

INTERPRETIVE SUBMISSION #1
FROM FRIENDS OF MOHAWK TRAIL STATE FOREST TO DCR
Friends of Mohawk Trail State Forest and the Native Tree Society

December 31, 2011, updated Jul 21, 2017, updated July 11, 2018

Introduction

This document is the first in a series of descriptions of nature trails developed by Friends of Mohawk Trail State Forest (FMTSF) and the Native Tree Society (NTS) for use by the Department of Conservation and Recreation's (DCR's) interpretive staff. We will maintain the source document on the NTS bulletin board and periodically update it, automatically sending updates to DCR. The document is also intended as a submission of the DCR Forest Reserve Science Advisory Committee (FRSAC).

Using an interdisciplinary approach, our basic plan is to present DCR with information that can be used for official trail brochures, kiosks, video, and web-based trail descriptions. We plan to present other materials, including recommended one-page narratives on State Forests and Parks.

The material presented in this initial submission is designed primarily for serious trail walkers with a desire for interpretive materials on the key features encountered along the trail. Submissions for all Mohawk Trail guides will highlight natural, historical, and cultural features. In particular, individual trees, old-growth forests, the original Mohawk Trail, the Shunpike, Indian and colonial history and superb scenery will provide the base information for the Mohawk Trail guide series, because these are the distinguishing feature of Mohawk Trail State Forest (MTSF). Because of the significance of the Elders Grove, trees are the primary focus of this first guide.

Questions, comments, and recommendations on this submission should be addressed to Robert T. Leverett at dbhguru@comcast.net.

Robert T. Leverett

President and co-founder, Friends of Mohawk Trail State Forest
Co-founder of the Native Tree Society
Senior Advisor to American Forests National Championship Tree Program
Chair, DCR Forest Reserve Scientific Advisory Committee

Elders Grove Nature Trail

By Robert T. Leverett

Location: Mohawk Trail State Forest, Zoar Gap.

County: Franklin

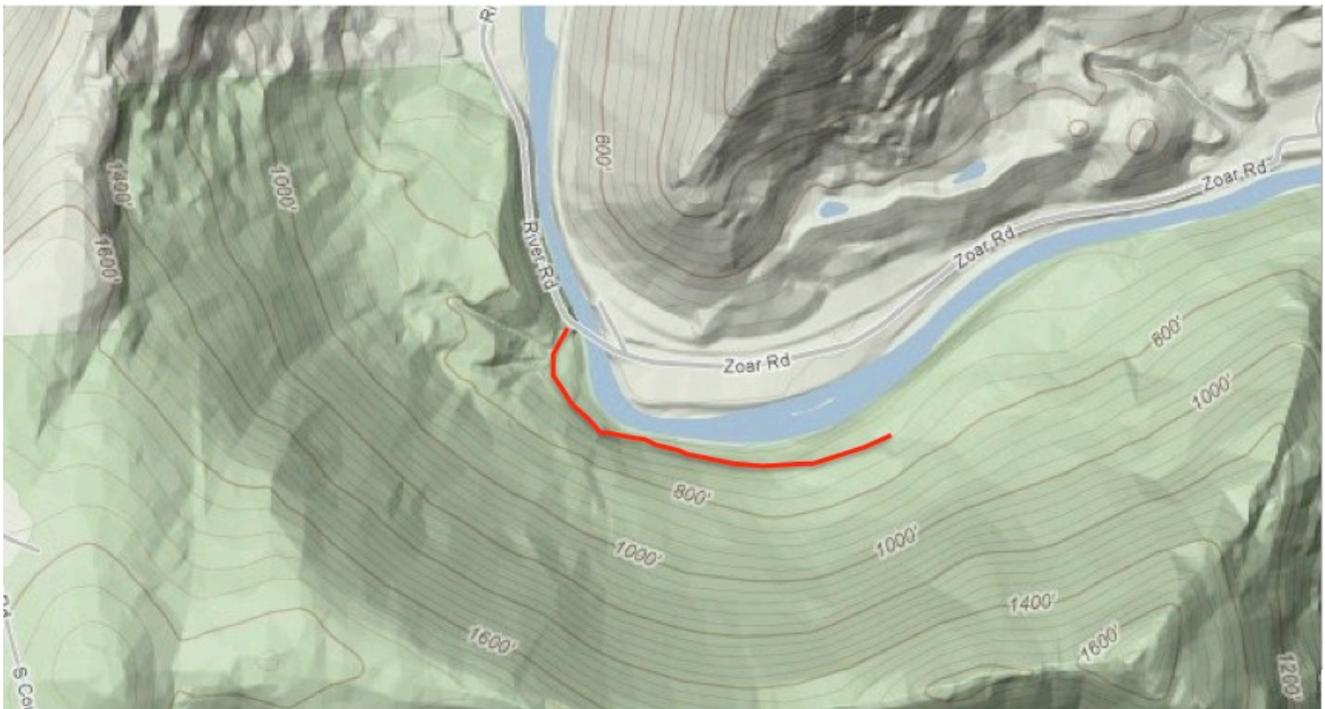
Township: Charlemont

Start of Trail: Lat 42.65260 N, Long 72.95517 W

End of Trail: Lat 42.65128 N, Long 72.94669 W

Trail length (one way): 0.5 miles

The nature trail to the Elders Grove starts on the south side of River Road at Zoar Gap just after the crossing of the Deerfield River. Parking is available at Zoar Gap Picnic Area on both sides of the road. A pedestrian walkway crosses the bridge, and at the end of the guardrail, the trail begins, going in a downstream direction for about 0.4 miles to the Elders Grove. The following image shows the trail on a terrain map.



Zoar Gap Setting

The Elders Grove Trail is located in Mohawk Trail State Forest (MTSF) on the Todd-Clark Ridge, an extension of Hoosac Mountain, in the central Berkshires of Massachusetts. Todd-Clark is rich in historic, cultural, geological, ecological, and aesthetic features. Most significantly, the original Mohawk Indian Trail runs along the crest of the ridge for approximately 1.25 miles. That historic route connected the waters of the Hudson and Connecticut Rivers. The pathway probably dates to the early 1600s, if not before. It served as both a trade and war-making route that witnessed the passage of Native Americans, British soldiers, and colonists until the end of the Revolutionary War. The 1600s were the heyday for passage by Native Americans, which saw the decisive defeat of the Pocumtucks in 1664 at the hands of the Mohawks. The home territory

of the Mohawks was in eastern New York, especially along the Mohawk River west of Albany. The Algonquin-speaking Pocumtuck Indians inhabited the Connecticut River Valley, and the Mahicans lived in the Housatonic and Hoosic River Valleys.

