Importance of Old Forests

Ali Kosiba, PhD
Extension Assistant Professor &
State Extension Forester
University of Vermont

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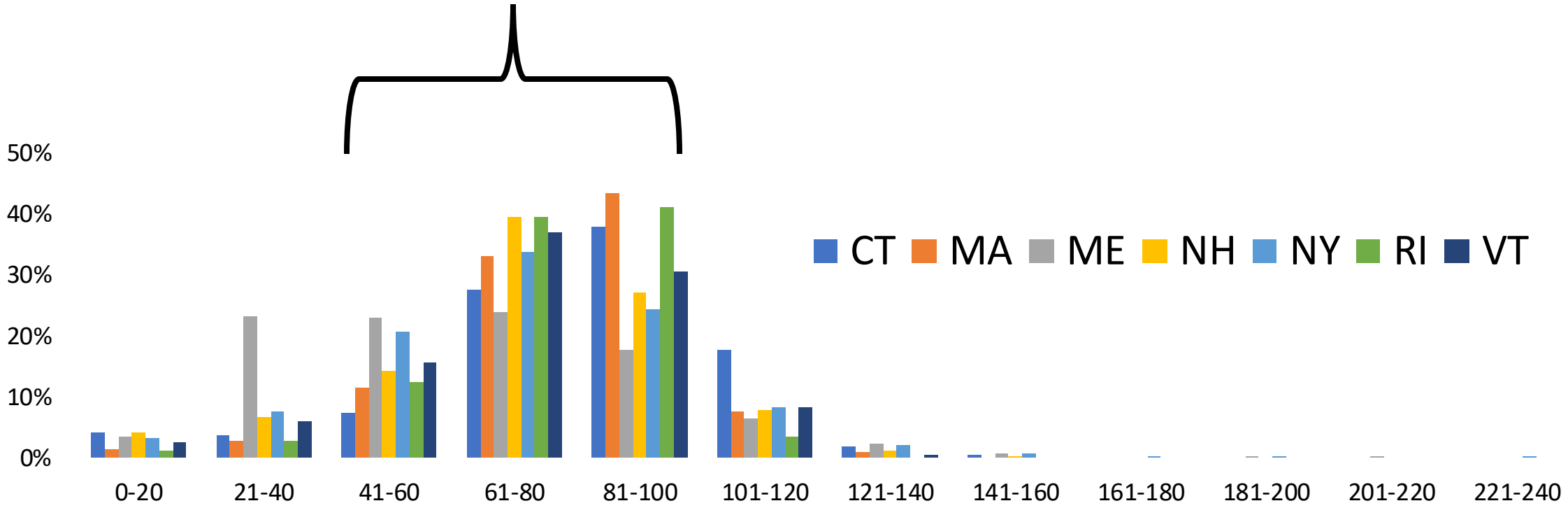
UVM Extension Forestry

Providing science-based information on forest ecology and management to landowners, professionals, and the public


Why are old forests important?

Old forest are uncommon

74% of region's forests between 40-100 years old



Data source: USFS Forest Inventory and Analysis

By 1900, Vermont had its lowest forest cover (30%)

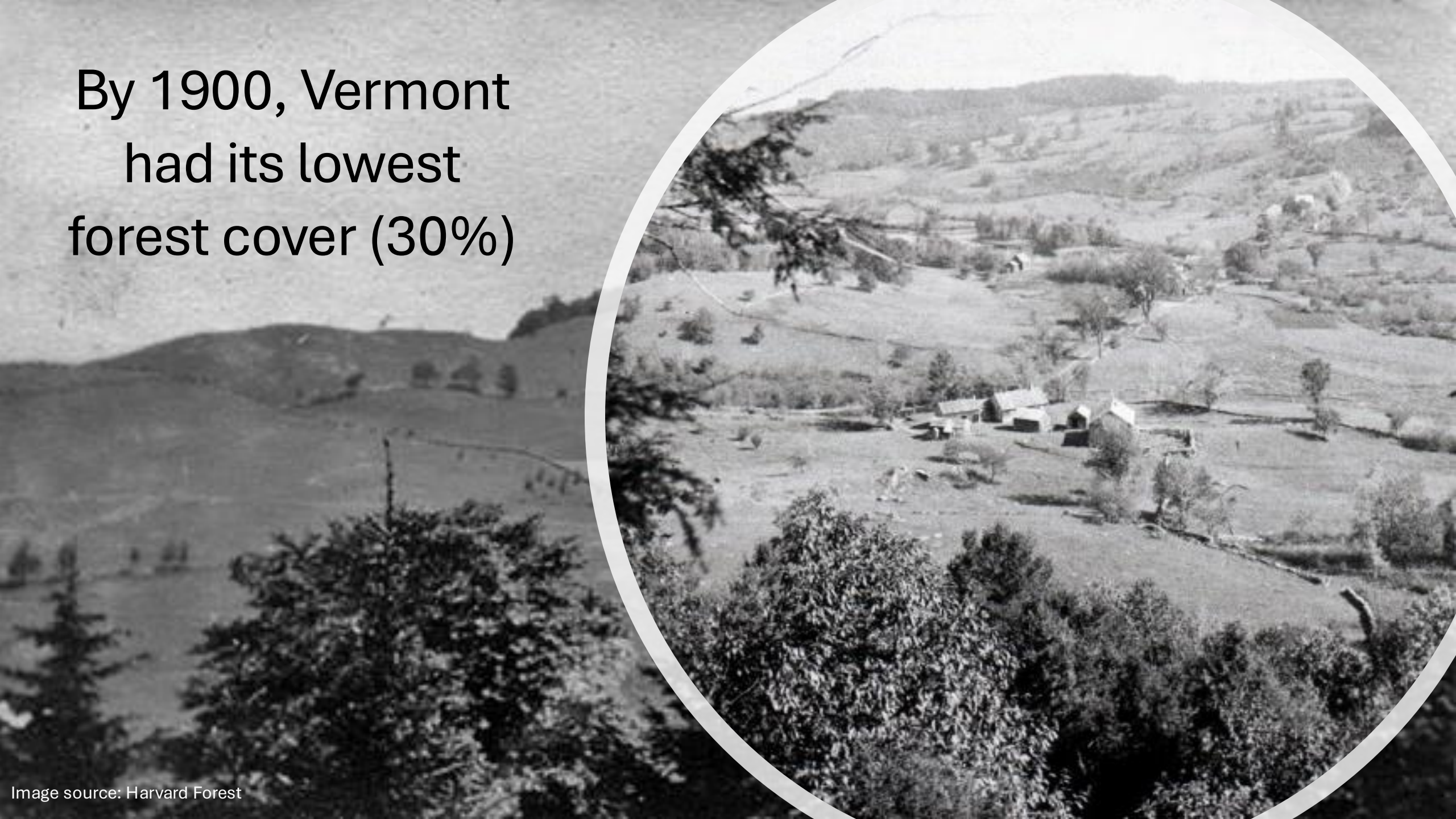


Image source: Harvard Forest

Remarkable recovery of Vermont's forest over the past century

Forests now cover about 75% of the state

Old-growth forests

Never cleared for agriculture, minimal human disturbance or large natural disturbances

Old trees (>150 yo) and other specific characteristic that take time to develop

”Continuity of process”

<0.1% VT’s forests

Other forests

Never fully cleared, but some human impact (selectively harvested, night pasture, etc.) or disturbance-prone site

Secondary forests

Cleared for agriculture or timber harvesting but subsequently regrew

~70% of VT’s forests

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Other forests

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Some of these forests contain trees >150 yr and characteristics found in old-growth forests
= Old Forests

