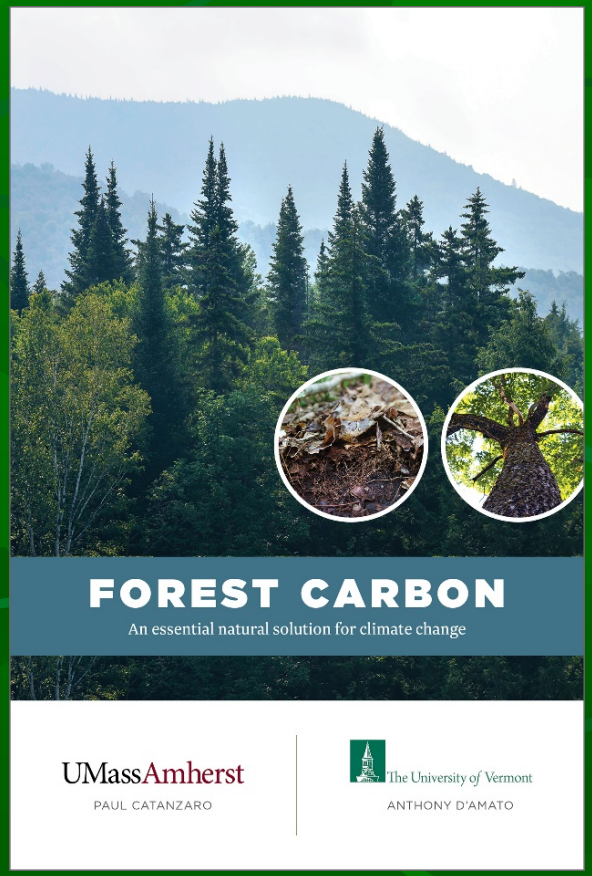
# Forest Carbon

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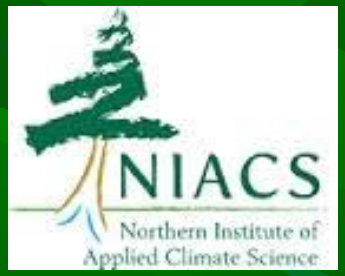
# Thank You!

- Thank you to our partners for additional support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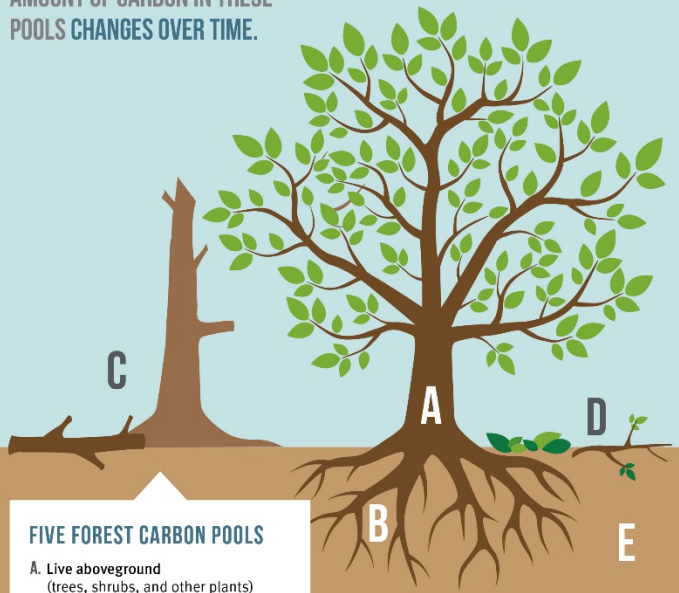
# Carbon Pools

## WHERE IS CARBON STORED IN A FOREST?

A FOREST STORES CARBON IN DIFFERENT POOLS, AND THE AMOUNT OF CARBON IN THESE POOLS CHANGES OVER TIME.




### FIVE FOREST CARBON POOLS

A. **Live aboveground**
(trees, shrubs, and other plants)

B. **Live belowground**
(roots)

C. **Deadwood**
(standing dead trees [snags] and downed logs)

D. **Litter**
(leaves, needles, and small branches)

E. **Soil organic matter**
(organic material in the soil, such as dead and decayed biomass [e.g., plant material and insects])

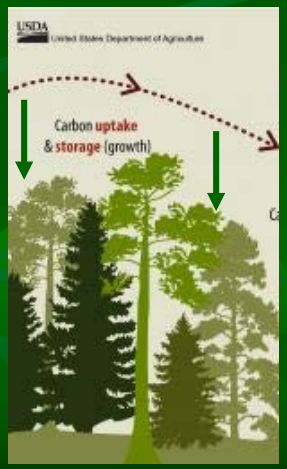
Factors that influence the amount and proportion of carbon in each of these pools:

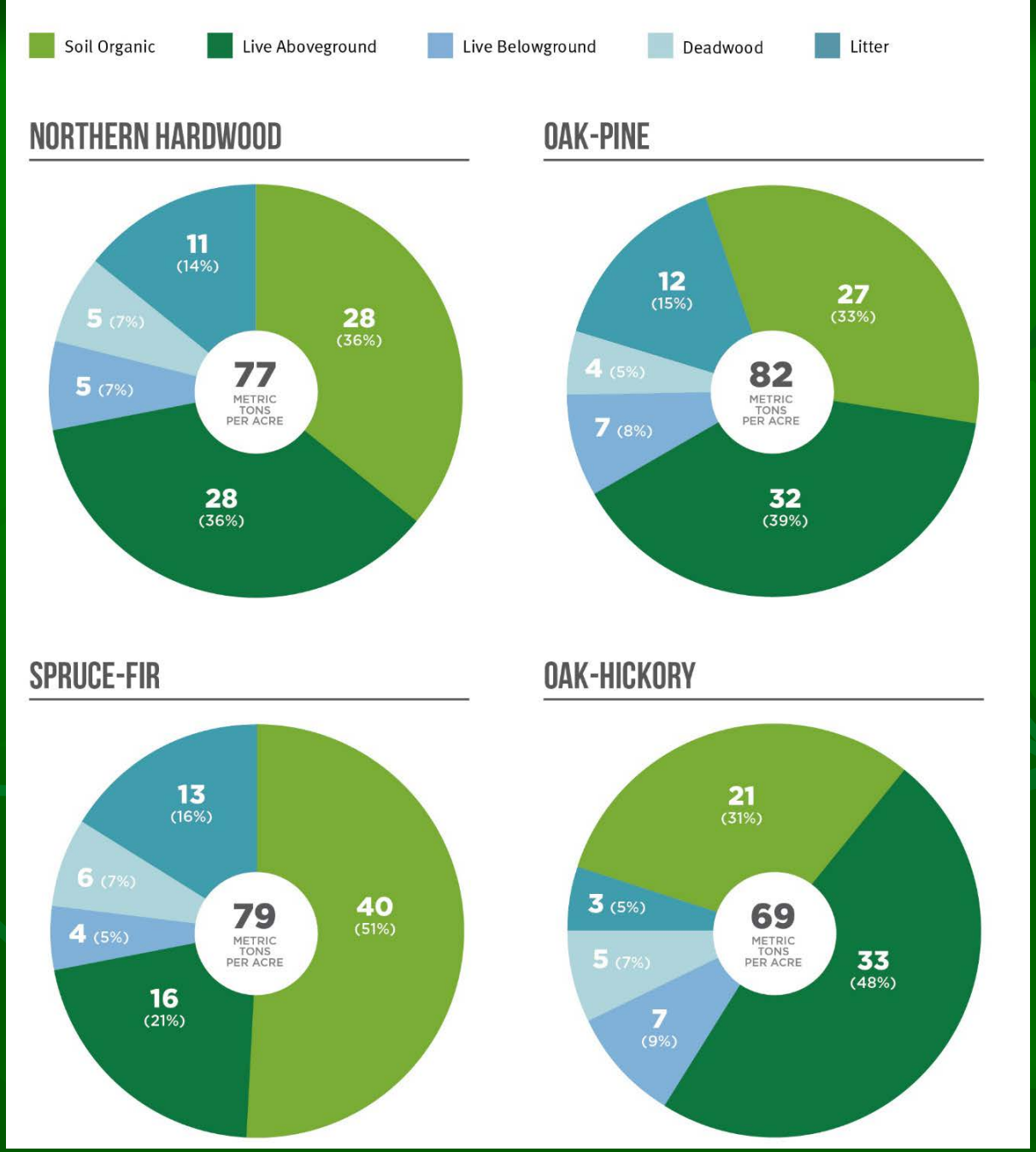
- the age of the forest
- the species of trees making up the forest
- natural and human disturbances
- soil characteristics (e.g., texture and drainage)
- past agricultural land-use history

# Carbon Terms

- **Carbon Storage** :
  The amount of carbon that is **retained** in a carbon pool within the forest.

- **Carbon Sequestration** :
  The **process** of removing carbon from the atmosphere for use in photosynthesis, resulting in the maintenance and growth of plants and trees.

