Forest Carbon in Your Sugarbush

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Introduction

A "sugarbush" is a "woodland or other group of maple trees tapped for maple sap." (Heiligmann et al. 2022). At any scale, from 5 to 10 maple trees along a stonewall to hundreds of thousands of maple trees in a forest, the "sugarbush" provides many personal and public benefits. These benefits include firewood and timber, water management, wildlife habitat, recreational and cultural activities, and sap for sugaring. An additional benefit that sugarbushes provide is that they help regulate the climate by sequestering and storing carbon. This sequestration and storage dynamic creates "forest carbon."

Each year during the growing season, the trees in your sugarbush take in carbon dioxide from the atmosphere and through photosynthesis use the carbon to make energy. They use this energy to maintain themselves and grow. In doing so, trees store carbon in the form of wood and other organic matter, such as leaves. Given one half of a tree's dry weight is carbon, the trees in your sugarbush represent important reservoirs of carbon being kept out of the atmosphere.

Sugarbush management is complementary to many aspects of forest carbon given the emphasis on maintaining healthy and productive trees over long time periods for sap collection. Understanding the basics of carbon in your sugarbush can ensure you are sustaining and enhancing the ability of these forests to absorb and store carbon from the atmosphere, and to reduce the impacts of climate change.

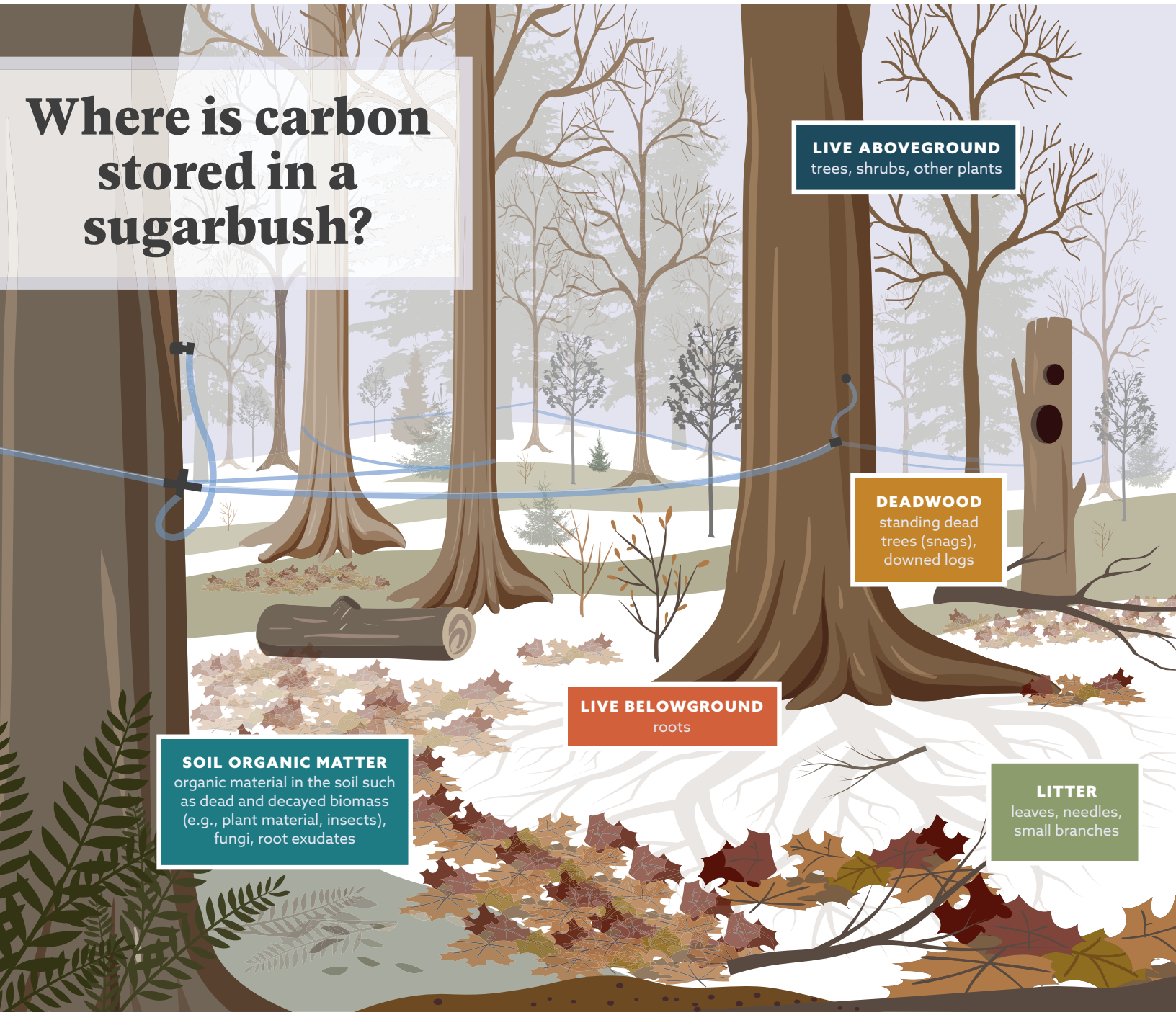
Photo credit: Christopher Lindgren

Carbon cycle basics

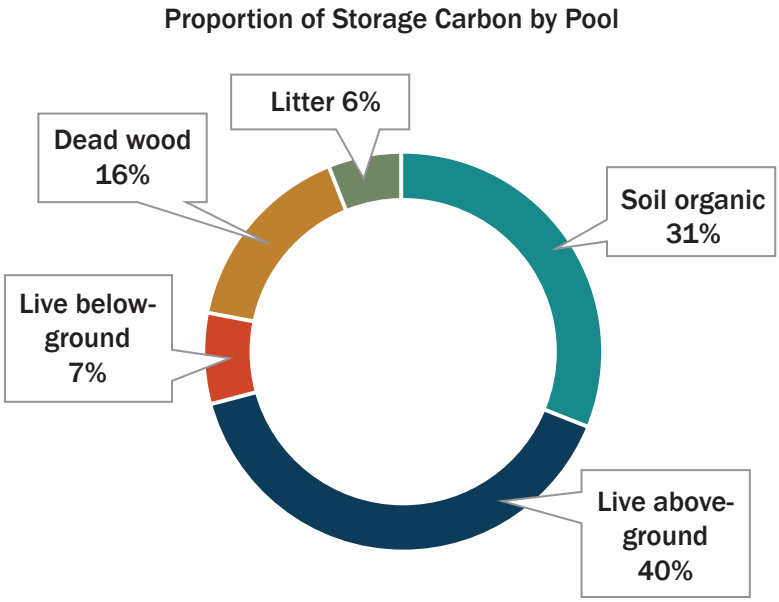
There are different ways to look at your sugarbush from a carbon standpoint, with much of the emphasis on the size and change in carbon pools. These pools are the parts of the sugarbush which store carbon and can accumulate or lose carbon over time (Figure 1). There are two basic aspects of a carbon pool: how much carbon is there and how is the amount of carbon changing over time? These aspects are referred to as carbon storage and carbon sequestration.

Carbon storage is the amount of carbon that is retained in a carbon pool. Carbon storage increases with forest age and typically reaches highest levels when forests are old (> 200 years old for northern hardwood forests). Carbon sequestration is the process of removing carbon from the atmosphere for use in photosynthesis, resulting in the maintenance and growth of plants and trees. The rate (or amount and speed) a forest sequesters carbon changes over time, but carbon sequestration typically peaks when forests are young to intermediate in age (around 30 to 70 years old for northern hardwood forests), but forests can continue to sequester carbon through their entire life span. Forests also emit carbon as organic matter decomposes, with these emissions largely being counterbalanced by sequestration as a forest grows.

Factors that influence the amount and proportion of carbon in each pool include: the age and mix of species of trees in your sugarbush, natural and human disturbances, soil characteristics (e.g., texture and drainage), and past land use. If you harvest trees from your sugarbush and they are used for building materials or other products, they are now considered part of the harvested wood products carbon pool. This pool can be an important component of long-term carbon storage outside of your sugarbush.