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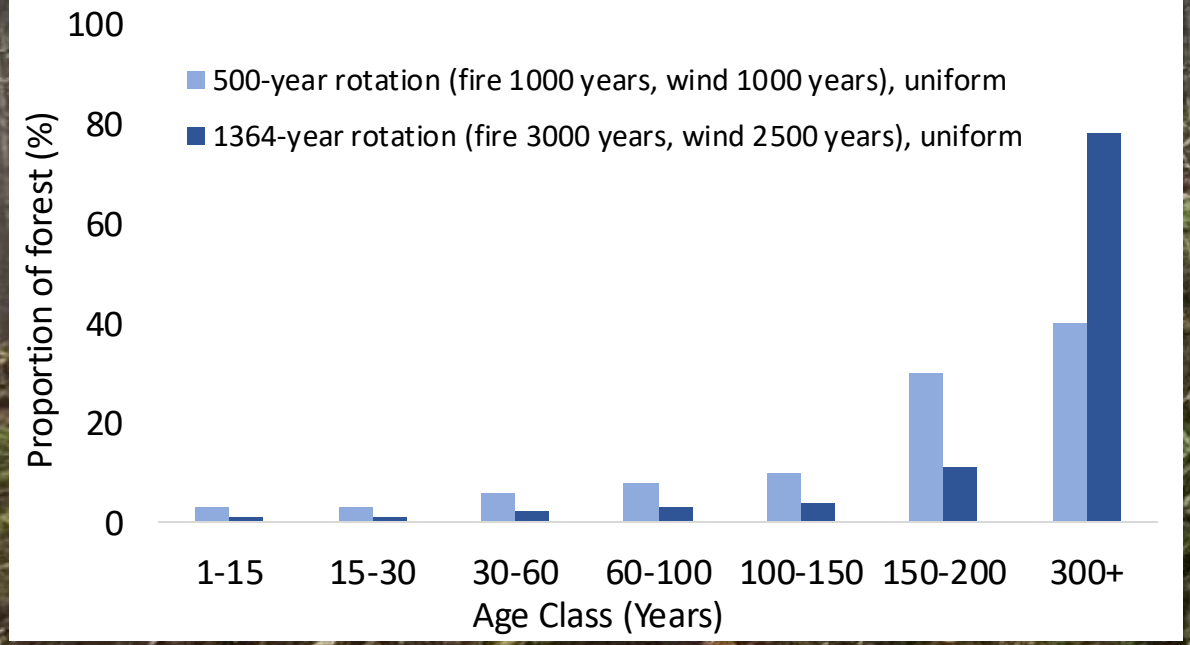
Some may have trees >100/150 yrs depending on when they regrew, but have not had time to develop characteristics of old forests

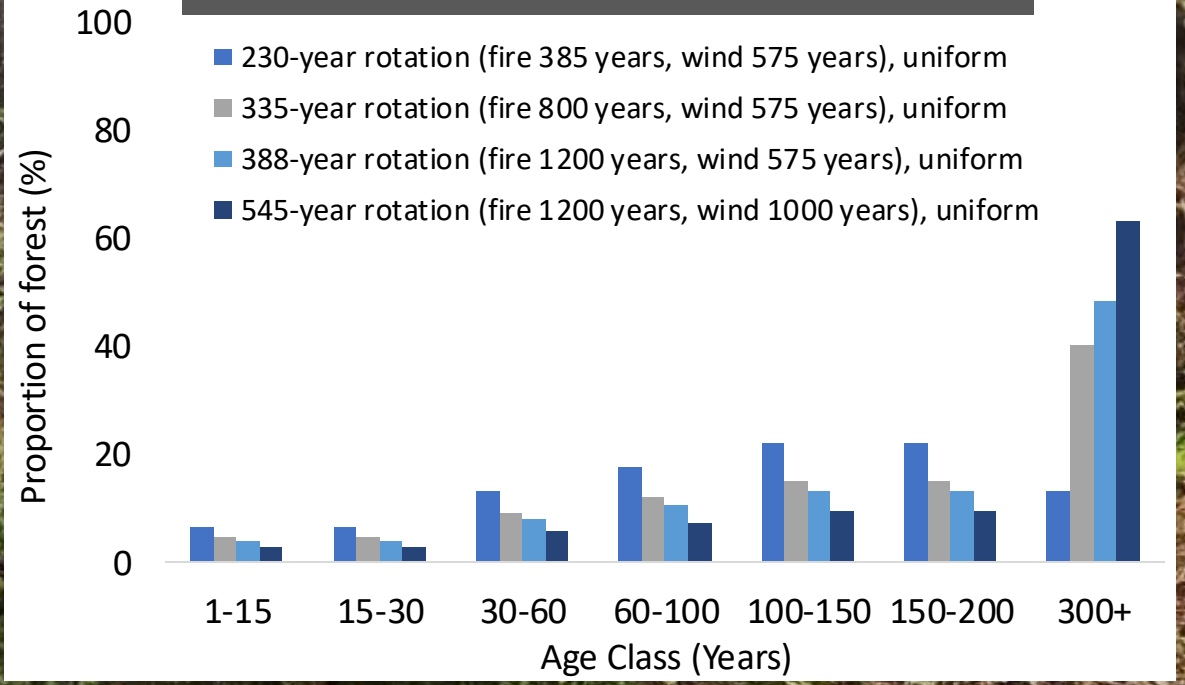
Historically, much more of the forested landscape would be in old age classes

