Is it time to harvest your timber? How do you know?

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Ohio Forestry Association Annual Conference

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Natural Resources Specialist
Ohio State University Extension
How do you decide?

- Landowner objectives
- Forest condition
- Tree value
  - Size
  - Quality
- Risks
- Markets
- Maturity
- Preferably not by a knock on the door!
Why do you own your woodland?

Reasons for Owning Woods
The percentage of landowners in this group who cited each of these reasons for owning land as important or very important to them.

- Beauty
- Wildlife
- Nature
- Water
- Legacy
- Privacy
- Family
- Recreation
- Hunting
- Investment
- Firewood
- Timber
- NTFPs*

* Non-timber forest products

Tools for Engaging Landowners Effectively
Woodland Owner Profile
All Family 10+ Acres
Ohio

The Ohio State University
College of Food, Agricultural, and Environmental Sciences
Step # 1- Know what you have:

A good inventory:

• Is needed for a forest management plan
• Helps you to identify resources and options
  • Timber value and future potential
  • Wildlife Habitat
  • Potential sites for non-timber forest product
• Helps you to evaluate condition of your forest
  • Stocking
  • Forest health issues
Step # 1- Know what you have:

A good inventory:

- Will allow you to determine your Basis
  - Reduces the taxes that you pay on the proceeds from a future timber sale.
- Help you determine growth rates and rates of return
- Helps you to harvest when your trees are mature
  - Financially mature
  - Biologically mature
An inventory should at least:

• Help you to set realistic goals for your woodland

• Give you a baseline to help you monitor progress
What information is needed?

• Age/Size Distribution
• Species
• Site Quality
• Tree Health & Vigor
• Growth Rate
• Maturity
• Stocking
• Current Value
  • Quantity (height and d.b.h)
  • Quality
Inventory by stands

Groups of trees with similar:

- Age Distribution
- Site Quality
- Species Mix

Stands are the management units. Similar to farm fields!
Site Quality - Topography
Crown Condition
Crown Condition
Maturity
Density and Stocking

Stand Density
How crowded is it?

- Combination of number and size of trees
- Usually expressed in Basal Area (sq. ft./acre)

Stocking
Are there enough trees to meet your objectives?

- Too many: Overstocked
- Too few: Understocked
- Just right: Fully Stocked
Stocking

The graph shows the relationship between basal area per acre (square feet) and trees per acre (number) to determine stocking status. The axes are labeled:
- Basal area per acre (square feet)
- Trees per acre (number)

Key points:
- A: Average tree diameter
- B: Overstocked
- C: Understocked

The graph indicates that a fully stocked area would be within the shaded region, while understocked and overstocked areas are outside this region.
Product Sale - Quantity

Trees are Cylinders with Taper

• Measure Length
• Measure Diameter
• Estimate Taper (Tables take care of this)
• Reduce for Slab and Kerf Loss (Tables do this also)
# Volume Table - Quantity

<table>
<thead>
<tr>
<th>DIAMETER ABOVE GROUND INCHES</th>
<th>½</th>
<th>1</th>
<th>1½</th>
<th>2</th>
<th>2½</th>
<th>3</th>
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<td>24</td>
<td>130</td>
<td>220</td>
<td>290</td>
<td>360</td>
<td>430</td>
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<td>740</td>
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<tr>
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<td>190</td>
<td>320</td>
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<td>520</td>
<td>620</td>
<td>710</td>
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<td>630</td>
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<td>840</td>
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<tr>
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<td>440</td>
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<td>730</td>
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<td>850</td>
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<td>1860</td>
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</table>
## Comparison of Doyle and International ¼” log Rules for 16’ logs

<table>
<thead>
<tr>
<th>Log Diameter (Inches)</th>
<th>International 1/4”</th>
<th>Doyle</th>
<th>Doyle % Internat. 1/4”</th>
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<td>16</td>
<td>180</td>
<td>144</td>
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<td>20</td>
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<td>88</td>
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<td>24</td>
<td>425</td>
<td>400</td>
<td>94</td>
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<td>576</td>
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<td>32</td>
<td>770</td>
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<tr>
<td>40</td>
<td>1220</td>
<td>1296</td>
<td>106</td>
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</tbody>
</table>
Quality

We’ll get to this later!
So, now that we have inventory data:

Is it time to harvest?
Are your trees mature?

