State University of New York at New Paltz

Determination of Health and Growth Patterns of White Pine and Black Oak in Gardiner, NY

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Research in Geology

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Abstract: Dendrochronology is the technique of dating timber and tree trunk growth rings in order to study environmental change, past events, or archeological artifacts. During October of 2022, Dr. John Rayburn of the SUNY New Paltz Geology department and Emma Paulsen, a senior studying Environmental Geochemical Science, utilized increment borers to take tree ring samples of nine different trees on a Wallkill Valley Land Trust Easement. Data was collected from five white pine trees and four black oak trees and analyzed to date each tree. The majority of the trees of both species were planted in the 1960s. The tree ring width data was then compared with existing chronologies to observe the alignment as well as environmental occurrences that are evident in the tree rings. A regional drought is evident in the small tree rings of 1965 in both tree species. Furthermore, data from local eastern hemlock trees do not match recent growth patterns of the white pines, indicating that the white pines on the property are healthy and not under attack by invasive species. The black oak chronologies taken from the Wallkill Valley Land Trust Easement matched existing black oak chronologies from the area, increasing confidence in the chronologies that were constructed from this site.

Key Words: Environmental Geochemical Science, environmental science, dendrochronology, increment borer, tree rings, tree ring measurement, tree ring dating, black oak, white pine

On Sunday October 16th 2022, we collected tree core samples from the Willow Pond Sheep Farm in Gardiner, NY. This property is part of the Wallkill Valley Land Trust. It is located at 2252 Route 44/55, about 6 miles southwest of the SUNY New Paltz campus.

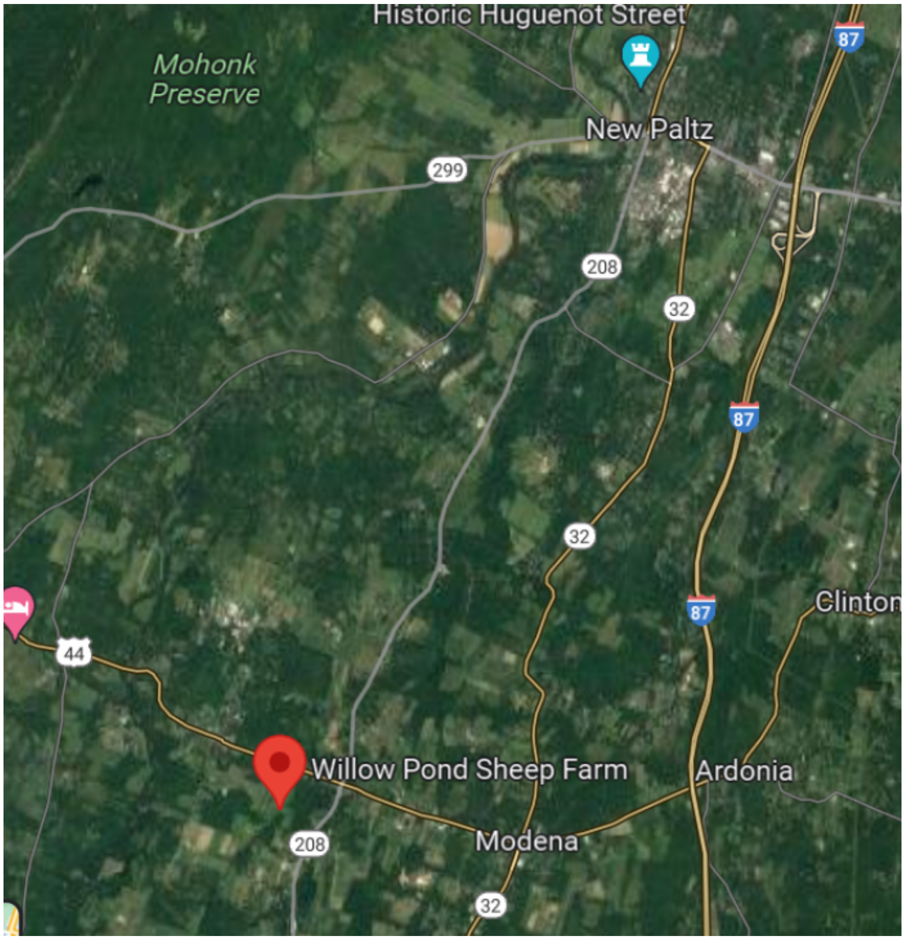

Figure 1. Site location relative to New Paltz. Route 44/55 is the road closest to the study location.

We used standard increment borers to sample five different white pine (*Pinus strobus*) and four different black oak (*Quercus velutina*) trees, taking two cores from each. The core pairs were taken 90° apart from each other. The cores were mounted on wood blocks, sanded to a flat plain, and polished smooth in order to clearly see the wood cells under a microscope and analyze the rings. The tree ages were determined by counting the rings. Every ring from each core was then measured using a computerized encoding scale and a plain light microscope. These measurements were then visualized, quantified, and analyzed using a computer program called ANTEVS, written by Dr. Vollmer in the Geology Department at SUNY New Paltz, and specifically designed for analysis of data like these with annual variation.