How much?
Estimates depend on the return interval of natural disturbances

Northern Hardwood Forests

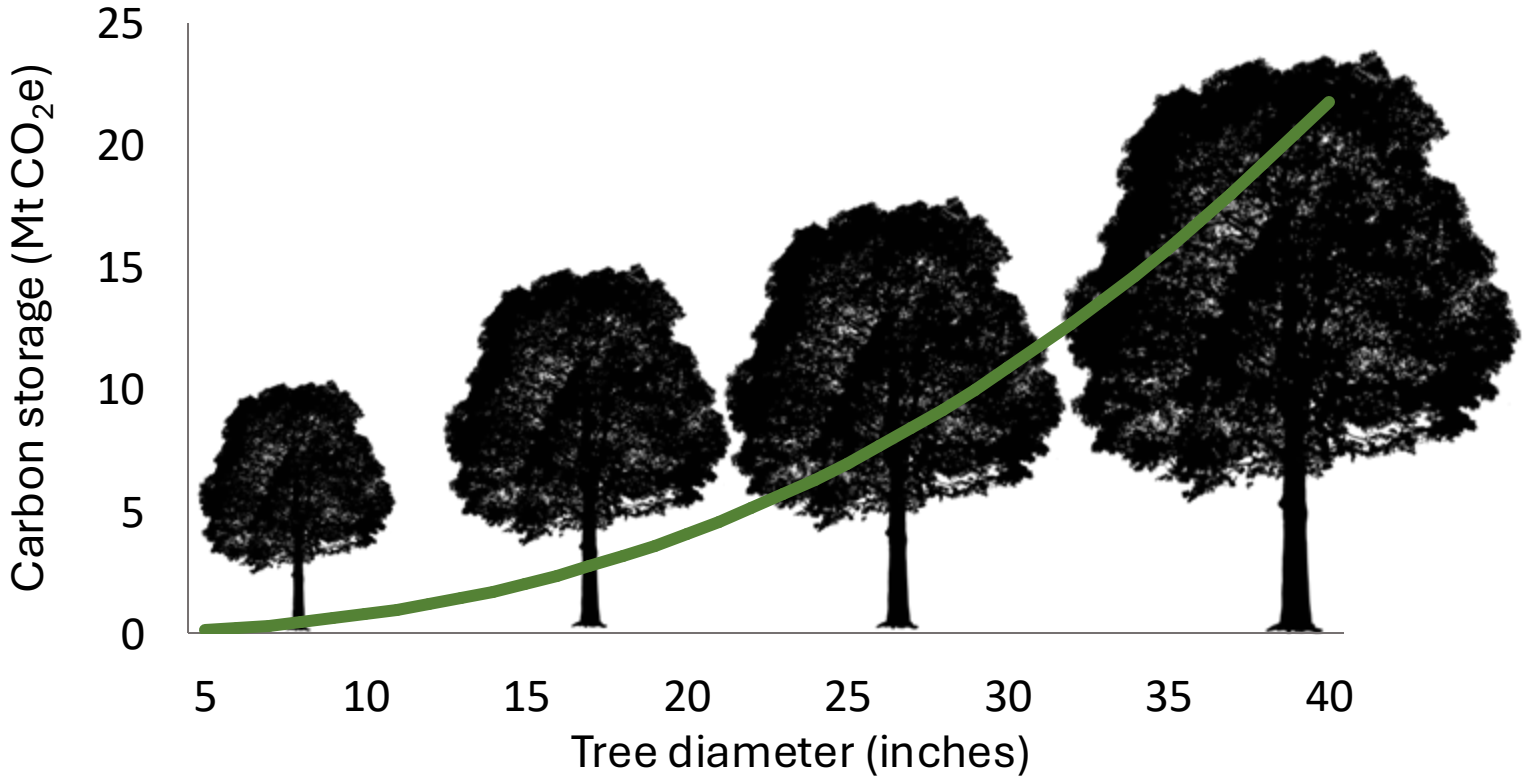


Spruce-Northern Hardwood Forests



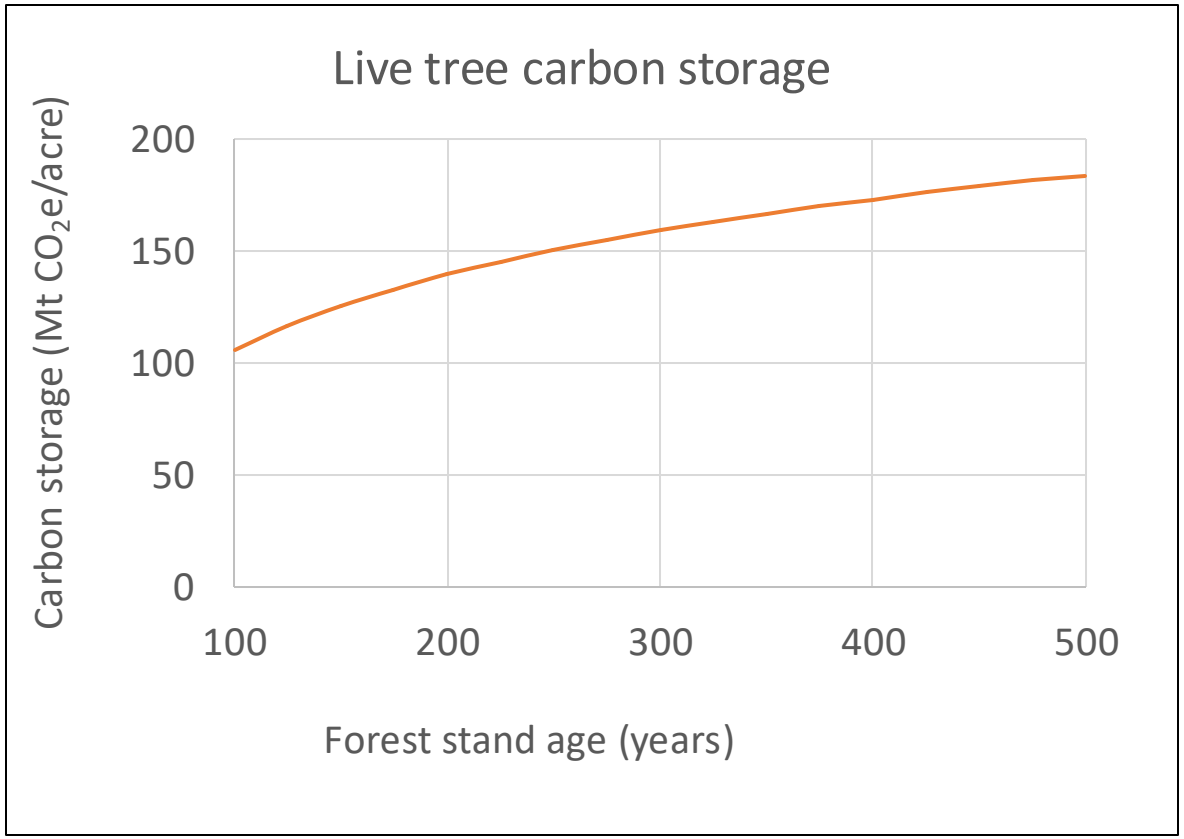
Source: Lorimer and White (2003)

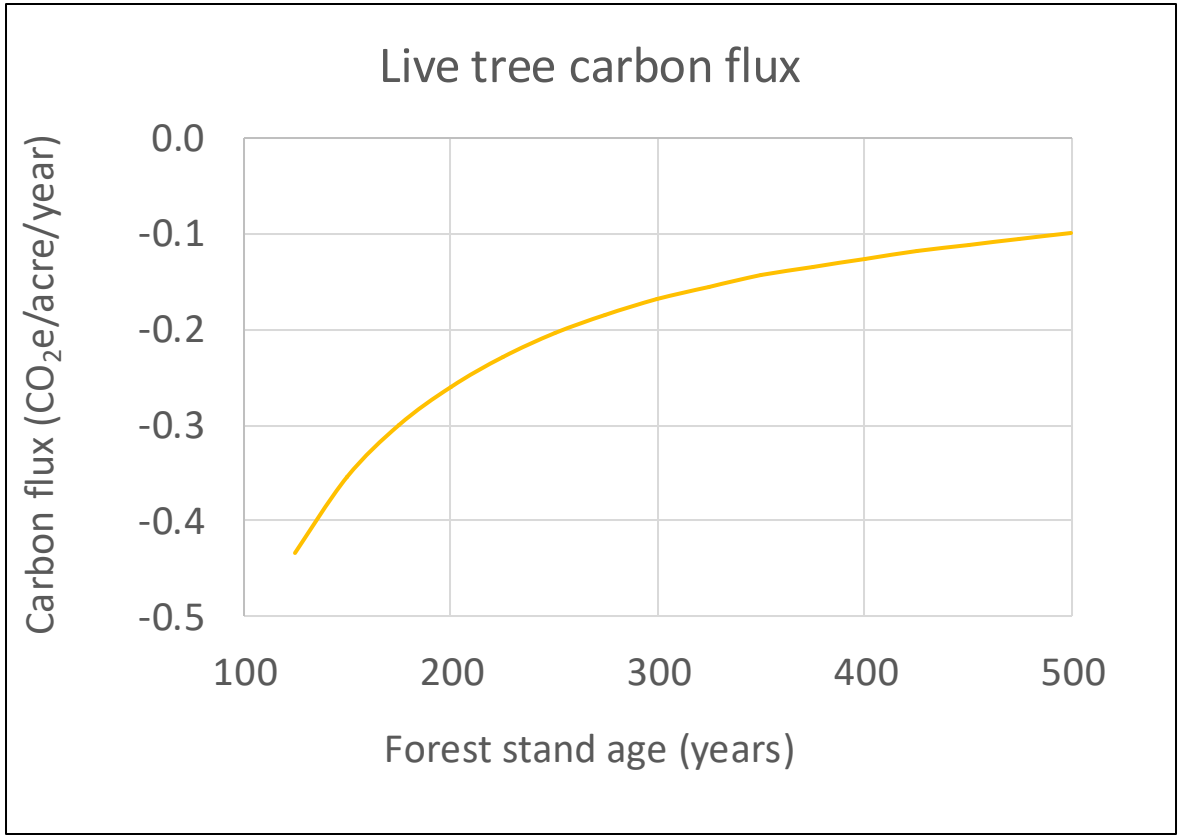
Old forests can have big trees which store a lot of carbon that was removed from the atmosphere



Data source: Jenkins et al. (2003) for sugar maple (*Acer saccharum*)