This depends on your definition of maturity!
## Biological Rotation and Physiological Maturity of Trees

<table>
<thead>
<tr>
<th>Species</th>
<th>Silvics of North America</th>
<th>Don Hilt Ohio</th>
<th>Ivan Sander Missouri</th>
<th>Clay Smith West Virginia</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Biological</td>
<td>Life Span</td>
<td>Biological</td>
<td>Biological</td>
</tr>
<tr>
<td>White Oak</td>
<td>120+</td>
<td>600</td>
<td>200-250</td>
<td>200-300</td>
</tr>
<tr>
<td>Red Oak</td>
<td></td>
<td>120</td>
<td>150</td>
<td>150</td>
</tr>
<tr>
<td>Black Oak</td>
<td>100</td>
<td>150-200</td>
<td>120-140</td>
<td>150</td>
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<tr>
<td>Chestnut Oak</td>
<td>120</td>
<td>250</td>
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<td>100-150</td>
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<tr>
<td>Scarlet Oak</td>
<td>Early</td>
<td>100</td>
<td>70</td>
<td>100</td>
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<tr>
<td>Sugar Maple</td>
<td>250</td>
<td>300-400</td>
<td>250</td>
<td>250</td>
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<tr>
<td>Red Maple</td>
<td>70-80</td>
<td>150</td>
<td>125</td>
<td>100</td>
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<tr>
<td>Black Walnut</td>
<td></td>
<td>150-250*</td>
<td>200</td>
<td>250</td>
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<tr>
<td>Hickory</td>
<td>200</td>
<td>340*</td>
<td></td>
<td>250</td>
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<tr>
<td>Yellow Poplar</td>
<td>200-250</td>
<td>300</td>
<td>200+</td>
<td>250</td>
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<tr>
<td>White Ash</td>
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<td></td>
<td>200</td>
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<td>Blackgum</td>
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<td></td>
<td></td>
<td>200</td>
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<tr>
<td>Sycamore</td>
<td></td>
<td></td>
<td></td>
<td>200+</td>
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<tr>
<td>Sassafras</td>
<td></td>
<td></td>
<td></td>
<td>100</td>
</tr>
<tr>
<td>Am. Elm</td>
<td>175-200</td>
<td>300</td>
<td></td>
<td>200</td>
</tr>
<tr>
<td>Beech</td>
<td>250</td>
<td>366</td>
<td></td>
<td>200</td>
</tr>
<tr>
<td>Black Cherry</td>
<td>80-100</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bigtooth Aspen</td>
<td>40-70</td>
<td>100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Figure 2. Volume growth of trees over time showing optimal rotations.

(a) Volume

(b) Timber-value growth

Alternative rate of return

Rate of return (%)

Time

Financial optimum

MSY maximized

Biological maximum

Jacobson, M. 2017 Forest Finance 8: to Cut or not to cut- Tree Value and deciding When to Harvest timber. PSU Extension
To Cut or Not to Cut: Tree Value and Deciding When to Harvest Timber

Jacobson, M. 2017 Forest Finance 8: to Cut or not to cut- Tree Value and deciding When to Harvest timber. PSU Extension
Figure 1. General pattern of stumpage prices and grade shifts for hardwood timber of different diameters.

Jacobson, M. 2017 Forest Finance 8: to Cut or not to cut- Tree Value and deciding When to Harvest timber. PSU Extension
The 12” PA black cherry

- 7 rings per inch- 2 inches every 7 years
- PA 2007 Prices used:
  - 12-14 d.b.h. - $602/MBF
  - 16 d.b.h. - $1,481/MBF
  - 18 d.b.h. - $2,360/MBF

Table 3. Volume and value for each diameter.

