Maine Adaptive Silviculture Network

Maine SAF/CRSF/CFRU Field Tour

August 18, 2021, Nashville Plantation, Maine

2021. Maine Adaptive Silviculture Network (MASN) Field Tour Booklet. Editors: Joshua Puhlick and Shawn Bugbee.

Cover page: Control (no cutting in 2020) at the Nashville Plantation MASN installation. Photo credit: Joshua Puhlick.

Field Tour Topics

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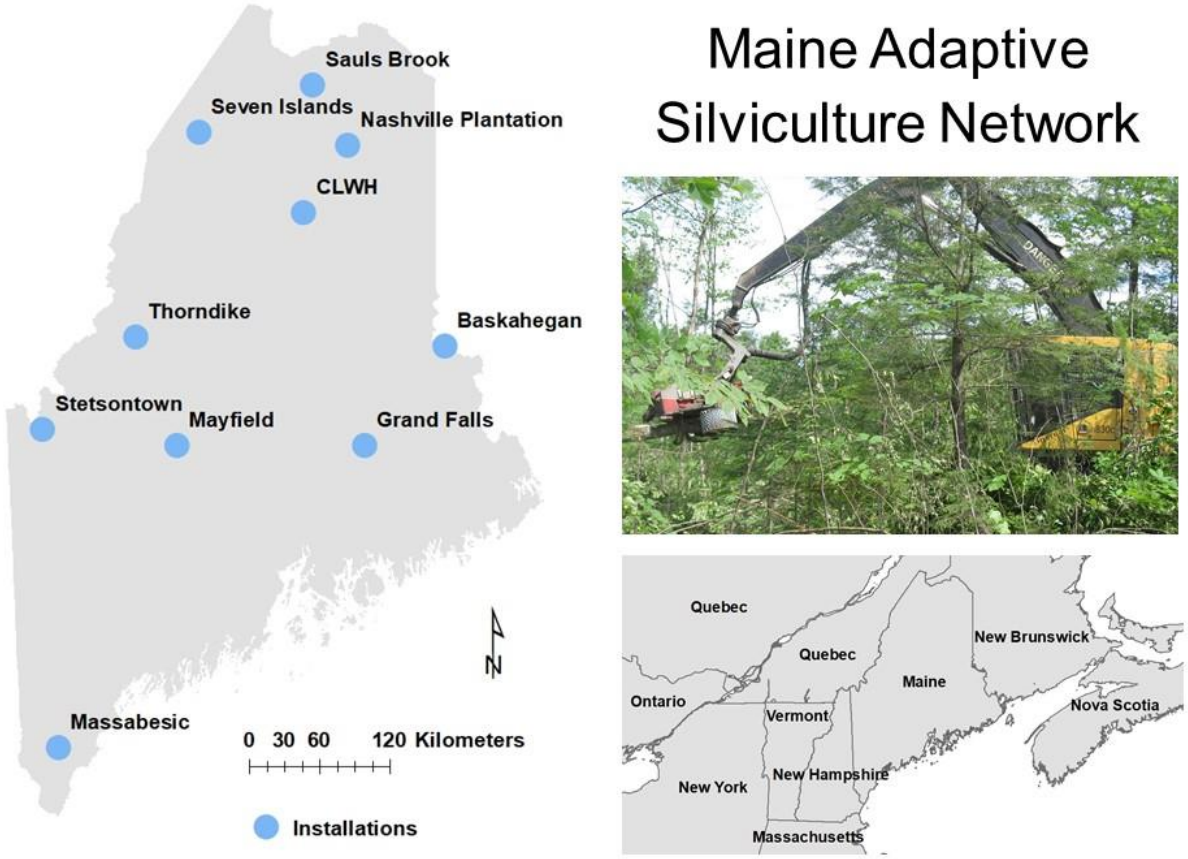
1. Overview of the Maine Adaptive Silviculture Network

Aaron Weiskittel (Director CRSF, University of Maine)

The MASN provides a field setting for conducting research on topics that include growth and yield, soil conservation, wildlife habitat, harvest productivity, regeneration dynamics, remote sensing of inventory, and forest health. The objectives of this CFRU-funded project are (1) to establish a network of operational-scale research installations across Maine representing low, medium, and high site productivities across hardwood, mixedwood, and softwood stand types, and (2) to encourage researchers to make use of these research sites for addressing issues applicable to CFRU members.