Carbon storage and sequestration can vary tremendously from sugarbush to sugarbush depending on the various factors mentioned above. The table below shows the average amount of carbon stored in different pools for 80- to 100-year-old northern hardwood forests across New England; however, you can work with a forester to generate more accurate estimates for your land.



Carbon Pool	Metric Tons/Acre	% of Total
Soil organic	31	31
Live aboveground	40	40
Live belowground	7	7
Dead wood	16	16
Litter	5	6
Total	99	100

Table 1. Average amount of carbon stored in different pools within a 90-year-old northern hardwood forest in the northeastern United States (based on Hoover et al. 2021). Note that soil organic pool size is likely an underestimate given the shallow depth of soil samples used for generating these estimates.

The amount of carbon sequestered by your sugarbush can be estimated by computing the change in the amount of carbon stored in each pool over time. This requires detailed, repeated inventories of the forests on your property and is commonly required for enrollment in carbon offset programs. Average sequestration rates in aboveground carbon pools for different aged northern hardwood forests (from Hoover and Smith 2023) are summarized below.

Table 2. Live average aboveground carbon sequestration rates for northern hardwood forests across different age classes in the northeastern United States. Note estimates do not include changes in soil carbon pools, which would result in peak sequestration rates likely occurring, on average in the 20- to 60-year range.

Forest age (years)	0–20	21–40	41–60	61–80	81–120
Aboveground sequestration rate (tC/ac/yr)	0.52	0.44	0.29	0.14	0.12

Your sugarbush plays an important part in mitigating the impacts of climate change given its ability to sequester and store carbon. Of principle importance for maintaining those benefits is ensuring your land remains forested for future generations by engaging in conservation-based estate planning. Because many of the values of your sugarbush are tied to maintaining mature forest conditions for collecting sap, they can make a unique contribution to climate change mitigation; however, all those values are eliminated if your land is converted to non-forest uses.

In addition to keeping forests as forests, the decisions you make about the management of your sugarbush can affect their carbon sequestration and storage. This includes considering the age structure, deadwood abundance, and species composition of your sugarbush, as well as protecting soils conditions when collecting sap. Carbon is only one of the many benefits your sugarbush provides, so integrating carbon-informed management actions with others that promote wildlife habitat and resilience to future stressors can ensure your sugarbush is able to sustain a diversity of benefits, in addition to sap production, over the long term. Recommendations for carbon-informed management of your sugarbush are covered in Factsheet 2: Enhancing the Carbon Benefits of Your Sugarbush, but you should work with a professional forester to develop strategies that can meet your carbon management goals.

For additional information and resources, visit www.maplemanager.org.

References and Resources

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Material adapted from Catanzaro and D'Amato (2019)

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