<table>
<thead>
<tr>
<th>DBH (inches)</th>
<th>Max merchantable height (logs)</th>
<th>Volume (BF)</th>
<th>Value ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>1.0</td>
<td>59</td>
<td>35.52</td>
</tr>
<tr>
<td>14</td>
<td>1.5</td>
<td>112</td>
<td>67.40</td>
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<td>16</td>
<td>2.5</td>
<td>223</td>
<td>330.26</td>
</tr>
<tr>
<td>18</td>
<td>3.0</td>
<td>336</td>
<td>792.96</td>
</tr>
</tbody>
</table>

Jacobson, M. 2017 Forest Finance 8: to Cut or not to cut-Tree Value and deciding When to Harvest timber. PSU Extension
The 12” PA black cherry (Cont.)

Table 4. The rate of return for waiting 7, 14, and 21 years to harvest a tree.

<table>
<thead>
<tr>
<th>Year</th>
<th>Value ($)</th>
<th>Present value at 4% ($)</th>
<th>Rate of return (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>36.00</td>
<td>36.00</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>67.00</td>
<td>50.91</td>
<td>Year 0–7</td>
</tr>
<tr>
<td>14</td>
<td>330.00</td>
<td>190.57</td>
<td>Year 0–14</td>
</tr>
<tr>
<td>21</td>
<td>792.00</td>
<td>347.56</td>
<td>Year 0–21</td>
</tr>
</tbody>
</table>

Jacobson, M. 2017 Forest Finance 8: to Cut or not to cut-Tree Value and deciding When to Harvest timber. PSU Extension
Worksheet: Estimating the Rate of Return for a Growth Period

1. Today’s volume per acre (MBF/acre) ................................................................. 6
2. Today’s stumpage price ($/MBF) ...................................................................... $300
3. Today’s stumpage value (MBF/acre) [Line 1 x Line 2] ....................................... $1,800
4. Growth period (years) ........................................................................................ 5
5. Annual volume growth (MBF/year) ..................................................................... 0.2
6. Total volume growth over growth period (MBF/acre) [Line 4 x Line 5] .......... 1
7. Expected future volume (MBF/acre) [Line 1 + Line 6] ........................................ 7
8. Rate of inflation (percent/year) ........................................................................... 0
9. Rate of real price increase (percent/year) ............................................................ 3
10. Add Lines 8 and 9 ............................................................................................... 3
11. Price adjustment factor (see below for equation) 
    [using data from Lines 4 and 10 above] .............................................................. 1.16
12. Expected future stumpage price ($/MBF) [Line 2 x Line 11] ......................... $348
13. Expected future stumpage value (MBF/acre) [Line 7 x Line 12] ....................... $2,436
14. Ratio of future value to present value [Line 13 ÷ Line 3] .................................... 1.4
15. Expected rate of return earned over growth period using data 
    from Lines 4 and 14 (percent/year) ................................................................... 7
Some basics of tree value:

- As trees increase in diameter (d.b.h.) and height they increase in volume and value.
- As d.b.h. increases the usable height can also increase which adds volume.
- As d.b.h. increases the value of the product that can be produced increases.
- Tree quality/grade is also diameter dependent.
All farm crops have some unit of measure associated with their market value. In the case of logs and lumber, the unit of measure is board feet—or more often, thousands of board feet (MBF). Most agricultural products are also judged by some quality scale or grading system. The grading criteria for hardwood lumber in Ohio are based on National Hardwood Lumber Association (NHLA) rules, which are universal throughout the United States and Canada.

There are, however, no set standards for grading hardwood logs and trees. The hardwood market is a value-driven sector, thus local market conditions can play a significant role in a log’s ultimate class and grade designation. Also, a mill’s available technology can significantly impact the amount of high-grade lumber produced from a single log. All contribute to the lack of an accepted grading standard. Even so, hardwoods are often classified by product: on the stump, as green, or sometimes when they come to the mill.

Log Classes

Hardwood logs can be merchandised into four log-use classes. Veneer logs are of the highest quality and are segregated at the logging site or log yard for veneer manufacturing. Veneer logs are cut to specified lengths and diameters, and their full form is preserved. Mill end logs are cut for sawmills and consist of the wood cut off when the veneer log is trimmed. Architectural timbers, which are used for beams, columns, and some other structural members, are usually taken from whole logs or from the core of a log that has been cut for veneer. Firewood logs are cut into sections suitable for burning. While firewood logs are not marketed, they are considered in calculating the number of board feet of hardwood available from a given number of logs.
Table 2. A summary of the hardwood tree grades for factory lumber (from Hanks 1976).

