Maple forests and carbon

THE UNIVERSITY OF VERMONT FORESTRY

Tony D'Amato
Rubenstein School of Environment and Natural Resources
University of Vermont

NE CASC Northeast Climate Adaptation Science Center

Overview

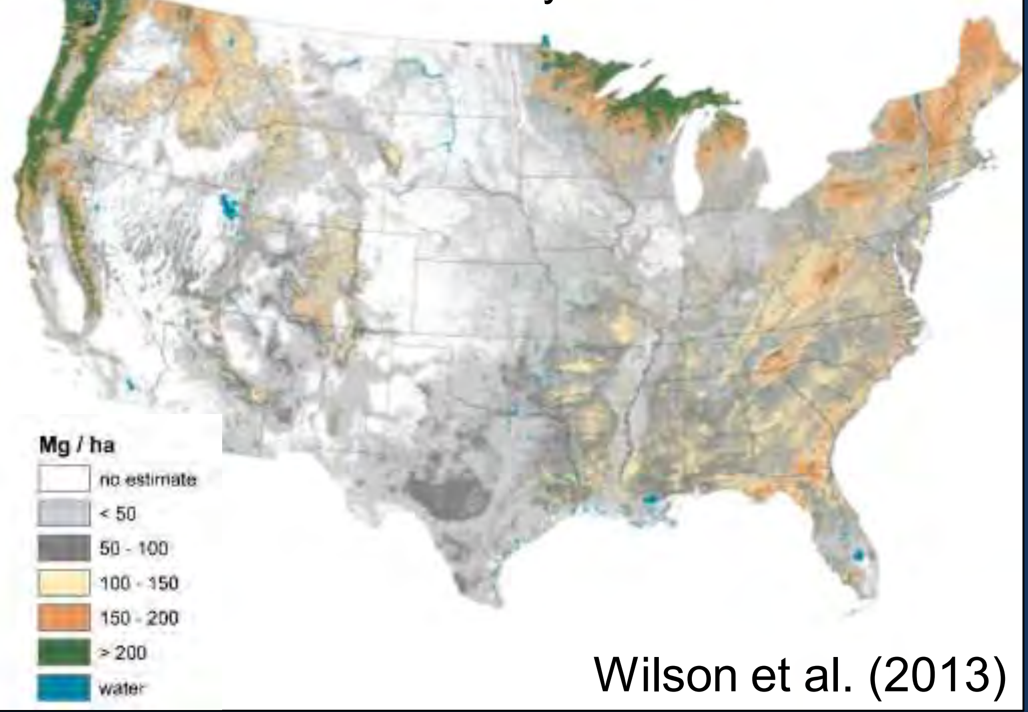
- Forest carbon basics
- Sugarbush management with carbon in mind
- Key tradeoffs and considerations
- **We will be using Menti.com**

Download a PDF: masswoods.org/carbon

Forests and carbon

- The ultimate natural climate solution
  - Forests represent world's largest terrestrial carbon sink
  - US forests offset 10-20% of nation's fossil fuel emissions
    - 40-60% of Vermont emissions are offset by VT forests

