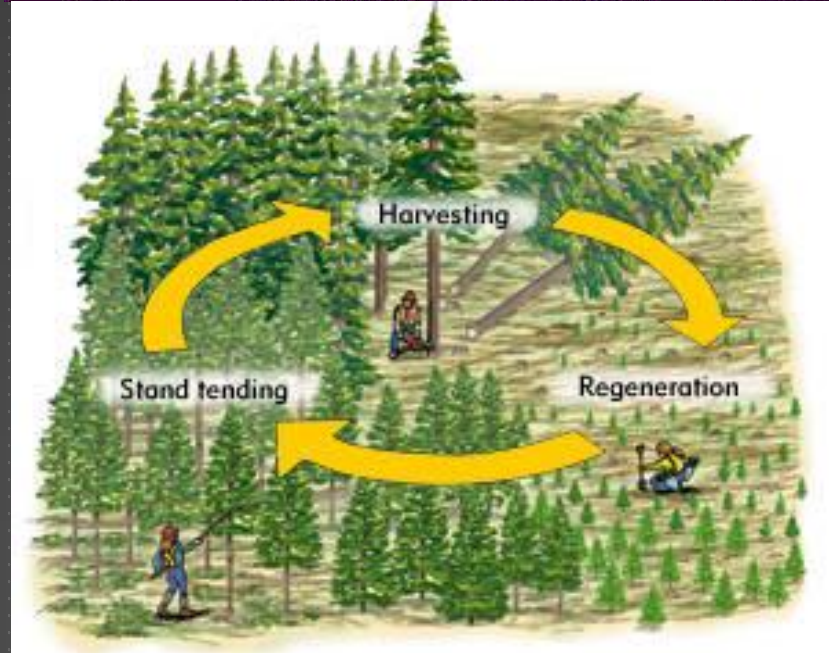


# TREE REGENERATION, A FOUNDATIONAL PROCESS TO SILVICULTURAL SUCCESS



Presented by Dr. Christel C. Kern,  
USDA FS Northern Research Station



For the Michigan SAF Spring Meeting,  
Petoskey, MI

On October 16th, 2014

# OUTLINE

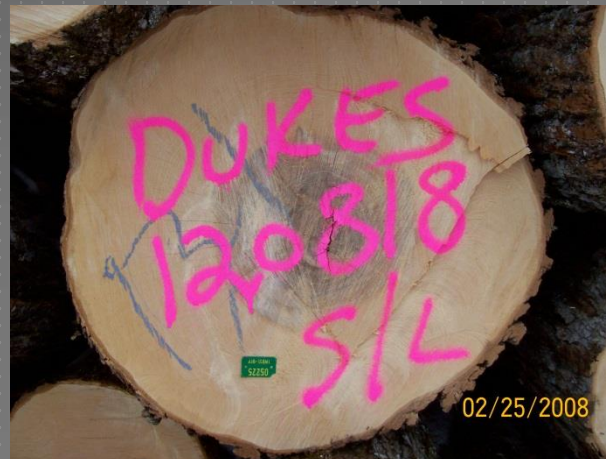
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  - ▶ Regeneration harvests
  - ▶ Regeneration methods
- ▶ Integrating knowledge
  - ▶ Diagnosing
  - ▶ Prescribing
  - ▶ Monitoring
- ▶ Challenges



[http://whitemountainsojourn.blogspot.com/2009/07/blog-post\\_24.html](http://whitemountainsojourn.blogspot.com/2009/07/blog-post_24.html)

# VALUES OF FOREST ECOSYSTEMS

- ▶ Forests support biodiversity.
- ▶ Forests provide a wide range of goods and services.
- ▶ Forests are a renewable resource
  - ▶ Because of tree regeneration!



U.N. International Year of Forests,  
2011

# OUTLINE

- ▶ **Forest ecology**
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# FOREST ECOLOGY

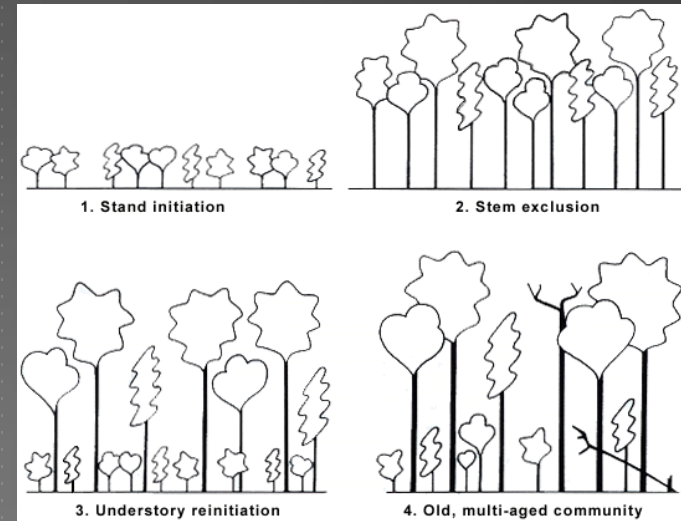
- ▶ Natural disturbance
  - ▶ Altered structure, resources, substrate availability, or environment conditions provide growing space for tree regeneration
  - ▶ Example: Fire is an important mechanism to regenerating patches/stands of red pine.



