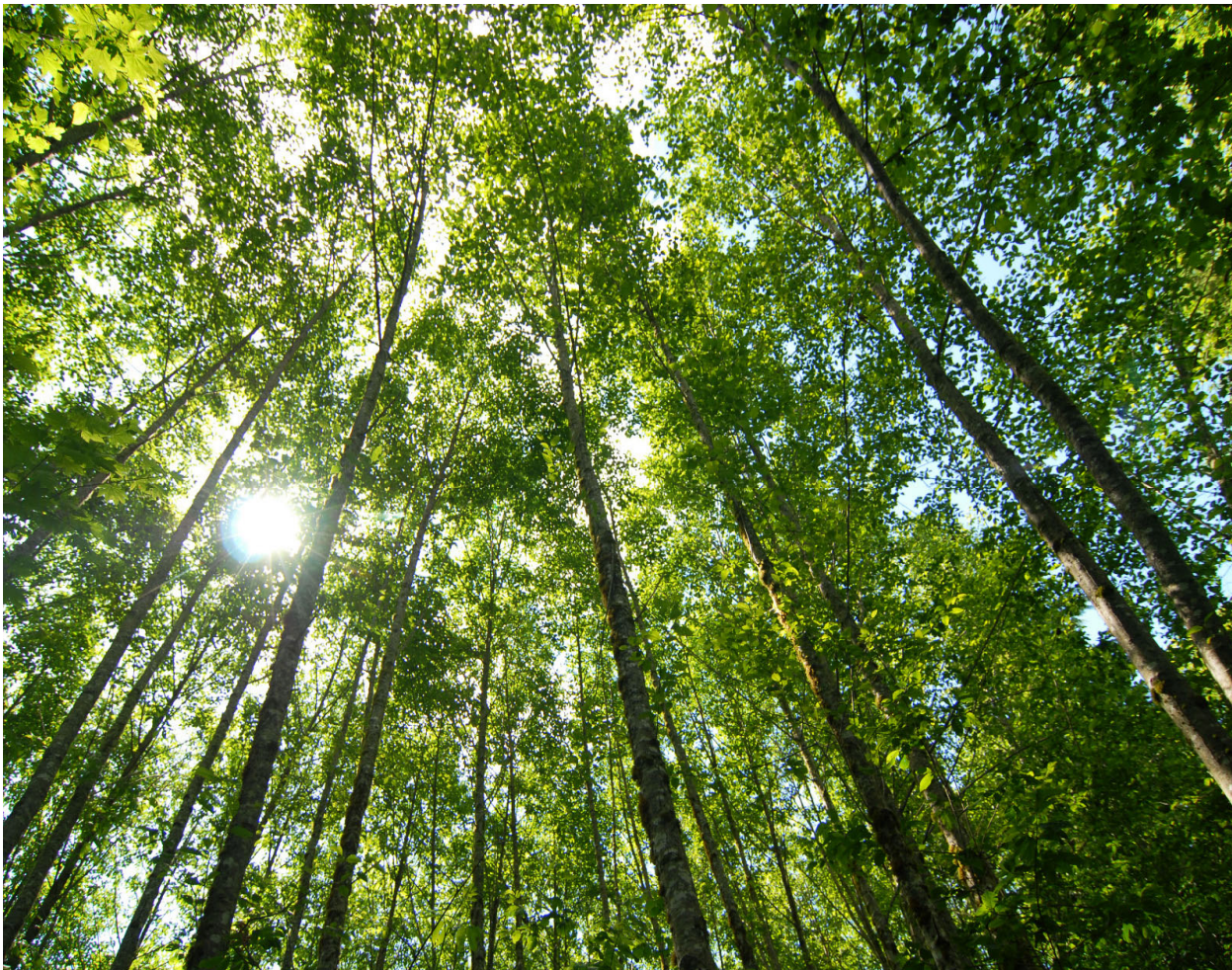




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Peter Hoagland, CF

State Forester



• Pennsylvania

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Advanced Forestry Concepts Boot Camp 2, Virtual Day # 1

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Objectives



- **Current PA Forest Conditions**
- **Silvicultural Systems**
- **Forest Stand Improvement Treatment Methods**



A Systemic PA Forest Problem

Common Resource Concern: Degraded Plant Condition-Structure and composition

Pennsylvania's forests mostly even-aged

Least acreage in new age classes

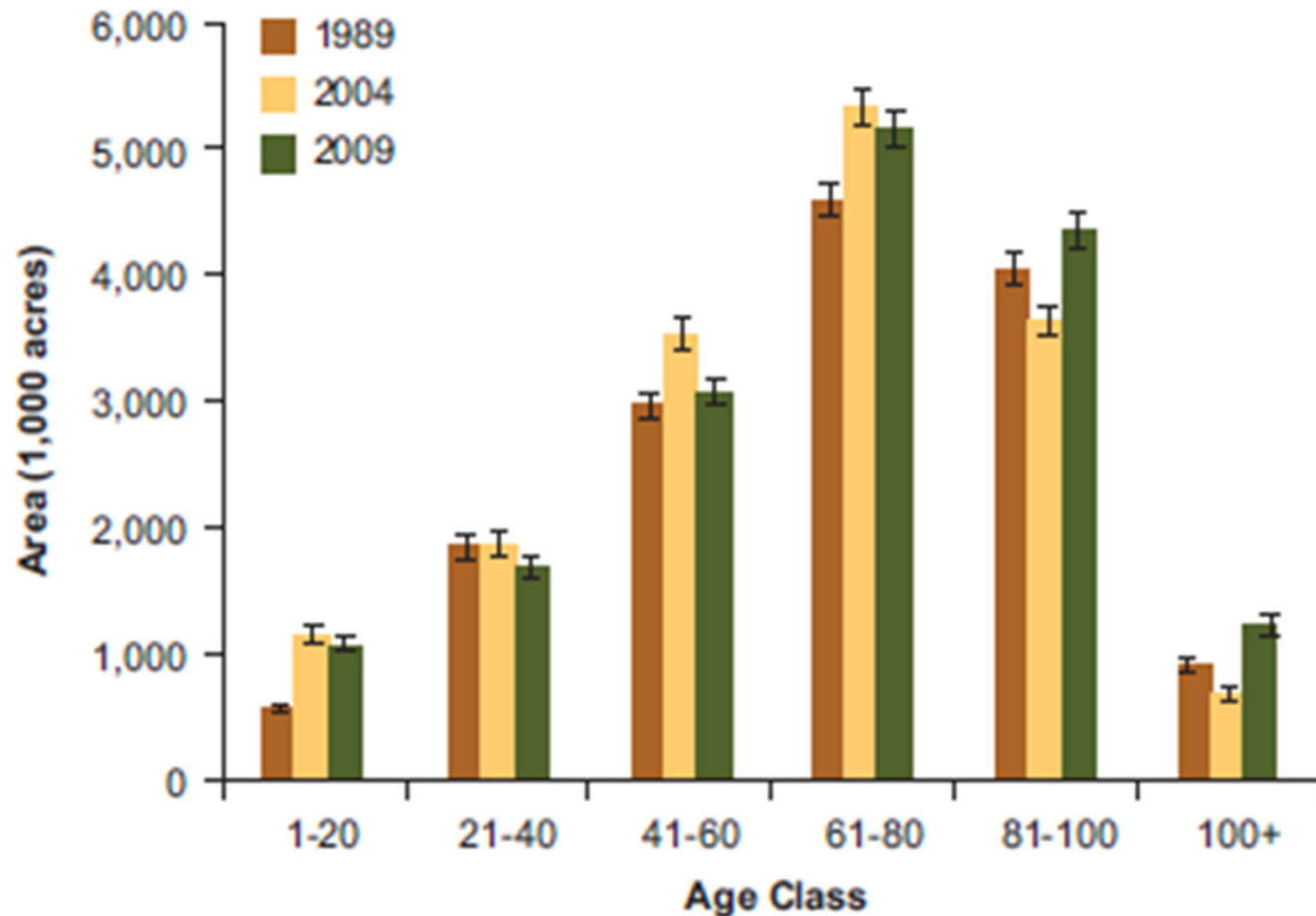


Figure 11.—Area of timberland by age class of dominant trees Pennsylvania, 1989, 2004 and 2009. Sampling error bars are for 68-percent confidence level.