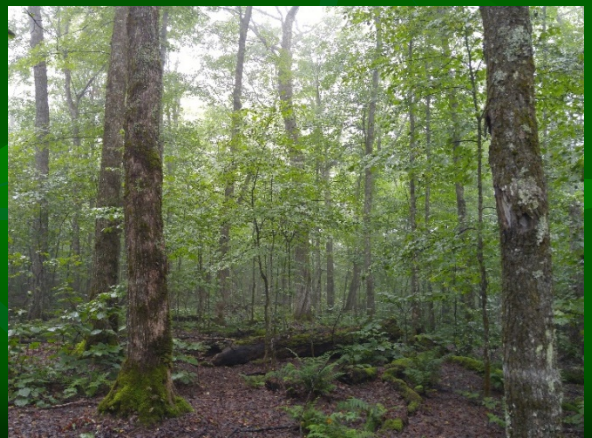





Take home: Soil organic and Live aboveground pools are very important

# How much carbon can our forests store?

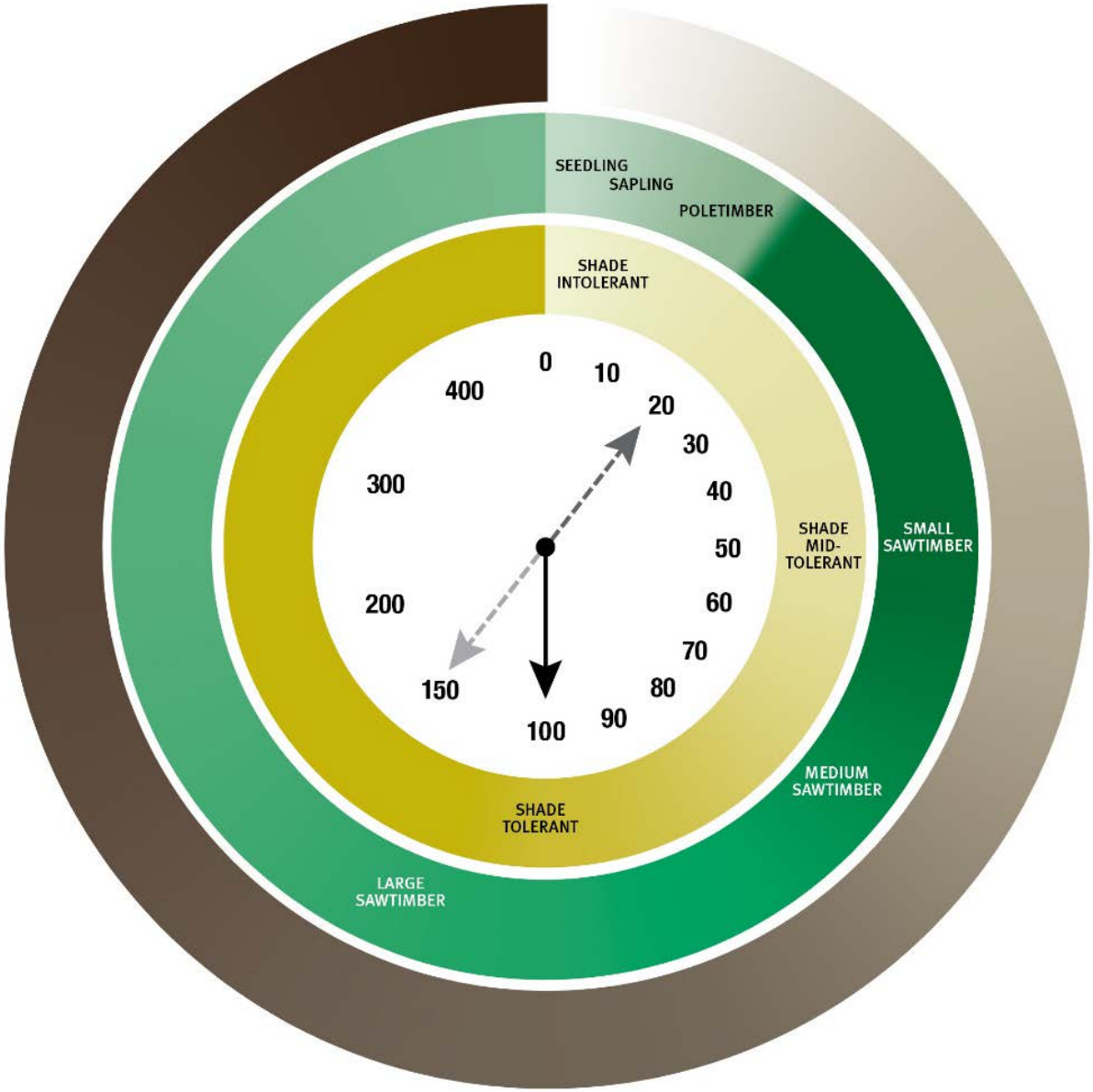
- Old-growth forests as a reference >100 – 120 m.t.
- Current forests > 60 – 80 m.t.
- Carbon accumulation ~.41 m.t./acre/year
- ~100 years…without a major disturbance….before we reach the maximum