Forest carbon density in conterminous US



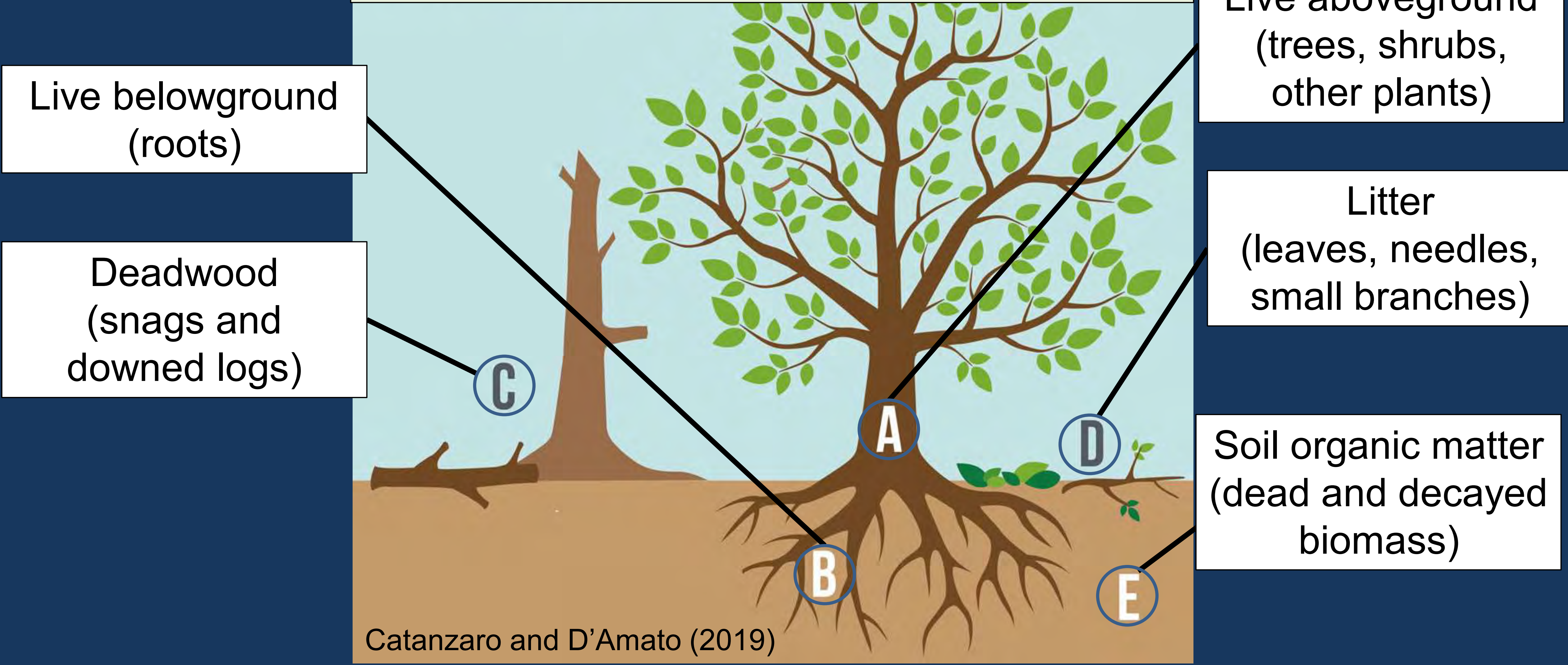
Wilson et al. (2013)

Key forest carbon terms

- **<u>Carbon pool</u>** – part of forest that stores carbon and can accumulate or lose carbon over time
- **<u>Carbon storage</u>** – amount of carbon that is retained in a carbon pool within the forest
- **<u>Carbon sequestration</u>** – process or removing carbon from the atmosphere for use in photosynthesis, resulting in maintenance and growth of plants and trees

