IDENTIFICATION AND HISTORY OF TWO OLD GROWTH STANDS IN SARATOGA NATIONAL HISTORICAL PARK

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Summary

I identified two stands of old growth trees in Saratoga National Historical Park based on external tree characteristics and confirmed them through tree ring analysis. The first site, a 9-acre hemlock-dominated mixed oak stand, called Kroma, is located near the eastern-most point of the Wilkinson Trail, above the Kroma Kill. The second site is at Victory Woods and includes 12 acres of oak – hickory among the 23-acre parcel. I confirmed stand history and tree ages by obtaining cores from 15 trees at each site. I analyzed tree rings and interpolated ages for rings not obtained in the core samples.

At Kroma Kill, cored trees averaged ~226 years (1790) with 9 trees predating 1800. Seven trees indicate germination within 10 years of 1777 suggesting a possible forest disturbance during the battle, and subsequently robust tree regeneration that developed into the standing cohort. Tree rings from several samples indicate rapid growth rates around 1800 suggesting limited tree canopy. However, two core samples indicated slow growth rate at that time suggesting some canopy cover. At Victory Woods where white oak, red oak, and pignut hickory dominate, 4 trees and a stump predate the battle reaching back to 1730 (the stump), 1748 (two trees) and 1767 (one tree). A total of 9 trees predate 1800. Six trees date to within a few years of 1800 and suggest a stand initiation period around that time. Victory Woods contains several coppiced trees indicating (limited) cutting around 1810. The stump was also coppiced indicating cutting (or fire) at 1730 on a white oak that germinated in the late 1600s.

At both sites the composition of the forest prior to 1777 was probably similar to that found today. However, the structure was likely somewhat more open at Victory Woods where indigenous burning – necessary for the maintenance of oak-hickory woodlands – would have kept undergrowth down. The Kroma site is noteworthy for its possible tie to the existing trees as a result of ecological disturbance that occurred during the Saratoga Battle. The Victory Woods site is notable for its handful of witness trees and as a regionally outstanding "old growth" oak-hickory forest. Additional research would provide a greater sample and allow additional insight into the stand dynamics at these historically important sites. It is possible additional old growth sites occur at Saratoga National Historical Park.

Cover photo: *A ~269 year old pignut hickory (*Carya glabra*) from Victory Woods*.

Introduction

As a local resident and ecologist who has walked the battlefield at Saratoga National Historical Park over a hundred times, I identified a few sites with what I believed were old growth trees. I based this interpretation on a number of tree characteristics: texture, exfoliation, and rugosity of the bark; lichen growth; shape and position of the canopy branches; and sinuosity of the trunk among other features described by Pederson (2011). Professionally, I've identified a number of old growth sites and ancient trees, up to 600 years old.

In Victory Woods, one of the two stands I identified at SNHP, a white oak fell naturally in 2015 or 2016 and was cut and removed by NPS. I counted rings on the stump multiple times from multiple directions. Counts averaged to ~286 years dating the tree to approximately 1730. The tree was 45-50 years old when the British camped around Victory Woods in 1777. Rings further revealed the tree had considerable sunlight (rings were widely spaced) suggesting some disturbance in the woods in the mid-1700s. As will be explained later, the stump also shows coppicing indicating the tree was cut or experienced fire at ~1730; the original maiden tree therefore likely dates to the late 1600s. This stump confirmed the presence of old growth trees at Saratoga National Historical Park.

The Saratoga Battlefield is a cultural landscape as much as it is a natural one. Because the park is grounded on an historic event in September – October 1777, any remnants of the vegetation from that period is exciting as it is important.

It is widely presumed that ancient trees and old growth forest no longer occur in the eastern forest. Indeed, they are rare. However, in my work inventorying and documenting forests in the northeast I find isolated old growth trees and small pockets of old forest relatively frequently. I've found several such sites in Saratoga County. Nonetheless, a few acres of old growth in the historically important and publically accessible Saratoga Battlefield would be a significant find.

Old growth has been defined a number of ways; the term is fraught with ambiguity and debate (see Hilbert and Wiensczyk 2007). While some contend 150-year old trees qualify, others suggest old growth depends on a specific forest structure including trees in all stages of life. Still others believe a forest should be at least *pre-settlement* in age; that is, the forest should have remained largely undisturbed since European settlers entered the region. That period varies for different regions, however, at Saratoga the middle-late 1700s serves as a good approximation.