 

Figure 2. Emma taking a black oak sample.   Figure 3. Increment borer inside of black oak.

Each living tree sample was labeled A through I, with A through E pertaining to white pines and F through I pertaining to black oaks. Their ages as determined are recorded in Table 1. Trees A through E were located alongside the house, while trees F through I were located north of the house in the Seven Meadows. Figures 4 and 5 displays the tree locations.

Figure 4. This map displays all white pine locations relative to the barn (seen on the lower left corner of the image).

Figure 5. This map displays all black oak locations relative to Route 44/55 (depicted as a yellow line across the bottom left corner of the image).

The raw tree data collected from each tree were "detrended" and graphed using the ANTEVS program. Detrending is a process that removes the regular natural growth rate from the ring width data and sets all mean values to zero. This results in displaying tree ring width (TRW) growth patterns that only represent trends due to environmental changes. All detrended data graphs for each tree species were averaged to a mean chronology to see the overall environmental trends at this site. This is shown in Figures 6 and 7.

Table 1. This table displays the earliest ring of each tree sampled.

Tree Sample	Earliest ring
A	1961
B	1955
C	1964
D	1963

E	1964
F	1947
G	1961
H	1948
I	1978

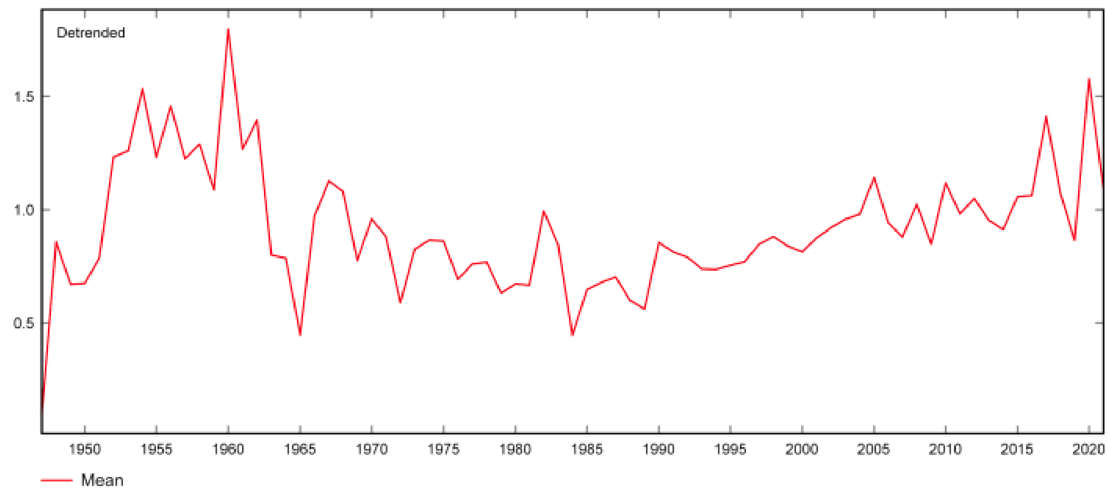

Figure 6. All White Pine chronologies averaged to a single mean chronology

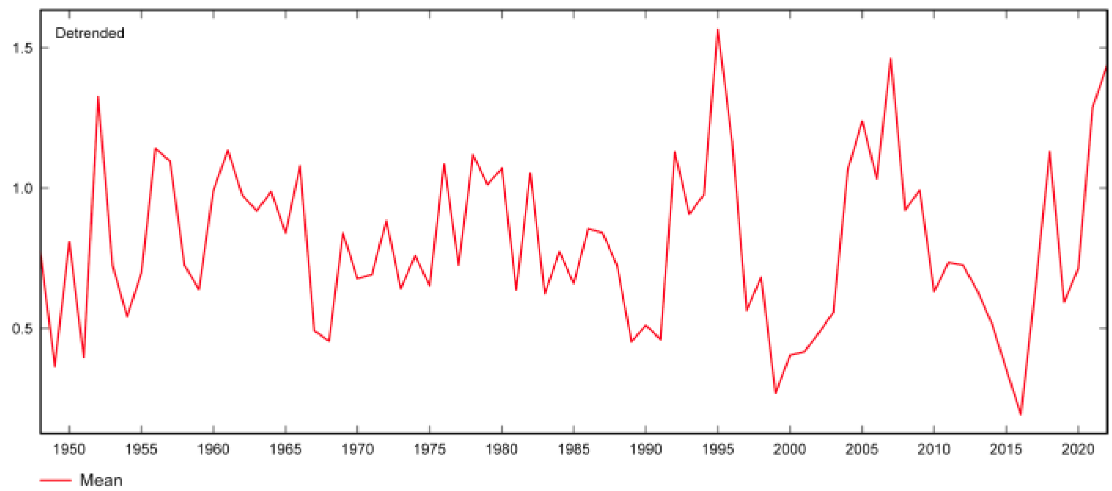

Figure 7. All Black Oak chronologies averaged to a single mean chronology

A severe regional drought that occurred in the northeast region in 1965 can clearly be seen in both Figures 6 and 7 as the large negative spike during that year. This both confirms that our chronology has an accurate timescale and shows that this tree stand was adversely impacted by the drought.