[http://www.lakestatesfiresci.net/webinar\\_1\\_19\\_12.htm](http://www.lakestatesfiresci.net/webinar_1_19_12.htm)

# FOREST ECOLOGY

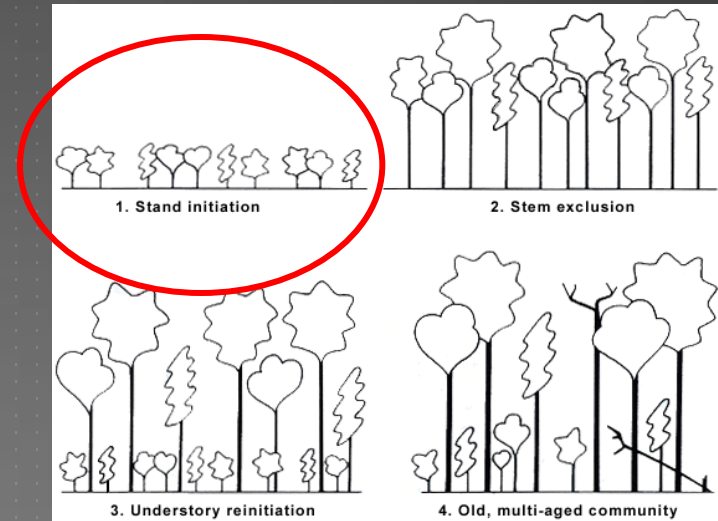
- ▶ Natural stand dynamics (Oliver & Larson 1996)



<http://www.na.fs.fed.us/spfo/pubs/misc/ecoforest/fig3trees.gif>

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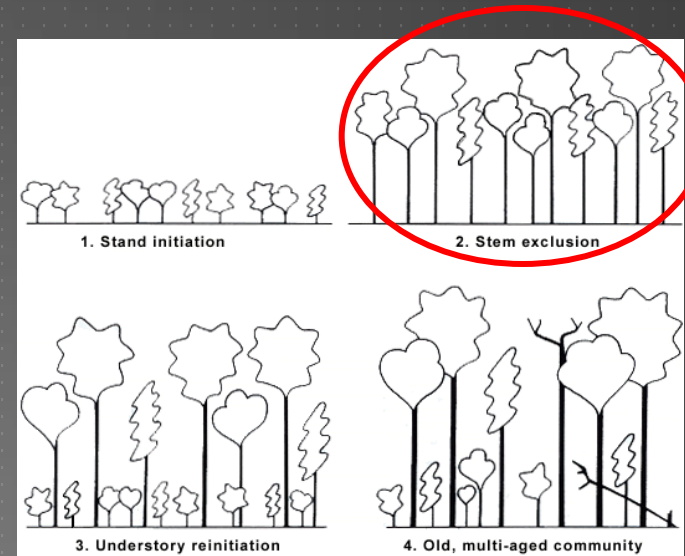
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  - ▶ Stand initiation (regen)



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# FOREST ECOLOGY

- ▶ Natural stand dynamics (Oliver & Larson 1996)
  - ▶ Stand initiation (regen)
  - ▶ Stem exclusion

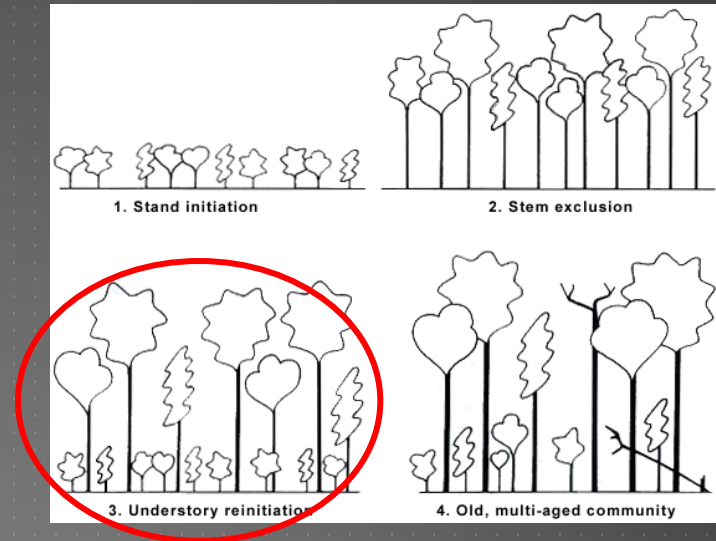


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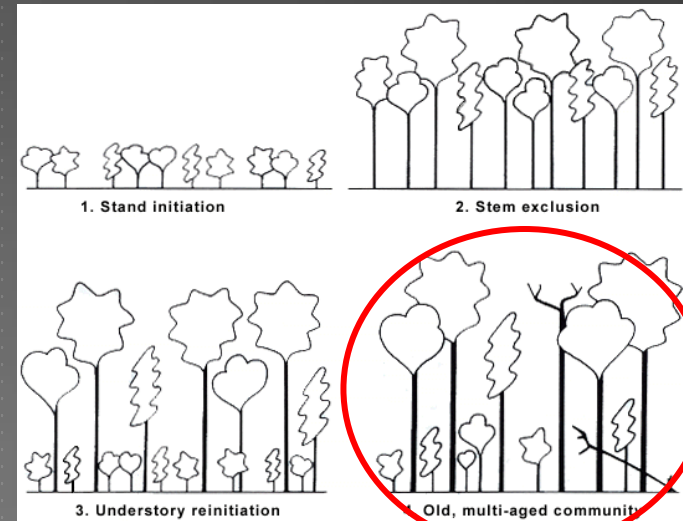
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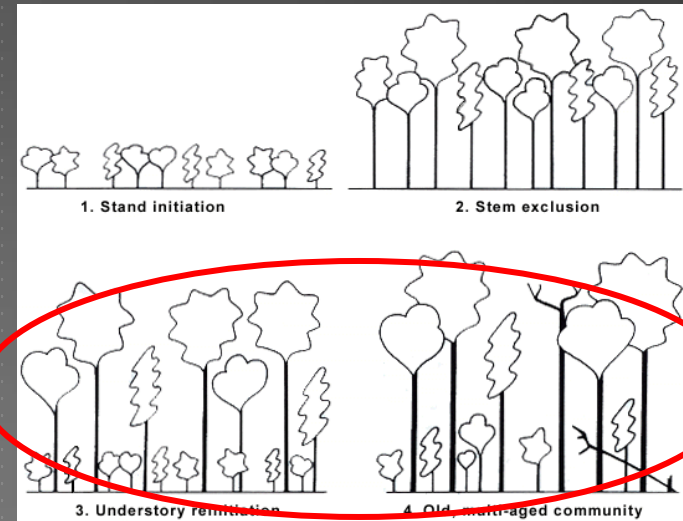
- ▶ Natural stand dynamics (Oliver & Larson 1996)
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<http://www.na.fs.fed.us/spfo/pubs/misc/ecoforest/fig3trees.gif>

# FOREST ECOLOGY

- ▶ Natural stand dynamics (Oliver & Larson 1996)
  - ▶ Stand initiation (regen)
  - ▶ Stem exclusion
  - ▶ Understory re-initiation (regen)
  - ▶ Old growth (regen)
- ▶ Example: Gap-phase dynamics in the old growth stage are important to regenerate small patches or individual trees in northern hardwood forests.