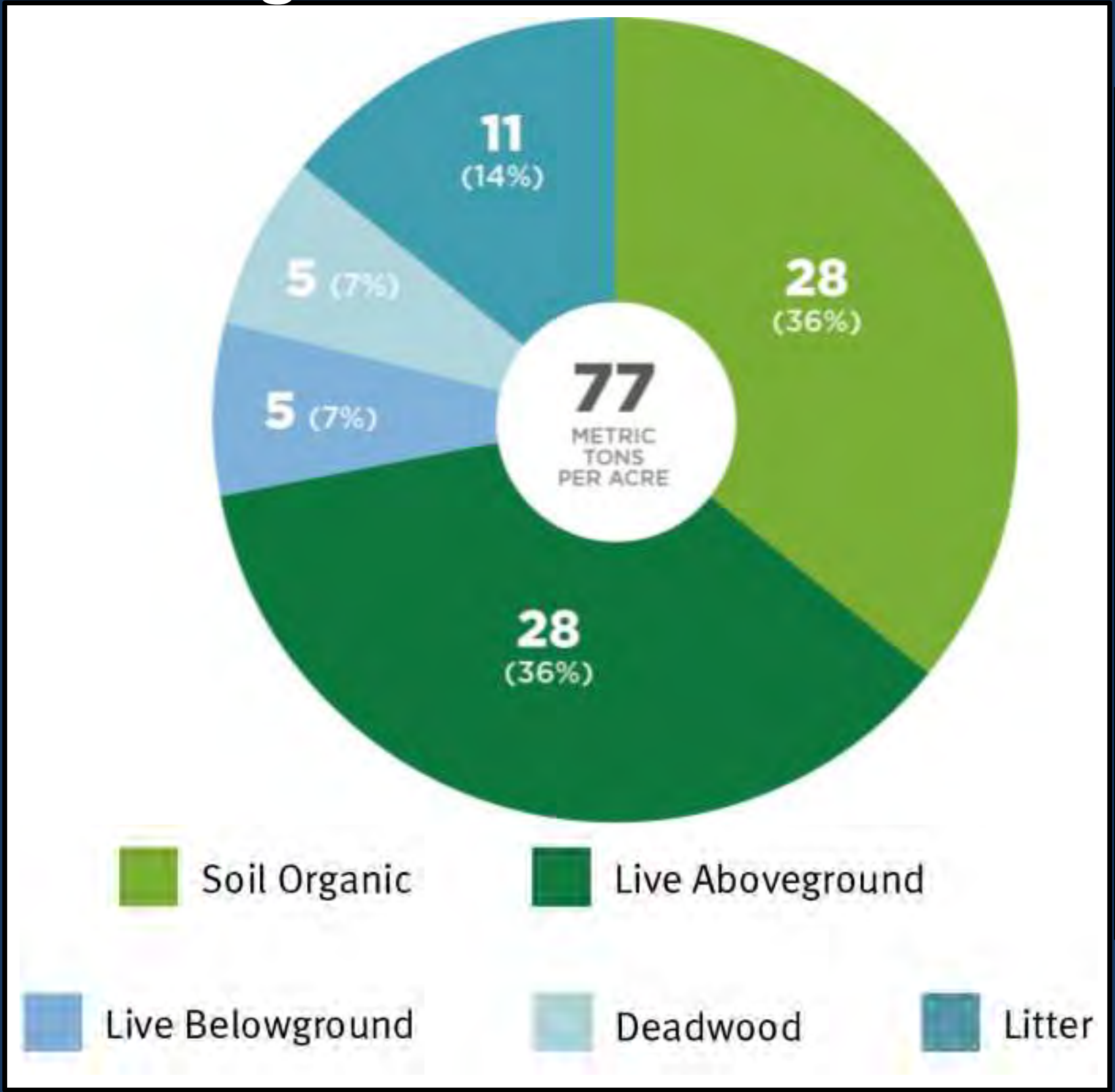
Forest carbon basics

Five primary forest carbon pools



Forest carbon basics

"Average" distribution of carbon across pools in northern hardwoods



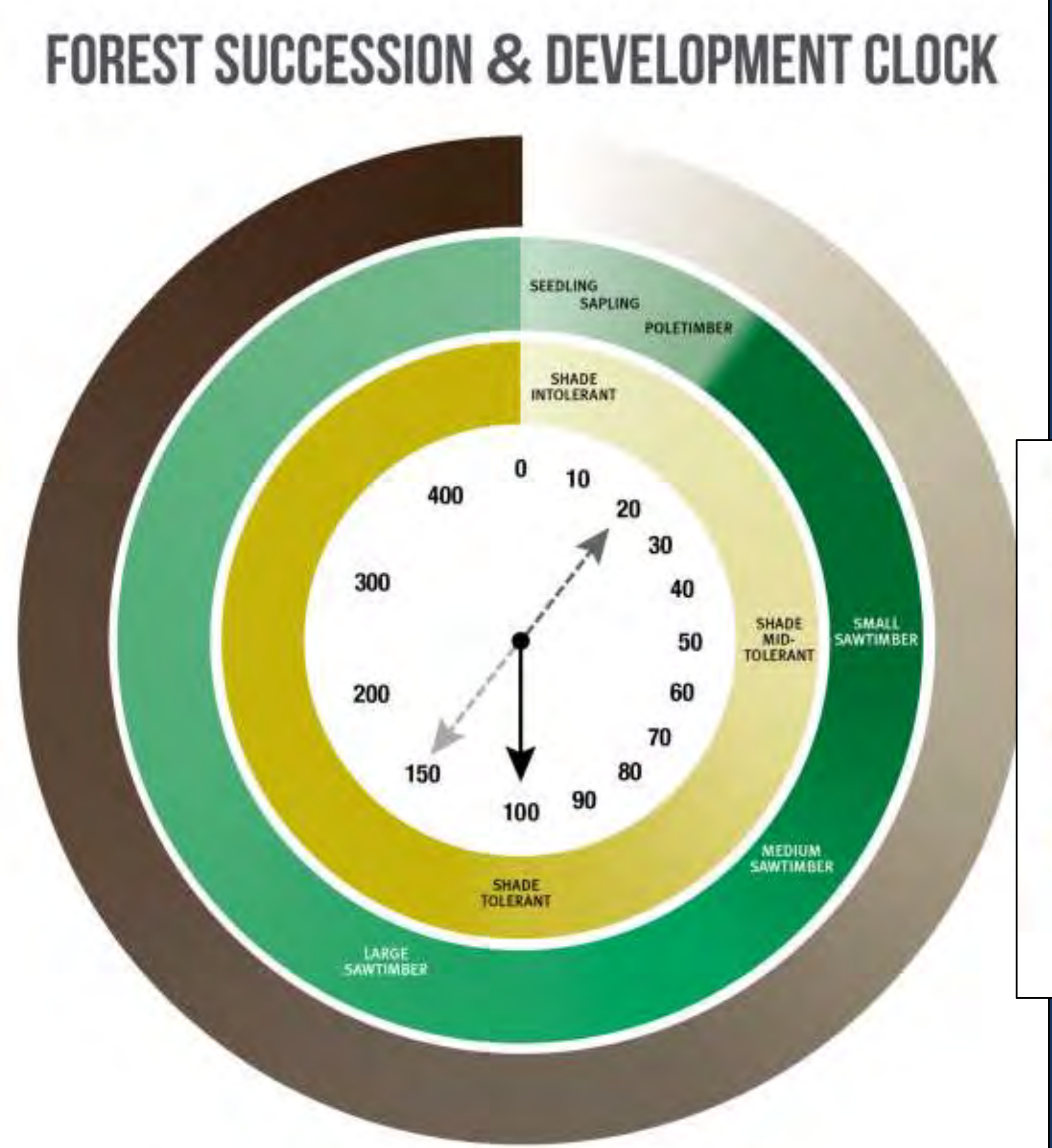
Key forest carbon *market* terms

- **Additionality** – future carbon storage on a given landbase in addition to what would have occurred under business-as-usual
- **Leakage** – a transfer of impacts to other property due to a carbon project on a particular ownership
- **Permanence** –stability of the land base and associated carbon offsets over time (often 40-100 yr time frames)