Source: *Pennsylvania's Forests*, McCaskill et al. 2013

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Changing Ecological Patterns

Disturbance regimes shape forests

- Type
- Frequency
- Scale and distribution

New disturbance regime:

- Fire absence
- Chronic browsing by deer
- Canopy disturbances affecting oaks (Gypsy Moth)
- Invasive pests limiting diversity (EAB, CSSM, HWA)
- Invasive plant competition
- Unsustainable Forest Harvesting



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PA Fire History



PA Fire History

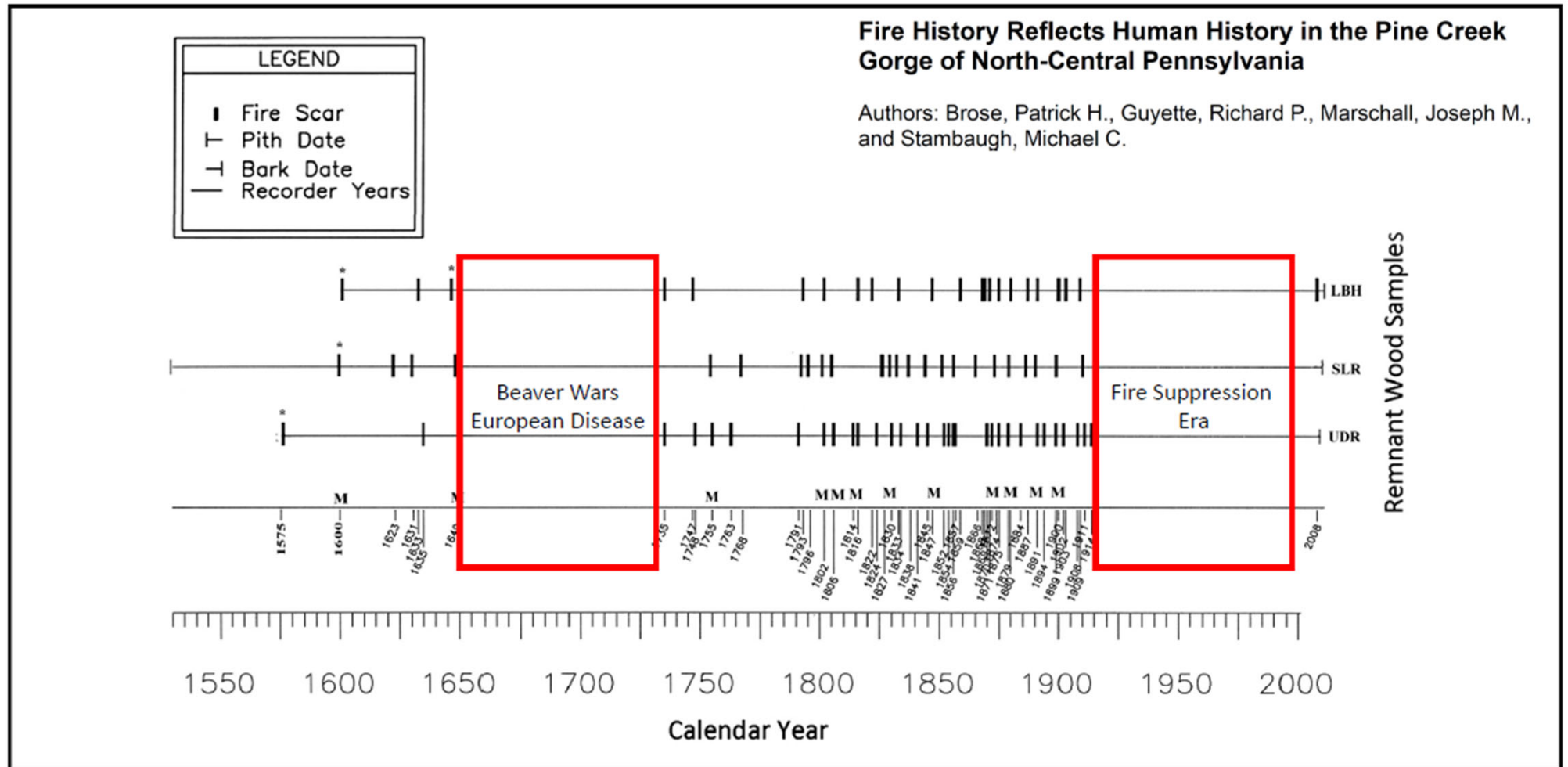


Figure 6. Composite fire chronologies of the Long Branch Hill (LBH), Slate Run (SLR), and Upper Dry Run (UDR) study sites in north-central Pennsylvania. Each horizontal line represents the chronology of one site and each dark black vertical bar represents a fire. Asterisks (*) denote fires identified from formation of red pine cohorts, not from fire scars. M indicates potential multisite fires. Note the synchrony of fires and fire-free periods among the three sites despite them being 12 to 14 km apart.

Transitioning Forests

Species composition

- Shade tolerant species dominance
- Oak species decline
- Non-Native Invasive Plant species

Lack of adequate regeneration



Forest Composition

Large diameter trees increasing

Small diameter trees decreasing

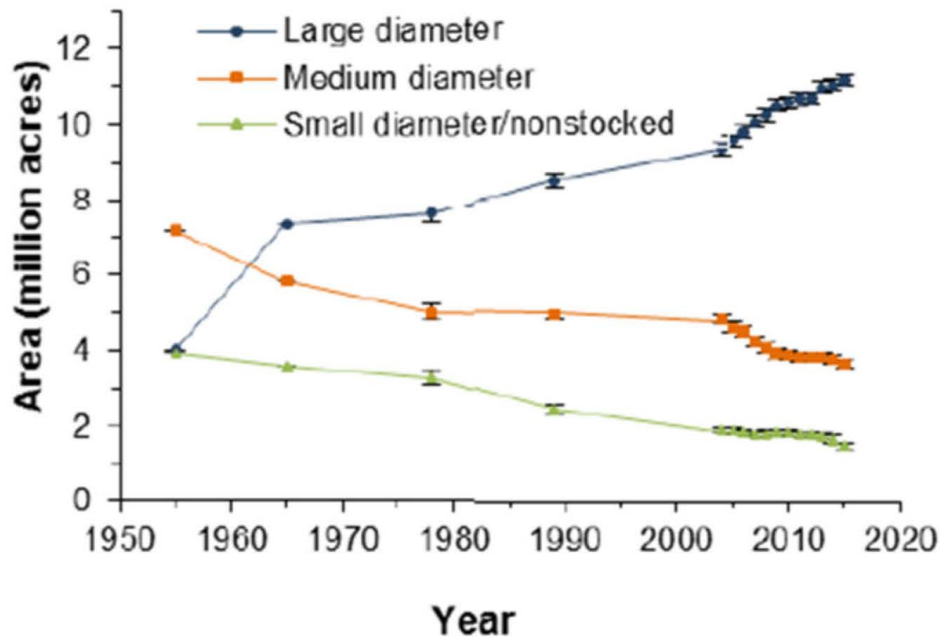


Figure 3.—Area of timberland by stand-size class and inventory year, Pennsylvania.

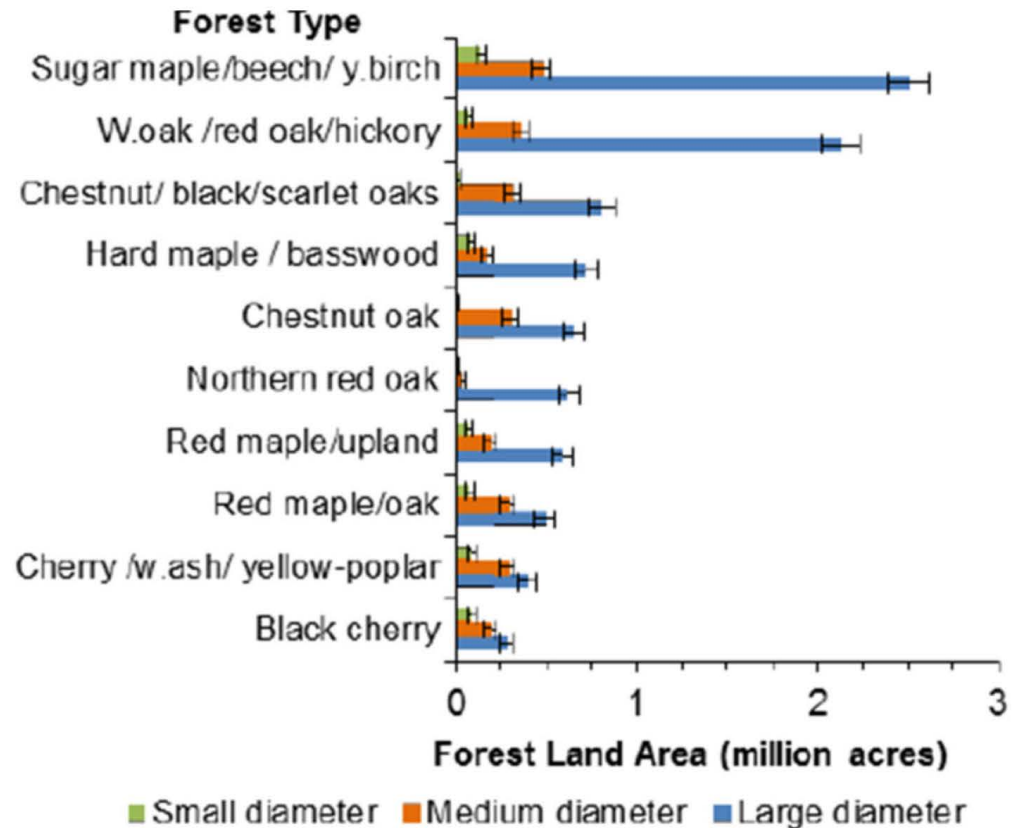


Figure 4.—Area of forest land by stand-size class² (based on small, medium, and large trees) for the top 10 forest types ranked by area, Pennsylvania, 2015.





