A Collection of Some Red Alder and Tanoak Volume Equations

by

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I. INTRODUCTION

Research Note No. 9 (Krumland and Wensel, 1978) presented a comprehensive collection of volume and taper relationships for coastal conifers. Hardwoods were not included because of lack of data and most cooperators indicated that they were not too concerned with hardwood volumes.

In some situations, however, some estimates of hardwood volumes are needed. This report presents a collection of volume equations for red alder and tanoak, developed by other researchers. Also included are "refitted equations" in the form of the standard volume equation used in Research Note No. 9. The basic procedure was to use the published equations to estimate volumes for different DPH – Height combinations and then refit these generated volumes to the standard model. In some situations, merchantable height was used as the independent variable in the original equation. Total heights were estimated in these cases by adding a constant to the merchantable height equal to the top d.b.h. multiplied by four. Specified details are described below for each equation.
II THE STANDARD VOLUME MODEL

\[ V = b_0 D^b H^{b_2} \]

where \( V \) = Volume in cubic feet or Scribner board feet
\( D \) = DBF in inches
\( H \) = Total height, height to a merchantable top in feet, or number of 16 foot logs to a merchantable top

The coefficients \((b_0, b_1, b_2)\) are derived from published equations. Table 1 and Table 2 present a synopsis of these refitted coefficients for Scribner Board Foot and Cubic Foot Volumes respectively. Detailed information concerning the original equations and conversion specifics can be found in section III.

**TABLE 1 (SCRIBNER BOARD FOOT VOLUME COEFFICIENTS)**

<table>
<thead>
<tr>
<th>Height Definition</th>
<th>( b_0 )</th>
<th>( b_1 )</th>
<th>( b_2 )</th>
<th>Merch. Top</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Height</td>
<td>.00012</td>
<td>1.8596</td>
<td>2.0252</td>
<td>10 inches</td>
<td>F1</td>
</tr>
<tr>
<td>Merchantable Ht.</td>
<td>.03429</td>
<td>1.8596</td>
<td>.89796</td>
<td>10 inches</td>
<td>F1</td>
</tr>
<tr>
<td>Log Height</td>
<td>.41345</td>
<td>1.8596</td>
<td>.89796</td>
<td>10 inches</td>
<td>F1</td>
</tr>
</tbody>
</table>

**Red Alder**

<table>
<thead>
<tr>
<th>Height Definition</th>
<th>( b_0 )</th>
<th>( b_1 )</th>
<th>( b_2 )</th>
<th>Merch. Top</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Height</td>
<td>.00018</td>
<td>1.8448</td>
<td>2.0316</td>
<td>8 inches</td>
<td>F2</td>
</tr>
<tr>
<td>Merchantable Ht.</td>
<td>.03055</td>
<td>1.8448</td>
<td>1.0011</td>
<td>8 inches</td>
<td>F2</td>
</tr>
<tr>
<td>Log Height</td>
<td>.43029</td>
<td>1.8448</td>
<td>1.0011</td>
<td>8 inches</td>
<td>F2</td>
</tr>
</tbody>
</table>
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TABLE 2 (CUBIC FOOT VOLUME COEFFICIENTS)

Tanoak

<table>
<thead>
<tr>
<th>Height Definition</th>
<th>$b_0$</th>
<th>$b_1$</th>
<th>$b_2$</th>
<th>Merch. Top</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Height</td>
<td>.00356</td>
<td>1.8580</td>
<td>.97016</td>
<td>4 inches</td>
<td>C3</td>
</tr>
<tr>
<td>Merchantable Ht.</td>
<td>.02242</td>
<td>1.8580</td>
<td>.58087</td>
<td>4 inches</td>
<td>C3</td>
</tr>
<tr>
<td>Log Height</td>
<td>.11222</td>
<td>1.8580</td>
<td>.58087</td>
<td>4 inches</td>
<td>C3</td>
</tr>
</tbody>
</table>