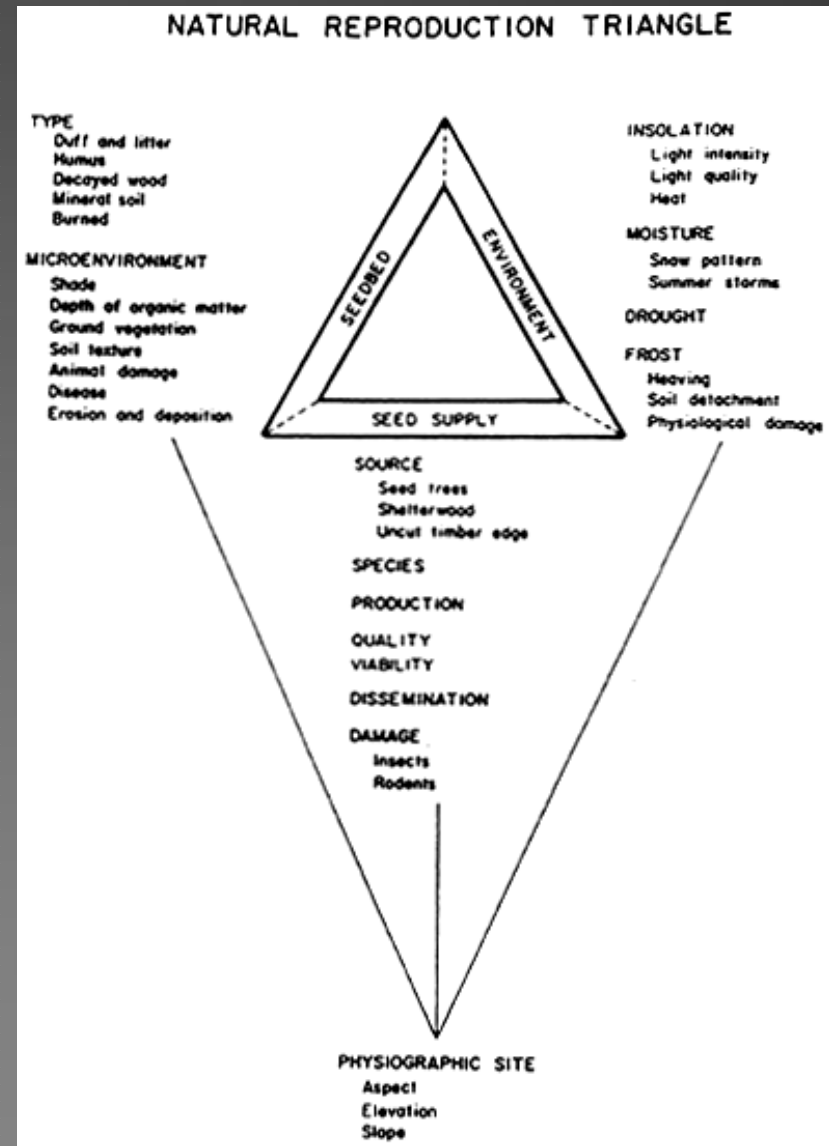
<http://www.na.fs.fed.us/spfo/pubs/misc/ecoforest/fig3trees.gif>



# FOREST ECOLOGY

## ▶ Regeneration triangle

- ▶ Definition: Seed supply and the interacting factors affecting germination, establishment and survival
- ▶ Example: Yellow Birch
  - ▶ Seed supply:
    - ▶ Mature, seed-bearing source available
    - ▶ Seed crop every 2-3 years
    - ▶ Wind dispersed up to 1,000 feet
  - ▶ Seedbed:
    - ▶ Decaying wood or mineral soil
  - ▶ Environment:
    - ▶ Partial light, moderate to well-drained soil



Roe et al. 1970;

<http://www.cof.orst.edu/cof/teach/for442/cnotes/sec13/trifin.gif>

# OUTLINE

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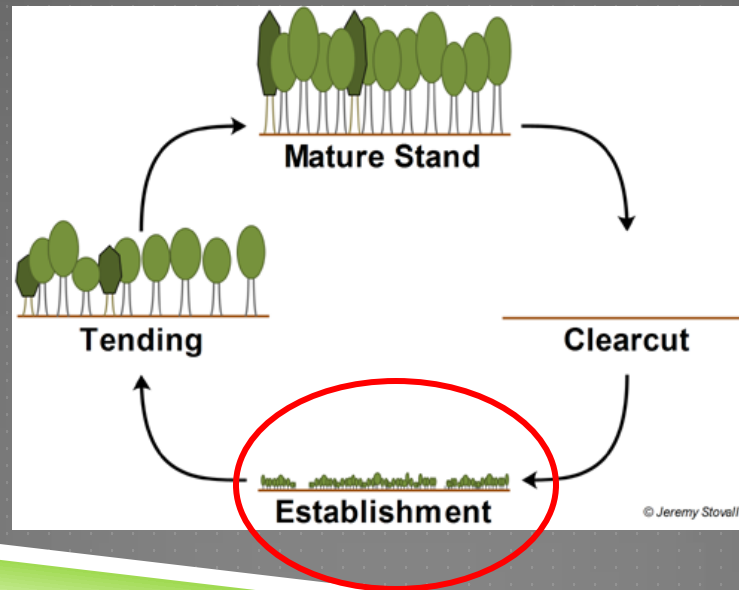
# SILVICULTURAL SYSTEMS

- ▶ Definition (from SAF Dictionary of Forestry)
  - ▶ Silviculture: “the art and science of controlling the establishment,...