A second dimension is extent. A single ancient tree may be "old growth" but the forest around it may not be. Similarly, a forest stand could contain a handful of ancient trees, but may have had grazing in the understory. It is exceptionally hard to find old growth

forests completely lacking disturbance. Most have had a few select trees cut, or had woodland grazing, or fire at some time. Thus old growth is a spectrum in space and time; there is no fixed or universally accepted definition.

Based on the ring count from the single stump in Victory Woods, we know trees at the site predate 1777. Based on the external characteristics of other trees at Victory Woods, as well as a second site at Saratoga Battlefield, I requested permission to core trees to document tree ages I believe predate the Battle, and to try to unravel the sites' history.

Approach

To document stand history and age I extracted tree cores using 16-inch and 24-inch Haglöf increment borers. An increment borer removes a 4mm diameter core from within a tree such that the tree rings are reveled without having to cut the tree. Coring a tree opens a hole in the tree; however, trees quickly heal the hole and compartmentalize the wound; the process rarely results in long-term injury to trees. Consider sugar maples that are tapped annually for sap (for syrup), over generations.

Trees were noted to species and the diameter measured at the height of the coring. I recorded tree locations with a GPS unit but trees were not marked in the field. Cores were mounted individually on poplar mounts. When needed, they were sanded to make rings more distinguishable. I used a 10x lens to count rings when necessary, typically marking 25 year increments.

Rarely is one able to derive a precise and complete age of a tree from a single core. Though trees generally add one ring each year (spring wood and summer wood), trees do occasionally add two rings in a year, or may have missing rings. This is rare and almost unheard of in the oak species cored at SNHP, but as such, a ring count is always a reasonably accurate estimation.

Second, it is extremely difficult to capture the pith of the tree with an increment borer. Typically, the tool misses the pith by 0.5 to 1.5 inches. This missing core needs to be estimated to reach a full approximation of the tree's age. To estimate the number of years in the missing core, one needs to calculate the length of missing core (to the pith), and consider the growth rate of the tree during its early years (determined by the size of the rings in the inner portion of the tree). I determine the length of missing core by matching the arc of the tree's inner rings to concentric circles on paper. This allows an estimate of ring-diameter and thus distance to the pith. The growth rate is calculated for the innermost rings and used to determine the number of years for the missing core.

Additionally, an estimate must be made for the amount of tree occurring below the core location. This number also varies based on the growth rate of the tree. A tree growing in full shade will grow slowly and a missing inch may represent 40 years. A tree