Approach:

- Working with forest managers, identify potential areas with uniform soils, drainage class, topography, stand type, and recent harvest history.
- For each installation, delineate four to seven units and randomly assign and implement various forest management treatments representing different forest management treatments commonly applied in Maine.

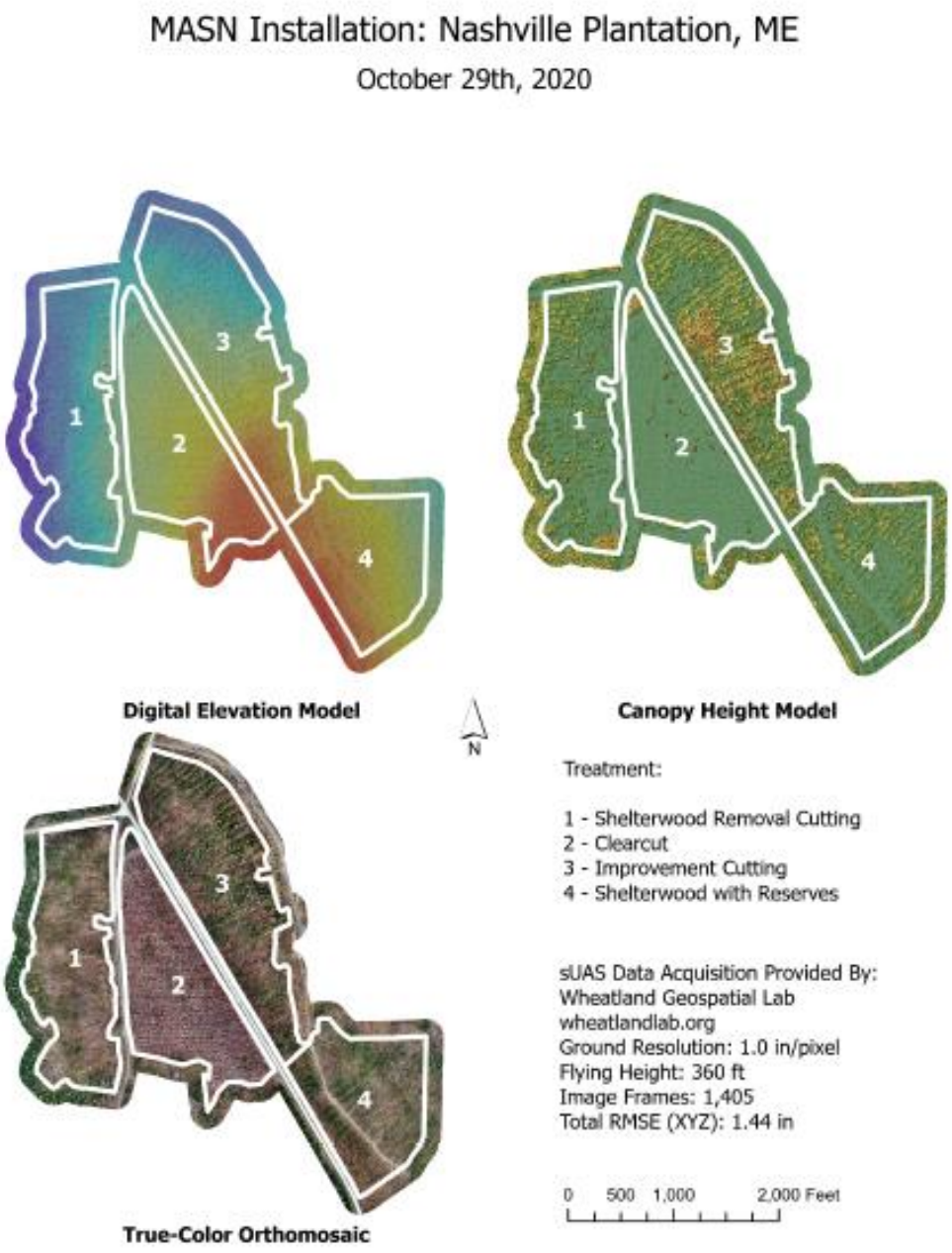


Installations of the MASN (figure produced by Joshua Puhlick).