<table>
<thead>
<tr>
<th>Grade Factors</th>
<th>Tree Grade 1</th>
<th>Tree Grade 2</th>
<th>Tree Grade 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length of grading zone, feet</td>
<td>Butt 16</td>
<td>Butt 16</td>
<td>Butt 16</td>
</tr>
<tr>
<td>Length of grading section, feet</td>
<td>Best 12</td>
<td>Best 12</td>
<td>Best 12</td>
</tr>
<tr>
<td>Minimum DBH, inches</td>
<td>16</td>
<td>13</td>
<td>10</td>
</tr>
<tr>
<td>Minimum diameter inside bark at top of grading section</td>
<td>13</td>
<td>16</td>
<td>20</td>
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<td></td>
<td>11</td>
<td>12</td>
<td>8</td>
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<tr>
<td>Clear cuttings on the grading face</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimum length, feet</td>
<td>7</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Maximum number of clear cuttings</td>
<td>2</td>
<td>2</td>
<td>3</td>
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<tr>
<td></td>
<td>No Limit</td>
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</table>
FINANCIAL MATURITY: A GUIDE TO INCREASING FINANCIAL RETURNS FROM YOUR WOODLAND

Randall B. Hurlimann, Extension Specialist, Forestry

When a forest is harvested using either the individual tree or group selection method\(^1\), trees to be cut or retained are commonly selected based on a number of factors including species, quality, diameter, distance from other trees, health and vigor, non-timber value (e.g., wildlife, aesthetics, etc.), risk of loss or damage (during harvest or during the time interval before the next harvest), and maturity. Maturity may refer to either biological or financial maturity, depending on the landowner’s objectives.

**Biological Maturity**

Biological maturity, as used here, refers to the age when a tree begins to decline in vigor and health and becomes increasingly susceptible to diseases and other harmful environmental factors that will ultimately result in death. This age of biological maturity, which might be referred to as a tree’s natural life expectancy, varies dramatically among species (even within genus) and with site quality. Red and silver maples, for example, often approach biological maturity well before they are 150 years old, while black and sugar maples are often still thriving well beyond 200 years of age. Other Ohio species, such as white oak, may live well beyond 300 years under favorable conditions. Trees growing on sites with less than favorable growing conditions generally have shorter life expectancies than those growing on more favorable sites. Landowners desiring large, stately trees, or who want their woodland to approximate an “old-growth” forest, define maturity primarily as biological. They want their trees to grow as large and live as long as possible and will probably only cut “mature” trees that constitute a safety hazard (extensive dead limbs, hollow, etc.).

**Financial Maturity**

In contrast, forest owners wishing to maximize the financial returns they receive from their woodland will be more concerned with financial maturity. Usually a tree is considered to be financially mature when its rate of value increase falls below a desired level. The rate of value increase of a tree can be determined by comparing the dollar value of its expected growth during a given time period (e.g., 10 years) with the dollar value of the tree prior to that growth. Think of the value of the tree as the principal in a bank account, and the value increase as the interest earned on that principal. This value increase can be expressed as an annual compound interest and compared with alternative investments or a desired rate of return. If the tree’s expected rate of value increase exceeds the desired rate, the tree is not financially mature and should be allowed to grow for the specified time period. If the tree’s expected rate of value increase is less than the desired rate, the

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Figure 1. Woodland owner evaluating financial maturity of white oak.

Figure 2. Compound Interest Calculations.