# SILVICULTURAL SYSTEMS

- ▶ Definition (from SAF Dictionary of Forestry)
  - ▶ Silviculture: “the art and science of controlling the establishment, ...”
  - ▶ Silvicultural system: “a planned series of treatments for ... re-establishing a stand — the system name is based on ...the regeneration method used”



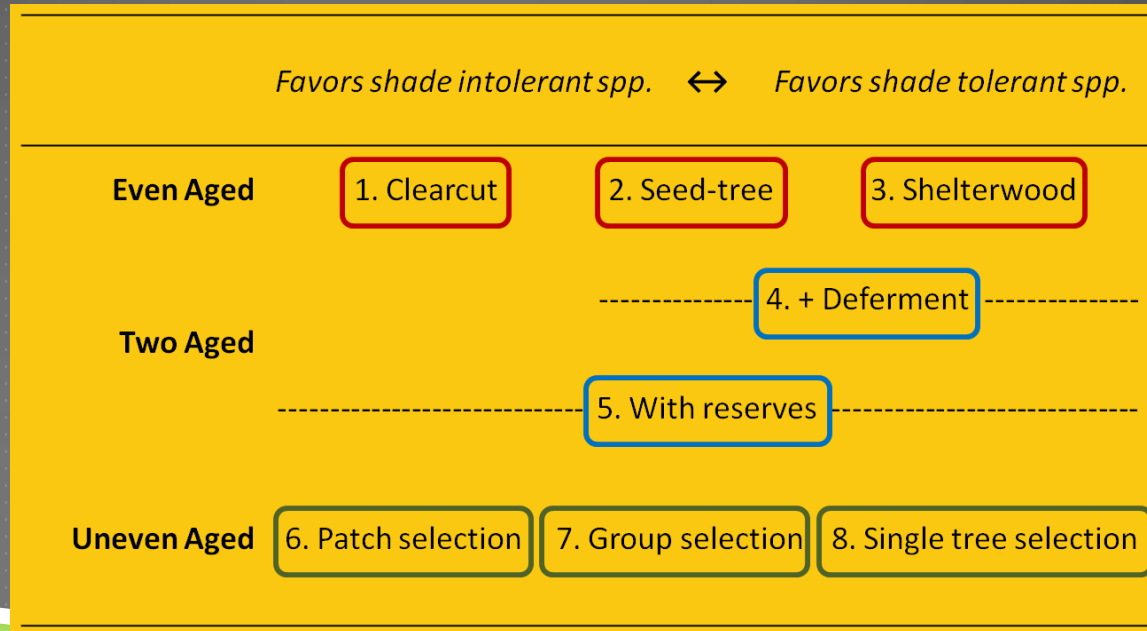
<http://forestry.sfasu.edu/faculty/stovall/silviculture/index.php/silviculture-textbook-sp-9418/150-silvicultural-systems-sp-28339>

# SILVICULTURAL SYSTEMS

- ▶ Regeneration (or reproduction) method: “a cutting procedure by which a new age class is created” (SAF Dictionary of Forestry)

Coppice  
-Coppice

<http://forestry.sfasu.edu/faculty/stovall/silviculture/index.php/silviculture-textbook-sp-9418/150-silvicultural-systems-sp-28339>





# SILVICULTURAL SYSTEMS

- ▶ Regeneration: “the act of renewing tree cover by establishing young trees naturally or artificially” (SAF Dictionary of Forestry)

## Artificial

- Direct seeding
- Planting



## Natural

- Natural seeding
- Coppice
- Root suckers



# SILVICULTURAL SYSTEMS

- ▶ Example: Red pine forests
  - ▶ “Classic” approach
    - ▶ Clearcut
    - ▶ Row plant



# SILVICULTURAL SYSTEMS

- ▶ Example: Northern hardwood forests
  - ▶ “Classic” approach
    - ▶ Single-tree selection
    - ▶ Natural seeding



# OUTLINE

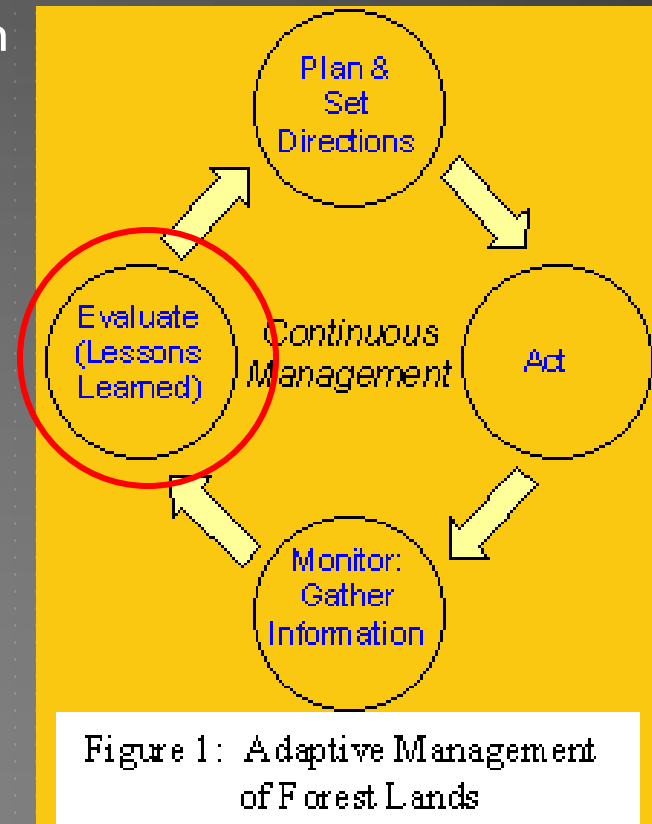
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# INTEGRATING KNOWLEDGE