2. Forest Management Treatments at Nashville Plantation

Shawn Bugbee (Forester, Seven Islands Land Company)

Treatments were initiated in the summer of 2020 and include: shelterwood removal cutting, clearcut, improvement cutting, shelterwood with reserves, and an unharvested control.



Map of the Nashville Plantation MASN installation produced by David Sandilands of the Wheatland Geospatial Lab, University of Maine.

3. Silvicultural Strategies to Promote Forest Resiliency to Future Change

Shawn Bugbee (Forester, Seven Islands Land Company) and Joshua Puhlick (Research Associate, University of Maine)

At the Nashville Plantation MASN installation, partial cutting occurred in the 1990s, which resulted in a forest with at least two cohorts of trees: an older cohort of large eastern hemlocks and hardwoods (including sugar maple, red maple, and yellow birch), and a younger cohort that included poplar and birches. Prior to timber harvesting in 2020, Seven Islands Land Company foresters and researchers from the University of Maine discussed using silvicultural strategies that promote forest resilience to the effects of climate change. At Nashville Plantation, such methods included retaining the seed sources of tree species such as yellow birch, sugar maple, and red spruce. Large eastern hemlocks were also retained to meet biodiversity and carbon storage objectives. Other objectives included maintaining a multi-aged structure and plan to regenerate yellow birch in gaps during future harvests. The naming convention assigned to the prescription was an improvement cut.

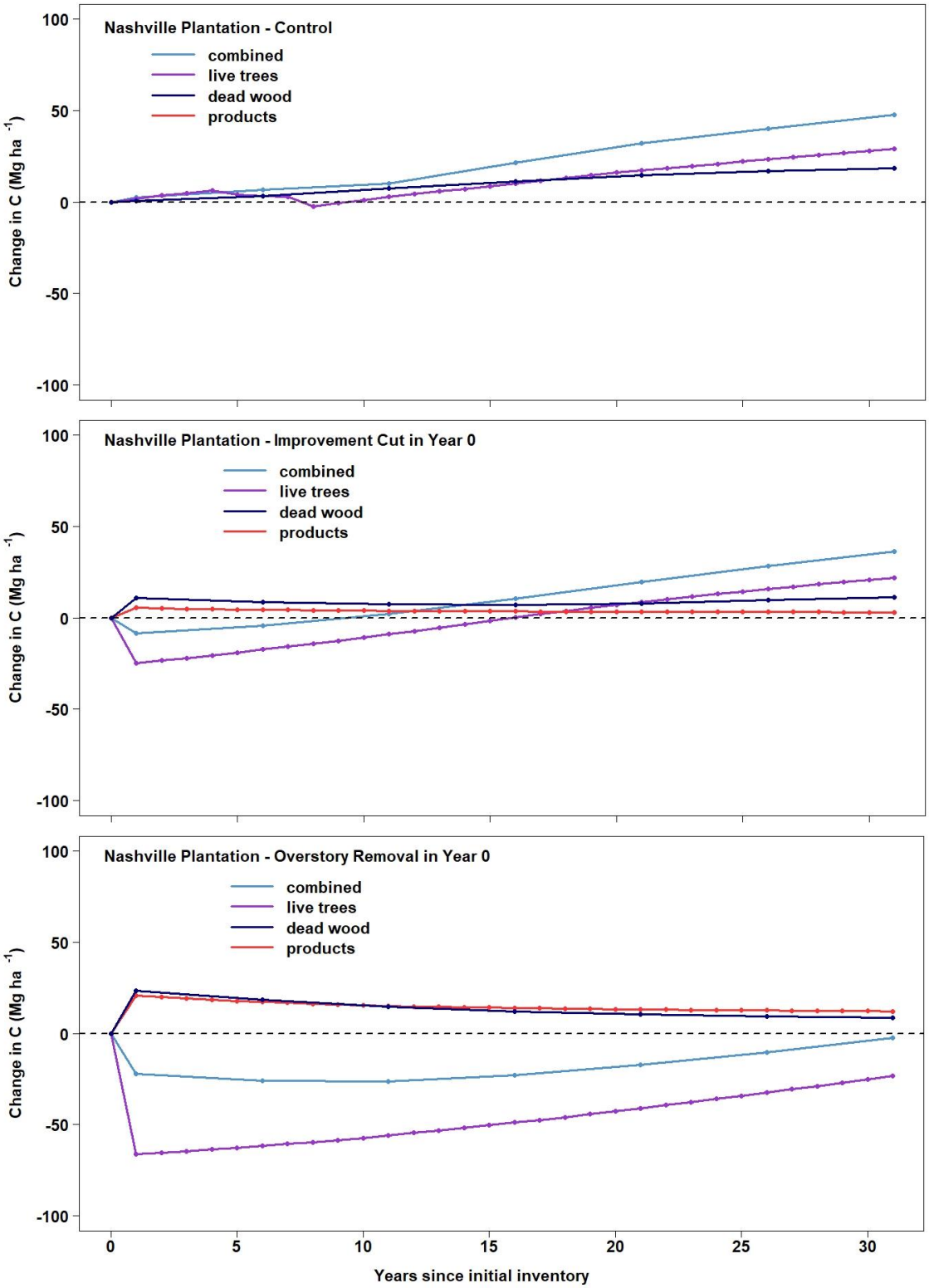
Improvement cut at the Nashville Plantation MASN installation. Photo credit: Joshua Puhlick.