Red Alder

<table>
<thead>
<tr>
<th>Height Definition</th>
<th>$b_0$</th>
<th>$b_1$</th>
<th>$b_2$</th>
<th>Merch. Top</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Height</td>
<td>.00005</td>
<td>1.9902</td>
<td>1.7121</td>
<td>8 inches</td>
<td>C1</td>
</tr>
<tr>
<td>Merchantable Ht.</td>
<td>.00613</td>
<td>1.9902</td>
<td>.75801</td>
<td>8 inches</td>
<td>C1</td>
</tr>
<tr>
<td>Log Height</td>
<td>.05014</td>
<td>1.9902</td>
<td>.75801</td>
<td>8 inches</td>
<td>C1</td>
</tr>
</tbody>
</table>

III. SOURCES OF THE PUBLISHED EQUATIONS

SOURCE B1 Table 1c, Hornibrook et. al. (1950).

Original Equation and Specifications:

$$\log_{10}(V) = 1.7747\log_{10}(D) + 0.9038\log_{10}(H) + 0.6051(F) - 0.8792$$

where

- $V$ = Scribner board foot volume as utilized but never less than 10 inches
- $D$ = DBH in inches
- $H$ = Number of 8 foot logs
- $F$ = Form class

Conversion Specifics

As this model was based on a form class, average form class by DBH class (Figure 1, Hornibrook, 1950.) was used to generate volumes which were then considered to be the average for the particular DBH - Height combination.
Total heights were estimated as the (Number of 8 foot logs x 8.3) + 40 feet

Merchantable heights were estimated as the (Number of 8 foot logs x 8.3)

Log heights were estimated as the (Number of 8 foot logs)/2.

**SOURCE B2** Table 1, Johnson, R.M. et. al. (1949).

**Original Equation And Specifications**

\[ \log_{10}(V) = 1.8468 \log_{10}(D) + 1.0090 \log_{10}(H) - 0.6032 \]

where
- \( V \) = Scribner board foot volume between stump and a merchantable top (8 inch minimum)
- \( D \) = DBH in inches
- \( H \) = Number of 8 foot logs to a merchantable top

**Conversion Specifics**

Total heights were estimated as the (Number of 8 foot logs x 8.3) + 32 feet

Merchantable heights were estimated as the (Number of 8 foot logs x 8.3)

Log heights were estimated as the (Number of 8 foot logs)/2.

**SOURCE C1** Table 11, Hornibrook et. al. (1950).

**Original Equation and Specifications**

\[ \log_{10}(V) = 1.8542 \log_{10}(D) + 0.7644 \log_{10}(H) + 0.0075(F) - 1.8517 \]

where
- \( V \) = Cubic foot volume, excluding bark, of main stem and forks between stump and utilized top.
- \( D \) = DBH in inches
- \( H \) = Number of 8 foot logs
- \( F \) = Form class

**Conversion Specifics**

Form class conversion, total height, merchantable height and log height estimates for these cubic foot volume equations are the same as the corresponding ones for board volume.
feet.

**SOURCE C2** Table 1, Wiant H.V. (1965).

**Original Equation And Specifications**

\[ \log_{10}(V) = -2.9127 + 1.0249 \left( \log_{10}(D^2) \right) \]

where \( V \) = Cubic foot volume between stump and 4 inch top
\( D \) = DBH in inches
\( H \) = Total height in feet

**Conversion Specifics**

Merchantable Heights were estimated as the \((\text{Total Height} - 16.3 \text{ feet})\)

Log Heights were estimated as the \((\text{Total Height} - 16.3 \text{ feet})/16 \).

**SOURCE C3** Table 4, Johnson, R.M. et al. (1949).

**Original Equation and Specifications**

\[ \log_{10}(V) = 1.8618 \left( \log_{10}(D) \right) + 0.9751 \left( \log_{10}(H) \right) - 2.462 \]

where \( V \) = Cubic foot volume between stump and a 4 inch top
\( D \) = DBH in inches
\( H \) = Total height in feet

**Conversion Specifics**

Total height, merchantable height and log height estimates for these cubic foot equations are the same as the corresponding ones for board feet (Source C2).
Literature Cited


Krumland, Bruce and Lee C. Wensel 1978. Volume and Taper Relationships For Redwood, Douglas Fir And Other Conifers In The North Coast Of California. Research Note No. 9