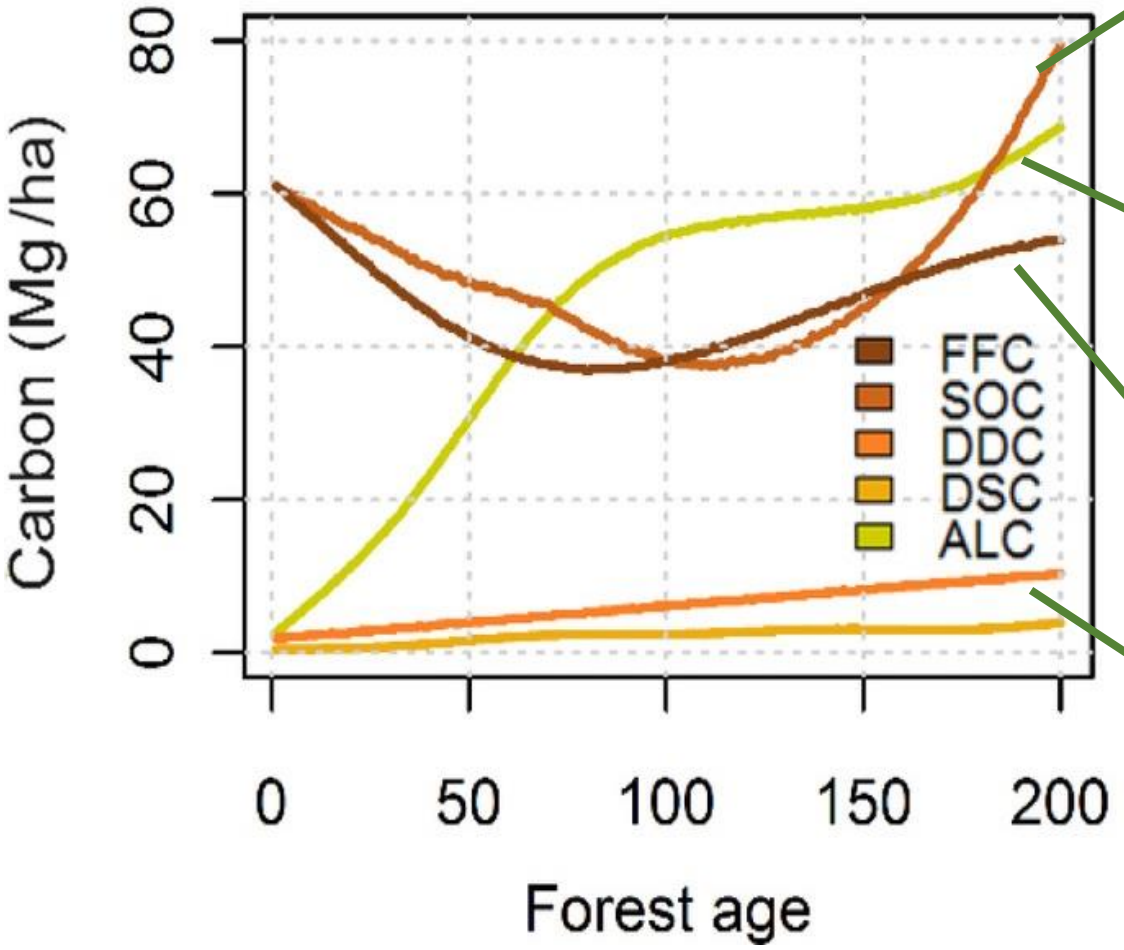
Old forests usually store more carbon in living trees than younger forests, but sequester (absorb) carbon at a slower rate





Data source: Keeton et al. (2011)

Old forests often store more carbon in soils and deadwood

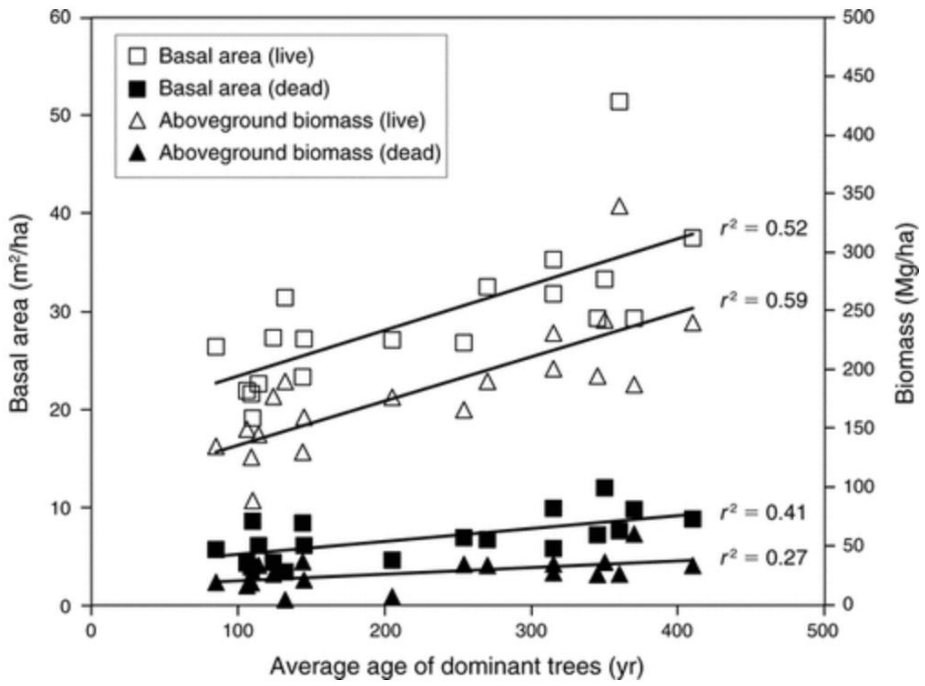


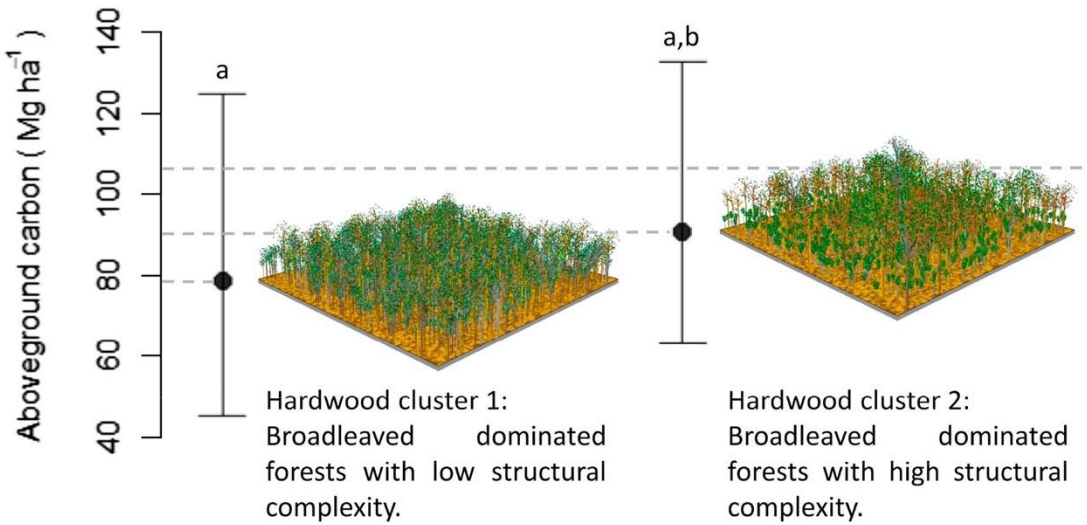
Source: Thom et al. (2019)

The larger amount of stored carbon in older forests is related to greater structural complexity and species diversity

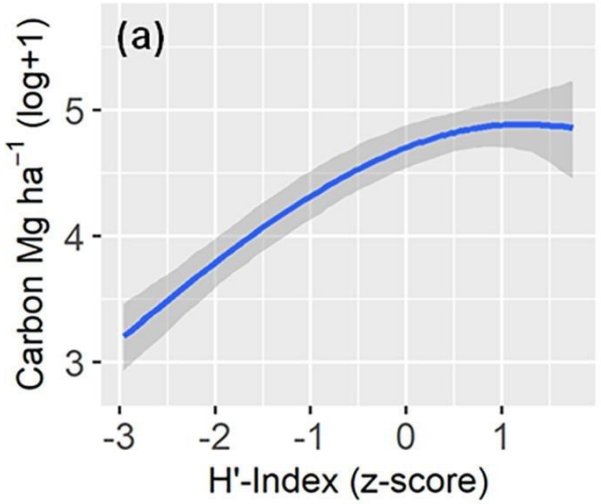
Structural complexity:
the horizontal and vertical distribution of layers in a forest

i.e., trees of many sizes, ages, and conditions, shrubs and other plants, standing dead and downed wood, irregular gaps in the canopy