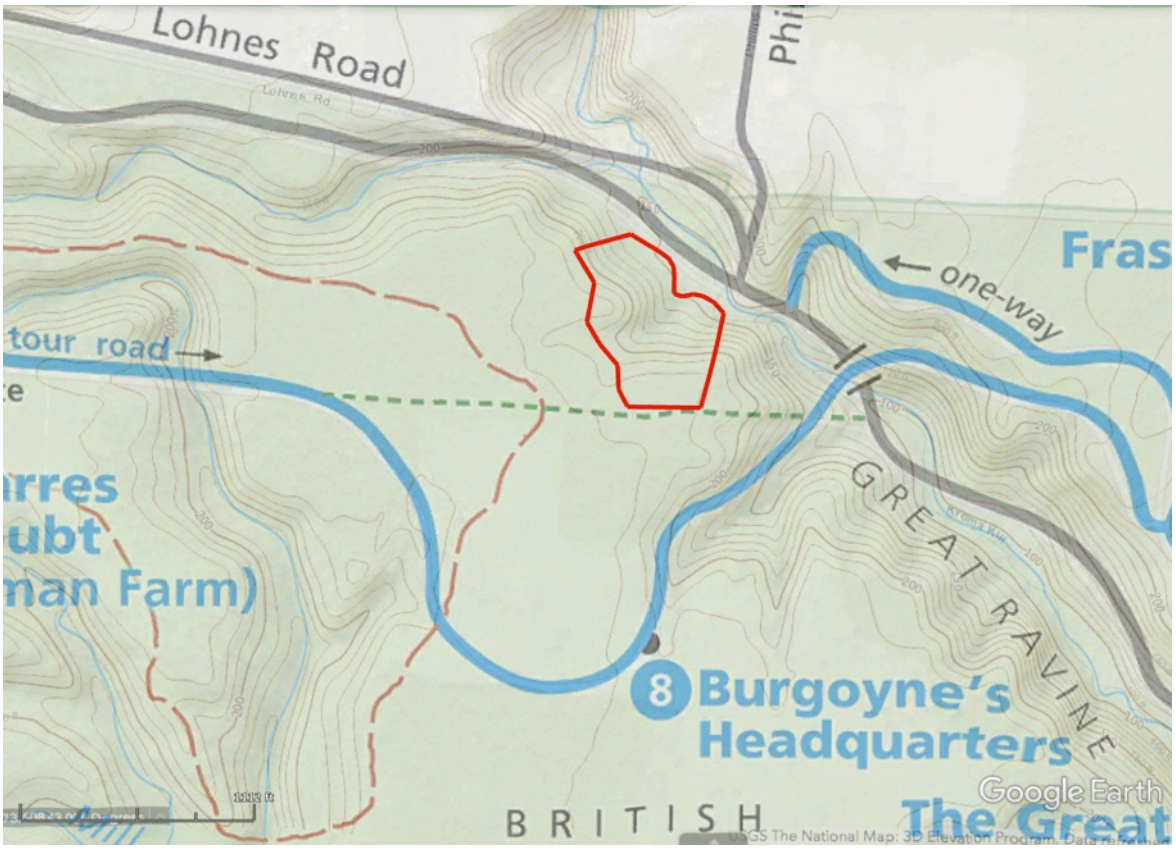
in full sun may be missing only 5 years in that same inch. The estimate for each tree is detailed on the tables below.

Sites

I identified two old growth stands in Saratoga National Historical Park. The fist site is named the Kroma Stand (after the Kroma Kill stream which bounds the stand). The second stand is at Victory Woods.

Kroma Stand

The Kroma Stand comprises approximately 9 acres of hemlock-dominated forest, with white pine and white oak, red oak, red maple, among other hardwoods. The substrate is flat, sandy soil on the terrace upland, and steeply sloping north to east facing down to the Kroma Kill. Two small ravines dissect the stand with two springs/seeps. Some shale bedrock crops out nearby.



Kroma Stand on the slopes of the Great Ravine. The old growth is concentrated on the upper slopes, but old growth elements occur in the flat terrace upland and low on the slope as well.

Earthworks at the top of the terrace bound the old growth stand on the northwest. These earthworks are of unknown origin, however, based on known history and field observation, it appears they were formed as a result of sand mining (Chris Martin, person communication). A tree cored on the earthworks dates to 1899 indicating the feature is older than that.

The surrounding matrix forest contains young hemlock on the slopes, while the flatter upland is dominated by early successional species including aspen, red maple, red oak, white pine, among others. Visual estimates suggest stand age in the surrounding forest is from the 1940s; the land was cleared prior to that.