ArcGIS ▾ FIA Forest Type Group: All Forest Types

Details | Basemap

Print | Measure

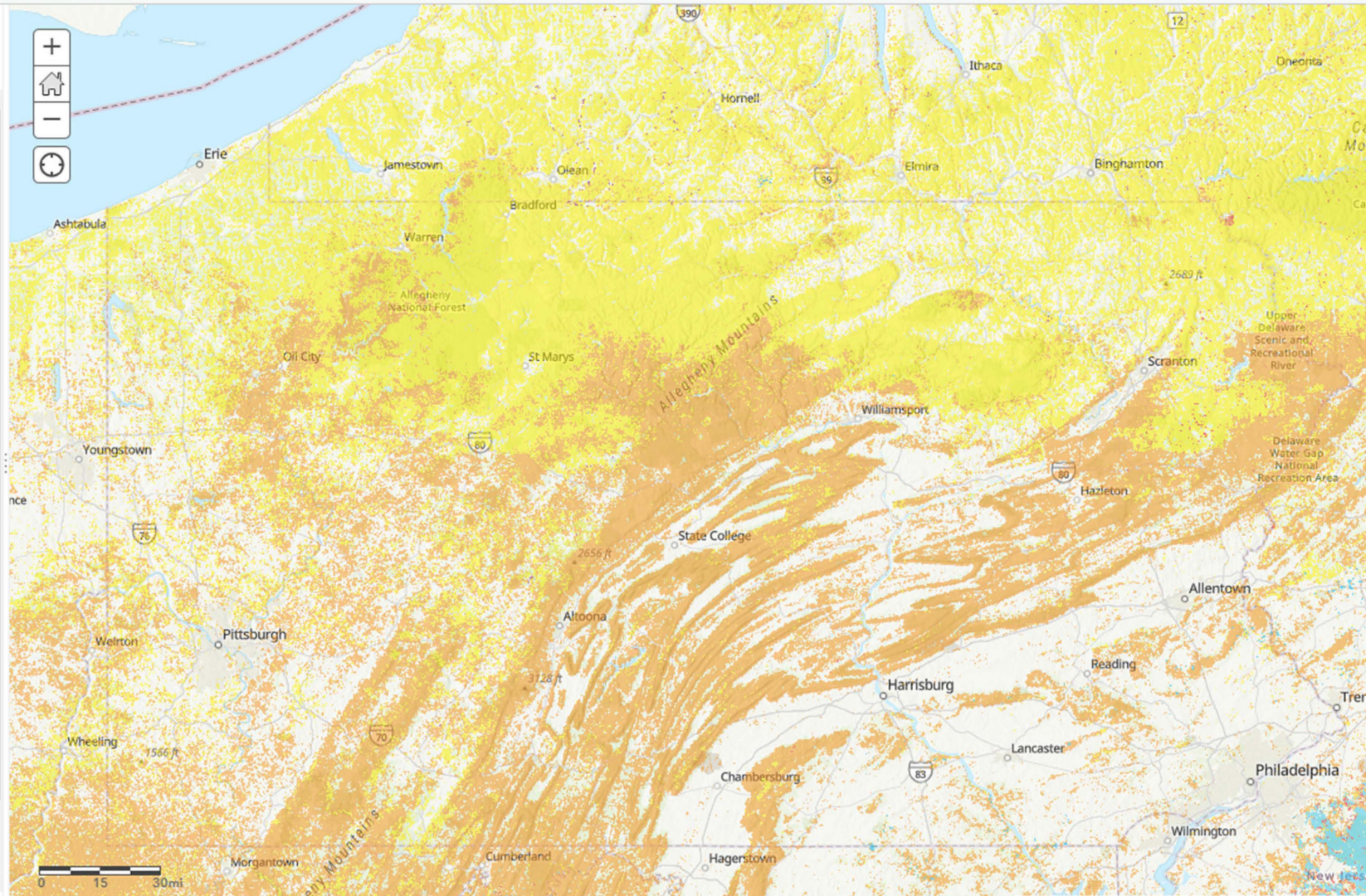
About | Content | Legend

Legend

FIA Forest Type Group: All Forest Types

CONUS Forest Type Groups

- Alder/Maple
- Aspen/Birch
- California Mixed Conifer
- Douglas-fir
- Elm/Ash/Cottonwood
- Exotic Hardwoods
- Exotic Softwoods
- Fir/Spruce/Mountain Hemlock
- Hemlock/Sitka Spruce
- Loblolly/Shortleaf Pine
- Lodgepole Pine
- Longleaf/Slash Pine
- Maple/Beech/Birch
- Oak/Gum/Cypress
- Oak/Hickory
- Oak/Pine
- Other Western Hardwoods
- Other Western Softwoods
- Pinyon/Juniper
- Ponderosa Pine
- Redwood
- Spruce/Fir
- Tanoak/Laurel
- Tropical Hardwoods
- Western Larch
- Western Oak



PA's Forest Types

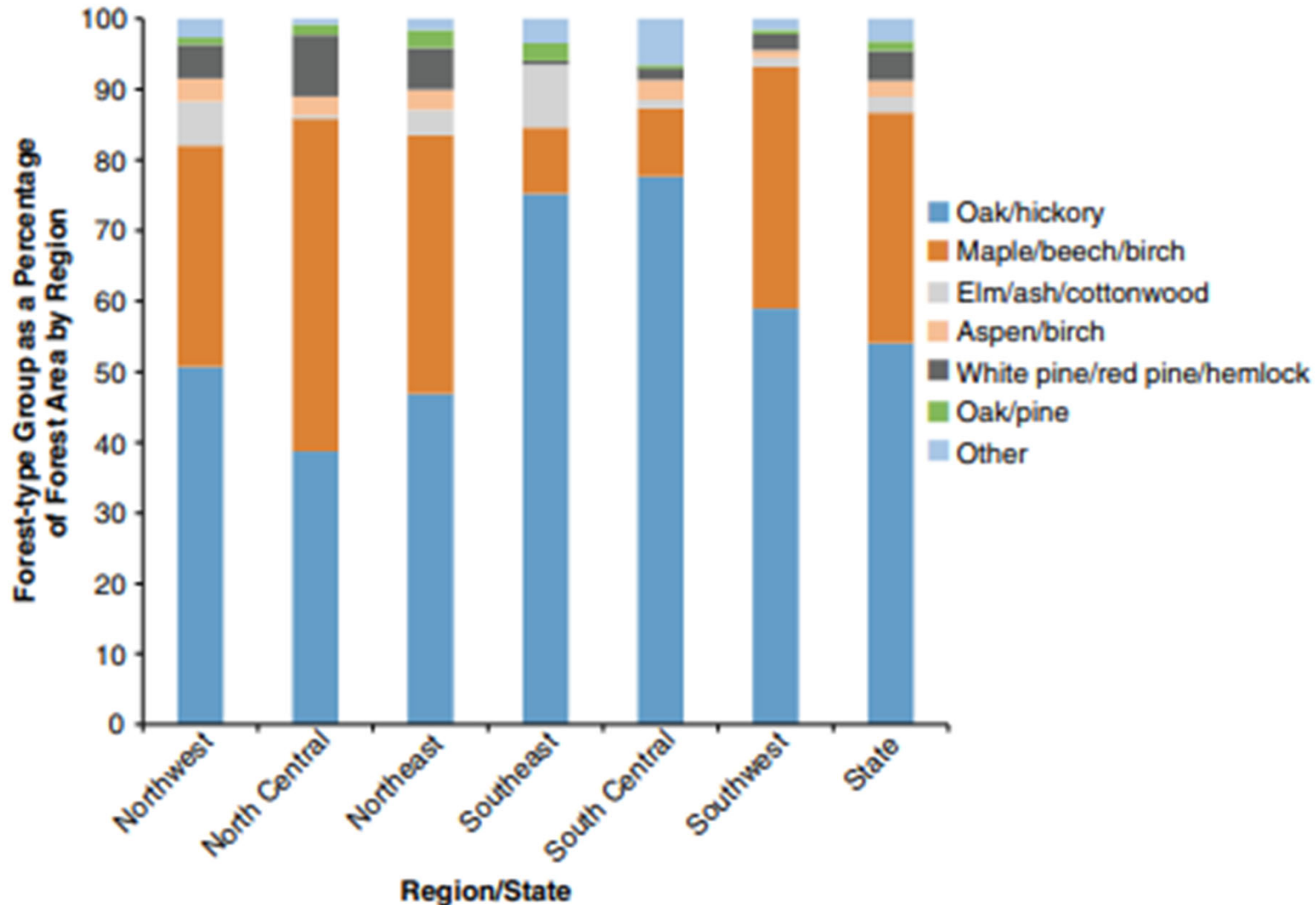


Figure 21.—Most abundant forest-type groups on forest land by region, Pennsylvania, 2014.