4. Carbon Accumulation after Implementation of Forest Management Treatments on the Maine Adaptive Silviculture Network

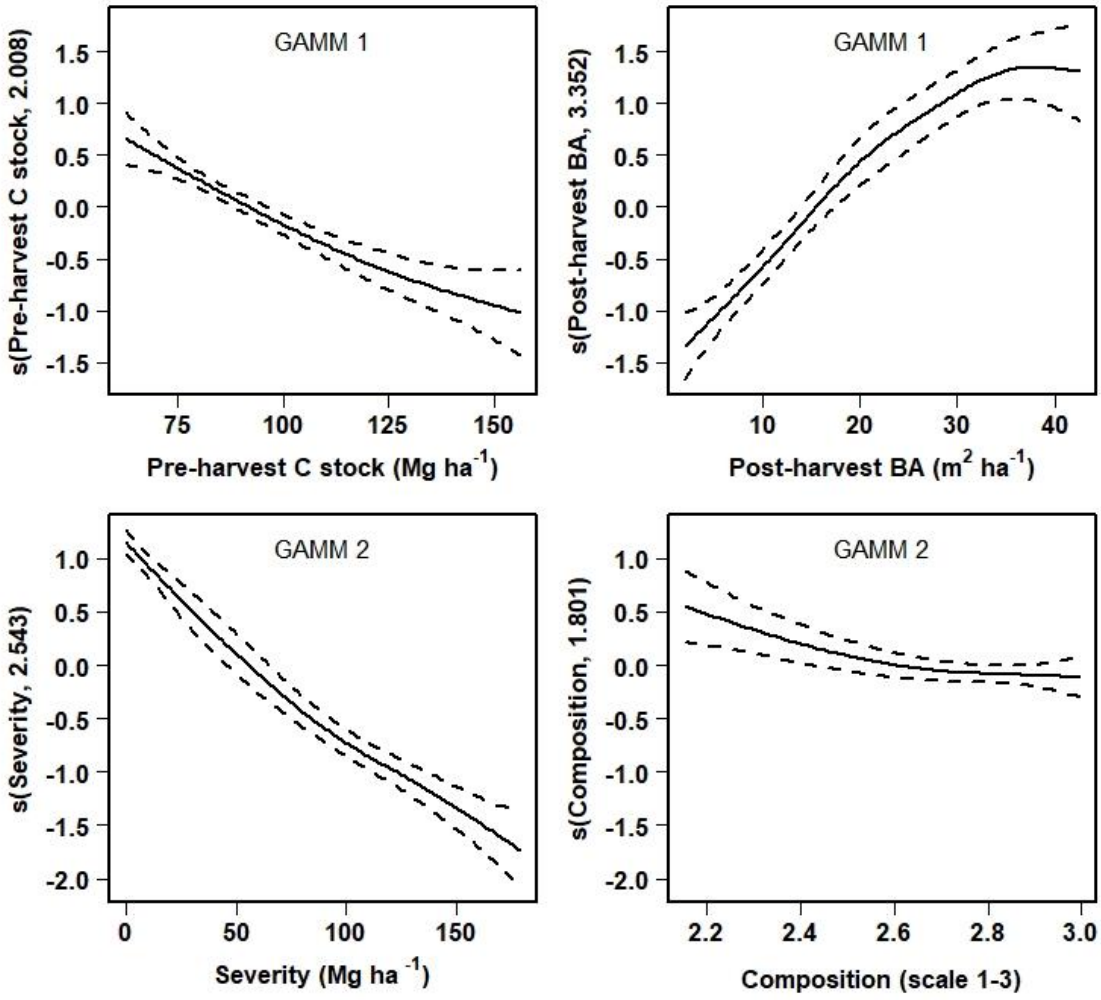
Aaron Weiskittel (Director CRSF, University of Maine) and Joshua Puhlick (Research Associate, University of Maine)

