PROCEDURE

Ninety-one forest grown trees, ranging from 5 to 12 inches in diameter at breast height (dbh), were selected in the Ozark Mountains of Missouri. The trees were felled and the diameter outside bark (dob) was measured at 4-foot intervals from the stump to a 3-inch top. Height to a 3-inch top ranged from 11 to 42 feet.

Inside bark diameters were estimated by applying appropriate bark factors. Volume of

each 4-foot section was calculated as a frustum of a cone, and these volumes were summed to obtain gross tree volume.

The trees were bucked into blocks (3 ft. 7 inches) or logs (7 ft. 2 inches) that were sawn into cants. The cants were measured, and total cant volume was determined for each tree. The cants ranged from 8½ x 6½ inches down to 3¾ x 3¾ inches. Seven trees contained no cants.

VOLUME PREDICTION EQUATIONS

Gross volume model

Gross tree volume (V_t) is the cubic-foot volume inside bark from the stump to a 3-inch top, dob. The following equation was derived by multiple regression techniques.

$$V_t = -0.531 + 0.02143 (\text{dbh}^2) + 0.05828 (h) + 0.0018519 (\text{dbh}^2 \times h),$$

where h = distance from the top of a 6-inch-high stump to a 3-inch top, dob.

$$R^2 = 0.98$$

$$SE = 0.39 \text{ ft}^3$$

Cant volume model

Cant volume (V_c) is the cubic-foot volume of merchantable cants sawn from the blocks and logs. Cull sections were removed from many of the trees. Therefore, it was necessary to include cull length (c) in the model.

I tried a model with $\text{dbh}^2 \times h$ and $\text{dbh}^2 \times c$, but found that the residuals were correlated with the dependent variable. Adding dbh² and height to the model resulted in independent residuals.

$$V_c = -2.1075 + 0.074167 (h) + 0.0006007 (\text{dbh}^2 \times h) - 0.0031305 (\text{dbh}^2 \times c) + 0.026377 (\text{dbh}^2)$$

where c = length of cull section, in feet.

$$R^2 = 0.89$$

$$SE = 0.44 \text{ ft}^3$$

Table 1.—Predicted gross volumes for eastern redcedar trees, in cubic feet

Height—stump to 3 inches dob (feet)	Dbh (inches)								
	5	6	7	8	9	10	11	12	13
8	0.8	1.2	1.7	2.2	2.9	—	—	—	—
9	0.9	1.4	1.9	2.4	3.1	—	—	—	—
10	1.0	1.5	2.0	2.6	3.3	—	—	—	—
11	1.2	1.6	2.1	2.8	3.5	—	—	—	—
12	1.3	1.7	2.3	3.0	3.7	—	—	—	—
13	1.4	1.9	2.4	3.1	3.9	—	—	—	—
14	1.5	2.0	2.6	3.3	4.1	—	—	—	—
15	1.6	2.1	2.7	3.5	4.3	5.2	—	—	—
16	1.7	2.2	2.9	3.7	4.5	5.5	—	—	—
17	1.8	2.4	3.0	3.8	4.7	5.7	—	—	—
18	1.9	2.5	3.2	4.0	4.9	6.0	—	—	—
19	2.0	2.6	3.3	4.2	5.1	6.2	—	—	—
20	2.1	2.7	3.5	4.4	5.4	6.5	—	—	—
21	2.2	2.9	3.6	4.5	5.6	6.7	8.0	—	—
22	2.3	3.0	3.8	4.7	5.8	6.9	8.3	—	—
23	2.4	3.1	3.9	4.9	6.0	7.2	8.5	—	—
24	2.5	3.2	4.1	5.1	6.2	7.4	8.8	—	—
25	2.6	3.4	4.2	5.2	6.4	7.7	9.1	—	—
26	2.7	3.5	4.4	5.4	6.6	7.9	9.4	11.0	—
27	2.8	3.6	4.5	5.6	6.8	8.2	9.7	11.3	—
28	2.9	3.7	4.7	5.8	7.0	8.4	9.9	11.6	13.5
29	3.0	3.9	4.8	6.0	7.2	8.7	10.2	12.0	13.8
30	3.1	4.0	5.0	6.1	7.4	8.9	10.5	12.3	14.2
31	3.2	4.1	5.1	6.3	7.6	9.1	10.8	12.6	14.6
32	3.3	4.2	5.3	6.5	7.9	9.4	11.1	12.9	14.9
33	3.5	4.4	5.4	6.7	8.1	9.6	11.4	13.3	15.3
34	3.6	4.5	5.6	6.8	8.3	9.9	11.6	13.6	15.7
35	—	4.6	5.7	7.0	8.5	10.1	11.9	13.9	16.1
36	—	4.7	5.9	7.2	8.7	10.4	12.2	14.2	16.4
37	—	—	—	7.4	8.9	10.6	12.5	14.6	16.8
38	—	—	—	7.5	9.1	10.8	12.8	14.9	17.2
39	—	—	—	—	9.3	11.1	13.1	15.2	17.5
40	—	—	—	—	9.5	11.3	13.3	15.5	17.9
41	—	—	—	—	9.7	11.6	13.6	15.9	18.3
42	—	—	—	—	9.9	11.8	13.9	16.2	18.7