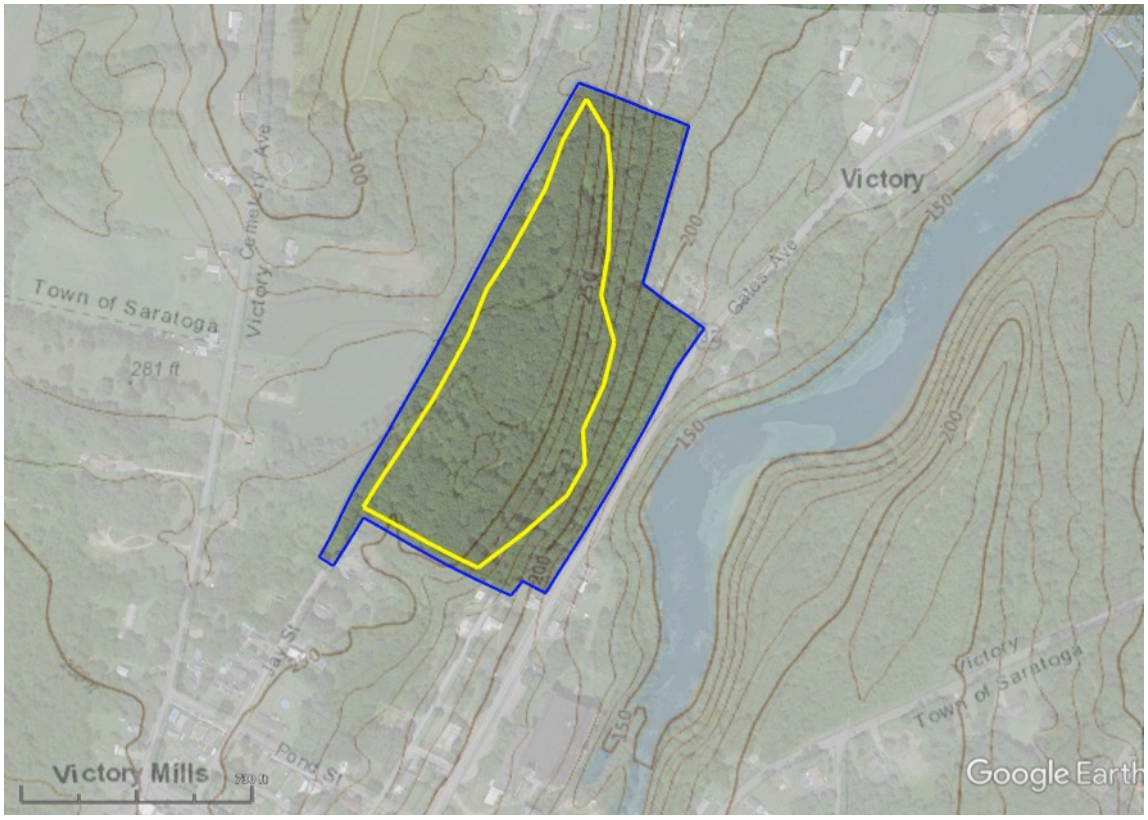
Victory Woods

The Victory Woods NPS parcel contains 22.78 acres of upland oak - hickory forest. Of that total, old growth trees and features are found on the inner 12.4 acres (see map below). The old growth section occurs east and south of the seepage wetland along the boardwalk. Old growth occurs on the flat upland terrace, and down the steep east-facing slope. Soils are loamy, glacial till with scattered stones and small boulders.

The forest is dominated by white oak, red oak, and pignut hickory, with lesser amounts of shagbark hickory, sugar maple, red maple, American beech, white pine, and swamp white oak, among others. The periphery forest is composed of younger, early successional species such as black locust, red maple, elm, and others. Victory Woods is a somewhat isolated forest in a largely residential and agricultural area.

The *Cultural Landscape Inventory* for Victory Woods (NPS 2007) outlines the site's history and recent archeological work. It briefly describes the natural aspects of Victory Woods and contains speculations on the land use history. The site has held a water tower and other water works, an icehouse, and other minor uses, some of which is still visible today. The document states, "Some of these trees are over 150 years old, indicative of an area that has not been cut for some time."

Kirk and DiVirgilio (2016) detail the archeological work done in Victory Woods mainly in 2006, and earlier. As will be described below, they speculate on the landscape appearance in 1777.



The Victory Woods parcel of Saratoga National Historical Park outlined in blue totals 22.78 acres. The old growth portion outlined in yellow totals 12.4 acres. Old growth occurs on the flat upland terrace and the steep southeast-facing slope. Victory Woods is dominated by oak-hickory forest.

Results and Interpretation

Kroma Stand

Of the 15 cores obtained at Kroma Kill, the average interpolated tree age is 226 years dating to 1790 (this figure excludes tree #6 which was cored in an effort to date the earthworks and was known to be younger). I obtained ring counts over 200 years for 10 trees, and 9 trees are estimated to predate 1800.

As the table indicates, many of the trees in the stand date (interpolated) closely to the 1777 battle of Saratoga. One tree, a white oak (#4) suggests germination before the battle. The 221 counted rings dates the tree to 1796, and with 2.5 inches of missing radius, I am confident the tree originated nearer to 1751 making the tree 26 years old at the time of battle. Other trees showed ring counts up to 232 years (1785), however, no tree showed a *ring count* older than 1777. To estimate complete age of the tree I had to interpolate the missing data.