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Oak –Hickory Forest Succession



Closed canopy

Even Aged forest

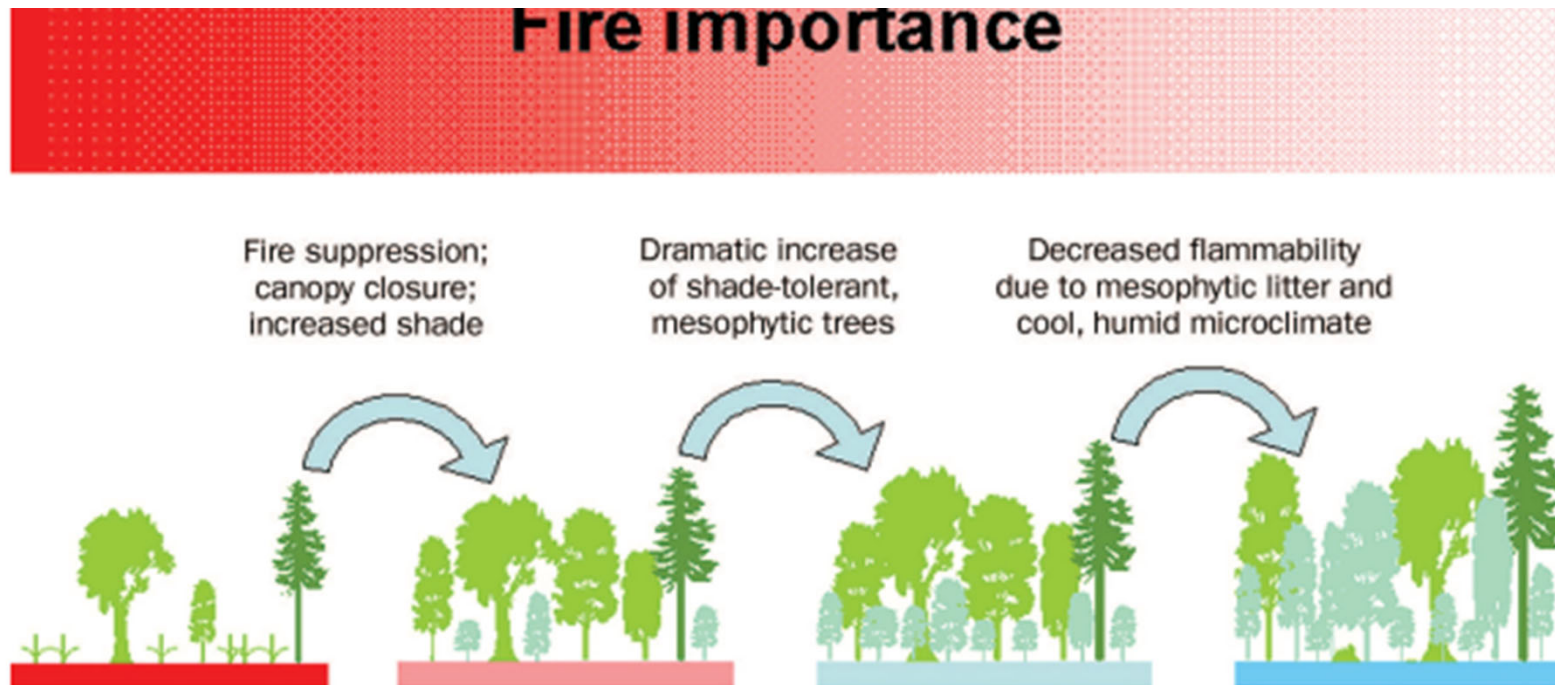
Dense understory shade



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Mesophication





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Wildlife Impact



2015-2025 Pennsylvania WILDLIFE ACTION PLAN



PA PGC



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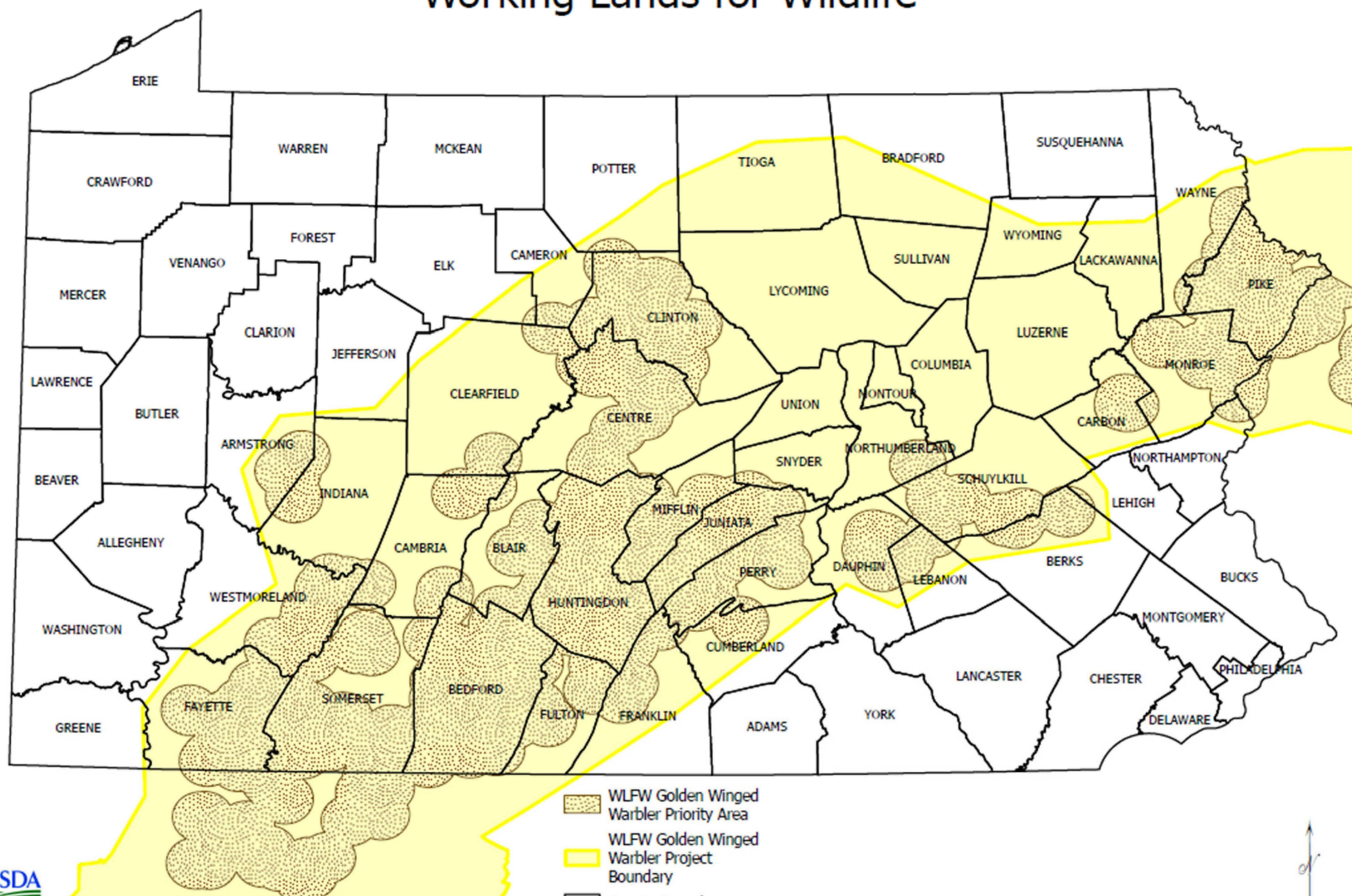


