SELECTION SYSTEM: REPRODUCTION METHODS

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Nyland - 2010

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Background reading:

Sources cited:

in Northern Hardwoods Using Different Cutting Cycle Lengths. Unpubl. manuscr. SUNY Coll. Environ.
Sci. and For. Syracuse, NY

Leak, W.B., and S.M. Filip. 1977. Thirty-eight years of group selection in New England northern


Fac. For. Misc. Publ. NO. 13 (ESF 87-002), Soc. For. Publ. No. 87-03
Recall that uneven-aged silviculture requires three prescriptions:

1- Residual density and cutting cycle length
2- Residual diameter distribution and maximum DBH
3- An appropriate reproduction method

... to uniformly intersperse the age classes

... to arrange them by family groups

For now focus on an **appropriate reproduction method** ...

... to uniformly intersperse the age classes

*or*

... to arrange them by family groups
Selection system silviculture
(GREEN shows the reproduction method)
One approach …

SINGLE-TREE SELECTION METHOD

Remove individual mature trees here and there from across the stand area …

... from an area (ground space) equivalent to that allocated to the mature age class

The space opened …

… that previously occupied by single mature trees

... cut from across the stand area, taking out widely dispersed mature trees

The area per age class:

\[ A = \frac{43,560}{(R \div CC)} \]

Where:

- \( R \) = years to grow an individual tree to maturity
- \( CC \) = interval between cuttings (the cutting cycle)
- 43,560 = ft²/ac
… cutting individual trees here and there across the stand

It assumes this kind of age class intermixing …
Like this …

Within single-tree selection system:

The reproduction method ...

Overmature & Defective #1
Dukes Experimental Forest
May 2009
Within single-tree selection system:

The reproduction method ...

- open the spaces occupied by widely-dispersed SINGLE mature trees

- remove sufficient individual mature trees to cover the area allocated to the different age classes

... with AREA = 43560 ÷ (R ÷ CC)

Single-tree selection method ...

Always ADDING tending ...

... to make it a system
Uniformly dispersed cutting …

… of mature trees and for the tending

Single-tree selection system …
By *ADDING* tending ...

- thinning intermediate age classes to allocate resources in their space to fewer of the best trees
To this ...

Based on this ...

... representing a composite of residual trees in several age classes
Single-tree selection system -- before cut

Single-tree selection system -- after cut

... uniformly distributed at the proper density
… tending and regeneration by cutting single trees

THE SELECTION SYSTEM

- a new age class in the space previously given over to the mature trees

- a tending of the immature age classes

- a harvest of excess trees

… and a timber sale to provide revenues from the process
A stand under single-tree selection system … ….

... with trees of the different age classes uniformly interspersed

And what does single-tree selection method lead to …

- low light levels near the ground
- poor environmental conditions for species of low shade tolerance
- largely shade-tolerant species in the regeneration

.... at least with traditionally used stocking levels
Regenerating dominantly shade-tolerant species ... like sugar maple

Unless you cut heavily and leave a low residual stocking ...

Such as these options ...

**TABLE 10-2**
ALTERNATE RESIDUAL STRUCTURES TO PRODUCE LARGE SAWTIMBER WITH DIFFERENT LENGTH CUTTING CYCLES FOR NORTHERN HARDWOOD STANDS UNDER SELECTION SYSTEM (AFTER HANSEN AND NYLAND n.d.; NYLAND 1986, 1987).

<table>
<thead>
<tr>
<th>ddb</th>
<th>15 yrs.</th>
<th>20 yrs.</th>
<th>25 yrs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>(ft²/ft²)</td>
<td>(ft³/ac)</td>
<td>(ft³/ac)</td>
<td>(ft³/ac)</td>
</tr>
<tr>
<td>2–5</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>6–11</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>12–16</td>
<td>30</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>17+</td>
<td>15</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>Total</td>
<td>85</td>
<td>70</td>
<td>65</td>
</tr>
</tbody>
</table>
... e.g., leaving 65 ft$^2$/ac for a 25-year cutting cycle

With elevated light near the ground due to the open canopy ...
… increasing chances of regenerating a component of less shade-tolerant species

How about GROUP SELECTION METHOD …

… given a scattered clustering of trees in different age classes by family groups
Group selection method:

Remove groups of 2 or 3 financially mature trees growing adjacent to each other …

… or more depending on the species characteristics
Group selection method:

Remove groups of 2 or 3 financially mature trees growing adjacent to each other …

… do this across an area (in groups) equivalent to that allocated to the mature age class
Cutting of family groups...

... of mature trees and for the tending

Group selection method:

Remove groups of 2 or 3 financially mature trees growing adjacent to each other …

...do this across an area (in groups) equivalent to that allocated to the mature age class

And disperse the groups across the stand area …
… with group locations depending on the clustering of mature trees

… to regenerate a new cohort by groups inside these larger openings
Within the context of group selection system ...