Seven trees with ring counts over 200 years are interpolated to within a few years before or after 1777. The species include a mix of red and white oaks and hemlock. Several of these trees showed fast growth in the years around 1800 suggesting more open canopy, gaps, or other recent disturbance. One hemlock (#14) shows tight rings early on suggesting considerable shade and that the area was not cleared of trees. A white oak (#3) also showed steady slow growth throughout.

The hemlock-dominated Kroma Kill stand is a typical community type in Saratoga County. Cool, shady ravines, like the Battlefield's Great Ravine, foster shade tolerant hemlock-dominated communities.

As an old growth community, Kroma Kill is also typical. There are more old growth hemlock forest remnants in the northeast than any other community type. They are most common on steep slopes such at Kroma Kill. Hemlock was never a high demand species with the exception of leather tanning, which was a relatively short lived industry and locally driven. Steep slopes, like Kroma, made extraction difficult whether for tanbark or timber. Steep slopes were unproductive for agriculture and prone to erosion, thus rarely cleared.

Hemlock is a long-lived tree with typical old growth ages in the high 300s and sometimes 400s. White oak is also long lived with the oldest documented tree 464 years (Filippo et al. 2015). Red oak is comparatively shorter lived with a maximum known age of 326 years (Filippo et al. 2015).

Hemlock is disturbance dependent species succeeding most strongly when the soil is disturbed and the canopy opened. However, it is also an exceptionally shade tolerant species – the most shade-tolerant species in the eastern forest. Two of the hemlocks showed fast initial growth (early 1800s) suggesting prior disturbance on the site. However, one tree had very slow initial growth suggesting closed canopy.

Red and white oaks have moderate shade tolerance, but typically do best after disturbance. The oldest white oak (tree #4) shows fast growth around 1800 suggesting more open canopy following the battle. It is possible that the seven trees with interpolated ages within a few years of 1777 could all have originated as a post disturbance cohort following the forest disturbance caused by the battle (British?).

Table 1: Trees cored and interpolated from the Kroma Kill Stand. Ring counts over 200 years (ca. 1817) are highlighted yellow. Trees with interpolated ages within 10 years of 1777 are highlighted green. The oldest tree is highlighted in blue. Hollow trees with incomplete cores were not included (e.g Wt 1). Tree number 6 was growing on the earthworks and was cored to date the feature and thus has a much younger age (1899).

Number	Point	Species	Diameter in inches	Ring Count	Radius Uncounted	Estimated years	Base years	Interpolated Age	Approximate year initiated
1	Wt 2	E. Hemlock	30.5	207	1.50	30	5	242	1775±
2	Wt 3	Red Oak	39.5	163	2.50	25	5	193	1824±
3	Wt 4	White Oak	16.5	212	0.25	10	10	232	1785±
4	Wt 5	White Oak	28.5	221	2.50	40	5	266	1751±
5	Wt 6	Red Oak	26.5	216	1.50	20	5	241	1776±
6	Wt 7	Red Oak	22.5	98	2.00	15	5	118	1899±
7	Wt 8	White Oak	29.0	224	1.00	15	5	244	1773±
8	WT 11	White Oak	25.0	226	0.50	10	5	241	1776±
9	Wt 12	E. Hemlock	21.5	195	?	10	5	210	1807±
10	Wt 13	White Oak	30.0	201	0.50	6	6	213	1804±
11	Wt 14	E. Hemlock	26.5	220	0.25	7	13	240	1777±
12	Wt 15	Red Oak	29.0	232	0.25	5	7	244	1773±
13	Wt 16	White Pine	29.0	135	2.50	30	5	170	1847±
14	Wt 18	E. Hemlock	28.5	194	1.50	15	5	214	1803±
15	Wt 19	E. Hemlock	28.5	208	?	5	5	218	1799±

Map of Kroma Kill stand and GPS locations for individual trees. Point names are referred to in the table.

In the years following the battle, the young hemlock-dominated steep slope would have attracted little attention from farmers or landowners. The steep slope was difficult to access. However, the oak-dominated upland would have offered fine timber. It's likely select trees were taken from the upland, however, there are no coppiced trees to indicate cutting. Several prime individuals were passed over and remain. A farmhouse apparently stood nearby to the east and is it unclear why the stand has been preserved for so long. Several trees show increased growth rate for a period in the early 1900s suggesting perhaps some harvest activity around that time; a harvest reduces canopy, allows additional light, and increases the growth rate of residual trees.

