### Shelterwood Method

**Characteristics**

- **Form**
- **Appearance** --- Removal of mature crop in a series of partial cuttings which (1) culture seed production, (2) prepare the site and (3) make room for regeneration
- **Versatility** --- Extremely versatile as far as use with different species and under different conditions. Examples

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### Shelterwood Method

**Characteristics**

- **Relation to Other Methods** --- Establishment of regeneration precedes the final cut
- **Protection of the Site**
- **Quality Growth on Residuals** --- species? MAYBE?

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### Shelterwood Method

**Uniform Shelterwood**

- Treatments applied uniformly over the whole stand. The *objective* of the method is to secure establishment of the new stand, but in addition to supplying seed, the shelterwood provides protection for the young seedlings. At some stage, the older trees start to interfere with growth of the new stand and must be removed.
Shelterwood Method

Uniform Shelterwood

• Thus, we are really describing sequences of harvest cuts used to (1) secure seed, (2) prepare the site and culture growth of seedlings, and then (3) release the seedlings.

Shelterwood Method

Uniform Shelterwood

• Cutting Sequences
  1. Preparatory Cut (subcanopy)
  2. Seed Cutting
  3. Removal Cutting
  4. Additional Removal Cuttings, if desired (in stages)

Shelterwood Method

Uniform Shelterwood

• Normal Procedure ---- Could involve the 3 types of cutting, but normal procedure is a seed tree cutting and 1 or 2 removal cuttings. Known as a 2 or 3-cut shelterwood. Last cut is the final harvest cut.
Shelterwood Method

Modifications

• Strip Shelterwood
• Group Shelterwood
• Irregular Shelterwood
  --- continues dbh growth on residuals
  --- remaining trees not evenly distributed

Shelterwood Method

Advantages of Shelterwood

• Reproduction is more certain --- perhaps?
• More quality growth on residuals
• Protection of the site
• More complete utilization of the site
• Length of rotation may be shortened
• Aesthetics
• Possible to time cuttings with good seed year

Shelterwood Method

Disadvantages of Shelterwood

• Often leads to overstocking
• Cost of logging is greater, potential damage to shelter trees, more entries
• More skill to apply
• Site prep is difficult with presence of residual or SW trees
Shelterwood Method

- Use of shelterwood in different forest types.
- Quite versatile
- Range of light tolerance
- Not used for species that are not windfirm
- Not used where soil moisture is not adequate
- Not used for serotinous cone habit

Shelterwood with Oaks

- In theory, tends to be favorable to more “intermediate” species such as oaks
- Must have advanced regeneration of oak (seedling in place) for method to work well
- Otherwise waiting for good mast year (unknown) and favorable germination conditions to obtain oak seedlings. Low probability!

Shelterwood with Oaks

- Usually a precommercial, midstory removal treatment is required
- DIFFICULT to Apply. Why?
  If canopy too open, will favor more shade-intolerant species such as poplar rather than oak
Shelterwood with Oaks

- If do not open the canopy enough, will favor more shade-tolerant species (maple) rather than oak.

- One prescribed burn usually does not promote the growth of oak seedlings. One burn promotes sprouting of most all hardwood species. Impact of multiple burns is unknown?? Time to implement? Forfeiting growth with time in regeneration phase.

Shelterwood with Oaks

- Thus, requires constant observation to establish reproduction, provide conditions for seedling development to obtain adequate seedling size so they can compete when overstory is removed.

- # of seedlings and adequate size

- Involves (a) providing environmental conditions for seedling establishment, growth and development and (b) controlling competing vegetation.

[Diagram showing selection, opening size, sunlight, shade tolerance]
Publications To Reference

1. Oak Shelterwood
   https://utextension.tennessee.edu/publications/Documents/SP676.pdf

2. Two-age System
Two-Aged System

- Essentially a Deferment Cut or an Irregular Shelterwood — *What is the difference?*
- Two-age classes in intimate mixtures, each going to rotation age
- Leaves less than 15 sq. ft. of basal area
- Residual trees are termed reserves or standards.

Deferment Interpretation

<table>
<thead>
<tr>
<th>Deferment – 2 Age</th>
<th>Deferment – SW</th>
</tr>
</thead>
<tbody>
<tr>
<td>15 ft² BA retained</td>
<td>30 ft² BA retained</td>
</tr>
<tr>
<td>Older trees maintained through next rotation</td>
<td>Canopy trees removed after 10-15 years</td>
</tr>
<tr>
<td>Almost full sunlight</td>
<td>Sheltering light</td>
</tr>
<tr>
<td>Purpose – alleviate appearance</td>
<td>Purpose: Regeneration method, even-aged</td>
</tr>
<tr>
<td>Tree longevity required</td>
<td>Tree longevity not an issue</td>
</tr>
</tbody>
</table>