Forest carbon trivia

- Go to Menti.com
- Enter code: 2217 7744

Carbon dynamics over forest time



Catanzaro and D'Amato (2019)

Amount of on-site **carbon storage** increases as forests age

Sequestration continues, but stand-level rates decline with age

Sugarbush management with carbon in mind

Sugarbush management with carbon in mind

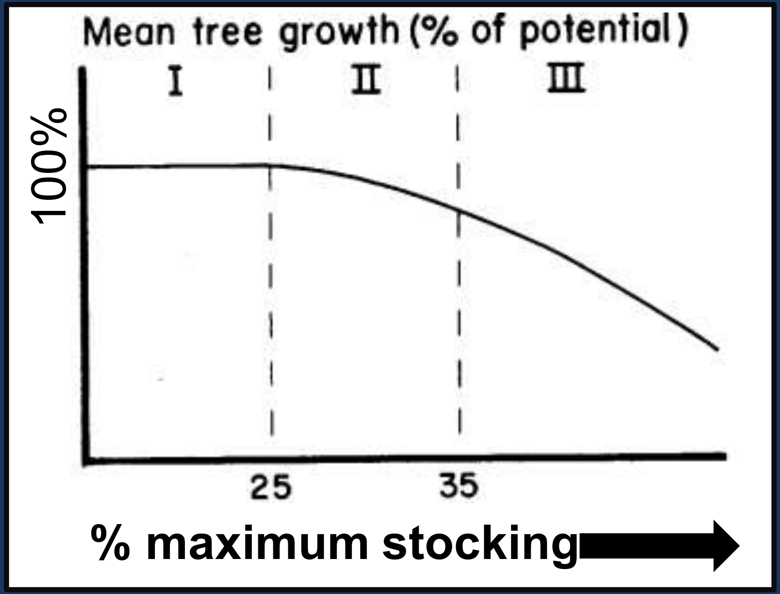
- Ensuring your sugarbush stays forest in the future is the most important action you can take to maintain the benefits of forest carbon (and many others)