Except for the probable occurrence of hemlock, white oak, and red oak, there is little we can say about the forest structure and composition prior to 1777. The results here suggest some disturbance to the site, possibly on account of activity in 1777, and that the stand today is comprised in part of a cohort of white oak, red oak, and hemlock that emerged after that human disturbance from the Battle of Saratoga. It's possible there was a wave of disturbance in the early 1900s. This could have been harvest or wind, but there is no indication of fire.

Victory Woods

Trees cored at Victory Woods revealed the same average age (226 years) as Kroma Kill, however, there were fewer trees centered on the battle period (1777), and more trees pre-dating the battle. Two trees date to approximately 1748 and a third to 1767. Only two trees date within 10 years before or after 1777. However, in total 9 trees predate 1800, and the remaining 6 are from the early 1800s. Eight trees had ring counts over 200 years and two trees had ring counts including the battle.

Ground Features

The substrate at Victory Woods contains indications of undisturbed forest. The ground on the slopes and flatter upland contains glacial boulders indicating the land has never been plowed. Had it been plowed, the stones would have been removed and lined up as stone fences on the periphery.

Second, the forest is riddled in dozens of tip-up mounds. These mounds are formed by fallen trees and are composed of a depression adjacent to a mound. When tree roots are ripped from the ground as a result of wind-throw, they lift soil and rocks with them. Over time, as the tree's roots decompose the soil is deposited in a mound and the depression, from which the soil came, remains. The wind direction origin can be determined by the orientation of the mound relative to the pit. The topography at Victory Woods contains large pit and mound features resulting from large old trees falling due to wind. These indicate the land has never been plowed and they also suggest the land has had limited or no livestock activity. Livestock typically tamp down pit and mound topography resulting in more subtle features; the features at Victory Woods are impressive and undisturbed. A couple old growth trees (>200 years) grow on a tip-up mounds indicating fallen trees at a time within a couple decades of germination. The tip-up mounds of several recently fallen trees offer huge, fresh soil exposures. These should be periodically investigated for historic and prehistoric artifacts.

Some of these mounds may be attributed to the "additional mounds" of "unknown origin" described by Stevens et al. (2007 p. 130).

Coppiced Trees

In addition to the old growth features on the ground, I also identified a handful of coppiced trees. Coppiced trees are trees with multiple trunks – usually two trunks, but occasionally three or more. Trees are controlled hormonally to have a single leader resulting in one trunk. Damage to a tree from fire or cutting can result in resprouting from buds hidden in the cambium. A tree that was cut (or burned) and subsequently resprouts will typically result in two or more trunks.

Victory Woods contains a few coppiced trees of considerable age. I cored two coppiced white oaks (an old coppiced sugar maple also exists but was not cored). The 286-year old stump near the boardwalk was also coppiced with two trunks (I never saw the tree so am not aware of the two trunks were present on the mature tree). A few younger trees near the boardwalk were also coppiced in recent times.

The two coppiced white oaks are listed in the table as trees #9 and #10. Tree 10 died within the past 5 years. On these trees I obtained counts of 187 and 188 years respectively. Interpolated ages for these trees are 202 and 206 years, or resprouting from cutting activity in 1811 and 1815 respectively. These dates are approximate and it is likely they were cut in the same cutting event. The sugar maple may also have been cut that year, and a coppiced red oak may also have been cut at this time. Despite the general lack of disturbance in Victory Woods, a small cutting event for small diameter oaks (and maybe maple) occurred in the early 1800s. Fire can also cause coppiced trees, but there is no indication from trees that were standing in ~1810 that a fire occurred; we would expect to see basal scars as a result of fire.

As noted in the introduction, the large stump that inspired this study contains 286 rings, dating the tree to 1730. As seen in the photo below, the tree had two small trunks when it initiated as a coppiced resprout. The trunks are ~6 inches apart which is also the diameter of the maiden tree. A 6-inch diameter white oak at moderate growth rate in Victory woods might be 50 years old, dating the original tree to the late 1600s. This is the oldest tree feature (now a stump) in Victory Woods.