H'-Index:
measure of variability in tree size and height and number of species

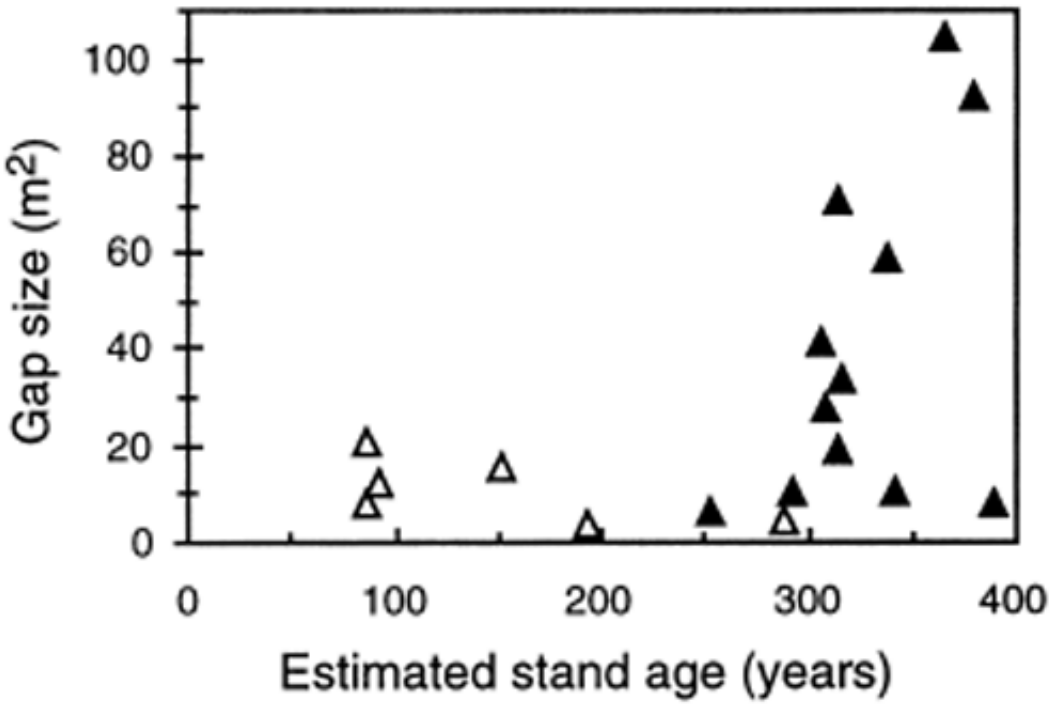


Sources: Thom and Keeton (2019, 2020), Keeton et al. (2007)

Over time, various disturbances to forests create a complex mosaic of conditions

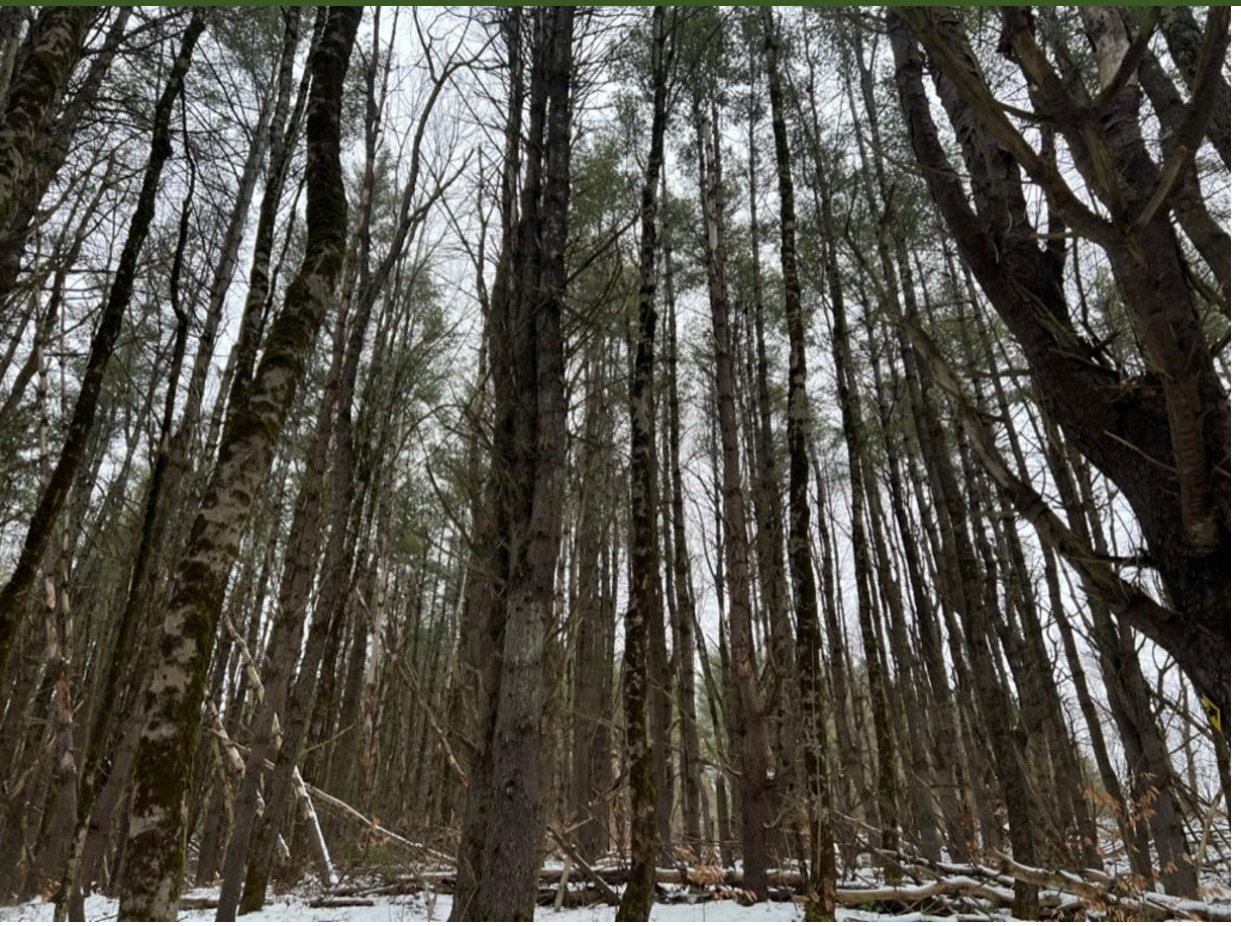
Creates both vertical and horizonal complexity

- Range of tree sizes
- Standing dead trees, downed trees and branches
- Multiple canopy strata
- Gaps in the canopy



Source: Ziegler 2000

Forests with greater species diversity and structural complexity can be more resilient to climate change