# Where will we see the biggest future carbon gains?

- Diameter growth of trees
- Additions to the deadwood pool
- Soil organic from root growth and decomposition

# FOREST SUCCESSION & DEVELOPMENT CLOCK




# Land Use Decisions Impacting Forest Carbon

1. Future use of the land
2. Forest management

# Decision 1:  Future Use of the Land

# Forest Conversion

- Forest conversion is the biggest loss of forest carbon benefit
  - Removes live aboveground, deadwood, and litter
  - Stumping, grading, and plowing decrease soil carbon
- Losses often permanent…or at least long-term
- It is also the loss of **many** other forest benefits

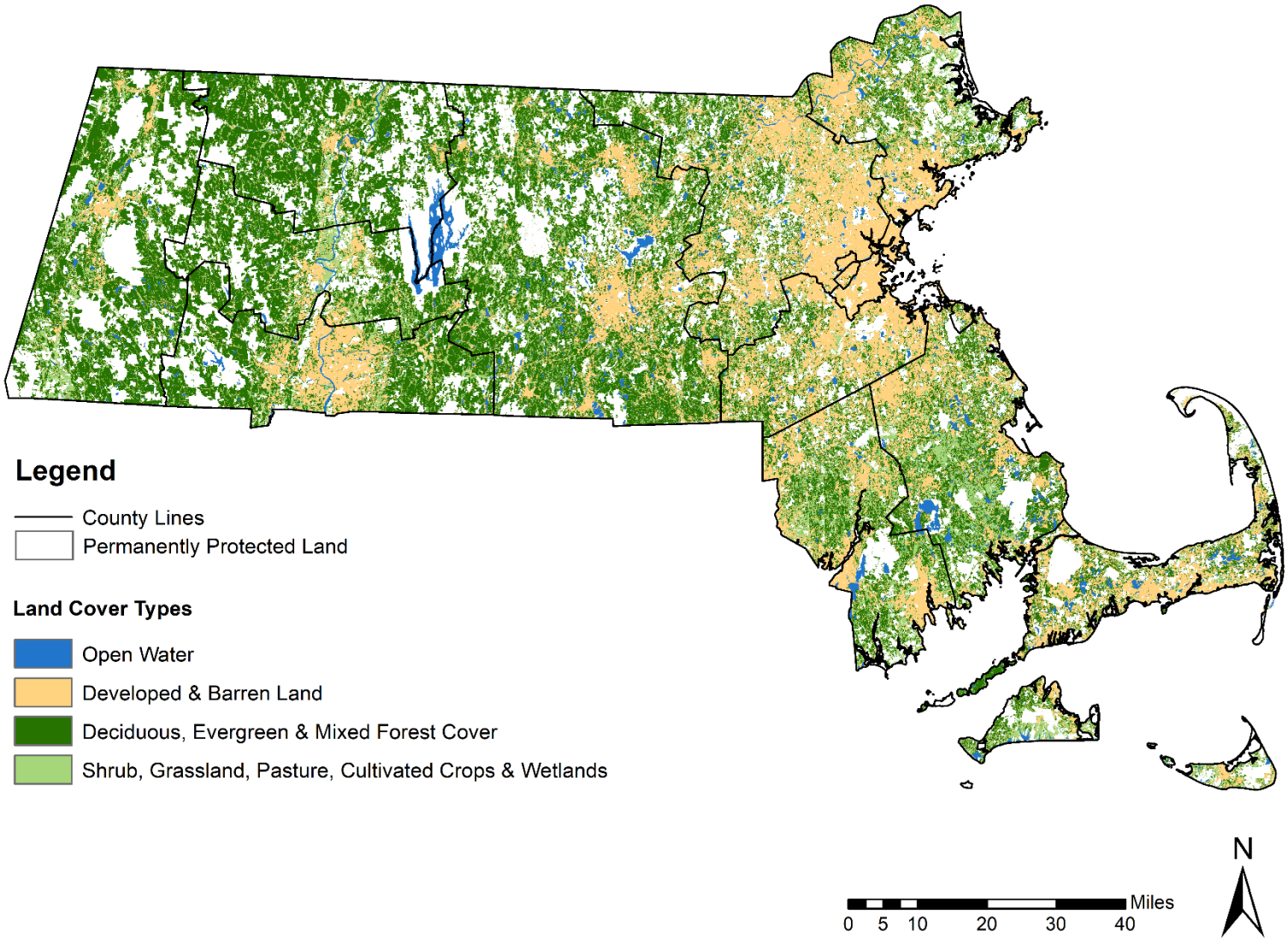
# Forest Loss

| Region | Acres of Forest Loss Each Day | Acres of Forest Loss Each Year |
|---|---|---|
| Southern New England | | |
| Connecticut | 11 | 4,049 |
| Massachusetts | 20 | 7,414 |
| Rhode Island | 2 | 838 |
| Northern New England | | |
| Maine | 23 | 8,398 |
| New Hampshire | 15 | 5,485 |
| Vermont | 6 | 2,123 |
| New England | | |
| Region-wide average | 77 | 28,307 |

New England Landscape Futures Explorer (newenglandlandscapes.org)
Data source: P. Olofsson et al. (2016).

# Unprotected Forest

*Phoebe Gelbard 2019*