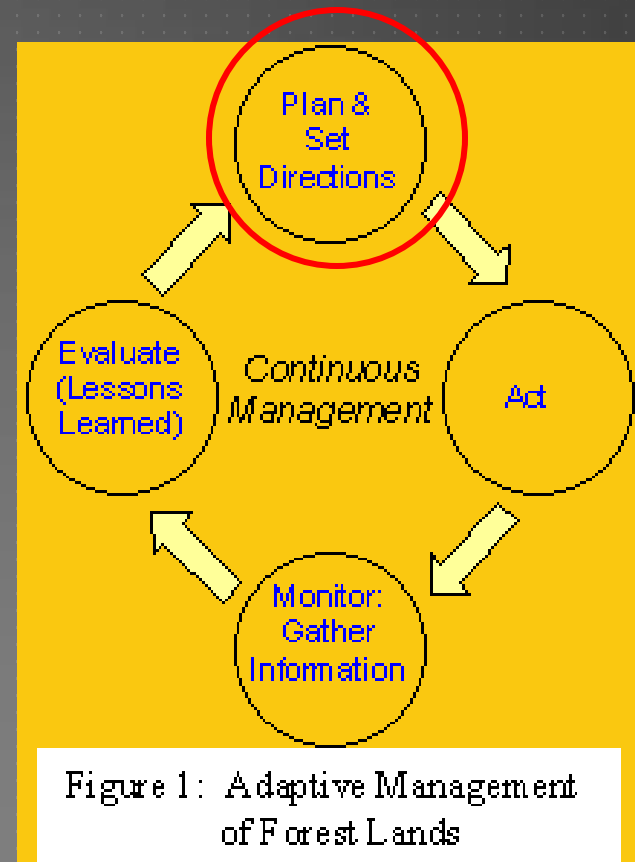
- ▶ Adaptive management through the prescription process



<http://www.reo.gov/ama/objectives.htm>

# INTEGRATING KNOWLEDGE

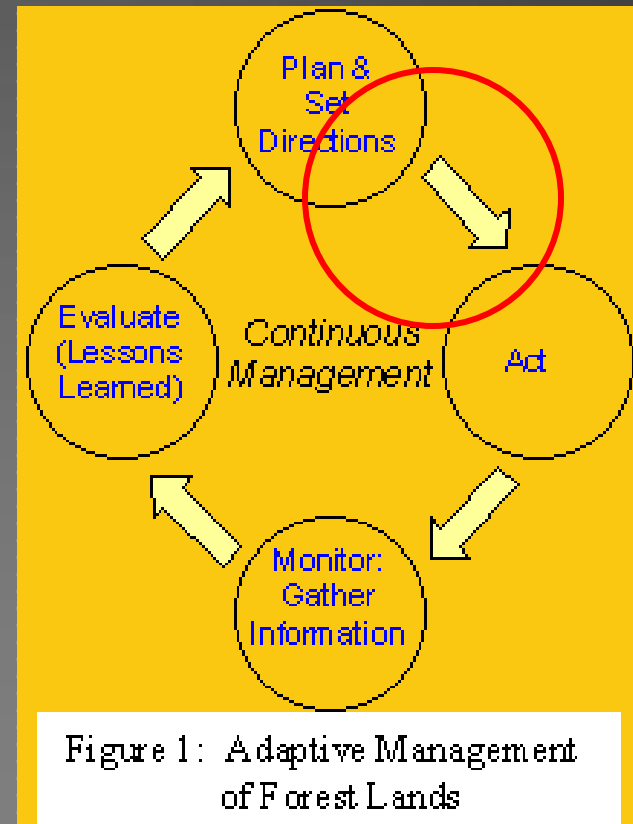
- ▶ Adaptive management through the prescription process
  - ▶ OBSERVATION: Describe site and current stand conditions, and desired future conditions



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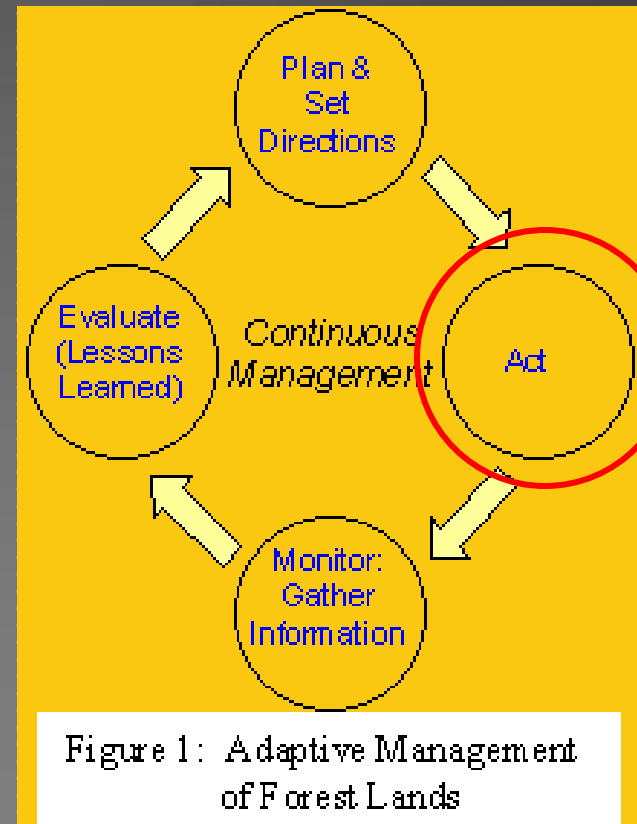
- ▶ Adaptive management through the prescription process
  - ▶ OBSERVATION: Describe site and current stand conditions, and desired future conditions
  - ▶ DIAGNOSIS: Determine management objectives



<http://www.reo.gov/ama/objectives.htm>

# INTEGRATING KNOWLEDGE

- ▶ Adaptive management through the prescription process
  - ▶ OBSERVATION: Describe site and current stand conditions, and desired future conditions
  - ▶ DIAGNOSIS: Determine management objectives
  - ▶ PRESCRIBE: Justify the recommended approach then detail the sequence of events, timing, techniques, and mitigation measures