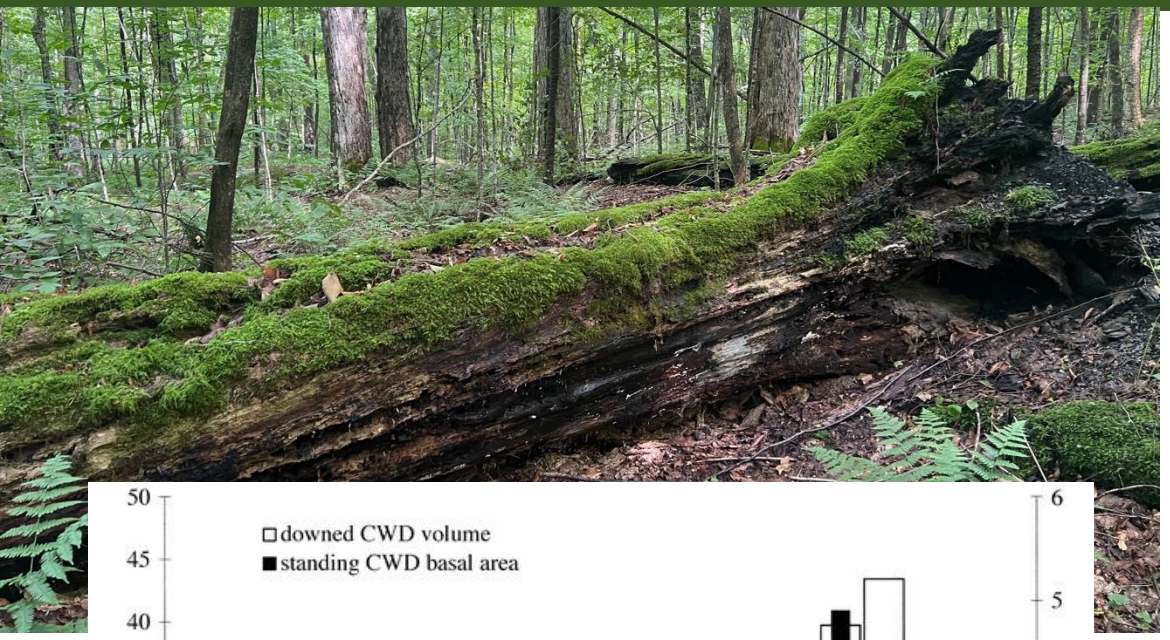


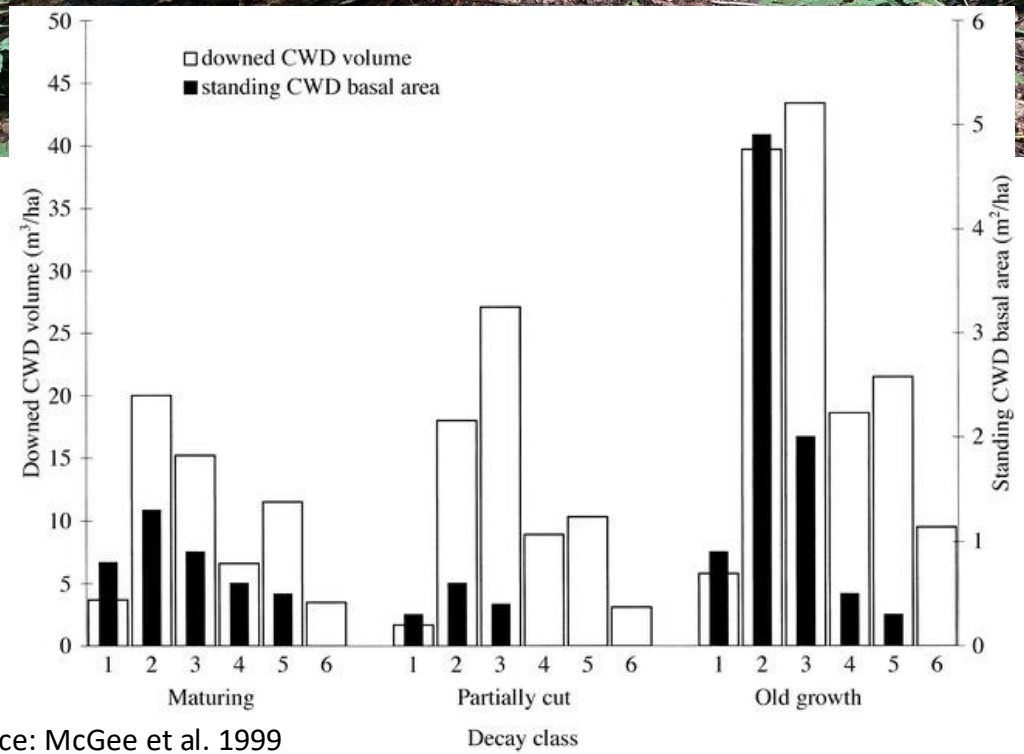
Resilience is the ability of a forest to recover or adapt following disturbance or stress

Characteristics of healthy, resilient forests

- Multiple species present (diversity)
- Vertical and horizonal structural complexity
  - Trees of different sizes and ages
  - Downed deadwood and standing dead trees in various sizes and stages of decay
  - Irregular gaps in the canopy
- Successful regeneration
- Hydrology and other ecological processes well functioning
- Limited impact by invasive plants
- Stressors do not cause catastrophic impacts

Old forests can have lots of deadwood in various stages of decay





Source: McGee et al. 1999

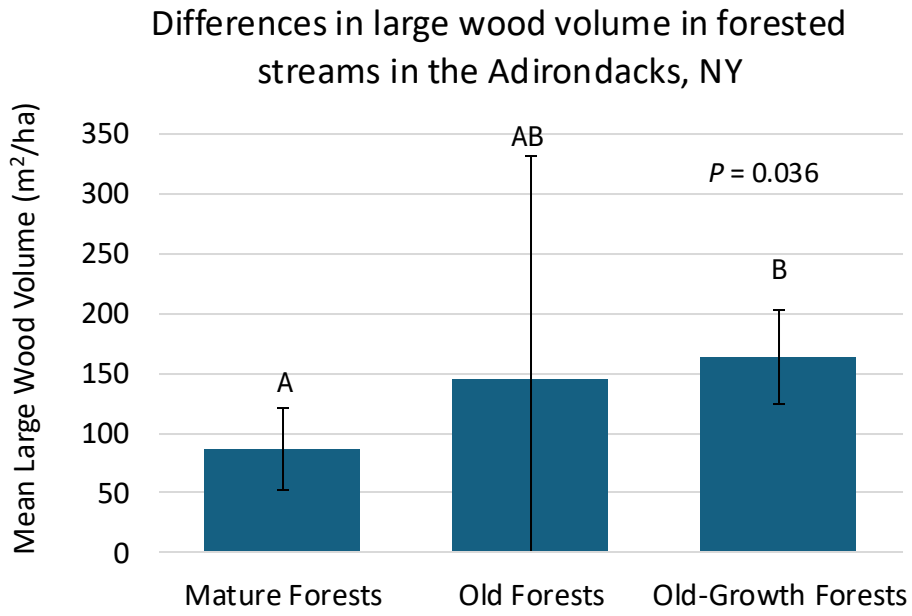
Dead logs

- Cycle nutrients to the soil
- Protect soils from erosion
- Control storm run off
- Hold water during times of drought
- Place for tree seedlings to germinate
- Rich habitats for fungi, insects, etc.

Old forests can have lots of downed trees in streams

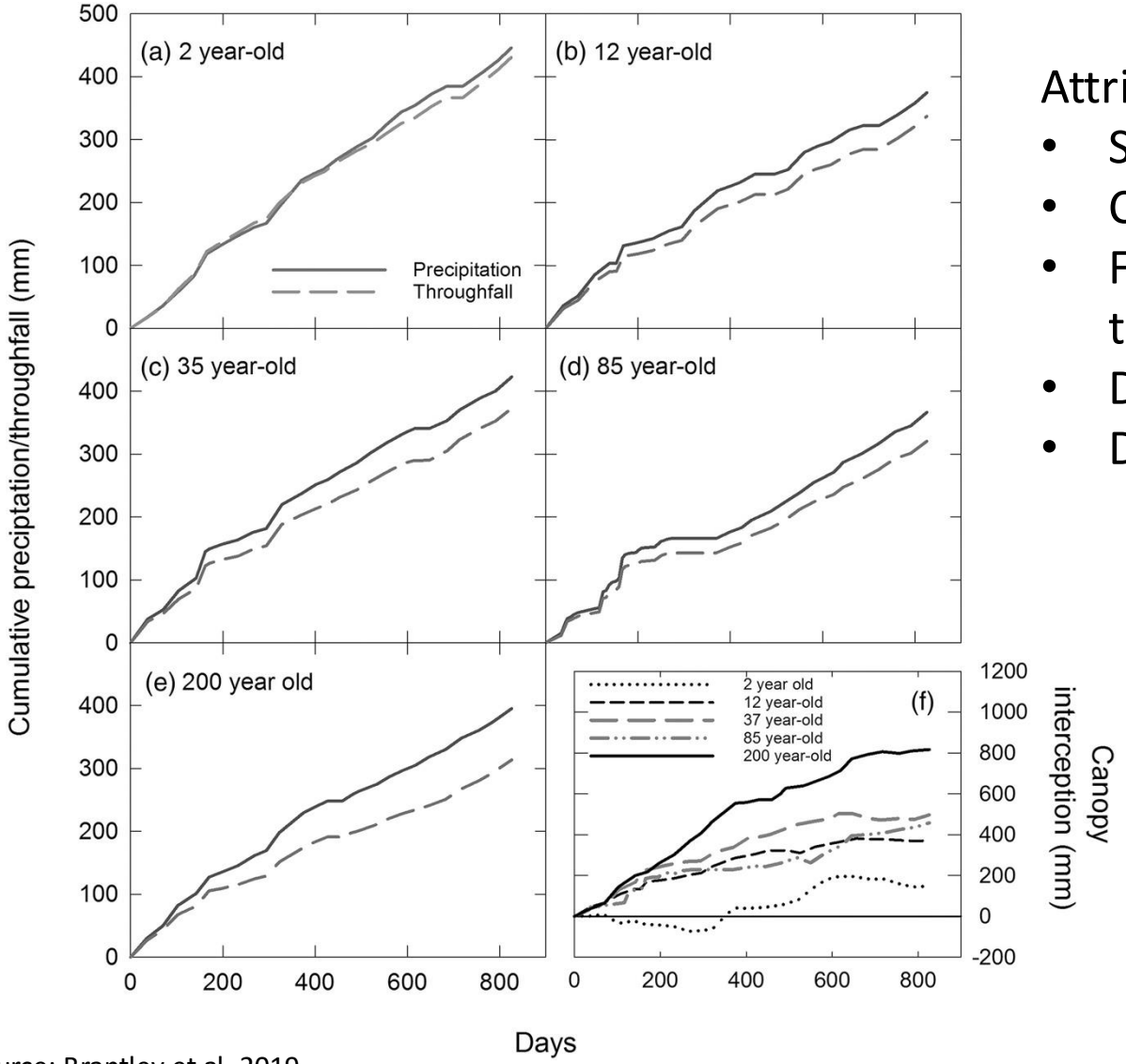
Logs in streams

- Control stream flow
- Protect streambanks from erosion
- Create diverse stream conditions (pools, waterfalls)
- Provide habitat for aquatic organisms (trout)