# Forest Carbon Strategy

- Helping a landowner with this step is the most important action a professional can take.


**Critical role for MLTC !!!!!!**

- Carbon markets as a land protection tool?
  - Voluntary market > MAS & NEFF > Aggregation?
  - AFF/TNC landowner program

# Reforestation

- If forest conversion is the biggest loss in carbon, then reforestation is the biggest gain
- Consider allowing abandoned or unproductive fields to grow back to forest
- Beware the tradeoffs!

# Decision 2: Forest Management

- Passive
- Active

# Passive Approach

- Let nature take its course.  No timber harvesting.
- Implement strategies to help resiliency (e.g., invasive plant control)
- **Maximize carbon storage** & continue sequestration
- Prioritize rich, productive, protected sites embedded within landscapes with low fragmentation

# Passive Trade-Off: Forest Resiliency

- We are expecting more frequent and more intense disturbances
  - Site (e.g., slope position)
  - Tree species (e.g., ash, hemlock)
  - Forest structure (e.g., even-aged)

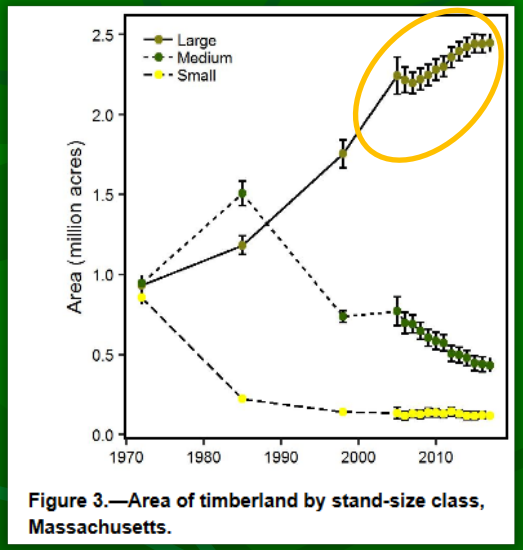
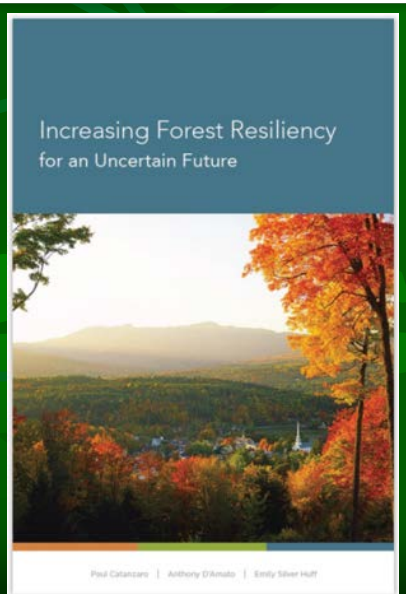
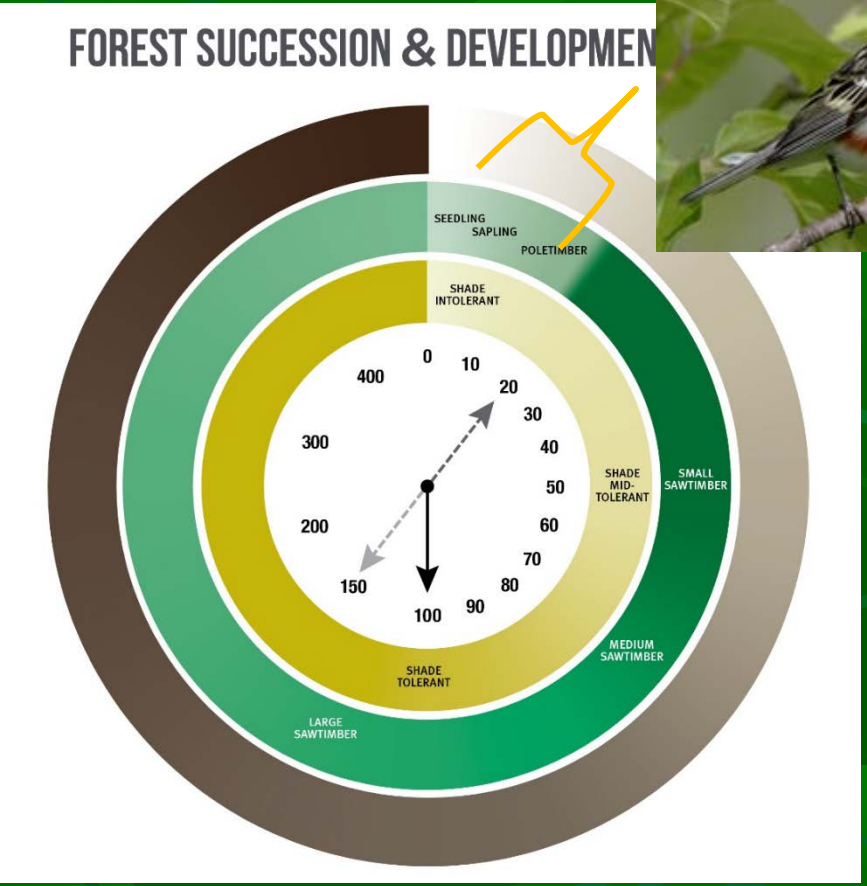