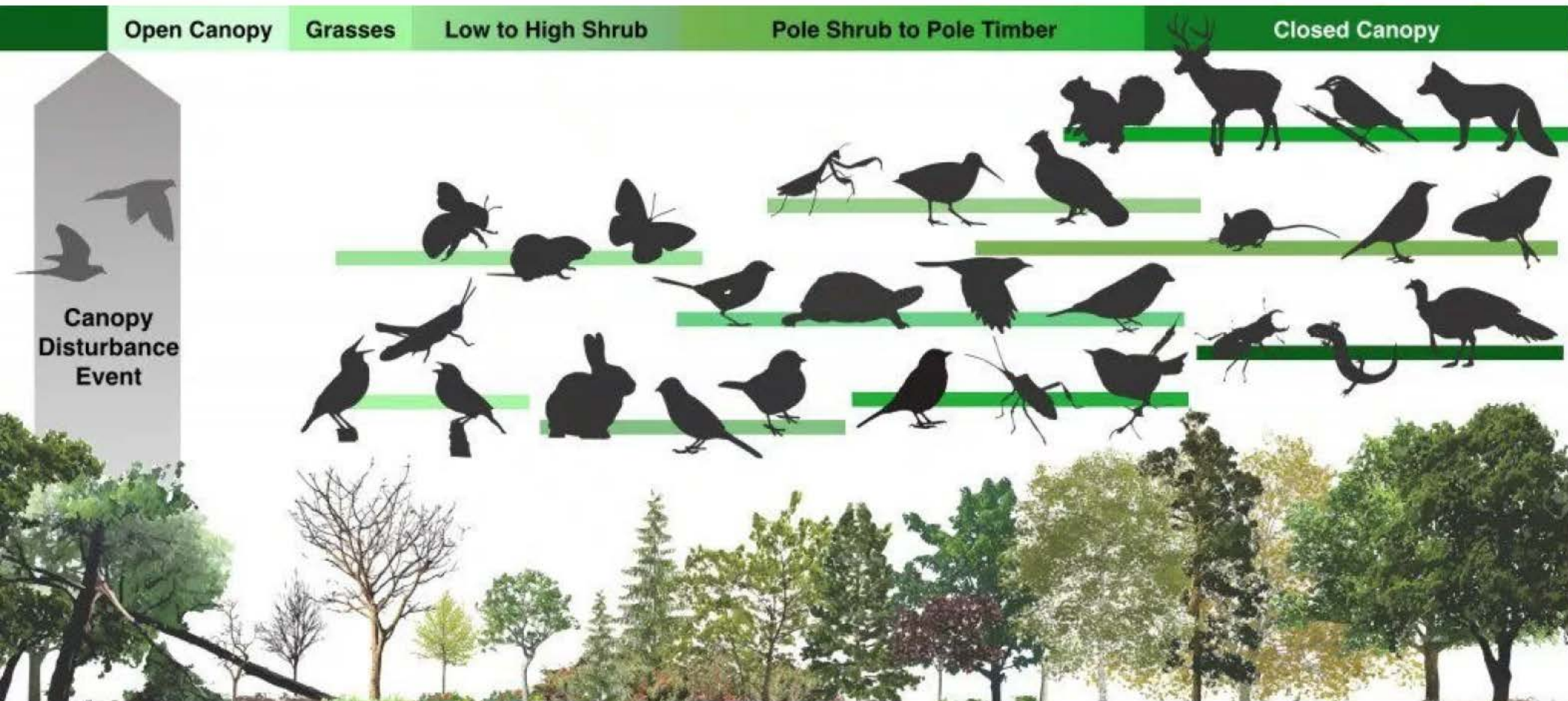
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Landscape Variability



Golden Winged Warbler Working Lands for Wildlife





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Oak Woodlands



Diffuse Shade

Open Canopy

**Diverse Herbaceous
layer**



Patrick Brose, USFS

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“Forests Grow on Their Own, Right?”



Fewer harvests, many degraded stands

Low shade

Invasive plants

Competing native vegetation

Deer browse damage to seedlings



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Forest Management = Lasting Impacts

Species diversity

Age diversity

**Forest composition,
density, structure, and function**

Forest resilience

- Climate
- Insect pests
- Diseases
- Natural disasters



Leslie Horner

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Silviculture

Controlling establishment, growth, composition, health, and quality of forests.

A planned program of vegetation treatments throughout the life of a stand

Objectives include:

- wildlife habitat
- water quality
- forest health



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Shade Tolerance

Different species of trees have differing abilities to tolerate extended shaded periods under a closed canopy.

Species are generally divided into tolerant, intolerant, and intermediate categories.

Shade tolerance varies from species to species.

A harvest that opens at least 50% of the canopy is favorable for oak regeneration.



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PA Shade Tolerance



Tree Species	Forest Type	Shade Tolerance
Black cherry	NH	I
White ash	NH	Im
Sugar maple	NH	VT
Red maple	NH/OH	Im
American beech	NH	VT
Red oak	NH/OH	Im
White oak	OH	Im
Black oak	OH	Im
Scarlet oak	OH	Im
Chestnut oak	OH	Im
Hickory	OH	Im
Yellow poplar	NH	Im
Black birch	NH/OH	Im
Basswood	NH/OH	T
Hemlock	NH/OH	VT
Cucumber	NH	T
Quaking Aspen	NH	VI
Black gum	OH	T
White pine	OH	I
Dogwood	OH	T
Black locust	OH	I

Forest Type:

NH = Northern Hardwoods

OH = Oak/Hickory

Shade Tolerance:

VT = very tolerant

T = tolerant

Im = intermediate in tolerance

I = intolerant

VI = very intolerant

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Intolerant Species

Intolerant species are usually the first to grow after a natural or human induced disturbance event that substantially opens the canopy.

These trees are often called pioneer species.

Typical characteristics:

- fast growing
- light seeds



Black Locust

Jeff McMilian



Eastern White Pine

J.S. Peterson



Quaking Aspen

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J.S. Peterson

Tolerant Species

These trees normally are not the first to colonize open areas. Instead, they grow up into an existing canopy.

Usually, these trees are found in the climax community.

These trees tend to:

- Long lifespan
- grow slowly



Eastern Hemlock

J.S. Peterson



American Beech

William Justice



Sugar Maple

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Intermediate Species



Trees that have characteristics that are in between the tolerant species and the intolerant species.

Seedlings may not reach sapling or pole size unless gaps are created in the canopy.



White Oak



Shellbark Hickory



Scarlet Oak



J.S. Peterson

Robert H. Mohlenbrock

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What to Look for in the Understory:

- Impact of white-tailed deer?
- Existing seedlings present and healthy?
- Invasive Plant Species present?



UGA5306027

Nancy Loewenstien, Auburn University

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Signs of High Deer Impact



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Matt Miller, TNC; Dave Jackson, PSU; Appalachian Forest Consultants



Presence/Absence of Seedlings



Dominant Species of Seedlings



Patrick Brose, USFS



Leslie Horner

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Species Diversity



Desired native species and a diversity of species types

Monoculture vs Diverse and Native Stand



UGA3948024

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What to Look for in the Overstory and midstory:

- Is forest overstory and mid-story present?
- Light reaching forest floor?
- Any interfering Overstory plants?
 - Invasive Trees (ex: Tree of Heaven)
 - Native interfering species (ex: Sweet Birch)



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Scott Weikert(top), Paul Demmert



Estimate Competition



Invasive Plant species? understory occupied with...

- Herbaceous: Ferns—NY, hay-scented, bracken?
- Grasses or sedges?
- Brush: Other woody vegetation that would interfere with the Desired Future Condition.

WHEG Questions:

- not widespread and occupy **< 10%** of the forested acres.
- not widespread, but occupy high-density patches covering **10 - 35%** of the forested acres.
- widespread OR present on **> 35%** of the forested acres.

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Looking for Seed Sources



Adequate Seed sources: 15-30 seed trees per acre

Desirable species diversity

Mast tree species for wildlife

Preferred: native species that produce 5 or more hard mast (nuts, hard seeds) and soft mast (fleshy fruits, berries) food sources for wildlife.



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Photo: Steve Williams nrcs.usda.gov/

Wildlife Features

Snags (dead trees) and cavity trees standing (Greater than 10 inches in diameter)

- Preferred greater than 8 snags or cavity trees per acre

Brush Piles

Nesting Boxes



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Categories of Silvicultural Systems

- **Even-aged System**
 - A planned sequence of treatments designed to maintain and regenerate a stand with one age class.
 - The range of tree ages is usually within 20% variability.
- **Uneven-aged System**
 - A planned sequence of treatments designed to maintain and regenerate a stand with multiple age classes.



Even-aged Management

Even-aged management options include:

- 1. Clear-cutting: Remove all trees**
- 2. Seed tree systems: Leave just a few trees per acre**
- 3. Shelterwood systems: leave 20+ trees per acre**