The Mohawks and others traveled the pathway later to be called the Mohawk Trail up through the period of the Revolutionary War. The trail then fell into disuse and was nearly forgotten, but the original route atop the ridge remained undisturbed. It now serves as part of the Mahican-Mohawk Recreation Trail in MTSF. State Route #2 between the French King Bridge and Williamstown is also called the Mohawk Trail in recognition of the historic Indian path.

In addition to the original Mohawk Trail, the colonial-era Shunpike climbs Clark Ridge, a short distance west of the Elders Grove trailhead. The Shunpike was established to avoid an old toll route, now River Road. Part of the Shunpike crosses private property, but most of it is in MTSF. At present, the Shunpike Route is not readily accessible to visitors.

One of the most significant ecological features of the area is a 200-acre swath of old-growth forest that follows the top third of the Todd-Clark Ridge. We have confirmed that eastern hemlock trees (*Tsuga canadensis*) approaching 400 years of age grow on the north side and near the crest of the ridge. The trees have been dated using increment borers to extract small cores, which are then ring-counted under magnification. Sufficient age data have been collected by a number of prominent scientists over the years to make the ages we quote authoritative. Accessible from the Mahican-Mohawk Recreation Trail, the old trees, high on the ridge, do not reach significant size: shallow soils prevent trees from growing either tall or large in girth. As a consequence, visitors can easily walk through the swath without being aware of the ages or history of this forest.

In Spring, the Todd-Clark Ridge presents showy displays of wildflowers. Early species include Dutchman's breeches, squirrel corn, and hepatica. Foamflower, toothwort, oxalis, trillium, dwarf ginseng, star flower, and other species follow, making use of the rich, moist soils. Hobblebush displays conspicuous white blossoms. Later, large concentrations of sugar maple contribute to colorful fall leaf displays.

The nature trail parallels the scenic Deerfield River, a tributary of the Connecticut River. The Deerfield begins in southern Vermont and cuts a 76-mile long path that affords abundant fishing and white water rafting opportunities, controlled by releases at the upstream Bear Swamp Dam. The Deerfield is also the site of America's first commercial atomic reactor at Rowe, Massachusetts, now de-commissioned.

The most outstanding geological feature of the area is the 1,000-ft deep river gorge, created between Negus Mountain (1,773 feet) to the north and Todd-Clark Ridge (1,923 feet) to the south. The dramatic views from atop Negus are famous among hikers. The elevation of the river is around 630 feet, creating a maximum gorge depth from the top of Clark Mountain of just under 1,300 feet. Though topographic maps refer to the course of the Deerfield River as a valley, suggesting a broad area between hills or ridges, in the vicinity of the Todd-Clark Ridge and Negus Mountain, the landform is more appropriately described as a river gorge.

The Todd-Clark Ridge lies in the 9th Forest Reserve managed by DCR in Massachusetts, an area set aside and preserved in its natural state for ecological purposes. No logging is allowed in the reserves.

Elders Grove

In addition to the above features, the Todd-Clark Ridge has another significant attraction: the Elders Grove, a stand of huge white pines (*Pinus strobus*) that is the destination of the nature trail. The pines are being named for noted Native Americans chiefs and elders of the past as a way of honoring the original inhabitants of the Americas. The Elders Grove also honors the white pine itself. No other tree species advertises New England as well. *Pinus strobus* was once the most valuable timber tree in the world. It achieved special recognition for its role as masts for the British Navy during the 1600s and 1700s, when the supply of “Riga fir” (*Pinus sylvestris*) in Europe was exhausted. Pines measuring 24 inches in diameter at 12 inches off the ground were deemed the property of the King of England. After colonists violated the prohibition, those trees were identified with the famous broad-arrow marking: /|\. This led to resistive actions on the part of the colonists, like the “Pine Tree Riot” in Weare, New Hampshire. In fact, competition for the economic value of the white pine was one of the principal factors leading to the American Revolution.

Today, many white pines suffer from attacks by the white pine weevil that leaves them contorted and multi-stemmed. Tall, single-trunked pines such as those in the Elders Grove reflect the true form and glory of the species. In the last decade the pines have contracted a needle cast fungus that kills new needles and robs the tree of photosynthetic surface to sustain growth and even life. It is unclear what long term impact the fungus will have on the mature pines, but the prognosis is gloomy.

Stops along the Elders Grove Trail

Stop #1 Bridge over Deerfield River

The bridge crossing the Deerfield River at Zoar Gap is not in Mohawk Trail State Forest (MTSF), but walking across the bridge from the parking lot provides the first good opportunity to view the Elders Grove from upstream. The pines are the trees with the cluster of blue-green foliage. The following two images show the Elders Grove from the bridge. The first image shows the stand in early winter. The second photograph is a telephoto image highlighting a double-stemmed pine in the center. That tree is named the Saheda Pine, for a Mohawk ambassador killed in 1664. That murder set off the conflict between the Mohawks of New York and Pocumtucks of western Massachusetts that essentially ended the domination of the Pocumtucks as a power in the Connecticut River Valley.



Stop #2 Trailhead

The Elders Grove Trail starts immediately across the Deerfield River Bridge, on the south side at the end of the guardrail. The first image shows the trailhead with conspicuous trail and boundary markers. The blue triangle marks the forest boundary.

The beginning of the trail features a relatively young forest with red maple, black and yellow birch, white ash, and northern red oak. This forest offers only a hint of what is to come, or the difference between a recovering forest and a fully mature one.

The path then enters an area of stately hardwoods, crossing a small stream on a log bridge built by the Student Conservation Association (SCA); a partly federally funded program helping to maintain our state parks. Mountain laurel grows on the uphill side before the trail crosses a second stream and enters a wet area. The laurel on the hillside is young, while more mature plants grow higher on the ridge.



Stop #3 Tree Identification

About sixteen species of trees grow on either side of the trail as it continues. White ash (*Fraxinus Americana*), sugar maple (*Acer saccharum*), northern red oak (*Quercus rubrum*), and yellow birch (*Betula alleghaniensis*) are the most numerous and conspicuous of the larger trunks. After crossing the first footbridge, two large trees appear on the right side of the trail. The first is a white ash, and the second a northern red oak. The next image shows characteristic white ash bark: the diamond weave pattern in the lower half of the image typifies the mature tree. When the bark sloughs off, it creates a more vertical pattern of cracks as seen in the upper half of the image.



To fully enjoy the trail experience, one must be able to recognize the different species of trees. Identification takes practice, requiring the study of the bark appearance of each species when young, mature, and advanced in age. Each species has characteristic patterns of aging. However, genetic variation, hybridization, attack by fungal elements, etc. produce a wide variety of bark patterns within the same species. One also comes to know the leaves, branching patterns, flowers, fruits, buds, and spring and fall colors of each species. They become instantly recognizable at a distance.