**Figure 3.—Area of timberland by stand-size class, Massachusetts.**



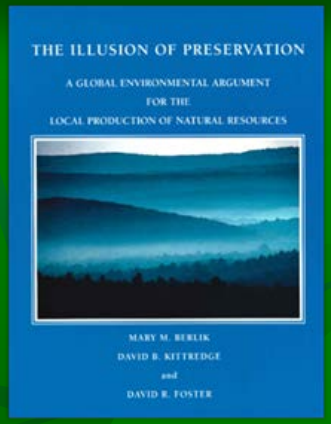
# Passive Trade-Off: Species in Decline




~80% of vertebrate species use multiple age classes for their life cycle

*-DeGraaf et. al.*

# Passive Trade-Off: *Wood Products*




- If not here, then where?
  - Environmental impacts?
  - Carbon impacts?
- Forest Product Substitution

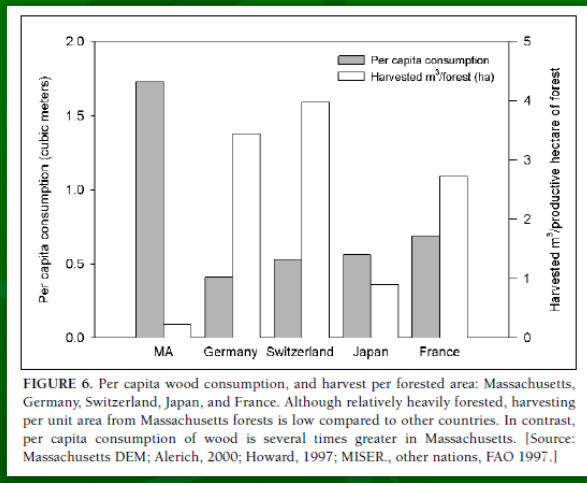



**FIGURE 6.** Per capita wood consumption, and harvest per forested area: Massachusetts, Germany, Switzerland, Japan, and France. Although relatively heavily forested, harvesting per unit area from Massachusetts forests is low compared to other countries. In contrast, per capita consumption of wood is several times greater in Massachusetts. [Source: Massachusetts DEM; Alerich, 2000; Howard, 1997; MISER., other nations, FAO 1997.]

2 – 4 times consumption rates
3 – 10 time production rates

Olver Design Building - UMass

Oslo, Norway – 280’

**TABLE 1**: Energy use by material.

| Material | Fossil fuel energy (MJ/kg) | Fossil fuel energy ($MJ/m^3$) |
|---|---|---|
| Rough sawn timber | 1.5 | 750 |
| Concrete | 2 | 4,800 |
| Steel | 65 | 266,000 |
| Aluminum | 435 | 1,100,000 |

[Source: www.fwprdc.org.au/publications/online/epotbrochure/manufacture. Ferguson, I., B. La Fontaine, P. Vinden, L. Bren, R. Hateley, and B. Hermesec, 1996, “Environmental Properties of Timber.” Research Paper commissioned by the Forest & Wood Products Research & Development Corporation.]