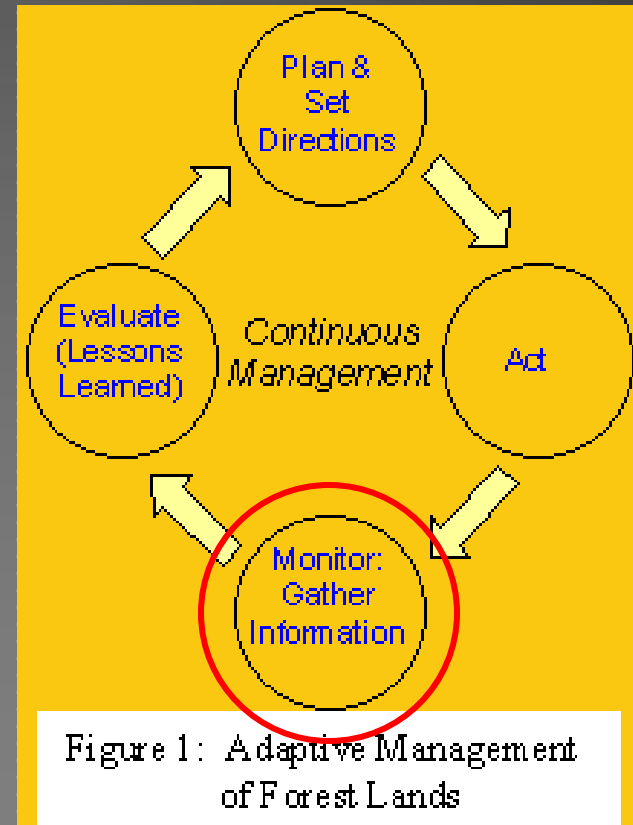


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# INTEGRATING KNOWLEDGE

- ▶ Adaptive management through the prescription process
  - ▶ OBSERVATION: Describe site and current stand conditions, and desired future conditions
  - ▶ DIAGNOSIS: Determine management objectives
  - ▶ PRESCRIBE: Justify the recommended approach then detail the sequence of events, timing, techniques, and mitigation measures
  - ▶ MONITOR: Detail criteria necessary to judge success of regeneration (or treatment effectiveness); use meaningful timeframes



<http://www.reo.gov/ama/objectives.htm>

# INTEGRATING KNOWLEDGE

## ▶ Judging “successful” regeneration

- ▶ Density
- ▶ Species
- ▶ Time frame

**Example: SILVAH**  
- Decision support for managers of Allegheny hardwood and mixed oak ecosystems  
By Scott Thomasma and Susan Stout

## ▶ Considerations

- ▶ Spatial distribution (e.g., group opening)
- ▶ Minimum density required in canopy
- ▶ Free of recruitment limitations (or “Free to grow”)

**Example: Wisc. NHW**  
- 13 years post harvest in gaps; sapling height equations; % tree cover; % species; # dominants; gap size...

# OUTLINE

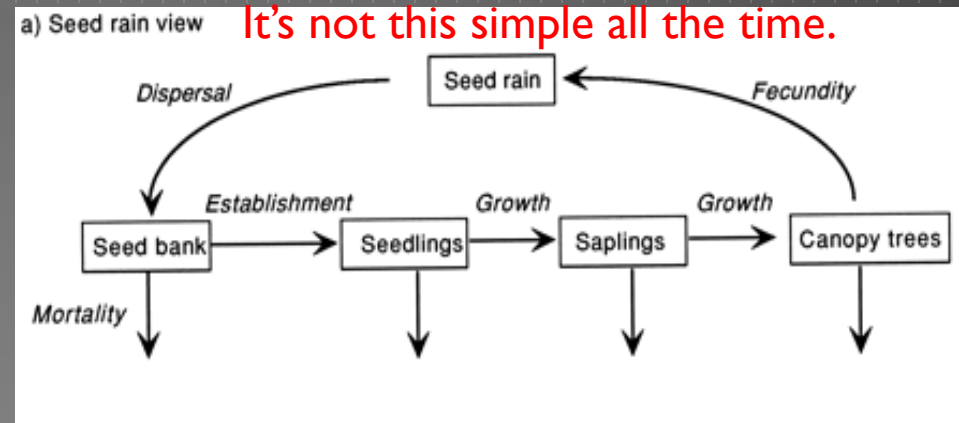
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# CHALLENGES

- ▶ Forest ecology is messy with bottlenecks to natural regeneration
  - ▶ Interference with the regeneration triangle
  - ▶ Non-tree vegetation
  - ▶ Animal feeding
  - ▶ Disease infestations
  - ▶ Insect outbreaks
  - ▶ Fire
  - ▶ Extreme weather events



Clark et al. 1999

# CHALLENGES

- ▶ Forest ecology is messy with bottlenecks to natural regeneration
  - ▶ Research study on tip-up mounds, WI
    - ▶ New mound creation lost with salvage
    - ▶ Mound creation in high value conservation areas?