There are numerous guides available on tree identification, as well as guides to forest interpretation explaining how forests develop and are perpetuated. "Bark: a Field Guide to Trees of the Northeast" by Michael Wojtech is an excellent source for learning to recognize tree species from their bark. The "National Audubon Society Field Guide to Trees: *Eastern Region*" is a reasonably good choice as a general guide. Dr. Tom Wessels has written several excellent guides to forest interpretation including "Reading the Forested Landscape" and "Forest Forensics."

The next image shows the previously mentioned white ash and a northern red oak to the left. Note the differences in the appearance of the bark. Mature ash trees exhibit the diamond pattern, as previously described, while the oak has more vertically aligned ridges.



Stop #4 Bitternut Hickory

The next image shows several small tree trunks. Let us look at the four most conspicuous. The nearest and largest appearing one is a bitternut hickory (*Carya cordiformis*). At its relatively young age, its bark is smooth. The most distant and smallest appearing tree in the center is an eastern hemlock (*Tsuga Canadensis*). Just right of center is a white ash, and the large tree at the right is a red maple (*Acer rubrum*). None of these trees are old or large in girth, and will not likely capture the attention of visitors. For example, when measured in 2011, the bitternut hickory measured just 3.8 feet in girth. Yet, it reached an impressive height of 100.5 feet. This significant height for a young, small diameter bitternut hickory is a good indicator of rich soils. The bitternut prefers the more moist growing conditions found along the trail, while the more familiar shagbark hickory grows farther up on the Todd-Clark Ridge where moisture isn't as abundant.



Although the larger trees in the vicinity are rather stately, the forest is not old growth. This region has been impacted by human activity for over 2,000 years. Archeological finds elsewhere in the Deerfield River Gorge suggest that early land use was restricted to hunting and fishing by indigenous peoples. Farther upstream, Fife Brook was a major archeological site before the creation of Lower Bear Swamp Reservoir.

When European settlers arrived in the middle 1700s, their impact became more intense and exploitive. Pasturage and lumbering were the two main uses in the immediate vicinity, and farther downstream charcoal was made. Fortunately, the rich soils and abundant water support exceptional tree growth and have allowed the forest to recover more quickly. The area has grown back and the canopy along the beginning stretch of the trail often exceeds 100 feet, with 110-115 feet being the maximum. This canopy height often surpasses what is common in the populated valley regions of western Massachusetts by 10 to 15 feet, and surpasses forest canopies in eastern Massachusetts by even more.

Stop #5 Northern Red Oak and common sedge before second footbridge

The next image show's DCR's Tim Zelazo (now retired) next to a northern red oak on the uphill side of the trail just before reaching the second footbridge. This oak measured 8.3 feet in girth and reaches 103 feet in height – again in 2011. However, elsewhere in Mohawk, the species surpasses this height, achieving 120 feet or more in at least five locations. Near the start of the trail and up the ravine on the right, a lone northern red oak reaches a height of 127.7 feet. It is presently the tallest member of its species we know of growing in Massachusetts. Farther west in Pennsylvania and New York, northern reds can be even taller, but not by much. It is possible to develop height profiles of species that correlate well with latitude, altitude, and the proximity of large bodies of water. The Native Tree Society specializes in these range-wide species height profiles.



Species composition provides clues to forest history. The percentage of ash, birch, and oak (what we call mid-successional species) is high, and alerts us to the existence of past disturbance events, in this case probably logging and/or pasturage.

Today the individual trees are mature, but this forest, as a whole, is in transition. As the forest continues to age, late-successional species like sugar maple, beech, and hemlock will increase their proportions, especially sugar maple. These three species reproduce in dense shade and can persist for millennia until a fairly extensive disturbance (such as from wind, landslide, wildfire, or human land clearing) allows direct sunlight to reach the forest floor. Wildfires and those intentionally started by humans have played an important role in determining species composition on parts of the ridge complex, especially the south side. The ones on the north side of Todd-Clark were likely small and associated with human, rather than natural, activity such as lightning.

While trees are the most conspicuous plant organisms that visitors will see, the smaller flora of the area are quite attractive and often provide surprises. The next image shows a plant that reveals itself to us in late fall when most greens have turned brown. An indicator of rich soils, *Carex plantaginea* is a common sedge found in the area. This specimen is very close to the footbridge.