# Land Use Decision 2:
# *Active Forest Management*

- Impacted Pools
  - Live aboveground (AGC) (it depends on how much you remove!)
  - Litter pools (20% -36% reduction)
- BMPs are effective at the protection of soil carbon



# Active Trade-Off: Carbon Storage

- Removal of logs from the forest temporarily reduces the carbon storage of a forest.
- Likely increases carbon sequestration rates

# Removal to Growth Ratio

| Region | Amount of Wood Removed (cubic feet) | Amount of Wood Growth (cubic feet) |
|---|---|---|
| Southern New England | | |
| Connecticut | 1 | 6.1 |
| Massachusetts | 1 | 5.3 |
| Rhode Island | 1 | 5.9 |
| Northern New England | | |
| Maine | 1 | 1.4 |
| New Hampshire | 1 | 1.8 |
| Vermont | 1 | 2.1 |
| New England | | |
| Region-wide average | 1 | 1.8 |

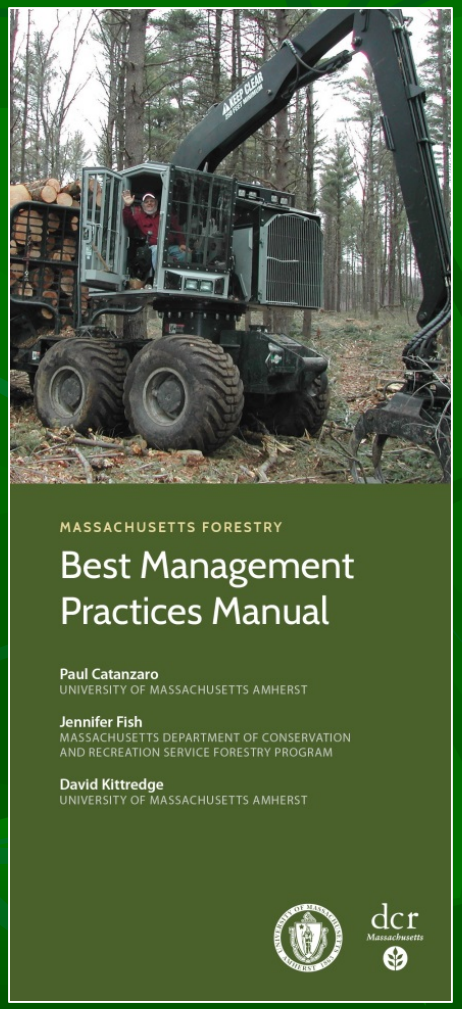
Data source: USDA Forest Service, Forest Inventory and Analysis Unit (2017)

# Carbon-Informed Forest Management

- Strategies to reduce the loss of carbon storage during active forest management.

# Forest Management Considerations
## *Soil*

- Implement Forestry BMPs
- Strong contract




Remember …
soil is one of the biggest carbon pools!!!

# Forest Management Considerations

*Aboveground Pool*

- **Large trees have a big influence on stored carbon**. Grow trees larger. Retain large trees.
- Encourage species predicted to be competitive in the future.
- Species that can become large dominant canopy trees store more carbon (e.g., red oak, white pine)
- Maintain multiple-age classes that balance:
  - large/older trees > storage
  - young fast growing trees > sequestration

# Taking Both a Passive & Active Approach

- It doesn't have to be all of one or the other!! We need both approaches !!
- Review each parcel individually and determine its characteristics (Species, structure, site quality, landscape position)
- Incorporate retention trees and/or patch reserves into your individual property

# Take-homes

- **Encourage landowners to engage in conservation-based estate planning!**

- Protect soil & above ground carbon pools > BMPs and silvicultural strategies
- Balance carbon tradeoffs