Note: The figures inside the boxed areas indicate the tree sizes that were sampled in the study.

Table 2.—Predicted cant volumes for eastern redcedar trees, in cubic feet^a

Height—stump to 3 inches dob (feet)	Dbh (inches)								
	5	6	7	8	9	10	11	12	13
13	0.0	0.1	0.5	1.0	1.6	—	—	—	—
14	0.0	0.2	0.6	1.2	1.7	—	—	—	—
15	0.0	0.3	0.7	1.3	1.9	2.5	—	—	—
16	0.0	0.4	0.8	1.4	2.0	2.7	—	—	—
17	0.1	0.5	0.9	1.5	2.1	2.8	—	—	—
18	0.2	0.6	1.0	1.6	2.2	2.9	—	—	—
19	0.2	0.7	1.2	1.7	2.4	3.1	—	—	—
20	0.3	0.8	1.3	1.8	2.5	3.2	—	—	—
21	0.4	0.9	1.4	1.9	2.6	3.3	4.2	—	—
22	0.5	0.9	1.5	2.1	2.7	3.5	4.3	—	—
23	0.6	1.0	1.6	2.2	2.9	3.6	4.5	—	—
24	0.7	1.1	1.7	2.3	3.0	3.8	4.6	—	—
25	0.8	1.2	1.8	2.4	3.1	3.9	4.8	—	—
26	0.9	1.3	1.9	2.5	3.2	4.0	4.9	5.9	—
27	1.0	1.4	2.0	2.6	3.3	4.2	5.0	6.0	—
28	1.0	1.5	2.1	2.7	3.5	4.3	5.2	6.2	7.3
29	1.1	1.6	2.2	2.8	3.6	4.4	5.3	6.4	7.4
30	1.2	1.7	2.3	3.0	3.7	4.6	5.5	6.5	7.6
31	1.3	1.8	2.4	3.1	3.8	4.7	5.6	6.7	7.8
32	1.4	1.9	2.5	3.2	4.0	4.8	5.8	6.8	8.0
33	1.5	2.0	2.6	3.3	4.1	5.0	5.9	7.0	8.1
34	1.6	2.1	2.7	3.4	4.2	5.1	6.1	7.2	8.3
35	—	2.2	2.8	3.5	4.3	5.2	6.2	7.3	8.5
36	—	2.3	2.9	3.6	4.5	5.4	6.4	7.5	8.7
37	—	—	—	3.7	4.6	5.5	6.5	7.6	8.9
38	—	—	—	3.9	4.7	5.6	6.7	7.8	9.0
39	—	—	—	—	4.8	5.8	6.8	8.0	9.2
40	—	—	—	—	4.9	5.9	7.0	8.1	9.4
41	—	—	—	—	5.1	6.0	7.1	8.3	9.6
42	—	—	—	—	5.2	6.2	7.3	8.4	9.7

^aCull length = 0.

Note: The figures inside the boxed areas indicate the tree sizes that were sampled in the study.

Sawmill residue volume model

Sawmill residue volume (V_r) is the cubic-foot volume of wood that reaches the mill in merchantable sections but is not converted into cants. It represents slabs, end trim, and sawdust.

I selected the same model for predicting this variable that was selected for predicting cant volume. The prediction equation is:

$$V_r = -1.2183 + 0.003358 (h) + 0.0002382 (dbh^2 \times h) - 0.0023042 (dbh^2 \times c) + 0.024052 (dbh^2)$$

$$R^2 = 0.76$$

$$SE = 0.42 \text{ ft}^3$$

VOLUME TABLES

The three volume equations were solved for combinations of dbh and height for trees with no cull length. Predicted volumes are presented in Tables 1 to 3. For trees with cull lengths, the equations should be used.