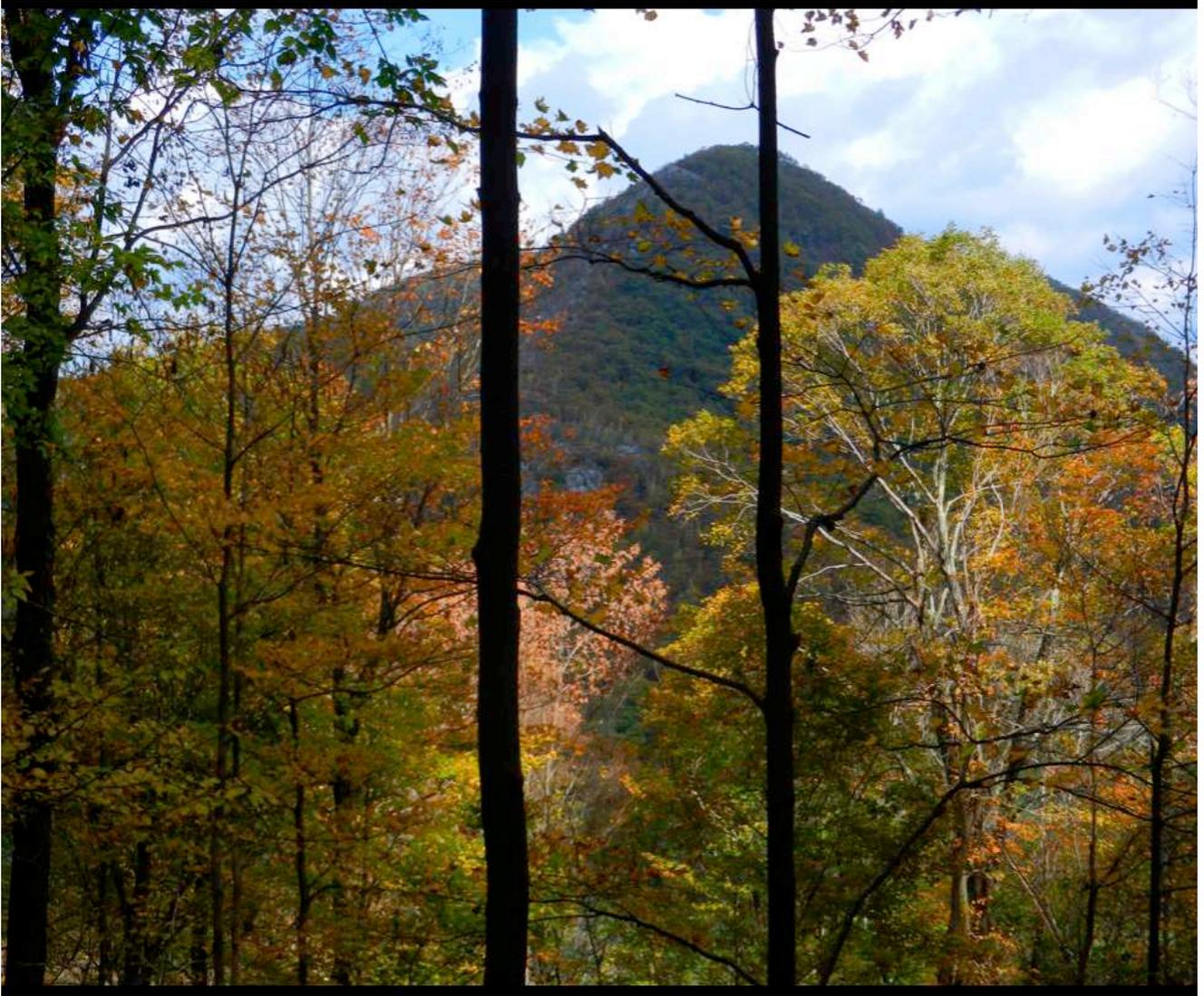


Stop #6 Negus Mountain

After a five-minute walk, the conical form of Negus Mountain comes into view across the river. As a side note, the name Negus itself is of biblical origin, as is Zoar. Negus was the name that was traditionally given to Ethiopian kings. Zoar, in the land of Canaan, was the city where Lot took refuge after the destruction of Sodom and Gomorrah. As far as we know, the names Negus and Zoar are the only biblical ones on maps for the landforms in the area. However, as romantic as the origin of the name, Negus was apparently named for a person who operated a tannery in the community of Zoar. As the story goes, he named the area Zoar for personal reasons.

The next three images feature Negus Mountain. The first is a distance shot taken from the trail. The second is from well upon Negus looking toward the summit of Todd Mountain in Mohawk. You can see the spires of the Elders Grove circled in red in the lower right hand corner. The third image was taken from the summit of Negus looking down into the gorge in an upstream direction. The Deerfield River and the railroad appear below and Upper Bear Swamp Reservoir is visible on the ridgeline near the center. The most distant peaks in the center of the image, slightly blue, are the Green Mountains of Vermont. Spruce Mountain, in Monroe State Forest, makes up the closer summits to the left of the Greens. That Mountain and nearby Crumm Hill (2,841 feet) are actually the highest elevations in the geological Berkshires. Mount Greylock, the Commonwealth's highest summit, is in the Taconics.

The late Harvey Broome, a co-founder of The Wilderness Society, once compared the view from the top of Negus Mountain to an impressive vista in his beloved Great Smoky Mountains in the southern Appalachians. Who would believe that Western Massachusetts could hold its own next to the Great Smoky Mountains?







Stop #7 Large Yellow Birches

Several conspicuously large yellow birches along the trail are between 150 and 200 years of age, if not older. One of them has four trunks that share a common root system, making it legitimately one tree. Multiple trunks often sprout near the base of a tree when damage occurs, such as from ice. Stump sprouting is a strategy for the species' survival, an alternative to sprouting from seed. Multiple trunks can signal this "coppicing" process or represent separate trees that have simply grown together. The next image shows a multi-stemmed yellow birch of the coppiced variety.



A little farther down the trail, another large birch catches the eye. Like some black birches (*Betula lenta*), hemlocks, and others of its kind, this yellow birch grows on top of a large boulder, with roots embracing the rock as they seek nutrient-rich soil. The birch grows a few feet below the trail and just above the river. The next image showcases this tree, over 200 years old.



Stop #8 Rich Herb Layer

Continuing on, the trail swings into the ridgeline. The terrain above the trail is extremely steep. Post-glacial action, i.e. periglacial processes, has resulted in an area of small to medium-sized boulders of Cheshire schist, creating a mineral-rich environment. An occasional crystalline white quartz rock serves as a reminder that glaciers transported rocks from distant regions. In other cases, the quartz occurs as an infusion in the schist. The glacial remnants are invariably rounded as a consequence of being pummeled by the ice movement.

Moss-covered rocks become increasingly conspicuous, and the boulder fields are veritable fern gardens. Around 8 species of ferns grow in the immediate area, some being indicative of particular trace minerals. Mosses, liverworts, and ferns take root on the boulders, each visible as a contrasting shade of green. The following image is a scene common on the lower stretches of the trail.



Stop #9 Sapsucker Signs

Patterns on trees can be made by wildlife. In this image, a yellow-bellied sapsucker has drilled holes to get at the sweet sap of the American basswood (*Tilia Americana*). This tree is now a mere snag. The author knew it when it was alive. Its gradual passing is a reminder that change in these forests is the norm.



Stop #10 Uphill Part of Trail

About 15 minutes down the path, the trail goes sharply uphill. The forest above the trail includes more white ash, suggesting past disturbance. Several healthy American beeches (*Fagus grandifolia*) grow on the downhill side. It is only a matter of time until they succumb to the beech blight.

Stop #11 Top of Trail Before Elders Grove

Northern red oaks are abundant on the downhill side. Hardwoods in the immediate vicinity on both sides of the trail vary from 5 to 8 feet in girth. These dimensions are just large enough to catch the eye of the tree-conscious person, but are not truly big trees. The forest is still relatively young from a biological maturity standpoint. An old logging path on the uphill side (not visible from the trail) bears testimony to a 1930s timber operation. A slender white ash, a short distance uphill, measures 6.4 feet in girth, but reaches an impressive height of 120.3 feet (2011). This suggests that growing conditions are highly favorable for rapid tree growth, which often results in tall, slender trees at 60 to 70 years of age. In fact, the story of this forest is told more in stature than girth. The largest hardwoods along the trail to the pines are around three feet in diameter, but there are relatively few of them. The most conspicuous larger tree close to the trail is a northern red oak that reached 9.3 feet in girth and 106.4 feet in height in 2011. Here is an image of it.



Shining club moss (*Lycopodium lucidulum*) grows a little farther down the trail. It is this one of the two species of club moss visitors can see along the trail corridor. The other is ground pine (*Lycopodium obscurum*).



In terms of what catches the eye, size is not everything. Fungi often grow on trees to create unusual designs. The following image shows a bell-shaped fungus, a tinder polypore (*Fomes fometarius*) growing on the trunk of a small tree. Though not visible from the trail, less colorful examples of this fungus can be seen on other trees along the trail.