# CHALLENGES

- ▶ Conventional silvicultural systems are based on assumptions about regeneration
  - ▶ Single-tree selection assumes trees less than merchantable size

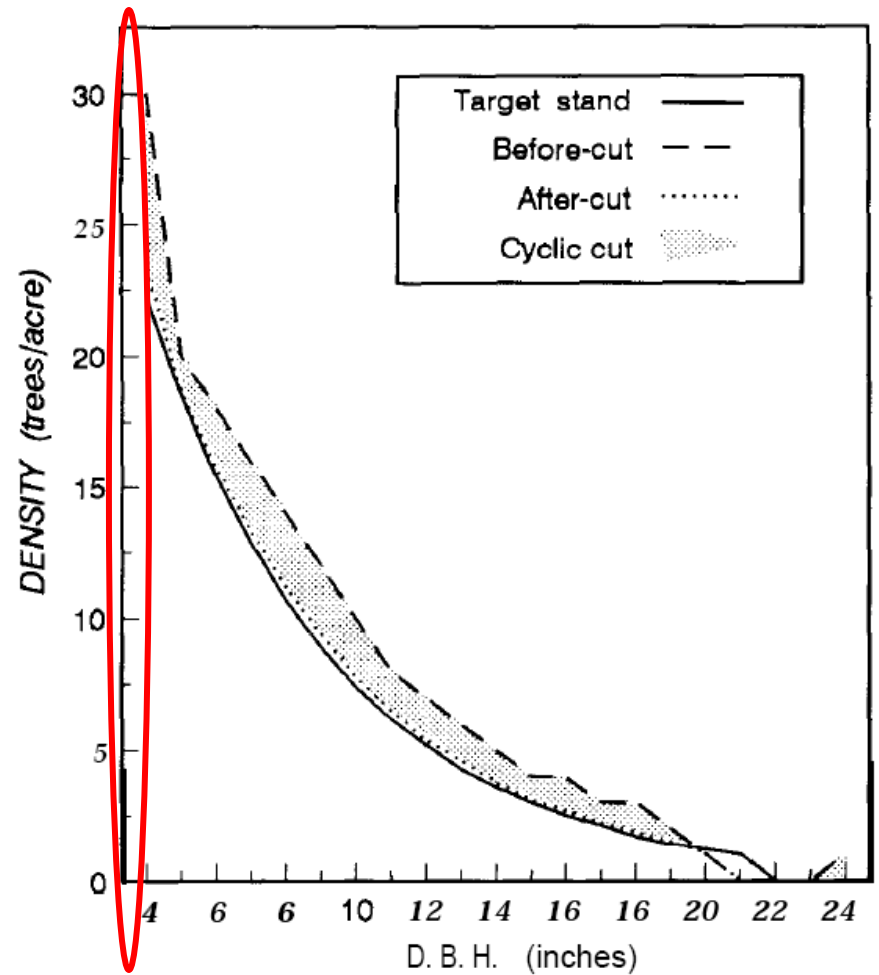


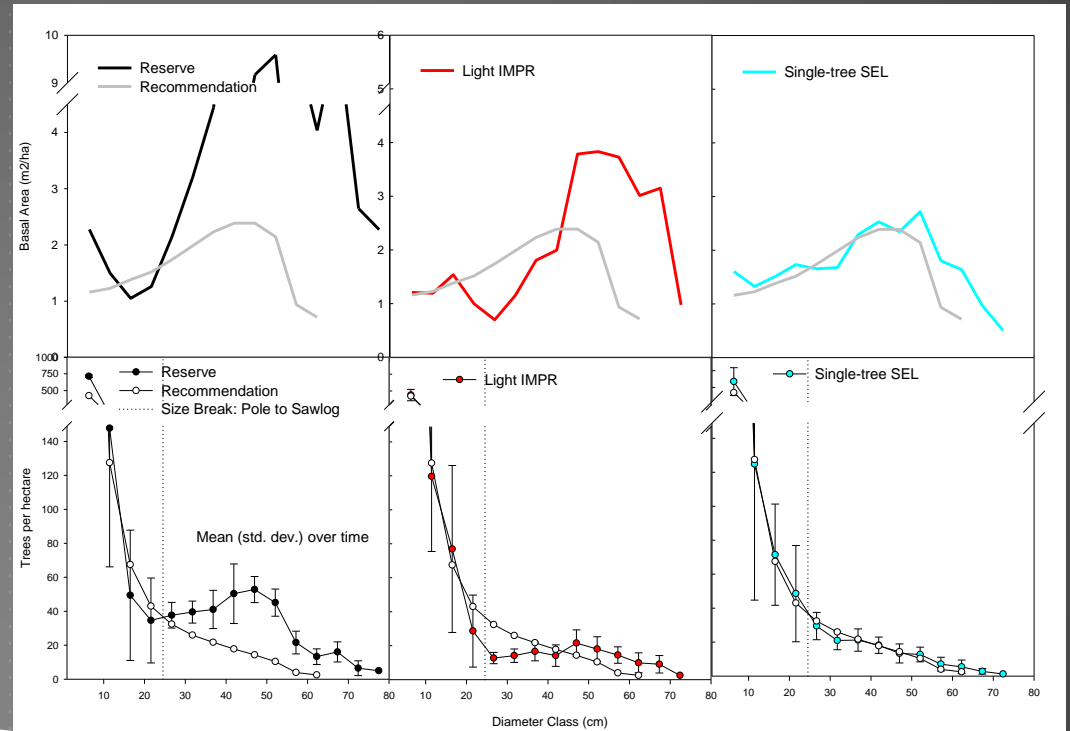
Figure 3.6.—Target, before-cut, and after-cut stand and cyclic cut.

[www.uky.edu/~jmlhot2/courses/for350/Uneven-aged%20Regulation%20La](http://www.uky.edu/~jmlhot2/courses/for350/Uneven-aged%20Regulation%20La)

# CHALLENGES

- ▶ Conventional silvicultural systems are based on assumptions about regeneration

Research study, Dukes Experimental Forest, MI  
Sustainability of Arbogast structure over time



# CHALLENGES

- ▶ Decoupling of natural processes
  - ▶ Migration and adaption of trees to new conditions may be uncoupled from functional processes such as pollination, symbiotic associations, ...