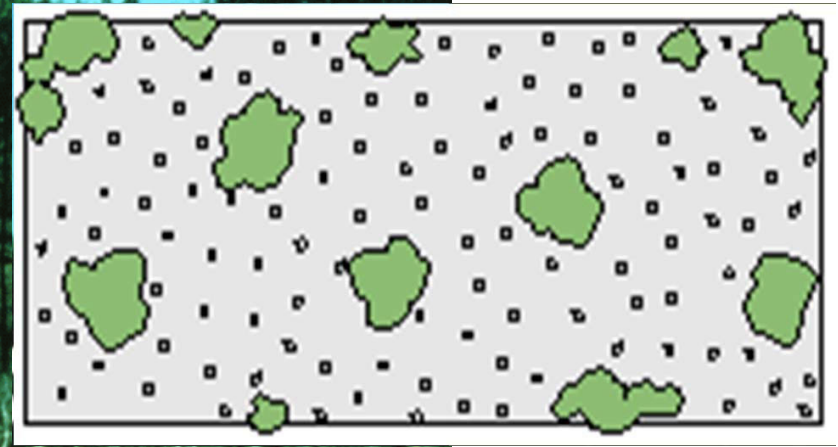
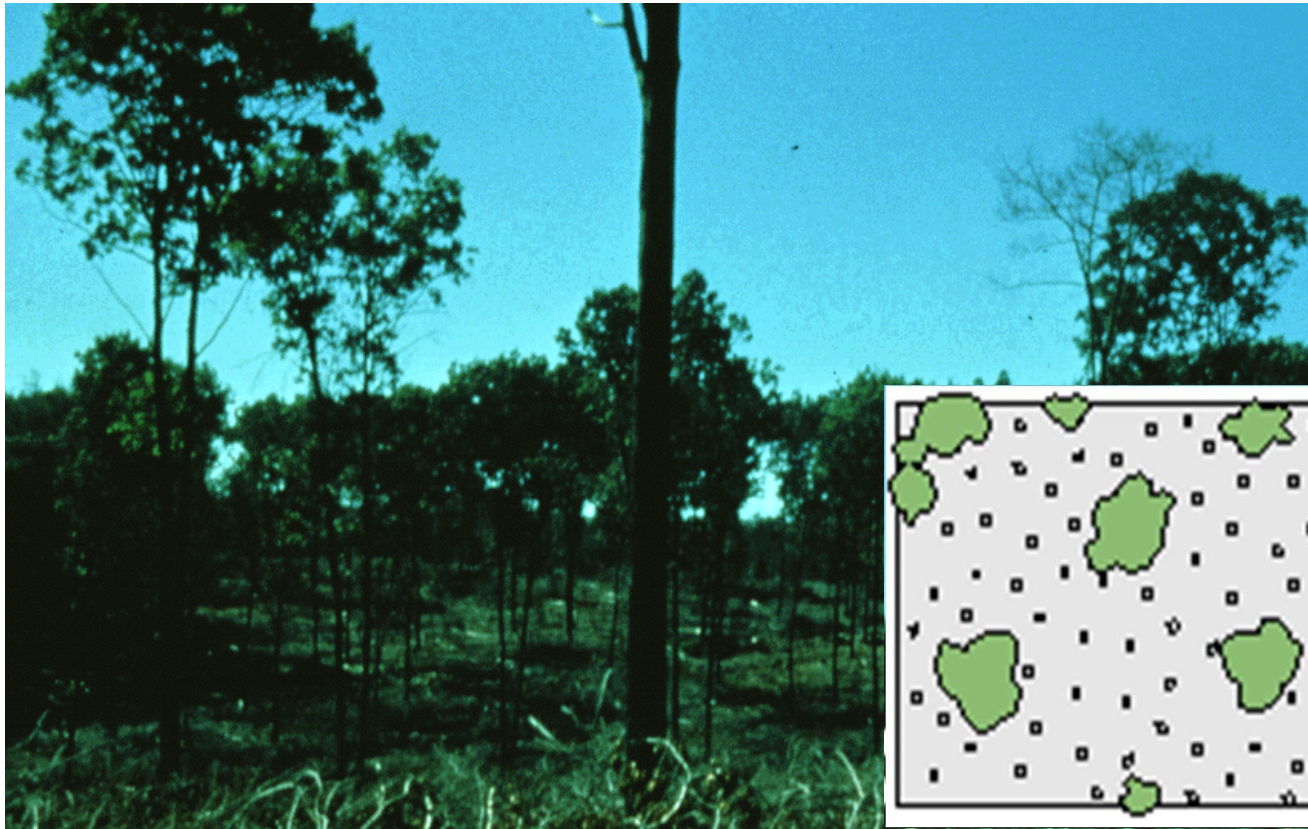


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Seed Tree (Even Aged)



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Even-aged Management: *Seed Tree*

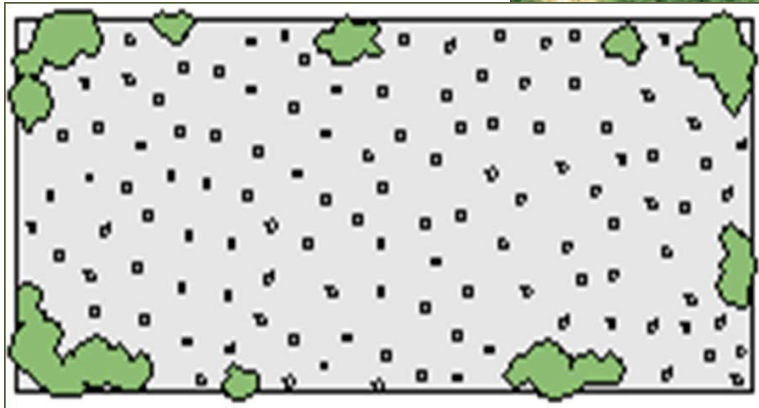
A few trees per acre are left to provide seed for the next crop. These trees should be large, healthy, heavy seed producers.



UGA1420141



Clear cut (Even Aged)





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Even-aged Management: *Clear-cut*



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Even-aged Management: Shelterwood



Scattered residual shade left on site to provide some shelter for seedlings for the first few years.

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Shelterwood (Even Aged)



* Univ. of Minnesota Extension



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Shelterwood

1. *Low shade removal prep cut*



2. *First shelterwood cut completed*



3. *Regeneration becomes established*



4. *Second cut removes remaining overstory*



Uneven-aged Management

The goal is to remove only enough of the canopy to allow shade-tolerant species to regenerate.

Used for regenerating shade tolerant species.

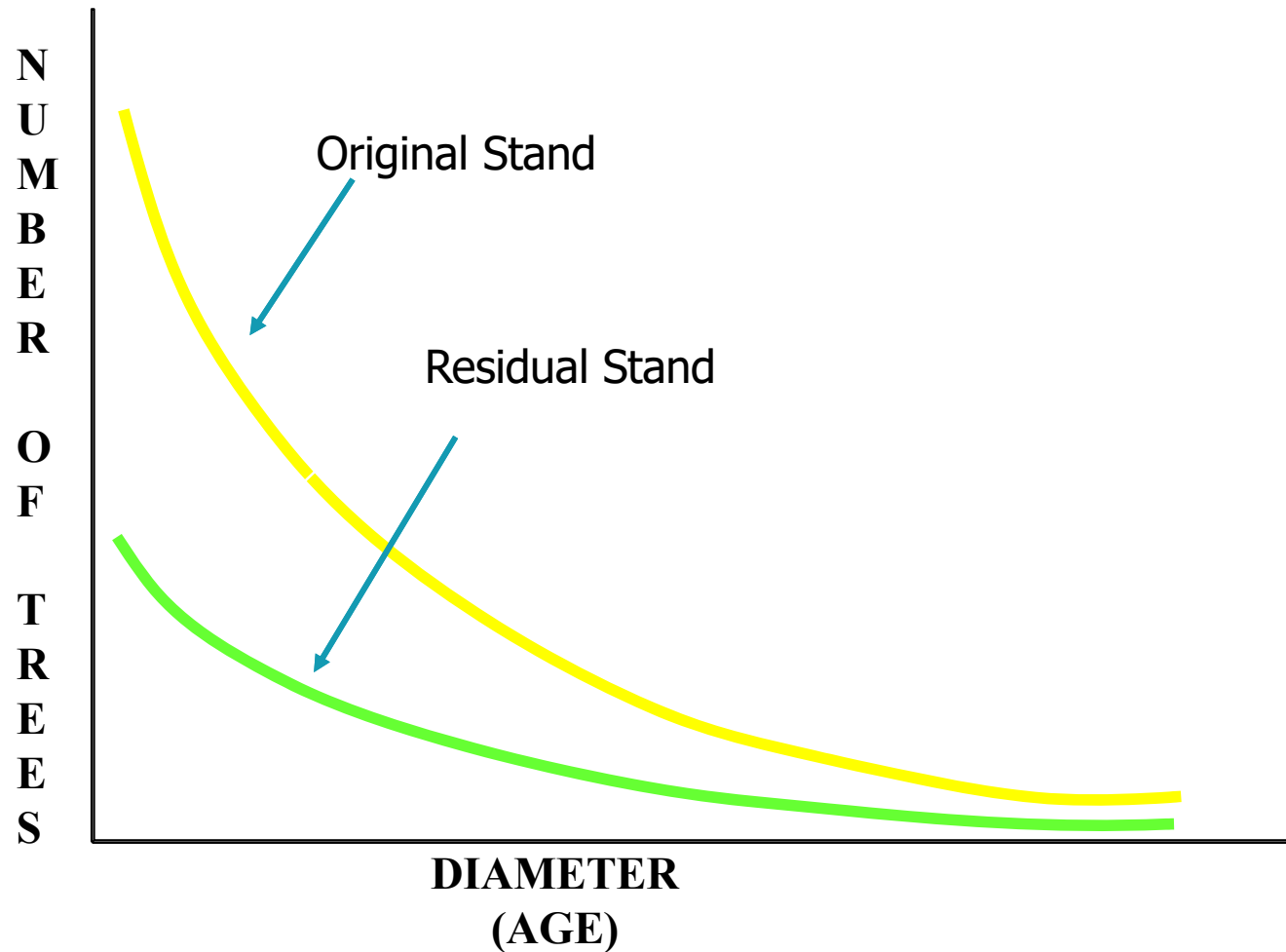
Multiple age classes.