Comparing forest and harvested wood product carbon (C) stocks and accumulation among forest management treatments commonly applied in managed forests is needed to inform planning and policy decisions for C objectives. Therefore, we quantified pre- and post-harvest C stocks and projected C accumulation over a 31-year period (to ~2050) among forest management treatments that were applied on a subset (n = 3) of the Maine Adaptive Silviculture Network installations in northern Maine, USA. Models of C accumulation indicated that low harvest severities (based on biomass removals) and greater representation of tree species with low tolerance of shade were associated with greater C accumulation. To accomplish C objectives, our results emphasize the importance considering forest reserves and using targeted yet operationally feasible silvicultural treatments that promote forest resilience relative to climate change.

Overstory removal at the Nashville Plantation MASN installation. Photo credit: Joshua Puhlick.



Projected cumulative sum of net changes in C stocks (Mg ha^{-1}) over a 31-year period for Nashville Plantation by forest management treatment. Net changes in C stocks between inventories can be positive (C accumulation) or negative (C loss).



Estimated smoothers and 95% confidence bands for two generalized additive mixed effects models (GAMM 1 and GAMM 2) of projected average annual net change in C (Mg ha^{-1} yr^{-1}) for the aboveground portions of live trees, dead wood, and harvested wood products over a 31-year period. The smoothers are centered around zero. Fitted values can be obtained by adding the intercept and contributions from random effects. BA = basal area. Severity = cumulative harvest severity index. Composition = species composition index (values are restricted to a range of 1–3, with values near 1 indicating dominance by species with low tolerance of shade).

5. Non-native Earthworm Discoveries and Implications for Forest Health

Joshua Puhlick (Research Associate, University of Maine) with examples of disturbance presented by Joshua Goldsmith (senior forestry student at the University of Maine)

This spring, Puhlick, Fernandez, and Wason published an article about the discovery of European earthworms at two MASN installations in northern Maine. This discovery has implications for northern Maine forests because non-native earthworms can cause abrupt changes in forest ecosystems by altering soil properties and depleting or redistributing soil carbon stocks. Monitoring changes in soil carbon will be important for evaluating loss or accumulation of soil carbon in areas with and without non-native earthworms.

Earthworms have consumed most of the organic horizon in this area of the control unit at Nashville Plantation (photo: July, 2020). Photo credit: Joshua Puhlick.

Key Findings

- At Nashville Plantation, earthworms were found across the entire installation and the median O horizon carbon stock was 39% less than that of a similar forest without earthworms.
- At Seven Islands, earthworms were only found across a portion of the installation, and the median O horizon carbon stock in the area with earthworms was 34% less than that of areas without earthworms.
- No earthworms were detected at Sauls Brook.
- Areas with earthworms had no or minimal eluvial (E) horizons, while earthworm-free locations always had E horizons.
- Earthworm presence was always associated with a topsoil (A) horizon, reflecting mechanical mixing and organic matter processing by earthworms.