Stop #12 Start of Elders Grove

The Elders Grove, a residual stand of very large white pines dating to around 1830, is reached at north latitude 42.65005 and west longitude 72.94943. To appreciate the pines in the Elders Grove, we must consider what the species typically achieves in maximum growth across New England. The Elders are pushing the limits for white pines at their respective latitude. Time and conditions have allowed the trees to reach great size, but the pines are not from a virgin stand. The surrounding area was once an open field, as evidenced by old rock piles and the remains of a rock wall. Sheep pasturing was likely tried, perhaps by the Nelson family whose cemetery is across the river at the end of the picnic ground. However, at the Elders Grove, the aspect of the ridge is north facing, and is not conducive to good pasturage. In addition, the flatter area that could function for pasture is relatively small, suggesting that the settlers cleared land wherever they could. Since the site was probably only marginally productive as pasture, upon abandonment, white pines seeded in. Pine seedlings would have come in very thickly and dominated as a stand. In time, the stems would have self-thinned and hardwoods would have grown up beneath the crowns of the survivors. Today we see the result: an over-story of super pines with a scattering of mature northern red oaks, sugar maples, red maples, yellow and black birches, and white ashes mixed in.

We will now describe four of the most prominent of the pines. Only one of the four (Sitting Bull) is on the trail. The others are near the pathway and can be seen from it, but visitors are encouraged to stay on the trail to minimize damage to the herb layer and to avoid compacting the soils around the roots of the trees.

Sitting Bull

At the beginning of the Elders Grove, visitors are greeted by a half dozen large, brown trunks, bare of limbs for the first 90 feet or more. Three pines stand above, three below, and one on the trail. The trailside pine grows on the uphill side. It has a hollow area on the side facing the trail. Bob Leverett stands next to the Sitting Bull Pine, named for Chief Sitting Bull of the Lakota or Sioux nation. The Sitting Bull pine measures 11.7 feet in girth and 156.9 feet in height. Even though it is around 185 years old, it is still growing at the rate of 5 to 8 inches in height per year. It grew fast for the first 50 to 60 years, probably averaging around 18 inches gain in height or more per year. A little mathematics will show that Sitting Bull experienced some years with slow growth and/or crown breakage. Most large, old pines have a history of both.



Saheda

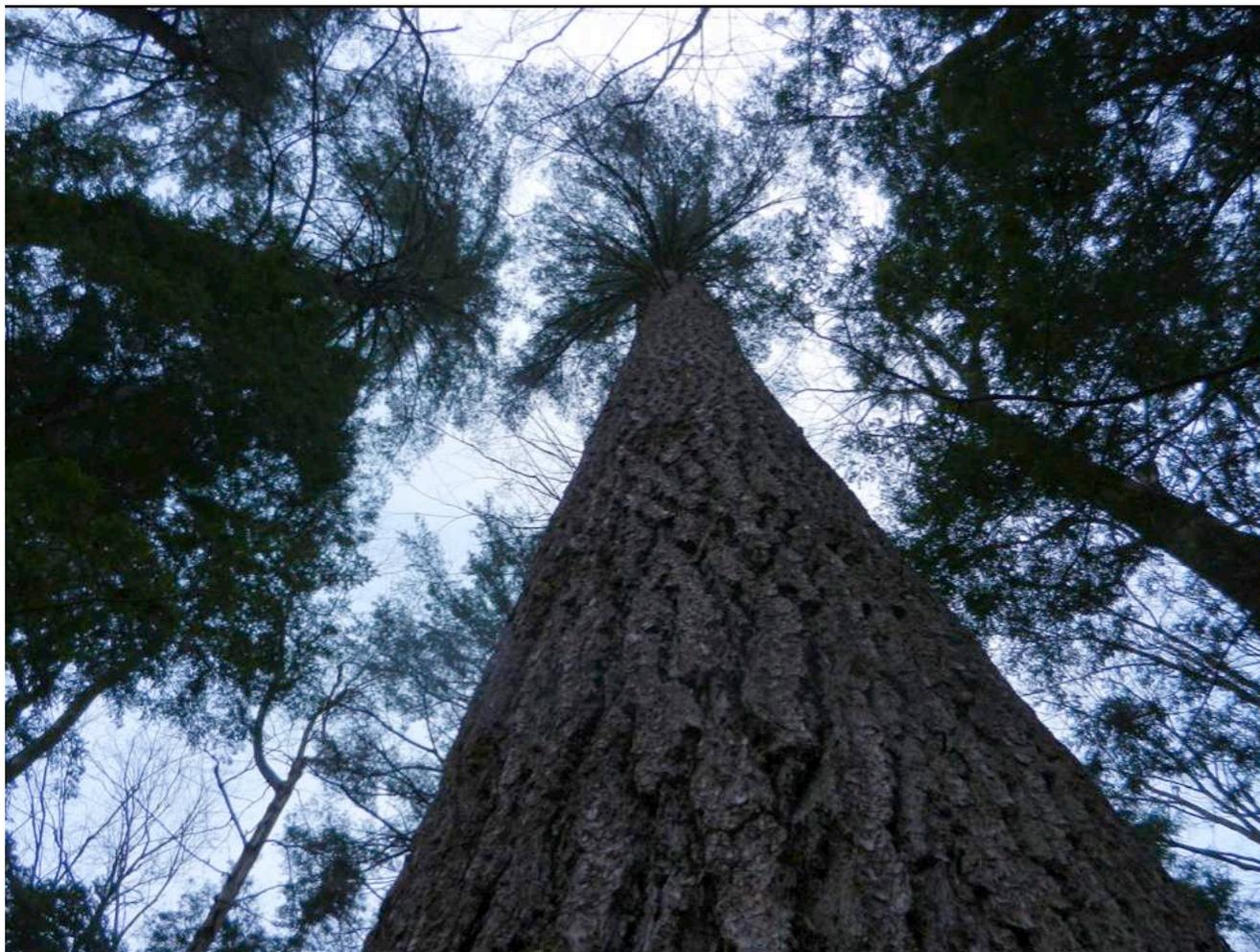
The next two images show Saheda, the first of the two largest pines of the grove, and the double-stemmed pine featured in the third view of the Elders Grove taken from the Deerfield River Bridge. Statistics for this huge pine are a girth of 12.2 feet and a height of 172.4 feet, just before the 2019 growing season. Saheda's height is roughly equivalent to a 15-story building and has the distinction of being the second tallest accurately measured tree of any species we know of in New England, and the 5th tallest in the Northeast. The first image shows DCR's Paul Jahnige and Robert Campanile next to Saheda.