# Thank you!

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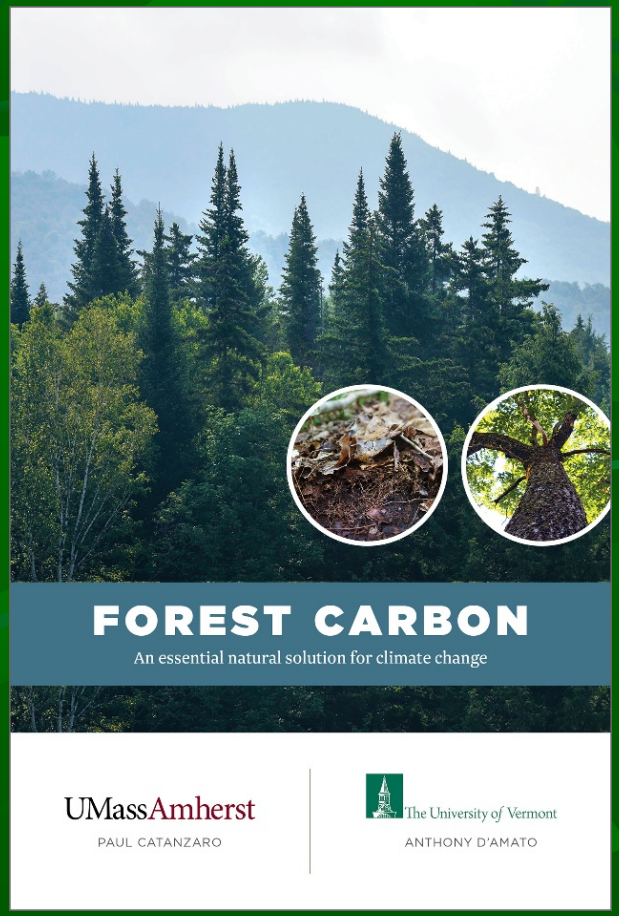
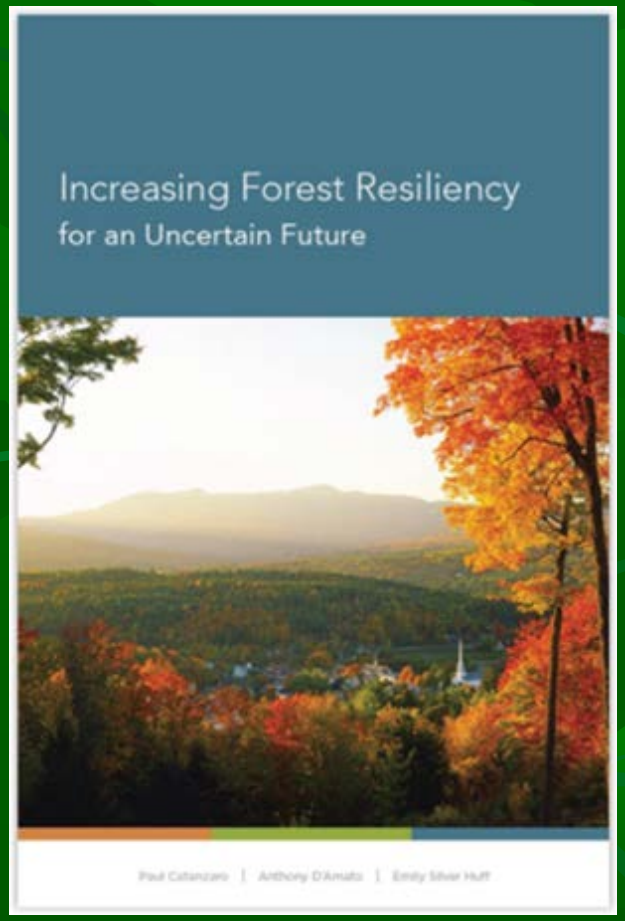
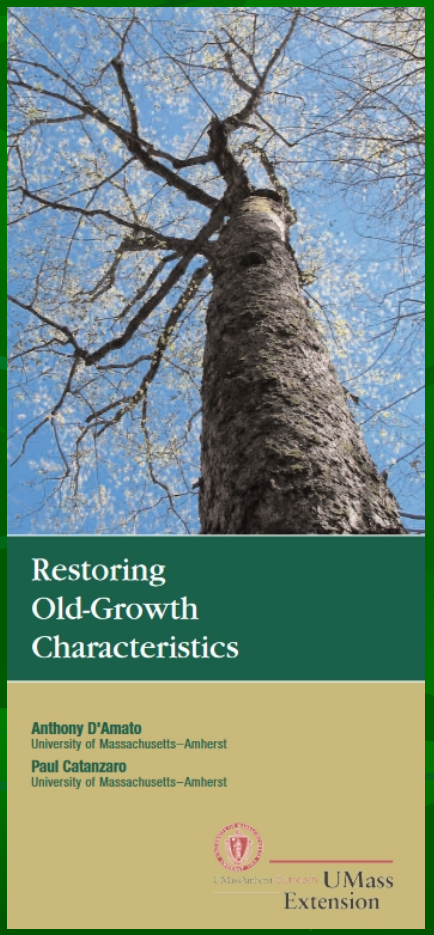



Masswoods.org/carbon




Masswoods.org/resiliency




Masswoods.org/caring-your-land