Two-Aged System

- Limited number of reserve trees allows abundant light to reach the forest floor and provides for rapid growth of the understory and the development of two age classes.
- The low basal area of reserves is necessary to ensure the continued growth of the regenerating age class
- Essentially environmental conditions of a clearcut with a few residual trees for better visual appearance
**Two-Aged System**

**Provides**
- Maintenance of sexual reproduction throughout the rotation --- age
- Maintenance of advance reproduction development
- Reduced visual impact
- Development of large diameter, high value timber
- Development of wide range of multiple products

**Two-Aged System**

**Problems**
- Some loss of production
- Influence of larger trees on growth & development of younger stems
- Logging damage & possible formation of epicormic branches on residuals
- Cognizant of species differences, growth characteristics, light tolerances, & longevity

**Two Age System in Eastern Hardwoods**

- Perpetuates 2 age classes composed of
  1. Younger regenerating class
  2. Older reserve trees (<15 ft^2/acre)
**Two Age System**

- Known in literature as
  1. Deferment cuts
  2. Irregular shelterwoods
  3. Shelterwood with reserves

**Advantages**

- Visual – first and primary use as an alternative to clearcutting (visuals)
- Ability to regenerate intolerant/intermediate species
- Provide structural diversity
- Develop large, high-value stems (perhaps)
- Produce multiple product lines
- Maintain sexual reproduction

**Disadvantages**

- Reserve tree candidates may not be present
  --- Short-lived
  --- Potential reduction of tree grade
- Aspects of forest fragmentation are present
- Ability of timber harvest operators
- Impact on mating system
- Potential poor performance of reserve trees
Requirements of Reserve Trees

- Less than 15 ft²/acre of basal area
- Commercial species and long-lived
- Potential tree grade of 2 or greater
- Ability to maintain tree grade --- avoid degrade
- Ability to withstand harvest
- Located to avoid windthrow
- Seed production ability
- Crown vigor rating
  1. Live crown ratio
  2. Visual crown rating system

Factors for Consideration

- Initial regeneration and development of advanced regeneration required
- Reserve tree performance
- Harvest damage to reserve trees
- Post harvest mortality of reserve trees
- Seed production
- Development of two-age guidelines

Guidelines for Reserve Tree Selection

- Minimum Value – Do not leave the most valuable trees (risk of degrade)
- Maintenance of Quality
- Ability for Additional Growth
- Maintenance of Butt Log Quality
  1. Epicormic Branches
  2. Harvest Damage
  3. Crown Classes / Vigor / Growth
Guidelines for Reserve Tree Selection

- Harvest Damage
  a. Operator
  b. Felling and Skidding Damage
  c. Topographic position --- slopes, exposed areas, moist areas
  d. Windthrow at post harvest

Guidelines for Reserve Tree Selection

- Harvest Damage

  Felling damage more severe than skidding (depends on operator)

  Thin soil areas, noses and bottom of drainage areas exhibited more knockdown

  **One Possible Solution** ---- leave trees in groups instead of isolated trees
Research To Explore the Regenerative Capacity of White Oak Reserve Trees

1. Acorn production: Could relatively small sawtimber-sized white oak reserve trees maintain or increase acorn production after release?

2. Advanced Regeneration Development: Could white oak reserve trees initiate the development of advance regeneration?
Study Area

- Eastern Kentucky
- 12 stands -- 60 to 90 years of age
- Site index range from 65 to 85 for upland oak
- Stands stratified by site index and 3 treatments with 4 replications

Methods

- 3 treatments
  - 20 reserve trees per acre
  - 35 reserve tree per acre
  - Untreated control
- Reserve Tree Criteria
  - White oak
  - Co-dominant
  - Potential tree grade of 2 or better
  - Live Crown Ratio > 35%

Summary for Acorn Production

- Full release of white oak trees can moderately increase acorn production
- A small number of trees contribute to the majority of acorn production
- Abundant producers are fairly consistent year to year
- Selecting prolific producers can be advantageous to reaching mast production goals
Research Summary

• Two-age system could be used to lifeboat white oak in stands where adequate advanced regeneration is not present at the time of harvest ---- 5 year results
• Reasonable regeneration treatment for private landowners
• Time element ???

Two Age Summary

• Less than 15 ft²/acre basal area retained
• Long-lived species
• Co-dominant crown class or perhaps vigorous intermediates
• Topographic position of reserves --- avoid thin or saturated soils
• Maintain stem quality / tree grade

Two Age Summary

• Logger buy-in to reduce logging damage
• System has potential to develop advance regeneration
• Time element
• Increased expense of management, control of undesirables
Primary Disadvantages with Two Age --- Summary

• Degrade in value of older trees due to exposure

• Potential reserve tree mortality ---- trees that once had value