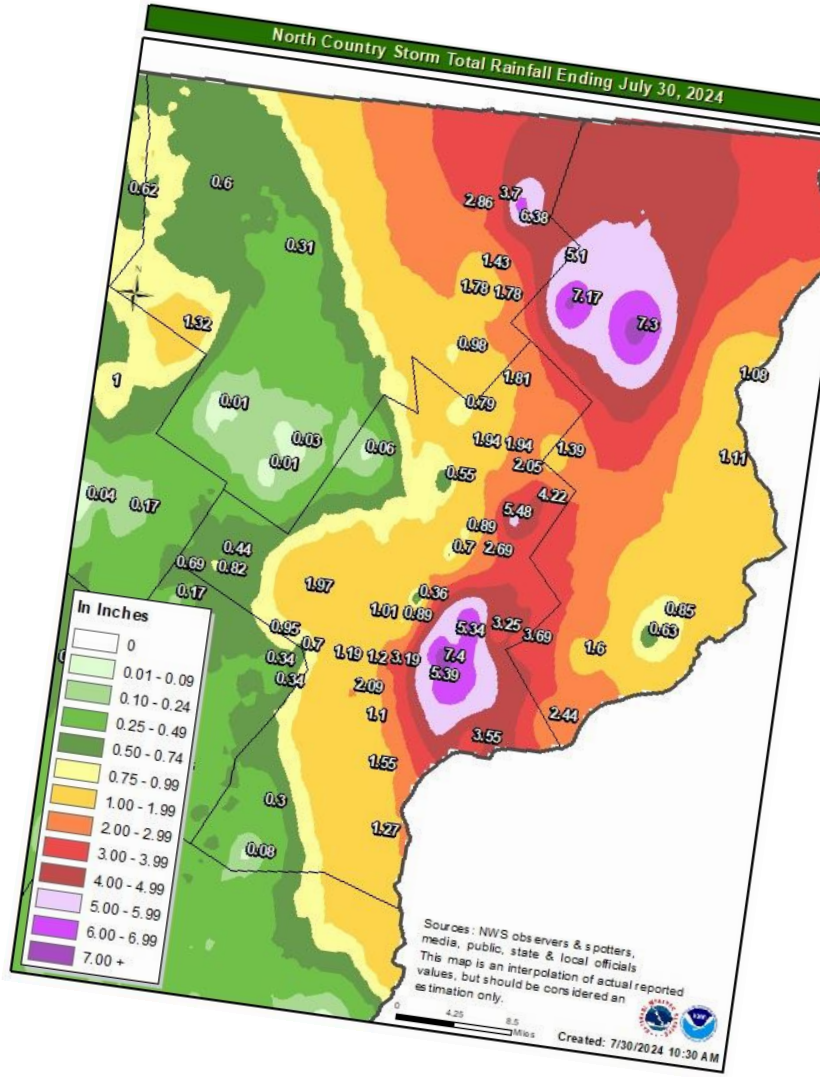
Data source: Keeton et al. 2007

Old forests can better intercept and slow down rainfall



Attributed to greater

- Species diversity
- Complex structure
- Furrowed bark in older trees
- Deadwood
- Deep forest floor layer

