



Species Potlight

Sugar Maple *Acer saccharum*

The late-winter sun warms the bark of the 220 year-old sugar maple just as it has done for hundreds of March's over the centuries. For the first time in many months, the tree draws sap up from it's roots to its crown to begin the process of waking up from a long winter of dormancy. What begins as a trickle of a few drops that make a tinny splash sound as they hit the bottom of a carefully placed sap bucket, soon becomes a steady flow of sweet sap. A rite of spring in the northeast officially kicks-off as the sugar-bush owner prepares for many long hours of boiling ahead.

What is it?

It would be hard to pick a more iconic tree for the northeast. Not only do sugar maples provide the primary source of maple syrup in the region each spring, they are also the star of the show in fall, with bright shades of red, orange, and yellow featured in so many fall foliage photos. It can be one of the oldest and largest hardwoods in a forest, reaching heights of over 100 ft. (up to 148 ft.), measuring 3-6 ft. in diameter, and potentially living over 400 years.



An autumn sugar maple leaf.

Why is it important?

Sugar maples play a defining role in the ecology of many northern forests. Among the most shade tolerant of deciduous (leaf-bearing) trees, it can persist (sometimes for decades) under a closed canopy as a tiny seedling or sapling, then quickly sprout upwards to fill a newly formed gap in the canopy.

In addition to the free services of carbon sequestration and oxygen formation that other trees perform, sugar maples also engage in *hydraulic lift*. Their long tap-roots draw deep groundwater up during the day, and their shallow roots release large quantities of it at night to the surrounding soil. Neighboring plants take advantage of this extra water supply, especially during droughts. Studies have shown that small plants like wild strawberry, goldenrod, spice bush, and lily growing near sugar maples are healthier than their counterparts found growing further away, with some getting more than half of their water from the tree.

How does NETN monitor it?

Throughout network parks, hundreds of long-term forest-health monitoring plots have been set-up to keep track of forest condition. In some parks, sugar maples make up a large proportion of plots, ranging from tiny saplings to multi-century old stalwarts. The monitoring program tracks the health of sugar maples and other trees through many different measurements. Tree condition, how fast they are growing, the soils they grow in, mortality rates, disease monitoring, and how many are coming up in the understory are recorded every 4 years in each plot.

How is it doing?

This is a complicated question to answer. On one hand sugar maples appear to be abundant in several NETN parks and across the region. On the other there have been significant declines in the number and health of sugar maples, especially in the understory of mature forests. There are many reasons this, and the long-term health of sugar maple populations will depend upon a kaleidoscope of factors – including climate change, air pollution, deer, and earthworms (yes – earthworms) to name a few.

Of all NETN parks, perhaps not surprisingly, Vermont's Marsh-Billings-Rockefeller NHP has the highest "recruitment" level (saplings that have become big enough to graduate to trees) of sugar maples. It is also the park with the most sugar maple seedlings. New York's Roosevelt-Vanderbilt NHS contains many seedlings too, but areas with heavy deer-browsing pressure are seeing less regeneration of sugar maples along with many other tree/plant species.

Fevers and Bad Acid Trips for Maples

Over the next century and beyond, climate change will play an important role in the health of this iconic species. National Oceanic and Atmospheric Administration data show that the average annual temperature in the Northeast has increased by almost 3° F since 1971, and it's still rising. Uncharacteristically hot weather stresses sugar maples. The summers, springs or falls with well above average temps we've sometimes experienced in recent



ED SHARRON



Sweet patience

At a 40-to-1 sap to syrup ratio, it takes many buckets and a lot of boiling time to make just a small amount of sweet syrup.

years reduces chlorophyll content of leaves. And if they don't get the right amount of freezing nights followed by warm days, the sugar content of sap can drop off by near 40 percent. This negatively impacts spring maple syrup makers and dulls fall foliage to muted yellows and browns.

Bright fall colors are not only good for the tourist industry but are also a sign of a healthy sugar maple returning the nutrients in its leaves back to its trunk. Landsat satellite data from 1972 onward already shows a shift away from the vibrant reds and oranges typical of sugar maples. If current trends continue, the Northeast Climate Impacts Assessment Report predicts that New England could feel more like North Carolina by 2100 and syrup makers and fall "leaf-peepers" could be limited to Canada.

Air pollution can also be a prime limiting factor for sugar maples, which are more sensitive than other species of maple. Besides climate-changing carbon dioxide, another major consequence of burning fossil fuels is the formation of acid rain. Since the industrial revolution began in earnest, it has altered soils and reduced the number of sugar maple trees that can grow in the Northeast, according to a Cornell University study. Nitric and sulfuric acid leaches away calcium in soils, increasing acidity which stresses sugar maples and makes it more difficult for them to grow, produce seeds, and for seedlings to survive and mature. Adult trees can also die. Implemented by the U.S. EPA, the Clean Air Act has helped reduce sulfuric acid by one-third since its peak in the 1960s, but nitric acid (produced mostly by automobiles) has not gone down by much.

Worming Their Way into Our Woods

Surprising to many, earthworms can play a significant role in the health and make-up of forests. When the most recent ice age scoured away the soils of the Northeast, the ice also obliterated any native earthworm species that were present. The worms that survived the onslaught of ice in the Central and Southern US haven't had enough time to naturally wriggle their way up this far north yet. Making a sloth look downright speedy, earthworms can only muster about 5 yards a year, meaning they could only have traveled just over 30 miles in the last 11,000 years if left to their own devices. People, however, have been intentionally and inadvertently spreading worms to the region for centuries, often through the rootballs

NPS PHOTOS



A tale of two plots: These NETN forest health monitoring plots show the difference between a healthy sub-canopy in Vermont's Marsh-Billings-Rockefeller NHP (right) with a thick duff layer and many sugar maple seedlings/saplings, and a plot in Weir Farm NHS (left) with exposed roots, little leaf-litter, sedge-grass ground cover, and no regeneration in the understory that are common signs of earthworm invasions.

of transplanted trees or plants or by dumping fishing bait into the woods. While they are a boon to the garden, they can be a boondoggle to the forest. Absent earthworms, decomposition of leaf litter in hardwood forests is controlled by fungi and bacteria. Natural decomposition is slower than the annual accumulation of new leaf-litter, and allows for the formation of a thick, spongy forest floor of leaves in various stages of rot - called a duff layer. This layer can be up to 5 inches thick in very rich sites. Many native plant and tree species need this layer to propagate and survive including much-loved spring wildflowers and the seedlings of trees like sugar maples. Research from the University of Minnesota has shown broad changes to native hardwood forests when exotic earthworms are introduced. The worms consume much or all of the duff layer, which changes the chemical makeup and structure of the soil. The mixing of the organic with the underlying mineral layer makes a new mixture that is no longer useful as a seed bed or germination medium for most native understory plants. Making matters worse, it has been shown that earthworm effects on nutrient cycling actually encourages the spread of invasive plants such as buckthorn, honeysuckle, multiflora rose, and garlic mustard. In forests dominated by sugar maples that don't contain earthworms, there can be as many as 100 tree seedlings per square meter that range in size from only a few inches, to a few feet tall. When earthworms are present, tree seedlings are often completely absent or as few as only 2 per square meter. There are a great many more white-tailed deer in hardwood forests today than there were a century ago, which often leads to a lack of regeneration of the understory. The combined effects of deer browsing and earthworm invasion can have a multiplying effect that is larger than either one would be alone, leading to even more severe impacts on plants and tree seedlings.

For More Information

See NETN's forest health monitoring protocols, reports and resource briefs available from the Forest Health page of our website.