Passive approach to forest carbon

- Mature, forested condition of sugarbush might suggest that no adjustments to current management are needed for carbon (passive approach)
  - Minimal harvest of mature trees; maintain high density of maple
    - Maximizes carbon storage, continues sequestration

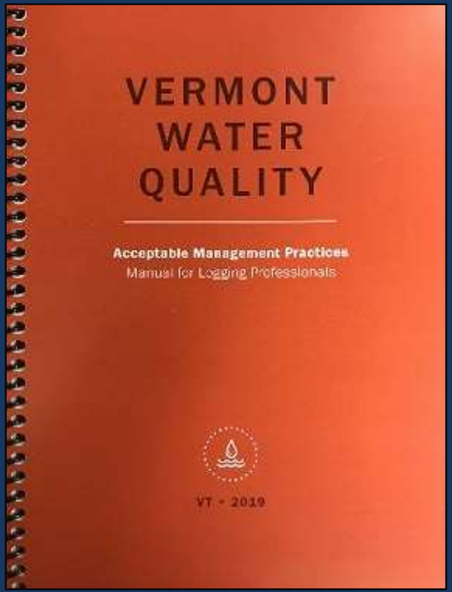
Passive approach to forest carbon

- Important to recognize tradeoffs with passive approach to forest carbon
  - Lower sequestration rates relative to younger or multi-aged stands
  - Lower resilience to disturbance and other stressors
    - High stocking=lower tree-level vigor, lower species diversity
  - Narrow habitat values for wildlife
  - Carbon and environmental impacts of not producing local wood



Active approach to forest carbon

- Carbon-informed <u>active forest management</u> (silviculture) = reducing carbon storage losses during harvest
  - Impacted carbon pools
    - Live aboveground: depends on how much you remove
    - Litter pools: 20-36% reduction post harvest
    - Soils: BMPs are effective at protecting soil carbon (very large pool)
      - Make sure they are implemented!



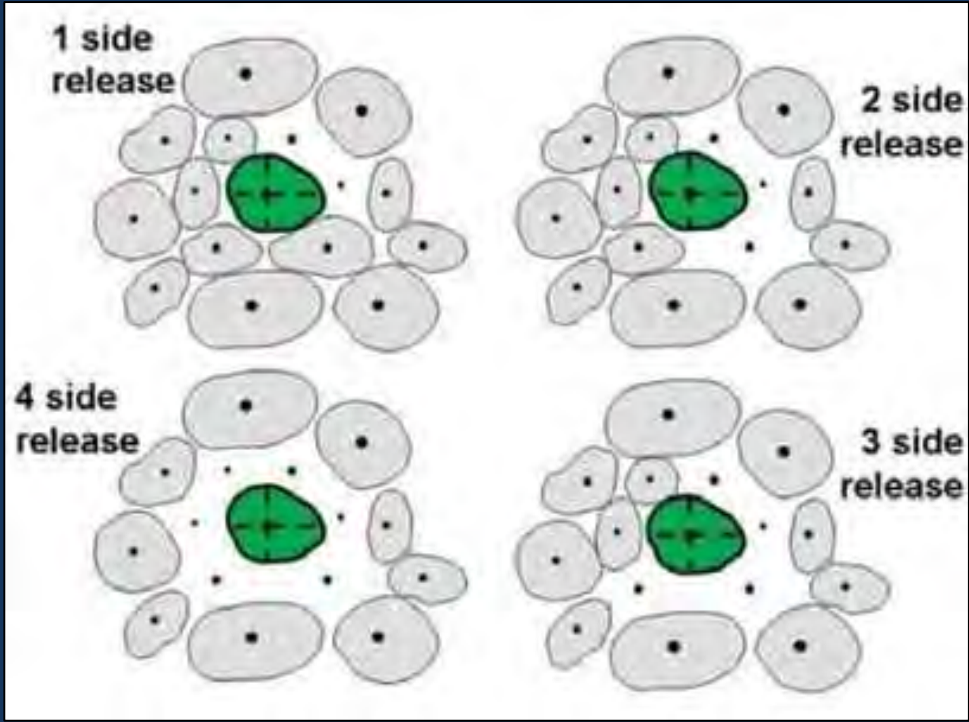
Active approach to forest carbon

Above ground carbon (AGC) and stand structure (size and age class distribution)