Stand History

Stand history revealed from the growth rings doesn't paint the clear picture suggested from Kroma Kill (British disturbance in the woods in 1777, succession following). Whereas many of the trees at Kroma Kill center within the a few years of 1777, at Victory Woods, there is a rough concentration between 1790 and 1815. This concentration began 10-15 years after the battle raising the question of additional disturbance in the 1790s and following decade.

Nonetheless, it is clear that Victory Woods was wooded in 1777. Three of the cored trees date to before 1777, and I estimate that 2 to 5 additional pre-battle trees grow on the site. The coppiced tree from the stump (1730) was 47 years old in 1777. It is notable that the small diameter stems *were not cut* during the British encampment for material or fuel. The tip up mounds and ancient trees growing on tip up mounds further suggests forest or woodland in 1777. Small-scale woodcutting occurred around 1810 and 1730 (possibly fire). Unfortunately, none of the trees presumably cut in 1777 by the British resprouted into contemporary coppiced trees. It's tempting to suggest the coppiced white oaks from ~1810 could date to the British encampment, but that would be a reach for the missing ring count as estimated.

Table 2: Trees cored and interpolated from Victory Woods. Ring counts over 200 years (ca. 1817) are highlighted yellow. Trees with interpolated ages within 10 years of 1777 are highlighted green. Trees (estimated) earlier than 1767 are highlighted in blue. Hollow trees were not included (e.g VW1). Trees with (c) are coppiced and reveal the year a tree was cut.

Number	Label	Species	Diameter in inches	Ring Count	Radius Uncounted	Estimated years	Base years	Interpolated Age	Approximate year initiated
1	VW2	White Oak	23.5	246	0.25-1.5	13	10	269	1748±
2	VW3	Red Oak	26.5	182	1.0	17	6	205	1812±
3	VW4	White Oak	26.5	204	0.50	7	7	218	1799±
4	VW7	White Oak	36.0	179	0.50	5	5	189	1828±
5	VW9	White Oak	28.5	226	1.5	13	7	246	1771±
6	VW10	Pignut Hickory	23	219	1.5	40	10	269	1748±
7	VW12	Pignut Hickory	29.0	192	2.5	26	5	223	1794±
8	VW13	White Oak	17.0	183	1.0	20	10	213	1804±
9	VW14	White Oak(c)	31.0	188	1.0	7	7	202	1815±
10	VW15	White Oak(c)	15/18	187	1.0	12	7	206	1811±
11	VW16	White Oak	27	240	0.25	5	5	250	1767±
12	VW17	Pignut Hickory	20.5	200	1.0	20	7	227	1790±
13	VW18	White Oak	22.75	201	1.5	20	5	226	1791±
14	VW19	Red Oak	32.75	183	2.0	25	5	213	1804±
15	VW20	Pignut Hickory	21	202	1.0	30	7	239	1778±

Stump of a fallen white oak removed from the boardwalk area at Victory Woods. The stump shows 286 years of growth, dating it to ~1730. However, as seen here with the yellow circles, the tree had two trunks as a result of cutting (or fire) in 1730 indicating the original tree dates back to the late 1600s.

It should also be noted that the broader oak – hickory forest composition of Victory Woods is also likely a cultural legacy. Oak – hickory is a disturbance dependent community type that thrives under intermediate fire regimes. American Indians frequently burned the land throughout eastern North America and it is believed by some ecologists that oak-hickory forest communities developed as a result of that land management activity (Abrams and Nowacki 2008). Without disturbance, the forest community at Victory Woods will shift toward more shade-tolerant species such as sugar maple, American beech, and red maple (and the Norway maple removed in 2006). Regeneration trends at Victory Woods were not noted during this project. The NPS reduced undergrowth in 2007 as part of an exotic removal project for Norway maple.

Discussion of the landscape from the Revolutionary era and the subsequent land use history occurs in Stevens et al. (2007). They note:

> By 1777, much of the surrounding land had been clear-cut for milling or agricultural operations. Period maps depict the steep slope and more level upland portions of Victory Woods covered with forest. The British troops would have likely been ordered to thin the forest for building or fire supplies and to increase views and usable space. The larger

> trees would have likely been left untouched, since they were too difficult to remove and provided some shelter from enemy view and protection from enemy fire. The resulting views across and from the encampment would then have included many large trees (Stevens et al. 2007: 185).
>
> The existing forest is at least 50 years old, and historic images such as the 1883 birdseye drawing of the Village of Victory suggest that is it much older. It is likely that Victory Woods has never been completely timbered (p. 189).