Saheda has been climbed and modeled for volume by Will Blozan of the Native Tree Society (NTS), first in 1998 and again in 2007. NTS maintains accurate records on Saheda's annual growth. Modeling involves measuring the diameters of the trunk, limbs, and major branches at intervals and computing the volumes of the sections to obtain estimates of the equivalent water displacement volumes. The individual sections are added to get the total. Once we get the total volume, we can compute the amount of carbon being sequestered by multiplying together the volume, the average density of the species, and a predetermined factor. One fact that has emerged from late scientific studies is that the large trees are doing us a considerable service in effectively holding carbon. Their larger crowns with their proportionately greater leaf

surface area lead to greater amounts of carbon being sequestered. See the discussion of “The Emerging Carbon Story” on page 30 below.

The second image looks aloft into Saheda’s crown.



Chief Crazy Horse

We have chosen a third named white pine to showcase in this trail description. It is the Crazy Horse Pine. Chief Crazy Horse was an Oglala Sioux who helped defeat General George Armstrong Custer at the Battle of the Little Big Horn in 1876. Chief Arvol Looking Horse, 19th generation Keeper of the Sacred White Buffalo Calf Pipe, personally requested that Bob Leverett name a tree for Crazy Horse in the Elders Grove. Crazy Horse's statistics are a girth of 11.1 feet and a height of 150.2 feet. The next image shows the tree with DCR's Tim Zelazo.



Tecumseh

The fourth flagship pine in the Elders Grove is Tecumseh, named for the famous Shawnee chief who died in the Battle of the Thames in 1813 trying to protect native lands from the encroachment and seizure by white settlers. Tecumseh measures 12.1 feet in girth and 165.8 feet in height as of 2017 based on what can be seen of its crown. These statistics make Tecumseh the 5th tallest tree of any species we know of in Massachusetts, and only one of four trees in New England that combine a girth of 12 feet or more with a height of 160 feet or more. The others include the Thoreau Pine in Monroe State Forest, the Ice Glen Pine in Stockbridge, MA, and the Saheda Pine in the Elders Grove. That all these trees are in Massachusetts suggests that there may be trees in at least nearby New Hampshire which would be competitors, if known. But just how significant are Tecumseh's dimensions? Let's put them into perspective.

By direct ground-based measurements, as of 2019, we have confirmed 23 white pines in Massachusetts to a height of 160 feet or more, 20 are in Mohawk Trail State Forest. Before a May 4th, 2018 microburst, we had confirmed thirty-eight 160-footers in Pennsylvania. We have 6 in New Hampshire, and 3 in New York. So, at present, Tecumseh is one of 70 white pines in the Northeast to reach the 160-foot threshold. However, another of Tecumseh's statistics places the big pine in an even more exclusive club. Before the microburst, there are four white pines in Pennsylvania that had the combined dimensions of a girth of 12 feet and a height of 160 feet or more. There are four pines in Massachusetts, and two in New York. The four in Pennsylvania, four in Massachusetts, and two in New York represent the total of white pines for the entire Northeast. Tecumseh is one of the ten.

Before leaving the topic, we point out that the use of LiDAR has allowed us to find stands of unusual stature, and that pines in MTSF measured a decade or more ago have apparently now grown into the 160-foot class. We may have as many as 30 to 35 pines in MTSF that have reached the threshold. The fall of 2019 will tell as we ground-truth the LiDAR hits.

The next image shows Paul Jahnige of DCR next to Tecumseh.



Elders Grove Summary

Let us summarize the key statistical information on the Elders Grove. Altogether, the grove has 27 pines. Five now reach heights of 160 feet or more (172.0, 165.5, 161.2, 160.5, and 160.1) feet. Fifteen pines exceed 150 feet. All are over 130 feet. Heights in the 150-foot class are matched in only a handful of places in the Northeast. But many people relate more to circumference than height. So, what about circumference, or more appropriately girth?

Seventeen pines achieve girths of 9 feet or more, 5 of which are over 11 feet, two over 12. These are impressive numbers, but not overpowering. Multi-stemmed white pines in Massachusetts growing in the open often exceed 12 feet in girth, but usually don't surpass 120 feet in height. Consequently, two attributes distinguish the Elders Grove pines: (1) individual heights, and (2) the combination of girth and great height for the largest pines.

Because of their sizes and ages, we can appropriately think of the pines in the Elders Grove as tree elders. We also honor Native American elders through them. Presently, there are six trees in the Elders Grove named for prominent Native Americans. They are:

Saheda – Mohawk ambassador, killed in 1664 by Pocumtucks near Old Deerfield
Tecumseh – Shawnee, 1768-1813, war chief
Sacajawea – Shoshoni, 1788-1812?, guide to Lewis and Clark expedition
Ouray – Utes, 1833-1880, Chief of Uncompahgre band of the Utes

Sitting Bull – Lakota, 1831-1890, medicine man and chief of Hunkpapa Sioux
 Crazy Horse – Lakota, 1840-1877, war chief of Oglala Sioux
 Washakie – Shoshoni, 1810?-1900

As a continuing project, trees will be named for other prominent Native Americans.

The Emerging Carbon Story

We may ask ourselves what are the specific values that we can associate with the Elders Grove pines. The pines are certainly inspiring to look at, but with only 27 of them, what other values do they possess? One value is their role in climate stability. They sequester almost 78 tons of carbon as shown in the table below. The table has not been updated to show the 5th 160-footer, but is close enough in terms of the carbon.