Earthworms have consumed most of the organic horizon in this area of the overstory removal unit at Nashville Plantation (photo: May 2021). Photo credit: Joshua Puhlick.

6. Prescribed Burning as an Alternative Form of Site Preparation

Shawn Bugbee (Forester, Seven Islands Land Company)

Seven Islands Land Company has been experimenting with using prescribed burning as a way to prepare clearcut areas for direct seeding or planting seedlings of species such as red spruce. This may potentially reduce the time to planting and costs associated with more intensive forms of site preparation (e.g., disking and use of herbicides). Plans to use prescribed burning at Nashville Plantation have been coordinated with the state of Maine for the summer of 2021, one year after clearcutting.

Logging residues along a side trail within the clearcut unit at the Nashville Plantation MASN installation (photo taken after cutting in 2020). Photo credit: Joshua Puhlick.

7. Strategies for Altering Species Composition in Stands with American Beech and Beech Bark Disease on the Maine Adaptive Silviculture Network

Joshua Puhlick (Research Associate, University of Maine) with discussion by Autumn Brann and Joshua Goldsmith (senior forestry students at the University of Maine)

In northern hardwood stands with American beech, harvest operations that damage the root systems of beech trees can induce root suckering leading to dense understories of beech. These understory root sucker origin beech trees often outcompete other tree species such as sugar maple. Understory beech can also become infected with beech bark disease, which may reduce tree quality and decrease the probability of infected trees yielding valuable timber products. It is for these reasons that some landowners are using methods to reduce the beech component of stands, especially when beech interference with the growth of desired tree species is a concern. The establishment of permanent plots on the MASN (e.g., Sauls Brook and Mayfield) will be valuable for monitoring stand dynamics and evaluating the effectiveness of treatments to shift species composition towards species such as sugar maple and yellow birch.

Control (no cutting in 2018) at the Sauls Brook MASN installation. Photo credit: Joshua Puhlick.

Table 1. Average values for large regeneration (≥ 4.5 ft tall and < 0.5 inches DBH) across 15, 1/300-ac plots for measuring trees and shrubs in the control unit at Sauls Brook during early summer of 2018. For this size class, there were 420 hobblebush stems ac^{-1}. Tree height was predicted from equations in the FVS-NE report by Dixon and Keyser (2016).

Species	Diameter inches	Predicted height feet	Density trees ac^{-1}
striped maple	0.14	5.4	140
red maple	0.20	7.6	20
sugar maple	0.10	6.0	100
yellow birch	0.04	6.2	20
American beech	0.22	6.3	1520
red spruce	0.43	5.9	20

Table 2. Average values for small regeneration (< 4.5 ft tall) across 15, 1/300-ac plots for measuring trees and shrubs in the control unit at Sauls Brook during early summer of 2018.

Species	Height feet	Density trees ac^{-1}
balsam fir	1.1	40
striped maple	1.6	1700
red maple	1.3	40
sugar maple	1.8	2900
yellow birch	1.8	120
American beech	1.9	2760
red spruce	4.0	40
hobblebush	2.1	2520

Woody interference at the Mayfield MASN installation (photo, 2021). Photo credit: Joshua Puhlick.

For trees ≥ 4.5 inches DBH across 12 permanent plots at Mayfield, there were 198 ± 65 trees ac^{-1} (mean ± SD), basal area was 76.5 ± 22.6 ft^2 ac^{-1}, and QMD was 8.5 ± 1.2 inches. For this size class, 7.7% of the basal area was composed of American beech and striped maple. Other tree species included sugar maple, yellow birch, red maple, paper birch, white ash, red spruce, and quaking aspen.

For trees ≥ 2.5 and < 4.5 inches DBH, there were 117 ± 65 trees ac^{-1}. For this size class, 24.5% of the basal area was composed of American beech and striped maple.

For trees ≥ 0.5 and < 2.5 inches DBH, there were 2675 ± 1197 trees ac^{-1}. For this size class, 78.7% of the basal area was composed of American beech and striped maple.