THE REPRODUCTION METHOD:

- identify family groups of mature trees
  
  … the size and shape of these groups depends on the arrangement of each “family group”

- cut family groups from the area allocated to the mature age class
  
  … with Area = 43560 ÷ (R ÷ CC)
Grouped by age class …

… after group selection system treatment
Always adding the tending …

… group openings for regeneration, PLUS thinning the clusters of immature trees

Group selection system -- before cut
Group selection system – after cut

… with uniformly distributed residual trees at the proper density between the former mature groups
NOTE THIS!

20-inch sugar maple tree has a crown area of

1500 ft$^2$ of space

A 3-tree group would cover

4,500 ft$^2$ of space

... a group opening about
1 tree height wide
With a 15-year cutting cycle …

… and growing each age class for 100 years

… you would have about 7 age classes per acre

Each age class will occupy

6,223 ft$^2$ of space

And to keep the age classes in balance …

… you can cut 3 groups per 4 acres

To maintain a balance among the age classes …

... representing a composite of residual trees in several age classes
And always add tending …

- thinning the immature family groups over the remainder of the stand area …

... to regulate the number per age class

... and concentrate the growth onto the best trees

… regeneration by groups, plus tending of the immature classes
And you get …

- a new age class arranged in new family groups in the area previously occupied by mature trees
- tending of family groups of immature ages
- a harvest of timber

… a system if you do it ALL!!!
Some characteristics of group selection method ...

- Site resources increase more *within the group space* than with single-trees selection method

- Surrounding trees modify the environment somewhat, making conditions less harsh than in large openings

- Root competition, soil moisture, nutrient withdrawals, and light / temperature levels change considerably within the group space

With brighter conditions inside the group openings ... 

... particularly if circular in shape
But in the space **between** the group openings ...

... environmental conditions do **NOT** change sufficiently for establishment and long-term development of regeneration

... particularly for species of low shade tolerance

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But inside group openings of sufficient size ...

... you can regenerate **SOME** less shade-tolerant species/trees, given an adequate seed source

... but **ONLY** in the group space opened by cutting **AT LEAST** 2 to 3 mature trees (and circular openings)

... *widths AT LEAST 1.5 to 2 times tree height*
Higher light …

... better for the less shade-tolerant species

SOME limitations to group selection as a reproduction method …

-- trees don’t necessarily occur in well-arranged family groups that occupy equally proportional areas within a stand

-- inventory methods don’t conveniently identify or locate family groups and their spatial distribution

... thus you have difficulty knowing what to cut to create & maintain a balance among the age classes
These limitations complicate marking for a group selection cutting …

... especially after the first entry

So we face uncertainty about …

... where and how many
Think about this alternative ...

PATCH-SELECTION SYSTEM ...

After Lezh and Filp 1977

PATCH-SELECTION ...

... a hybrid method

... splitting the reproduction area between single-tree and patch cutting

... some fixed-area circular patches fitted to the silvical characteristics of the target species

... most of the regeneration area in single-tree removals
Mostly single-tree removals …

… but adding some patches, too

Patch cutting and single-tree selection methods put together …

… across an area (crown space) equivalent to that allocated to the mature age class
Cutting designed patches AND uniformly dispersed individual trees …

… of mature trees and for the tending

A patch …

… and single-tree cutting
And add tending in between …

… regenerate …tend … harvest

Stand ready for patch-selection treatment …
Note the patch opening …

Patch-selection as a reproduction method:

- Cut trees to regenerate the area allocated to the mature age class

  …over SOME of this area cut fixed-size patches tailored to silvical characteristics of the target species

  … for the REMAINDER of the regeneration area, cut individual mature trees

- Distribute the patches based on convenience, or by some geometric design
Patch - selection system -- before cut

Patch - selection system -- after cut
The higher light levels inside the patches …

… will support development of the less shade-tolerant species

… given a seed source

… more diverse species
To make this into a silvicultural system ...

... **ADD tending of the intermediate age classes**

Keeping the balance with patch-selection system ...

... representing a composite of residual trees in several age classes

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So how many of these patches can you cut per acre ...

... *to cover the proportion of area allocated to each age class*
NOTE THIS!
20-inch sugar maple has a crown area of

1500 FT$^2$

If you use 1/5-acre patches ....

... each patch covers

8,712 ft$^2$

With a 15-year cutting cycle ...

... and growing each age class for about 100 years

... you would have about 7 age classes per acre

Each age class will occupy

6,223 ft$^2$ of space
And to keep the age classes in balance ...

... you must integrate the numbers of patches
  (e.g., @ 8,712 ft² / fifth-acre patch)

... with cutting individual mature trees
  (e.g., @ 1500 ft² / tree)

... to cover ONLY the area allocated to the
mature age class
  (e.g., 6,223 ft² of space per acre)

{See Notation 11-2 for an example}
All these selection systems have these common features:

- Remove mature trees from a \textit{FIXED} proportion of the stand area

  \textit{... regenerate each new age class in the space previously occupied by mature trees}

- Thin the stand area allocated to immature age classes

  \textit{...to concentrate the growth potential of that space onto fewer of the best trees}

- Apply regeneration, tending, and harvesting \textbf{concurrently}

  \textit{... and if you do, you have a \textit{silvicultural system}}
Otherwise, just exploitation ...