- When it comes to AGC, big trees disproportionally carry the most weight (quite literally)!
  - 20-50% of total AGC is in largest 1% of stems in a stand (Lutz et al. 2018)

Active approach to forest carbon

- Managing for **large tree carbon storage**
  - Extend cutting cycles/tree-level rotations 15-20 yrs (1-2" DBH)
  - Use crop-tree release to accelerate large tree development
  - Maintain mature trees as legacies in areas being regenerated



Active approach to forest carbon

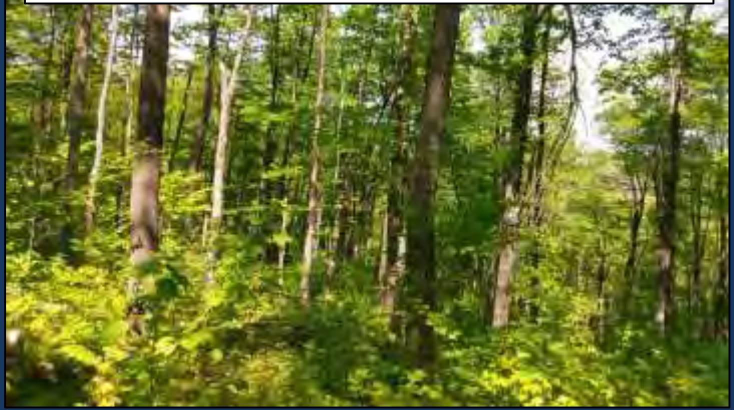
- Balancing large tree storage and young tree sequestration
  - Combination of crop-tree release with canopy gap formation (cf. VT Foresters for the Birds)
    - Crop-tree release applied to 30-70 crop trees per acre using crown release
    - Creation of canopy gaps in areas between crop trees to recruit new cohorts of sugar maple and other species (5-15% of sugar bush)

Active approach to forest carbon

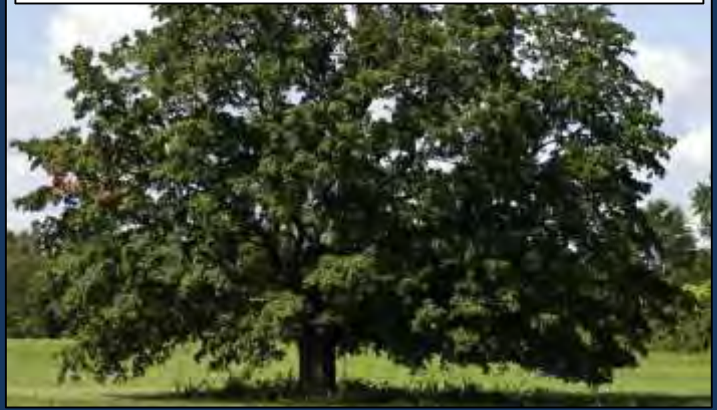
- What stand stocking is best for carbon?
  - High live-tree stocking = high levels of carbon storage…
  - ….BUT, it does not translate to healthy, vigorous crowns built to last (and produce high sap yield)
  - Zones corresponding to sawlog production (60-90 ft^2/ac) provide balance between stand-level storage, long-term vigor, and regeneration opportunities