- 1. Group selection systems: small areas are harvested.**
- 2. Single tree selection systems: individual trees are harvested.**
- 3. Crop Tree / Mast Tree Release**



Uneven-aged Stand Structure

Shade Tolerant Species

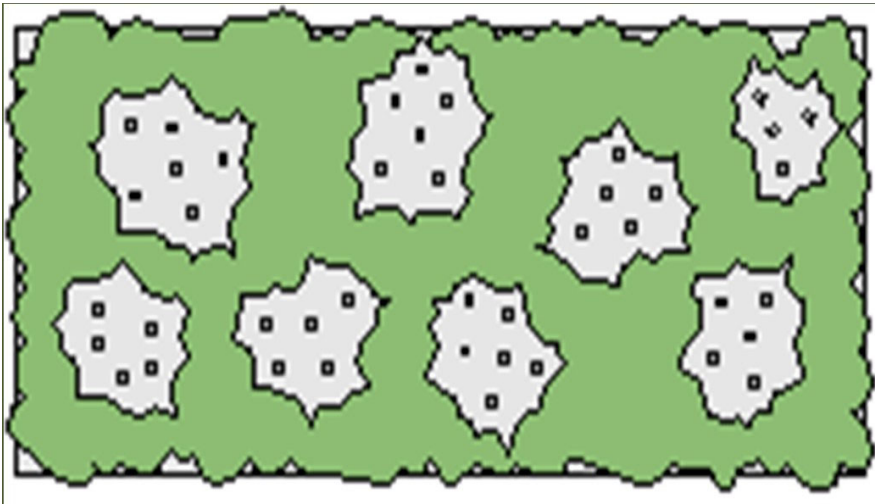


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Group Selection (Uneven-aged)





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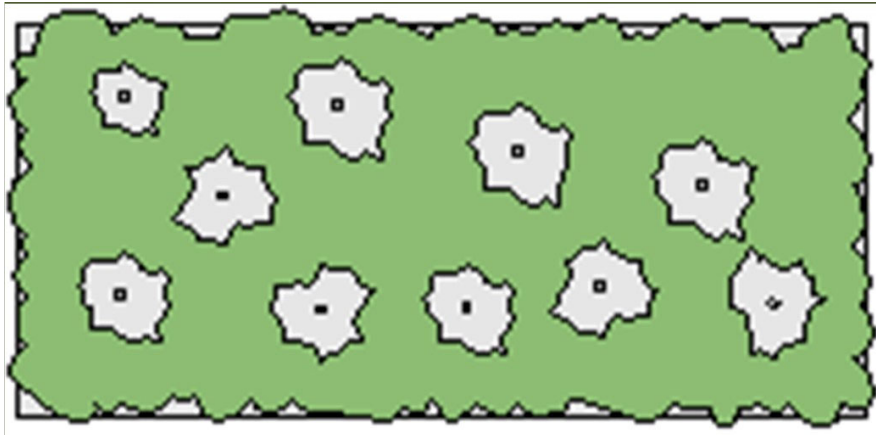
Group Selection (Uneven-aged)



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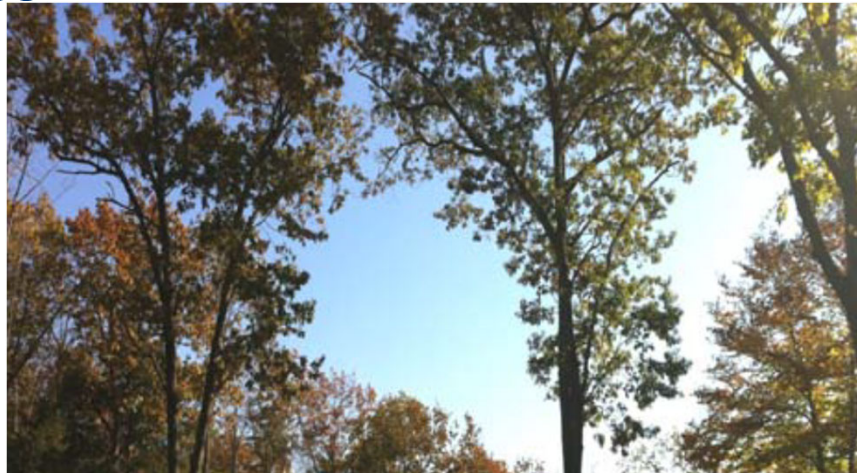
Single Tree Selection (Uneven Aged)



Methods: Wildlife Crop/Mast Tree Release

Soft or hard mast producing trees are released in order to improve wildlife habitat.

Removes competing woody vegetation from at least three sides of individual residual trees



High-grading (not a silvicultural practice)



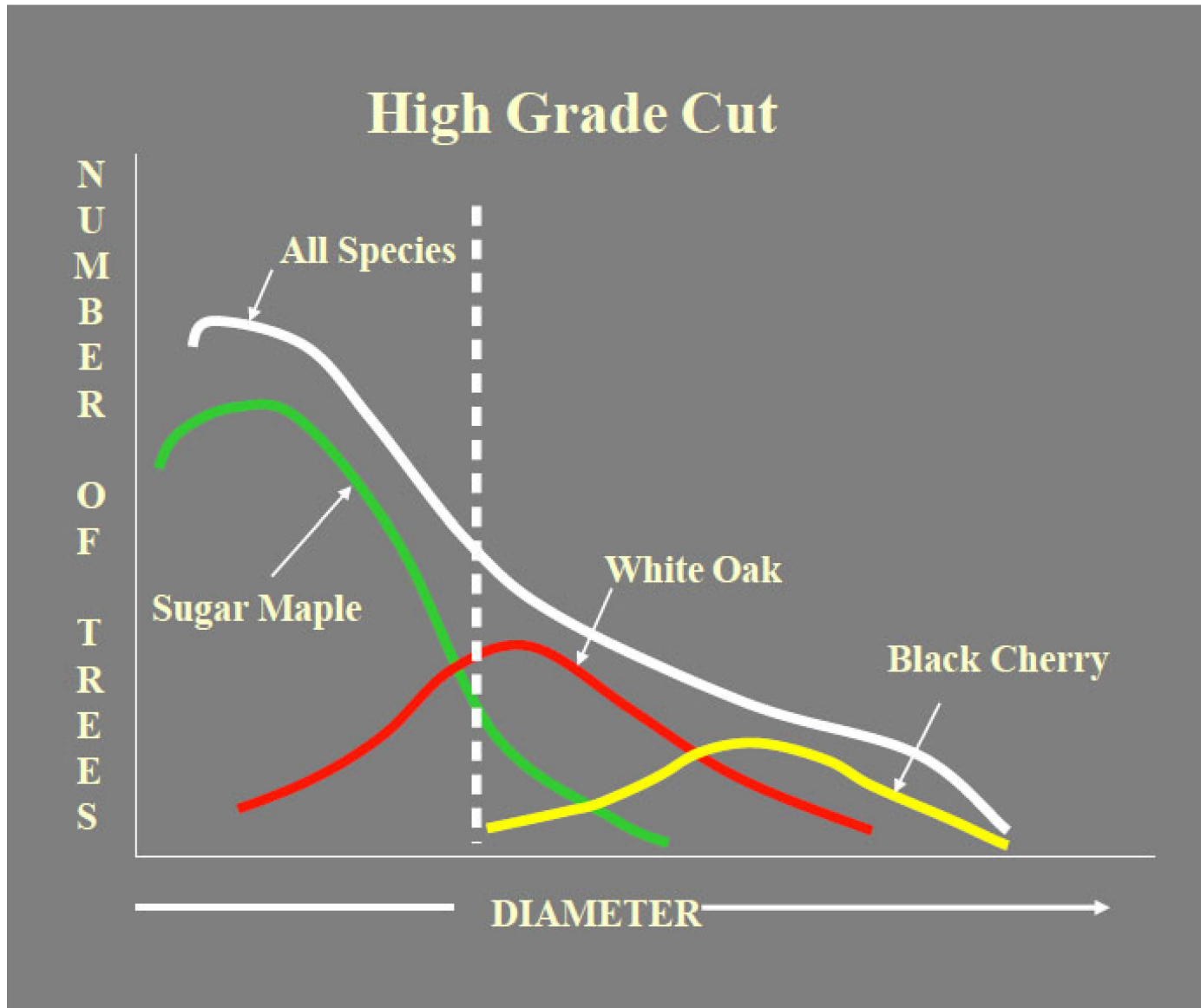
A. Stoltman

- Removes high value trees (Ecological and Monetary)
- Reduces diversity and future management options
- Removes seed sources
- Concentrates growth on low value trees
- Limits management control over stand density and spacing
- Maximizes immediate income yield