| Elders Grove in Mohawk Trail State Forest | | | | | | Approximate Age of Pines: 175 - 195 Yrs | | | | Percent Vol in Limbs | | 7.5 Red font = recently measured | | | | |
|---|--------------|-------------|-------------|---------|-------------------|---|---------------------|-------------------------------|-------------------|----------------------|-----------------------|----------------------------------|-------------------------|-------------------------|---------------------------------|---------------------------------|
| Tree | Name | Tag No | Form Factor | Hgt -ft | Circumference -ft | Diameter -ft | Vol ft ³ | Density - lbs/ft ³ | Trunk Mass in Lbs | Trunk Mass in tons | Trunk & Limbs in tons | Proportion of Elemental carbon | Elemental carbon - tons | Cumulative Carbon -tons | Equivalent CO ₂ tons | Cumulative CO ₂ tons |
| 1 | Saheda | 154 | 0.43 | 172.0 | 12.2 | 3.88 | 876.01 | 24 | 21,024.13 | 10.51 | 11.30 | 0.48 | 5.42 | 5.42 | 19.89 | 19.89 |
| 2 | Tecumseh | 160 | 0.44 | 165.6 | 12.1 | 3.85 | 848.93 | 24 | 20,374.41 | 10.19 | 10.95 | 0.48 | 5.26 | 10.68 | 19.27 | 39.16 |
| 3 | Sitting Bull | 155 | 0.43 | 156.9 | 11.7 | 3.72 | 734.94 | 24 | 17,638.62 | 8.82 | 9.48 | 0.48 | 4.55 | 15.23 | 16.68 | 55.84 |
| 4 | Wampanoa | 158 | 0.42 | 152.5 | 11.5 | 3.66 | 674.07 | 24 | 16,177.68 | 8.09 | 8.70 | 0.48 | 4.17 | 19.41 | 15.30 | 71.14 |
| 5 | Crazy Horse | 157 | 0.42 | 150.2 | 11.4 | 3.63 | 652.41 | 24 | 15,657.78 | 7.83 | 8.42 | 0.48 | 4.04 | 23.45 | 14.81 | 85.95 |
| 6 | Sacajawea | 153 | 0.42 | 161.4 | 10.6 | 3.37 | 606.11 | 24 | 14,546.75 | 7.27 | 7.82 | 0.48 | 3.75 | 27.20 | 13.76 | 99.71 |
| 7 | Unnamed | 165 | 0.42 | 152.6 | 10.3 | 3.28 | 541.09 | 24 | 12,986.13 | 6.49 | 6.98 | 0.48 | 3.35 | 30.55 | 12.28 | 111.99 |
| 8 | Moomaw | 159 | 0.42 | 153.1 | 10.2 | 3.25 | 532.37 | 24 | 12,776.92 | 6.39 | 6.87 | 0.48 | 3.30 | 33.85 | 12.08 | 124.08 |
| 9 | Ourray | 152 | 0.4362 | 154.5 | 10.24 | 3.26 | 562.35 | 24 | 13,496.32 | 6.75 | 7.25 | 0.48 | 3.48 | 37.33 | 12.77 | 136.84 |
| 10 | Osceola | 161 | 0.42 | 160.2 | 9.3 | 2.96 | 463.09 | 24 | 11,114.22 | 5.56 | 5.97 | 0.48 | 2.87 | 40.19 | 10.51 | 147.35 |
| 11 | Unnamed | 164 | 0.42 | 153.3 | 9.3 | 2.96 | 443.15 | 24 | 10,635.52 | 5.32 | 5.72 | 0.48 | 2.74 | 42.94 | 10.06 | 157.41 |
| 12 | Unnamed | 167 | 0.42 | 151.5 | 9.2 | 2.93 | 428.58 | 24 | 10,285.82 | 5.14 | 5.53 | 0.48 | 2.65 | 45.59 | 9.73 | 167.14 |
| 13 | Unnamed | below trail | 0.42 | 141 | 9.5 | 3.02 | 425.31 | 24 | 10,207.44 | 5.10 | 5.49 | 0.48 | 2.63 | 48.23 | 9.65 | 176.80 |
| 14 | Unnamed | below trail | 0.42 | 145.2 | 9.3 | 2.96 | 419.73 | 24 | 10,073.56 | 5.04 | 5.41 | 0.48 | 2.60 | 50.82 | 9.53 | 186.32 |
| 15 | Unnamed | above trail | 0.42 | 129.2 | 9.5 | 3.02 | 389.72 | 24 | 9,353.20 | 4.68 | 5.03 | 0.48 | 2.41 | 53.24 | 8.85 | 195.17 |
| 16 | Unnamed | at trail | 0.42 | 138.1 | 9.12 | 2.90 | 383.90 | 24 | 9,213.70 | 4.61 | 4.95 | 0.48 | 2.38 | 55.62 | 8.71 | 203.88 |
| 17 | Unnamed | 156 | 0.42 | 134.7 | 9.19 | 2.93 | 380.22 | 24 | 9,125.34 | 4.56 | 4.90 | 0.48 | 2.35 | 57.97 | 8.63 | 212.52 |
| 18 | Unnamed | below trail | 0.42 | 143.9 | 8.8 | 2.80 | 372.45 | 24 | 8,938.75 | 4.47 | 4.80 | 0.48 | 2.31 | 60.28 | 8.45 | 220.97 |
| 19 | Unnamed | 163 | 0.42 | 150.5 | 8.6 | 2.74 | 372.03 | 24 | 8,928.61 | 4.46 | 4.80 | 0.48 | 2.30 | 62.58 | 8.44 | 229.42 |
| 20 | Unnamed | at | 0.42 | 129.3 | 8.89 | 2.83 | 341.54 | 24 | 8,196.96 | 4.10 | 4.41 | 0.48 | 2.11 | 64.69 | 7.75 | 237.17 |
| 21 | Unnamed | 162 | 0.42 | 160.1 | 8.41 | 2.68 | 378.46 | 24 | 9,083.10 | 4.54 | 4.88 | 0.48 | 2.34 | 67.04 | 8.59 | 245.76 |
| 22 | Unnamed | 166 | 0.42 | 140.3 | 8.1 | 2.58 | 307.66 | 24 | 7,383.77 | 3.69 | 3.97 | 0.48 | 1.91 | 68.94 | 6.98 | 252.74 |
| 23 | Unnamed | None | 0.42 | 125.4 | 8.5 | 2.71 | 302.81 | 24 | 7,267.52 | 3.63 | 3.91 | 0.48 | 1.88 | 70.82 | 6.87 | 259.62 |
| 24 | Unnamed | 168 | 0.42 | 150 | 7.7 | 2.45 | 297.24 | 24 | 7,133.84 | 3.57 | 3.83 | 0.48 | 1.84 | 72.66 | 6.75 | 266.36 |
| 25 | Unnamed | below trail | 0.42 | 124.7 | 8.4 | 2.67 | 294.08 | 24 | 7,057.90 | 3.53 | 3.79 | 0.48 | 1.82 | 74.48 | 6.68 | 273.04 |
| 26 | Unnamed | | 0.42 | 106 | 9.3 | 2.96 | 306.42 | 24 | 7,353.98 | 3.68 | 3.95 | 0.48 | 1.90 | 76.38 | 6.96 | 280.00 |
| 27 | Unnamed | below trail | 0.42 | 120.7 | 7.2 | 2.29 | 209.13 | 24 | 5,019.07 | 2.51 | 2.70 | 0.48 | 1.29 | 75.77 | 4.75 | 284.74 |
| sum | | | | | | | 7,788.41 | | 186,921.74 | 93.46 | 100.47 | | 77.67 | | 284.74 | |

The above numbers utilize a volume model that is based on trunk form factor. The trunk volume uses the simple formula:

$$V = FAH$$

where V = trunk volume, F = trunk form factor, A = cross-sectional area of trunk at 4.5 feet above base, and H = total height of the tree. If the cross-sectional area is considered circular, any of the following formulas can be used to compute cross-sectional area, where C = circumference, R = radius, and D = diameter of the trunk at 4.5 feet.

$$A = \frac{C^2}{4\pi}$$

$$A = \pi R^2$$

$$A = \pi \frac{D^2}{4}$$

The F value is empirically derived or estimated for each tree.

