The role of unmanaged forests in climate mitigation and adaptation: the benefits of proforestation

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Terms

- **Climate Mitigation in forests** – enhancing carbon storage/sequestration in forest ecosystems to alleviate potential adverse effects of climate change
  
  Carbon *Sequestration* – the rate at which carbon is taken up by plants from the atmosphere
  
  Carbon *storage* – the accumulated carbon stored in the forest as a result of sequestration

- **Climate Adaptation in forests** – maintaining high levels of compositional, functional, and/or structural complexity to enhance the ability of an ecosystem to respond or adapt to new or changing conditions associated with a changing climate
  
  *Resilience* – ability of a system to recover quickly from a disturbance and return to a previous state
  
  *Resistance* - the capacity of a system to absorb disturbance or stress and remain relatively unchanged

From D’Amato et al. 2011
and GC3 working definitions
Unmanaged forests store more carbon than do managed forests

‘No management’ forests stored 39-118% more carbon than managed forests

“We all harvesting reduces carbon storage of a forest below the maximum potential for the site.”
(D’Amato and Catanzaro 2019)

Connecticut’s forests have the potential to almost double aboveground carbon storage

"Stand age was the strongest predictor of [carbon] biomass" (Keeton et al. 2011)

1 Data from USDA FIA
Creating younger forests from older forests does not help climate mitigation

“The mitigation value of forests lies not in their present net uptake of CO2, but in the longevity of their accumulated carbon stocks” (Mackey et al. 2013. Nature Climate Change)
Unmanaged lands at early successional stages: leveraging the power of afforestation

- Afforestation sequesters about 2 metric tons of carbon per acre/year – that’s about ~10-20 times the annual carbon sequestration rate in grasslands¹

Forest structural complexity is greater in unmanaged forests than in managed forests

“Based on the findings of previous work conducted at the stand-level, we expect more complex forest structure across the landscape will develop over time to a greater degree in unmanaged than managed forests” Young et al. 2017

“[we] found [forests in national] parks to have consistently greater structural complexity than surrounding forests...and [thus] potentially be more resilient to climate change” Miller et al. (2018)
Unmanaged forests have greater tree species diversity than do managed forests. "higher species richness was observed in 77% of parks compared to matrix forests" Miller et al. 2018
A greater density and diversity of forest birds often occurs in unmanaged than in managed forests

- Total density of birds
- Total number of bird species
- Abundance of individual species

"the richness of early-successional forest species did not vary between wilderness and managed forest...likely because of the presence of natural openings [in the wilderness sites]...that provided appropriate open, shrubby habitat (Zlonis and Niemi 2014)

Less management results in fewer invasive plant species

Data from Riitters et al. 2018

"[In Pennsylvania] the most significant Ailanthus invasions closely followed large scale clearcuts in the aftermath of oak roller defoliation as well as subsequent salvage logging following statewide gypsy moth defoliations…" (Kasson et al. 2013)

"[In Massachusetts] more intensive harvests were more likely to have Berberis thunbergii and Rosa multiflora” McDonald et al. 2008
Unmanaged forests are generally far more resilient than we realize: tree regeneration and deer

“As trees mature and die, or topple over during storms, gaps in the canopy become larger and more numerous. There are no young trees to fill the gaps.”

Rawinski, TJ 2008. *Impacts of White-Tailed Deer Overabundance in Forest Ecosystems: An Overview*

(photos by Neil Pederson)
Forest stressors result in a host of benefits: dense regeneration, diversity of structures, abundant dead wood, and habitat for shrubland species.

“…our results suggest that allowing the insect [HWA] to progress naturally may have lower impacts on long-term net Carbon flux than conducting presalvage harvests over the next 50 years” (Krebs et al. 2017)

“tree regeneration layer diversity…was higher in the tornado-damaged sites than salvaged sites, but levels of sapling density and richness were the same” (Santoro and D’Amato 2019)
Forest stressors also benefit rare species

“...the New England cottontail is not limited to...young forests as other authors have suggested, but also occupies sites in maturing forests with overstory canopy cover of up to 80%”

“more New England cottontail [were detected] in the 61%-80% tree canopy class than any other canopy class” Buffum et al. 2015
Insect outbreaks often do not increase fire risk and may reduce it.

“Interestingly, many...studies have found that insect outbreaks reduce the risk of fire (e.g., Flower et al. 2014, Meigs et al. 2016) or do not affect it at all (e.g., Hart et al. 2015). Similarly, a...study in the eastern spruce budworm system also found no evidence for an effect of defoliation on area burned (James et al. 2011).” (James et al. 2017. Ecological Applications)

“to date most available evidence indicates that bark beetle outbreaks do not substantially increase the risk of active crown fire in...forests under most conditions” (Black et al. 2013. Natural Areas Journal)
Less management often reduces the risk of fire severity

“Areas that were salvage-logged and planted after the initial fire burned more severely than comparable unmanaged areas”  Thompson et al. 2006 PNAS
Preemptive management for resilience: uncertain success and the ‘cure’ may be worse than the stressor

“Evidence of successful use of silviculture to minimize damage from invasive species remains limited...Despite decades of research and extensive implementation, there remains uncertainty about how successful these established approaches are for limiting damage” (Muzika 2017)

“...little evidence exists to suggest that it is possible to manage for increased resistance or resilience to the array of disturbances and stresses that temperate forests may experience. Many studies suggest that forests are...more vulnerable to exogenous impacts following management” (Foster and Orwig 2006)
Connecticut is ranked last in the northeastern US in ‘reserved’ forests – public lands protected from management

Reserved forest - permanently prohibited from being managed for the production of wood products through statute or agency mandate; prohibition cannot be changed through decision of the land manager. [However] logging may occur to meet protected area objectives” (O’Connell et al. 2015).
Summary and Recommendations

1. Set aside a lot more forest land as unmanaged reserves to **store the most carbon (mitigation)** and **to create the most complex and diverse forests (adaptation)**

   -- e.g., 50% of state, county, and municipal lands protected as reserves = 14-15% of CT’s total forest area.
   (Connecticut should be a leader in forest reserve protection, not bringing up the rear)

   -- Prohibit management after natural disturbance (windstorms, insect/pathogen outbreaks, fire etc.) in forest reserves
   Natural disturbances will:
   -- provide habitat diversity in the forest
   -- better resist invasive plant species than managed areas
   -- store abundant carbon in deadwood,
   -- have far less ecosystem impacts than pre or post salvage harvesting
   -- have little effect on the forest’s ability to recover

2. Increase afforestation on abandoned agricultural land, vacant lots, and other unused fields

3. Continue to manage some of Connecticut’s forests for **local** wood products.