High carbon stocks, low tree-level vigor

Moderate-high carbon stocks, high tree-level vigor

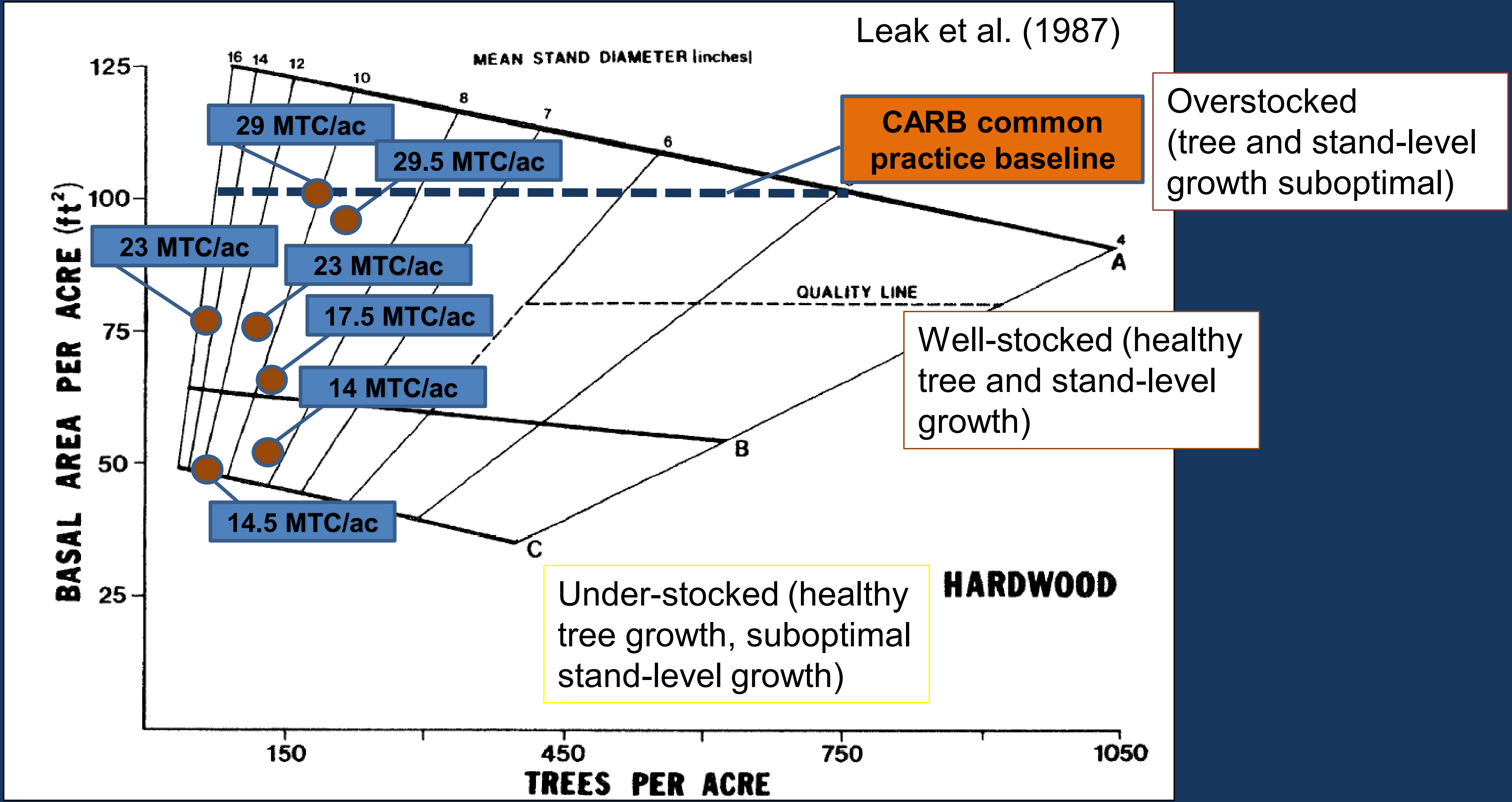


Low carbon stocks, very high tree-level vigor



Active approach to forest carbon

- What stand stocking is best for carbon?