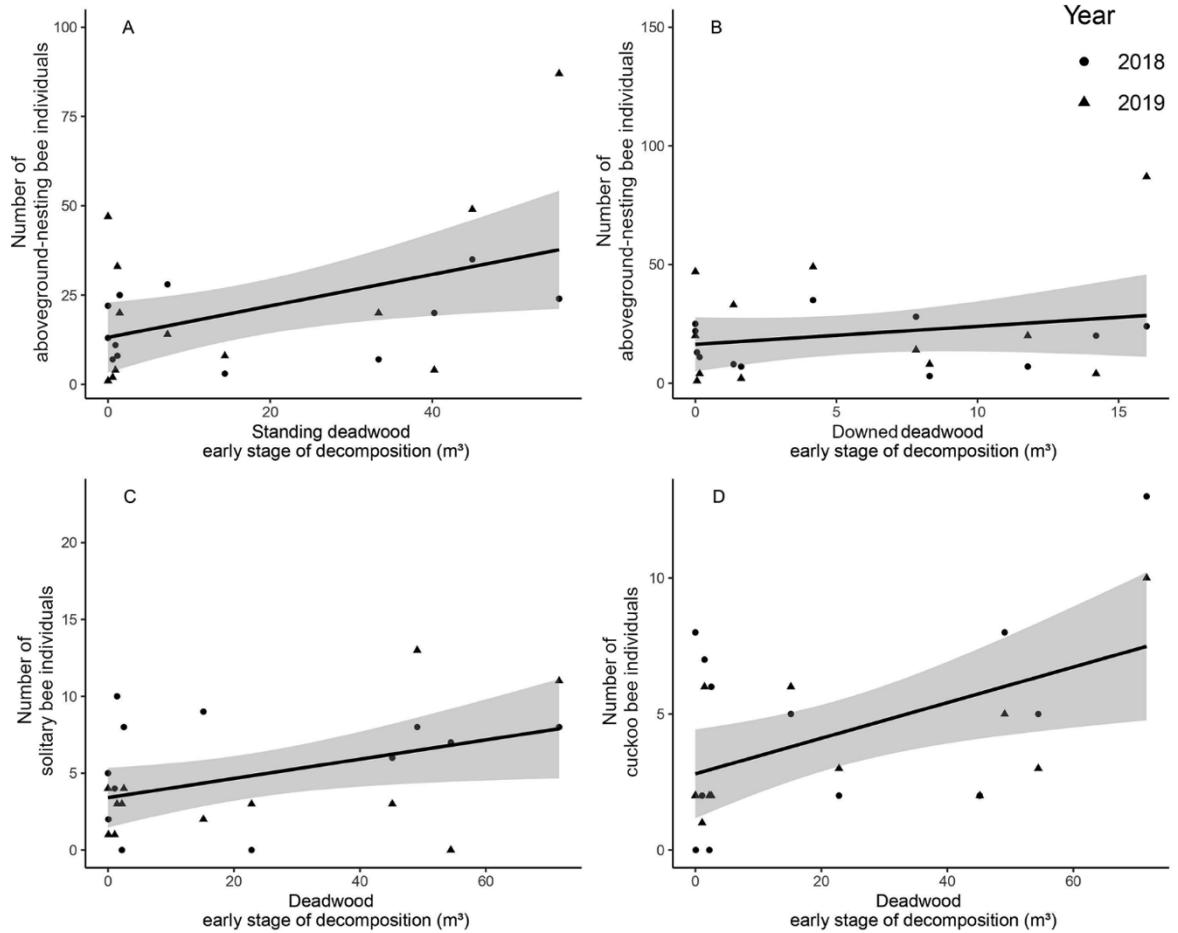


Source: Brantley et al. 2019

Old forests can support biodiversity

Complexity found in old forests can support many species

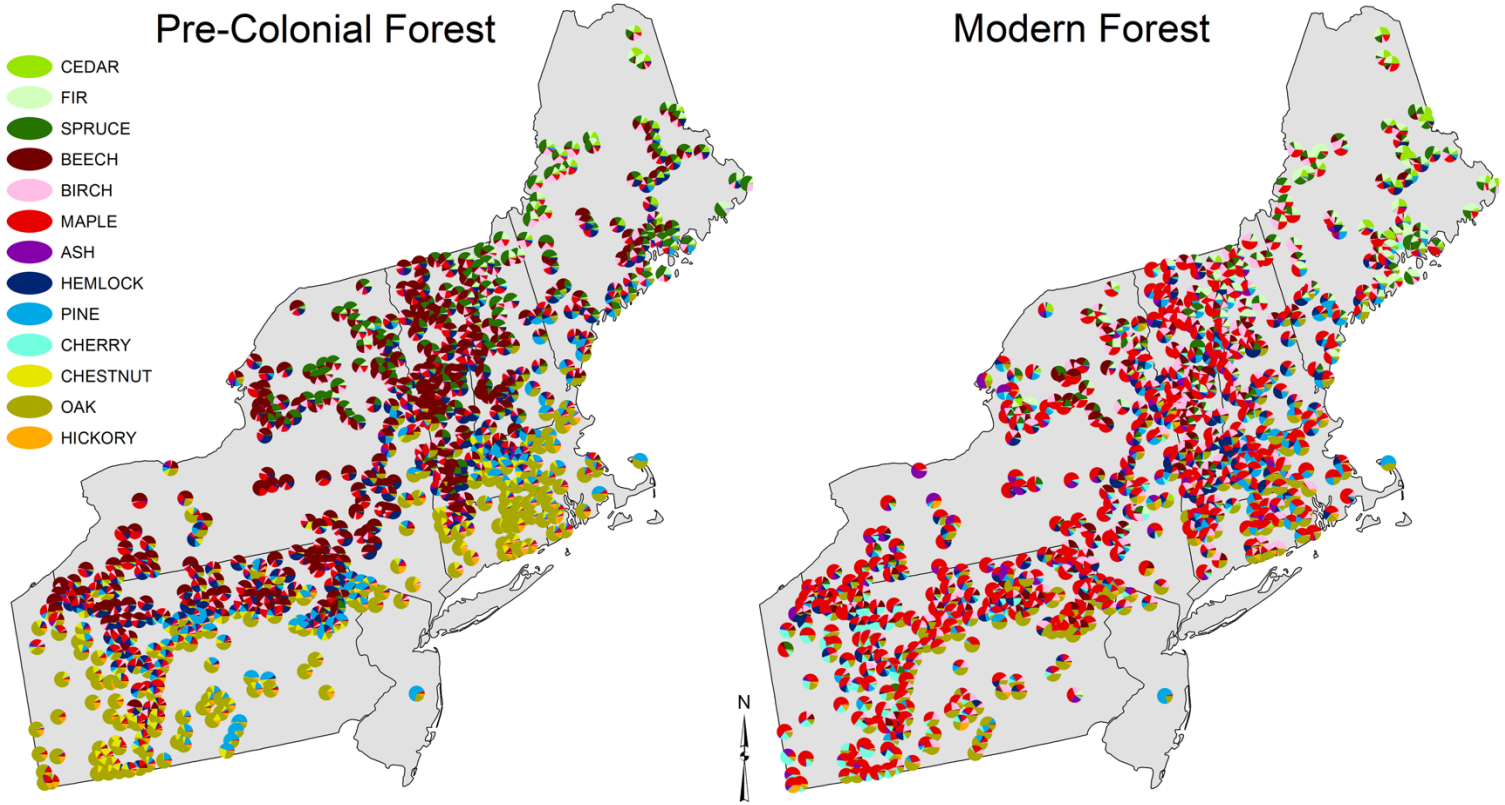
Including many that provide critical ecosystem services (bats, birds, bees)



Source: Eckerter et al. 2021

Not every forests with some of the characteristics of an old forest has the same ecological functioning

Land use history altered the species composition, structure, and condition of most of the forests we have today



Increases: maple, pine, birch
Decreases: spruce, beech, chestnut

Source: Thompson et al. (2013)

Many forests face novel stressors, such as invasive insects, diseases, and plants

Many forests have been impacted by intensive browsing, which may affect forest continuity

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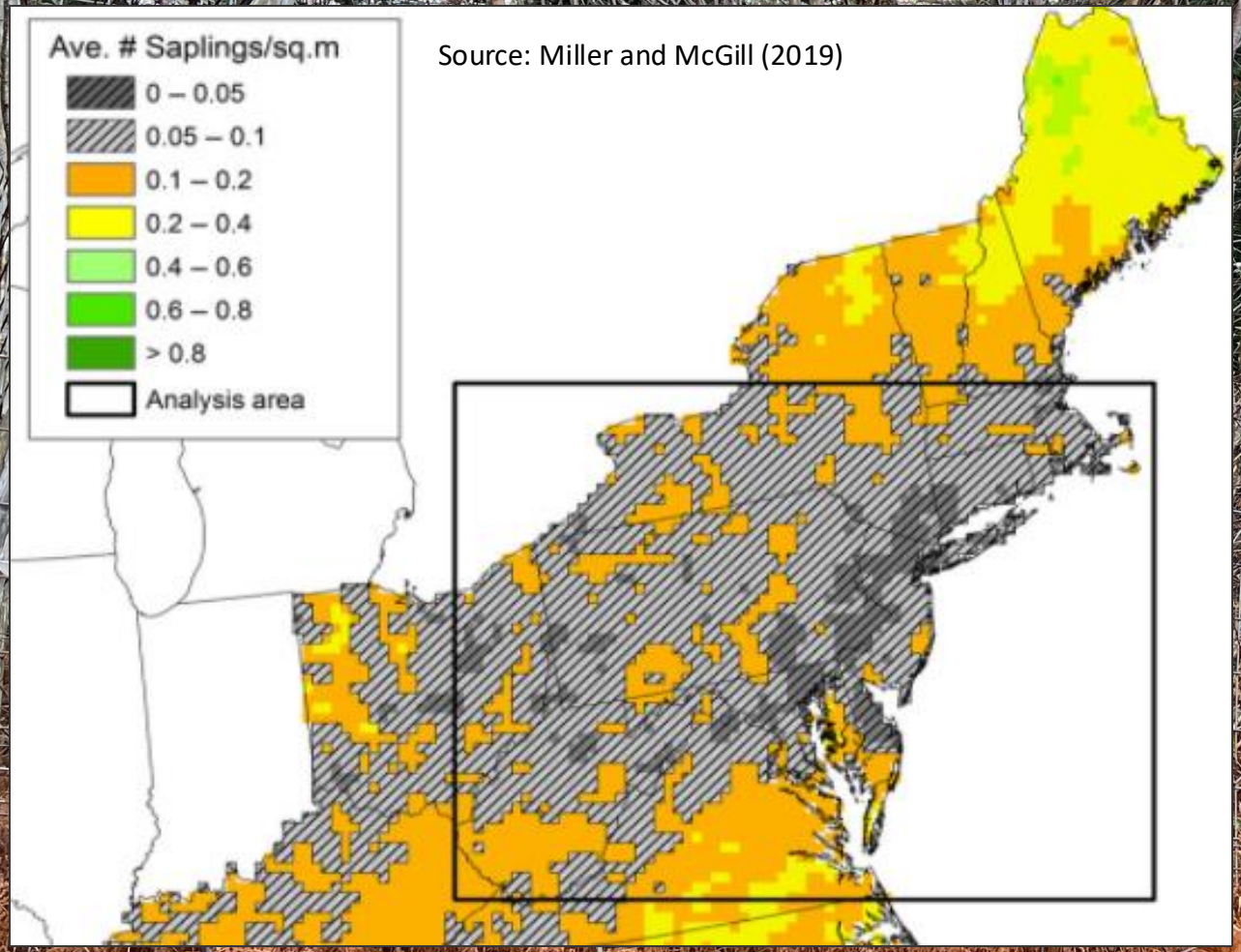

Source: Miller and McGill (2019)

Forests develop complex structure and diversity over long periods of time

Currently, our forests occupy a narrow band of conditions. And are often novel ecosystems with no past analog.

Will take centuries for them to develop into “old growth” forests with complexity

If a landowner wants to actively manage, we can use timber harvesting as a tool to accelerate the development of the characteristics found in old forests – which also promotes resilience


Reducing competition around healthy trees to allow them to grow larger
Creating horizonal complexity by doing different things in different places


Creating canopy gaps to
provide vertical structure


Girdling trees to create more standing dead trees (snags)


Designating permanent
”legacy” trees to live out
their full lifespans


Leaving tops and limbs on site ("messy")


Adding large wood back to streams

Technical assistance, demonstration sites, and cost-share available to landowners

USDA Natural Resources Conservation Service
U.S. DEPARTMENT OF AGRICULTURE

USDA United States Department of Agriculture 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
- Alter quantity, quality, and timing of water yield
- Increase or maintain carbon storage

In progress:
Enhancing old-growth characteristics

Growing number of landowners, land managers, foresters employing these techniques around Vermont

Summary points

- Very few examples of true old-growth forest in Vermont
- There are forests that have or are developing characteristics of old forests
- Old forests provide many important functions and services
  - Storing carbon, biodiversity, rainfall interception, controlling runoff
- Not every forest will develop the characteristics and ecological values of an old-growth forest
- Management decisions (passive to active) needs to be based on the conditions of the specific forest
  - We can use characteristics found in old forests to guide forest management
- Challenge is and will continue to be working with landowners to identify the best management that aligns with the forest's condition and their goals