But wouldn't younger, fast growing pines do more work for us in sequestering carbon? That is the general perception. But is it true? A moderately fast growing pine at 50 years may hold 80 ft³ of trunk volume. Adding 7% for limbs, gives us 85.6 ft³. The fastest we have measured is approximately 166 ft³. Using a density of 24 lbs/ft³ and 48% carbon by weight, we get 986.1 lbs or 0.493 tons of carbon in our moderately growing young pine and 0.959 ft³ for the fastest. By comparison, Saheda holds 5.42 tons in trunk and limbs. It would take eleven 50-year old moderately fast-growing white pines to provide this much carbon, and 5.65 extremely fast growing 50-year old pines.

There are other ways to approach these comparisons. At age 50, the young pines may be adding between 4.5 and 5 ft³ in volume per tree in a year. The current average that can be expected of the Elders Grove pines is between 5 and 6 ft³ per tree. This suggests that by the time the younger pines reach the calculated trunk and limb volume of 85.6 ft³, they will have just about caught up with the older pines in terms of the annual growth rate on a per tree basis. But the young pines started at 0, while the older pines are adding volume continuously at the 5 to 6-ft³ annual rate of growth. In the case of a huge tree like Saheda, the annual increase in trunk volume is closer to 8 ft³ per year. This would seem to favor the Elders in terms of carbon sequestered annually, but there is more to the analysis.

Thinking in terms of a stand of 50-year old pines, stem density must be considered. There may be as many as 200 stems occupying the current area of the 27 big pines. But there are also hardwoods growing among the pines, some adding volume relatively fast. A full carbon accounting must take all the trees into account above and below ground along with the carbon tied up in the soil.

The Elders Grove area will continue to be monitored and analyzed, but the author's conclusion is that with the pines approaching 200 years old, the site continues to function as a significant carbon sink, and perhaps more generally, that white pine sites with high site indexes should be valued for sequestration out to at least 150 years, and maybe to 200. Health issues currently being faced by the pines may be the biggest limiting factor in how long the big pines can function effectively.

Stop #13 Other Prominent Species

Although the white pines are the flagship trees of the nature trail, several other species within the Elders Grove make strong statements. A red maple above trail near Tecumseh reveals its advanced age through its curling brown bark. Usually depicted in tree guides as having fairly smooth, gray bark, common for young trees, older red maples develop characteristic curls that are displayed longitudinally, and the bark turns brown. People have sometimes mistaken old red maples for shagbark hickory.

For a forest-grown red maple, the uphill tree is about as large as a visitor is likely to encounter in the Berkshires. It measures 8.4 feet in girth and an impressive 114.4 feet in height. In the next image, Monica Leverett stands next to the tree. A red maple below the trail and near the start of the Elders Grove reaches 115 feet in height.



Mature red maples are thinly scattered through the Elders Grove. The species would have once been more abundant, but many have reached the end of their life cycles. The ones that remain have achieved near maximum dimensions for the growing conditions. For example, a red maple near Saheda measures 6.8 feet in girth, and reaches the extraordinary height of 121.3 feet. As such, it is the second tallest of its species that we know of in Massachusetts. However, because of its proximity to the huge Saheda pine, visitors are unlikely to even notice it.

Another species that achieves significant dimensions is the white ash. Ashes growing near the borders of the Elders Grove have been measured to heights of nearly 130 feet. The mature hardwoods along the trail and on the lower reaches of the ridge are between 100 and 150 years of age. However, ages increase higher on the ridge, as do canopy heights. The Todd-Clark Ridge has one of the greatest concentrations of 140-foot white ash trees we know of in the Northeast. One specimen reaches the height of 147 feet, a remarkable growth achievement for the latitude. Tom Wessels, Rick Van de Pole of Antioch Graduate School, and Bob Leverett originally measured the ash. Leverett has since monitored the tree: its girth slightly exceeds 11 feet, and from physical characteristics it appears to be over 200 years in age, perhaps over 225.

Let us take a final look at the trees in the vicinity of the trail. The single feature that distinguishes the trees on the north-facing side of the Todd-Clark Ridge is their stature. Eight species reach exceptional heights. They include:

- (1) white pine (172.4 ft.)
- (2) white ash (147.0)
- (3) sugar maple (131.3)
- (4) American beech (128.0)
- (5) northern red oak (127.7)
- (6) American basswood (126.9)
- (7) bigtooth aspen (*Populus grandidentata*) (122.0)
- (8) red maple (121.3)

Altogether, the Todd-Clark Ridge trail corridor has fourteen species that reach heights of 100 feet. The overall average of the tallest member of each of the tallest 10 species is close to 130 feet, making the north side of the Todd-Clark ridge an area of exceptional growth worth understanding from multiple perspectives.

Circumferences of the mature trees on the Todd-Clark ridge range up to 12 feet with one white ash exceeding 13 feet. The majority of mature trees have circumferences between 6 and 9 feet. The lower half of the ridge was logged in the 1930s and later. The remnant of an old logging road makes a large arc starting near the beginning of the nature trail. It is largely grown over now. In the early to mid-1990s, it offered convenient access to a grove of tall white ash trees measured by the author and timber framer Jack Sobon, using a transit. In 1996, the author acquired his first laser rangefinder and using it and a clinometer for angles began measuring tree heights using the following formula. It has been named the Sine Method.

$$H = L_1 \sin(A_1) - L_2 \sin(A_2)$$

Where L_1 = straight-line distance for eye to top of tree,

A_1 = angle from eye to top of tree

L_2 = straight-line distance from eye to base of tree

A_2 = angle from eye to base of tree

Angles below eye level are treated as negatives and since the sine of a negative angle is negative, subtracting the second factor, i.e. $-L_2 \sin(A_2)$ is equivalent to adding it. However, this simple formula virtually revolutionized measuring tree heights, allowing accurate height measurements close to +/- 1.0 feet.

Stop #14 End of Elders Grove

Past the end of the Elders Grove, the big trees rapidly thin out. Logging operations have been more recent, and the impact of human land use is visible. The result is an aesthetically less impressive woodland. The trail continues for another mile around the spine of Todd Mountain through a younger forest. However, for at least a few yards beyond the end of the Elders Grove, impressive trees can still be seen.

The last image shows the late Professor Gary Beluzo of Holyoke Community College next to a black cherry (*Prunus serotina*) a few yards past and uphill from the end of the Elders Grove. The tree measures 8.4 feet in girth and 101.5 feet in height. These measurements place this black cherry well within the top 1% of mature members of its species in Massachusetts.