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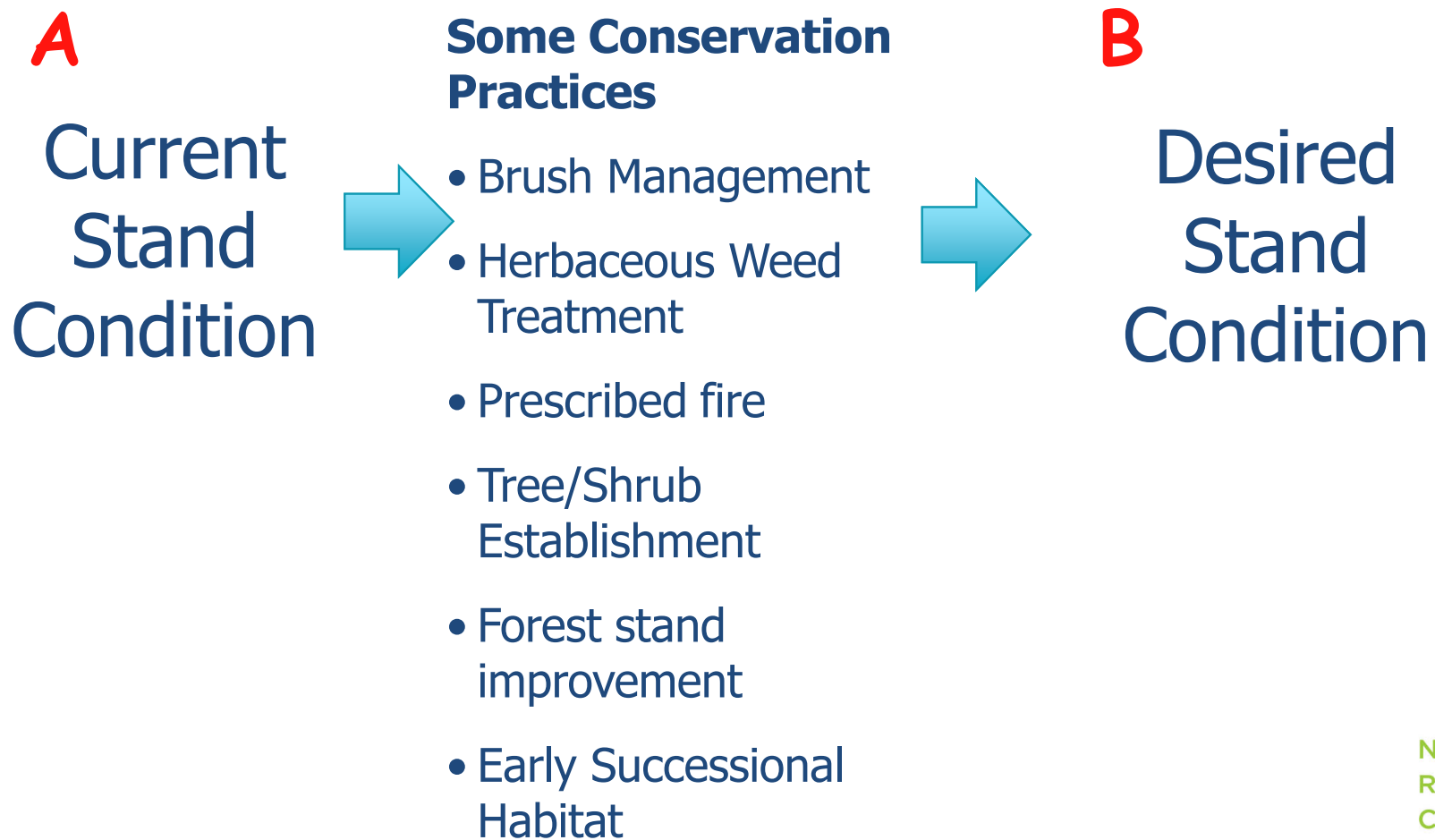


How does NRCS assist with Forest Management

1. **Determine landowner objectives**
2. **Evaluate existing conditions in the forest.**
3. **Determine if existing conditions constitute a resource concern.**
4. **Plan**
5. **Implement Practices**
6. **Evaluate/Certify**



Getting from Point A to Point B



Forest Stand Improvement (666)



The manipulation of species composition, stand structure and density by cutting or killing selected trees and/or understory vegetation.





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Forest Stand Improvement



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666-CPS-1

Natural Resources Conservation Service
CONSERVATION PRACTICE STANDARD
FOREST STAND IMPROVEMENT

Code 666

(Ac.)

DEFINITION

The manipulation of species composition, stand structure, or stand density by cutting or killing selected trees or understory vegetation to achieve desired forest conditions or obtain ecosystem services.

PURPOSE

- Improve and sustain forest health and productivity
- Reduce damage from pests and moisture stress
- Initiate forest stand regeneration
- Reduce fire risk and hazard and facilitate prescribed burning
- Restore or maintain natural plant communities
- Improve wildlife and pollinator habitat
- Increase or maintain carbon storage

CONDITIONS WHERE PRACTICE APPLIES

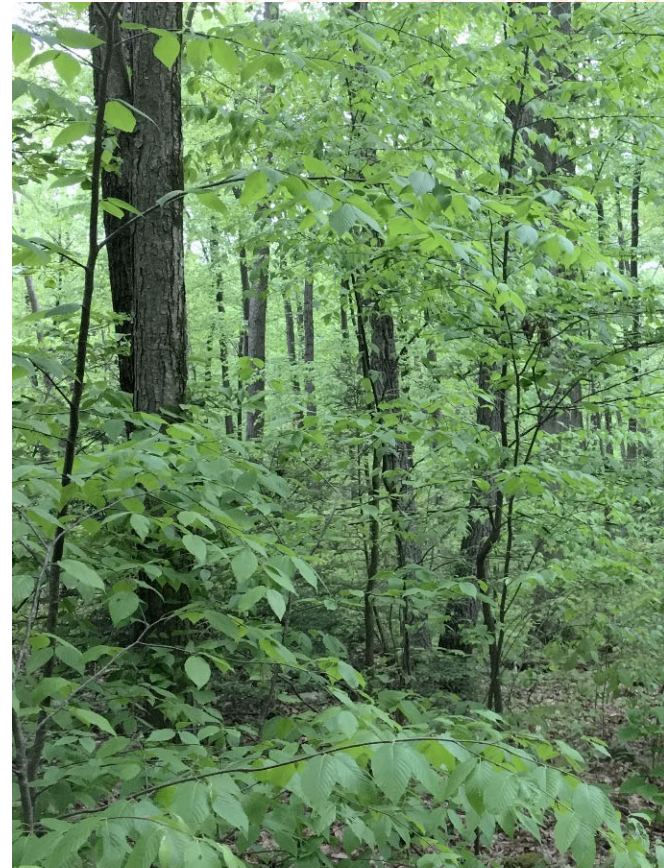
All land where the quantity and quality of trees can be enhanced.

CRITERIA

Methods: Thinning

Thinning adjusts the stand's stocking to an acceptable level to promote stand growth, condition, and improve overall quality.

Results in sunlight reaching the forest floor which improves wildlife habitat.



Methods: Chemical Thinning

Species composition, stand structure, and stocking density are managed by controlling selected trees and understory vegetation.

Undesirable species consist of hardwoods and shrubs that can propagate via root systems.

Hack-n-Squirt method



D. Jackson



Methods: Chemical Ground



Removal of target, undesirable species is achieved using ground applied chemicals

Releases young, desirable tree species competing with overtopping vegetation.

Target removal is necessary to promote plant health and vigor and to achieve the appropriate spacing and trees per acre of the desirable species that facilitates plant growth.



D. Jackson



Methods: Basal Stem Treatment

Interfering understory vegetation is treated with herbicides applied into or on the bark of targeted undesirable woody plants.

Used for species that are difficult to effectively control with foliar herbicides.

This treatment is intended to be utilized in forest stands up to ten years prior to a regenerating timber harvest.

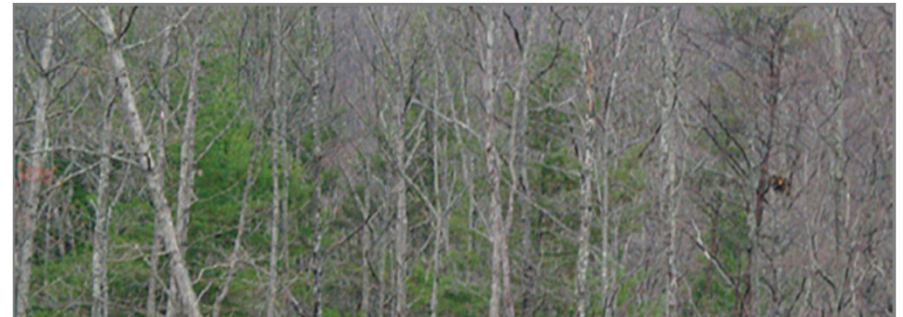


Methods: Mechanical



The stocking rate of an unhealthy stand with competing vegetation is adjusted to an acceptable level using mechanical equipment (brush hog, masticator, mulcher, etc).

The competing vegetation is controlled to manage desirable trees and species.





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