Forest carbon trivia

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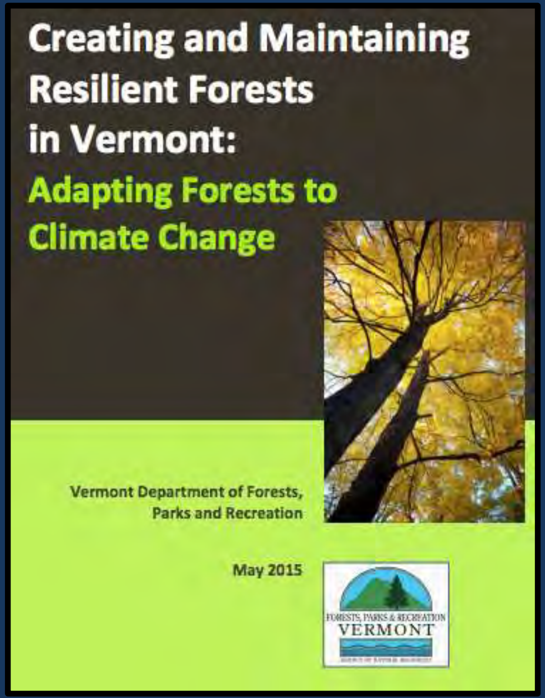
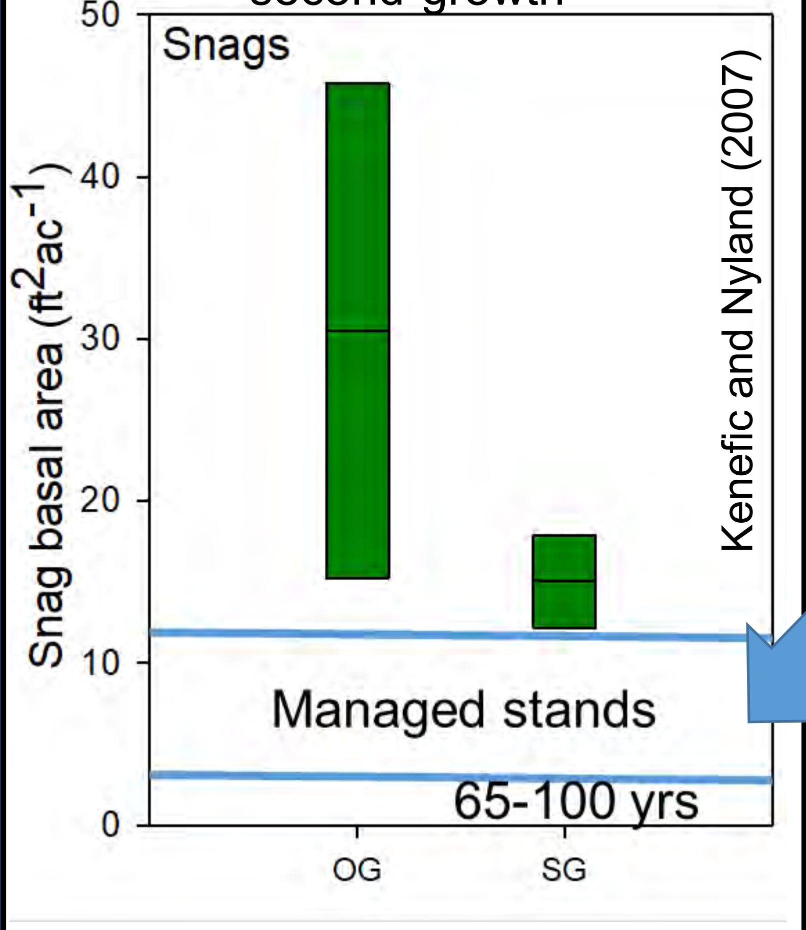
Active approach to forest carbon

- Which species are best for carbon?
  - Sugar maple, of course, but why?
    - Dense wood, long-lived, grows to large dimensions
    - Favor non-maple components with similar attributes, including future competitiveness under changing climate/disturbance
      - Yellow birch, red oak, red maple, basswood



Active approach to forest carbon

- There is much room for improvement in relation to deadwood carbon pools



Emphasis on removing all poorer quality trees can quickly eliminate these key habitats & carbon stores

Aim to leave:

- Cavity trees (> 2 per acre, where possible)
- Downed logs (> 4 logs > 10” diameter per acre)

Active approach to forest carbon

- Controlling invasives, interfering species, and browse impacts critical to maintaining long-term options for high AGC stocks and maple

Active approach to forest carbon

- Key tradeoff to active management is temporary reduction in carbon storage in forest due to removal of logs

Thinking beyond sugarbush/stand-level

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)

Taking both passive and active C approaches

- Forest carbon strategies do not need to be all of one or the other (i.e., passive vs. active)—we need both!
- Multiple scales
  - Entire property
  - Sugarbush and other stands within a property
  - Retention trees within a stand
- Key is ensuring mosaic of conditions (young, old, diverse) to sustain biodiversity and resilience




Key take-homes

- Keeping forests as forests is most important C management strategy
- Protect soil and aboveground carbon pools through application of BMPs and carbon-informed silviculture
- Managing to maximize any single objective is not appropriate for ecosystems providing so many benefits
  - Recognize and balance tradeoffs between carbon and other important economic and ecological objectives




Thanks!