Similarly, Kirk and Divergilio (2015) discuss the land's history and present composition noting:

> The mixed hardwood parcel today is dominated by oak and maple trees, many dating between 50 and 150 years.
>
> It is likely that the area was not farm fields, as there is no archeological evidence of plowing. At the time of the Revolutionary War, it seems that it was partially wooded, but may also have been a woodlot, pasturelands, or selectively forested for the nearby mills. The few trees that remained were no doubt quickly felled by the British to create defensive breastworks and to use for cooking and heating. Afterword, the area was largely controlled by the nearby mills, eventually reverting to a mature stand of trees, when it likely developed the moniker Victory Woods.

Speculations on the landscape of Victory Woods from Kirk and Divergilio (2016) largely agree with the interpretation of tree cores and my observation of the ground. However, it is worth noting that *young* trees remained on the site following the battle. Cores revealed trees growing in the decades prior to the battle still stand at Victory Woods today. Two of these trees are within ~50 feet, (but outside), the bounded British fortifications. The coppiced tree that is now a stump is located on the east side of the wetland near the entrenchment and canon battery. The coppiced stems were ~47 years old at the time of battle and, despite being roughly 6 inches in diameter and within entrenchment building activity, they were not cut. This suggests the amount of clearing activity occurring in Victory Woods may not be as extensive as Kirk and Divergilio (2016) suggest and even small trees within the activity of Victory Woods were left standing.

Nonetheless, it is worth noting that of the 15 trees cored, none reaches close to 300 years (except the stump at 286) years. In a pure, undisturbed old growth stand we would expect to find white oaks nearer to, or surpassing, 300 years. Rare as they are, I have found a few such trees at other sites. The cohort of trees originating in the late 1600s and early 1700s (that would be 300 years today) may have been cut during or after the war, or lost later due to natural disturbance such as wind. Victory Woods' position on a high terrace may contribute to such disturbance.

Locations of trees cored at Victory Woods. Labels (e.g. VW2) refer to Labels column on the table above.

Conclusions

Saratoga National Historical Park contains at least two remnant old growth stands totaling approximately 21 acres. The stand at Kroma Kill is notable for the trees' impressive stature, and also for the possible link among forest disturbance caused by the battle, to the initiation of trees that occur on the site today. A tie of direct ecological effects of the battle on the forest would make a compelling and unique story. At Victory Woods, the oak-hickory stand is regionally outstanding as Saratoga occurs near the northern reach for oak-hickory forest community types. That the site already provides public access (ADA no less) makes it all the more exciting. Typically, old growth stands are located in remote, difficult terrain. The combination of a unique natural community, with significant (and related) cultural history, at an accessible site with existing trail infrastructure, makes Victory Woods an important regional asset.

References

Abrams, M. and G. Nowacki. 2008. Native Americans as active and passive promoters of mast and fruit trees in the eastern USA. *The Holocene* 18(7): 1123-1137.

Filippo, A., et al. 2015. The longevity of broadleaf deciduous trees in Northern Hemisphere temperate forests: insights from tree-ring series. Fronteirs in Ecology and Evolution 3: 46.

Hilbert, J. and A. Wiensczyk. 2007. Old growth definitions and management: a literature review. *BC Journal of Ecosystems and Management* 8(1): 15-31.

Kirk, M., and J. Divirgilio. 2016. The Retreat to Victory Woods. In: *The Saratoga Campaign: Uncovering an Embattled Landscape*, W. Griswold and D. Linebaugh, editors. University Press of New England.

OldList. 2013. A list of the oldest known ages for eastern forest trees. http://www.ldeo.columbia.edu/~adk/oldlisteast/

Pederson, N. 2010 External characteristics of old trees in the Eastern Deciduous Forest. *Natural Areas Journal* 30(4): 396-407.

Stevens, C., L. White, W. Griswold, and M. Brown. 2007. Cultural Landscape Report and Archeological Sensitivity Assessment for Victory Woods. National Park Service