The basic compound interest formula is

\[ FV = (1 + r)^n \times PV \]

Where \( FV \) = present value, \( r \) = compound interest rate, \( n \) = number of years interest compounded, and \( PV \) = future value of \( PV \) earning interest \( r \) for \( n \) years. For example, if you wanted the value of $100 five years in the future if it was earning 6% compound interest annually, the answer would be

\[ 100 \times (1.06)^5 = 131.81 \]

The quantity \((1.06)^5\) may be obtained by multiplying \(1.06\) by \((1.06)\) five times or by entering \(1.06\), then pressing the \( y^x \) key, entering \(5\), and pressing the equal's key.
Observations on Financial Maturity

1. If butt log will increase in grade prior to the harvest period it is not financially mature
2. The rate of earning power (%) is less for large diameter trees
3. The rate of earning power is lower for high quality trees
4. Earning power is greatly increased by increasing tree quality

Heiligman, OSUE F-48
Trimble, GR, J.J. Mendel, R. A. Kennell. NE-292
Observations on Financial Maturity

5. Earning power increases with diameter growth rate
6. Trees with greater merchantable height have slightly greater earning power
7. Trees that increase in merchantable height have higher earning power.

Heiligman, OSUE F-48
Trimble, GR, J.J. Mendel, R. A. Kennell. NE-292
Remove these trees to improve future financial return (>11 d.b.h.)

For all rate-of-return classes:
1. Culls and near culls
2. Trees with significant rot in butt log
3. Very-low-vigor trees
4. Extremely rough trees with butt-log grade 5
5. Any tree over 15 inches with butt-log grade 4
6. Any short-lived species, such as black locust, sassafras, and butternut, unless they are unusually vigorous.

A Procedure for SELECTION Marking in Hardwoods
Why is tree grade so important?

- Grade 1 or veneer logs may be 3-10 times more valuable than lower quality logs of the same size or species.
- Compare prices by grade on the timber price reports.
What does this mean for you?

Absolutely nothing if….

• You don’t receive a competitive price for your timber….

• And, the harvest compromises your objectives.
What does this mean for you?

It all comes back to your reason for owning your woodland

• Maximum timber income?
• If not, it is still something to think about

Most importantly

• Work with a professional forester to develop a management plan to match your goals
• Work with a professional forester to assist with your timber harvest
When you do decide to harvest:

1. Mark all trees to be harvested
2. Pay attention to timber markets
3. Avoid high-grading, diameter limit cuts, and “Select Cuts”
4. Remove low-grade, risky trees to make room for “more valuable” trees
5. Don’t remove trees before they reach their grade potential
When you do decide to harvest:

6. Remember to protect residual trees from felling and skidding damage

7. Follow BMP’s to prevent loss in site productivity

8. Make the process competitive

9. Do not sell on shares....
Selling on Shares? Why not?

- What is a “fair percentage”?
- What can go wrong?
- Liability issues
- Tax implications

In most instances a Lump Sum-Sealed Bid Sale is the best option!
When you do decide to harvest:

6. Remember to protect residual trees from felling and skidding damage

7. Follow BMP’s to prevent loss in site productivity

8. Make the process competitive

9. Do not sell on shares!

10. Consider forest regeneration and invasive plants
Regenerating oaks in a nutshell!

• “Cut and Pray” rarely works

• Plan to manage new oak seedlings before and after good acorn crops

• Use treatments that improve the competitiveness of these seedlings
  • Mid-story removal
  • Partial overstory removal (Shelterwood)

• Remove the overstory canopy once seedlings are competitive
Timber harvests and invasive plants

• Timber harvests create vegetation voids
  • Plants already on site can take advantage of and expand rapidly in these voids
  • Wind, birds and other animals can help to introduce plants

• Additional species can be brought to your property
  • Logging equipment
  • Seed, mulch and gravel

• Consider addressing this in your timber harvest contract!
Benefits of Working With a Professional Forester

A good consulting forester:

- Designs the harvest to meet landowner objectives
- Marks trees to be harvested
- Focuses on the residual trees and looks for ways to improve the future forest
- Advertises the sale and makes the bidding process competitive
- Understands forest regeneration and other issues and can help to avoid future problems
Benefits of Working With a Professional Forester

A good consulting forester:

- Develops and enforces robust timber harvest contracts
- Monitors the harvest to minimize damage
- Protects and enhances forest, soil, water, wildlife and other resources.
- Can lessen the visual impact of the harvest

Landowners who use consulting foresters are often more satisfied with harvesting experience!
Questions?

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