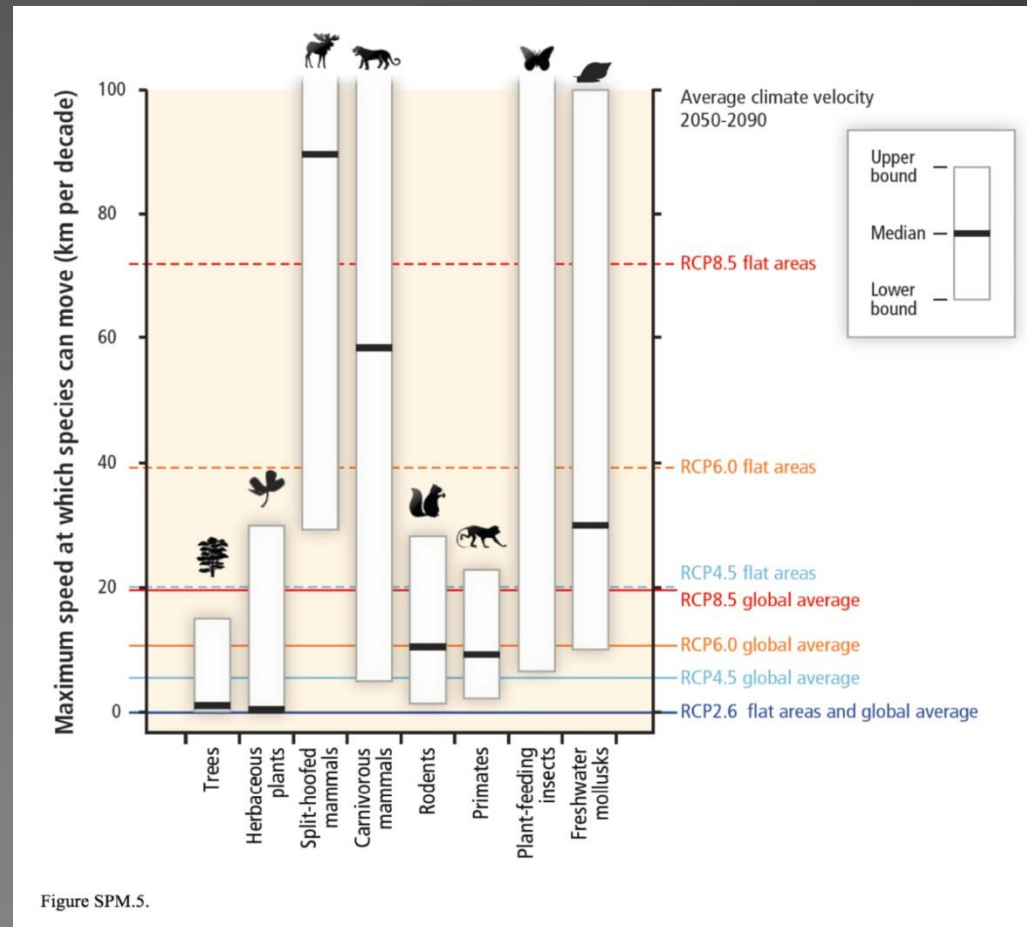


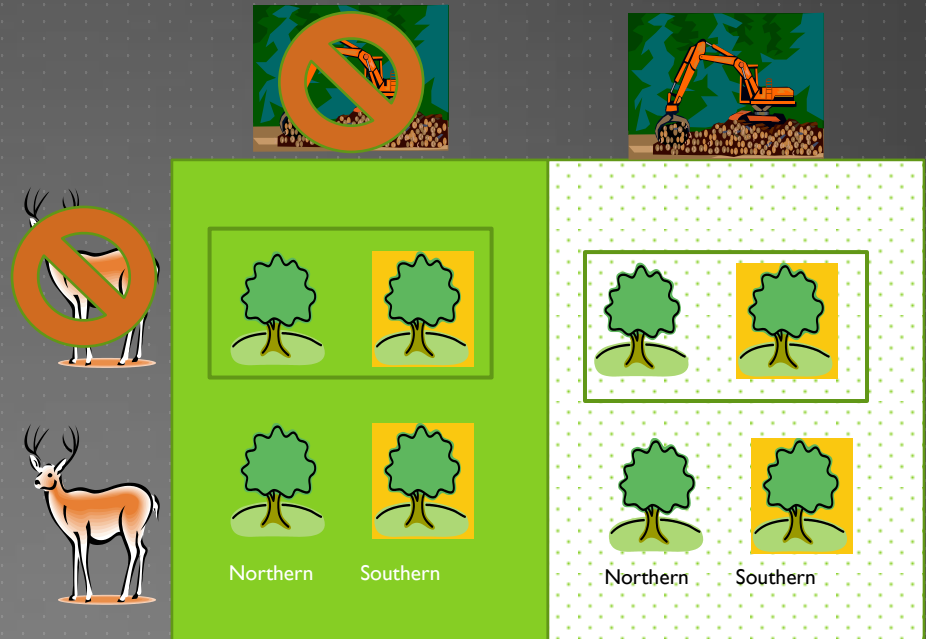
Figure SPM.5.

<http://www.torreyaguardians.org/assisted-migration.html>



# CHALLENGES

- ▶ Decoupling of natural processes
- ▶ Research study, sites?
  - ▶ Susceptibility of species x seed source to browse



# OUTLINE

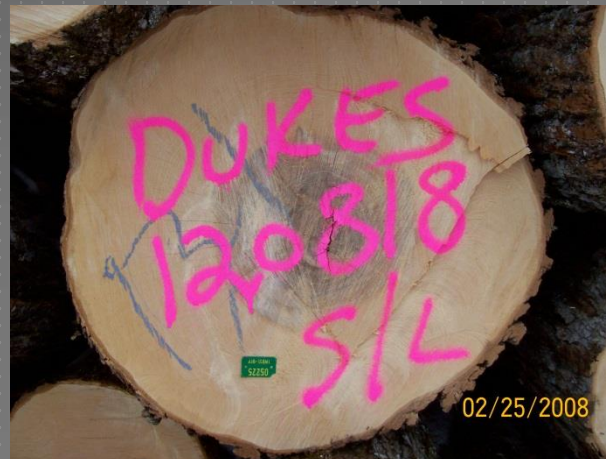
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  - ▶ *You can help!*



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# THANKS! - - - QUESTIONS?

*Please contact:*

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*Email: [cckern@fs.fed.us](mailto:cckern@fs.fed.us)*