The difference between gross tree volume and the sum of cant volume plus sawmill residue volume represents roundwood volume between the last cant and the 3-inch top.

APPLICATION

The boxed areas in Tables 1 to 3 indicate the tree sizes sampled in the study. Volumes for some size classes beyond the boxes are shown. You are cautioned against using the

Table 3.—Predicted volumes of sawmill residue for eastern redcedar trees, in cubic feet^a

Height—stump to 3 inches dob (feet)	Dbh (inches)								
	5	6	7	8	9	10	11	12	13
13	0.0	0.2	0.5	1.0	1.4	—	—	—	—
14	0.0	0.2	0.6	1.0	1.5	—	—	—	—
15	0.0	0.3	0.6	1.1	1.5	2.0	—	—	—
16	0.0	0.3	0.7	1.1	1.6	2.1	—	—	—
17	0.1	0.4	0.7	1.2	1.6	2.2	—	—	—
18	0.1	0.4	0.8	1.2	1.7	2.2	—	—	—
19	0.1	0.4	0.8	1.2	1.7	2.3	—	—	—
20	0.2	0.5	0.9	1.3	1.8	2.3	—	—	—
21	0.2	0.5	0.9	1.3	1.8	2.4	3.0	—	—
22	0.3	0.6	1.0	1.4	1.9	2.4	3.1	—	—
23	0.3	0.6	1.0	1.4	1.9	2.5	3.1	—	—
24	0.3	0.7	1.0	1.5	2.0	2.6	3.2	—	—
25	0.4	0.7	1.1	1.5	2.1	2.6	3.3	—	—
26	0.4	0.7	1.1	1.6	2.1	2.7	3.3	4.0	—
27	0.5	0.8	1.2	1.6	2.2	2.7	3.4	4.1	—
28	0.5	0.8	1.2	1.7	2.2	2.8	3.4	4.1	4.9
29	0.5	0.9	1.3	1.7	2.3	2.9	3.5	4.2	5.0
30	0.6	0.9	1.3	1.8	2.3	2.9	3.6	4.3	5.1
31	0.6	1.0	1.4	1.8	2.4	3.0	3.6	4.3	5.1
32	0.6	1.0	1.4	1.9	2.4	3.0	3.7	4.4	5.2
33	0.7	1.0	1.5	1.9	2.5	3.1	3.8	4.5	5.3
34	0.7	1.1	1.5	2.0	2.5	3.1	3.8	4.6	5.4
35	—	1.1	1.5	2.0	2.6	3.2	3.9	4.6	5.4
36	—	1.2	1.6	2.1	2.6	3.3	3.9	4.7	5.5
37	—	—	—	2.1	2.7	3.3	4.0	4.8	5.6
38	—	—	—	2.2	2.7	3.4	4.1	4.8	5.7
39	—	—	—	—	2.8	3.4	4.1	4.9	5.7
40	—	—	—	—	2.8	3.5	4.2	5.0	5.8
41	—	—	—	—	2.9	3.5	4.3	5.0	5.9
42	—	—	—	—	3.0	3.6	4.3	5.1	5.9

^aCull length = 0.

Note: The figures inside the boxed areas indicate the tree sizes that were sampled in the study.

equations to compute volumes for size classes that are not included in the tables.

Use of the equations or tables to predict gross tree volume requires measurements of dbh and height to a 3-inch top. To estimate cant volume or sawmill residue volume, you must also determine cull length. Nearly all cull in redcedar is confined to the butt section and is related to fire damage. The base of each tree should be inspected for indicators of fire damage.

If you want to predict the value of redcedar trees, you must know the value per cubic foot of cants and sawmill residue.

Tree value can be estimated by multiplying product value per cubic foot by product volume. This value should be reduced by appropriate costs to arrive at stumpage value.

Cant volumes in board feet can be obtained by multiplying by 12 the cubic-foot volumes

in Table 2. Board-foot estimates will be useful for estimating tree value if cant value per board foot is known rather than cant value per cubic foot.

The redcedar sampled in this study did not include glade cedar, a name given to open grown trees in the Ozarks. We applied the equations to nine glade cedar trees and found that actual gross tree volume for the nine trees was 5.5 percent less than predicted. Actual cant volume was 3.9 percent less than predicted cant volume. If glade cedar is absent or represents a small part of the total number of trees being considered, we suggest using the equations presented here.

LITERATURE CITED

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