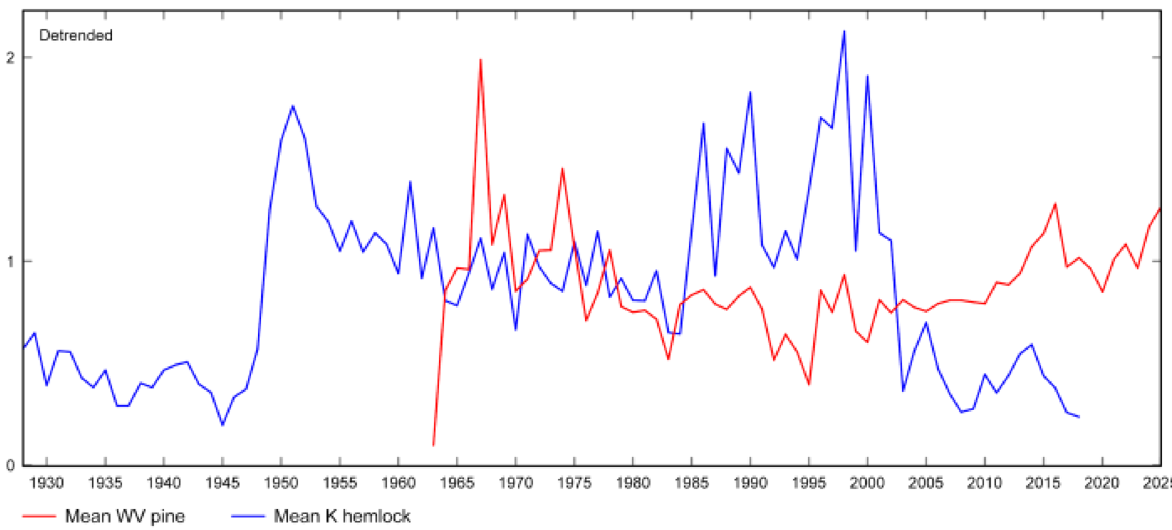

Figure 8. Detrended data for all average White Pine chronologies vs Eastern Hemlock chronologies

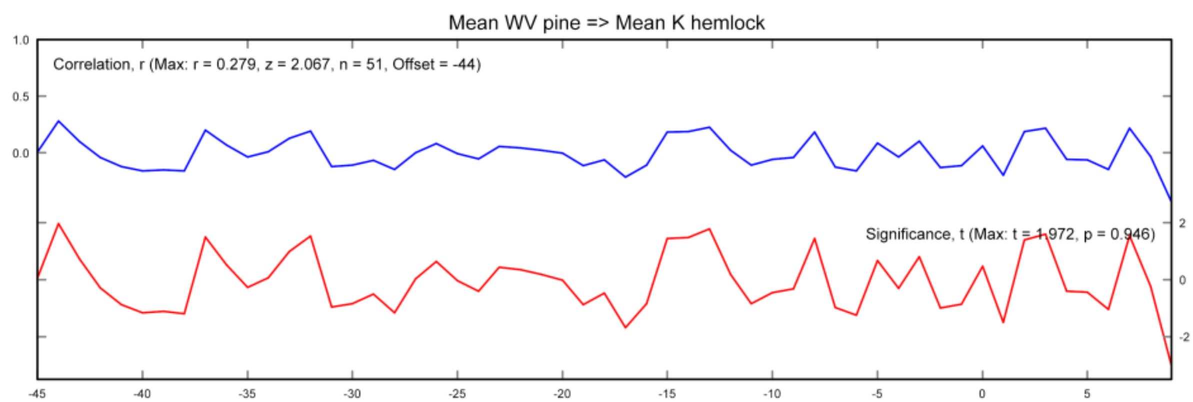

Figure 9. Correlation of all average White Pine chronologies vs Eastern Hemlock chronologies

All White Pine chronologies were compared to the chronologies of three Eastern Hemlock tree samples, taken by Kaefer on May 9, 2019 on the property of Rob Hare (Figure 8 and 9). Unlike White Pines, Eastern Hemlocks face the threat of an invasive species: the Hemlock Woolly Adelgid (or "HWA"). No such parasite currently threatens white pines in the region. While the white pines continue to be able to respond to climate signals, the hemlock trees suffer and are unable to respond to climate patterns (Figure 8). This data suggests that the white pines on the WIllow Pond property are healthy.

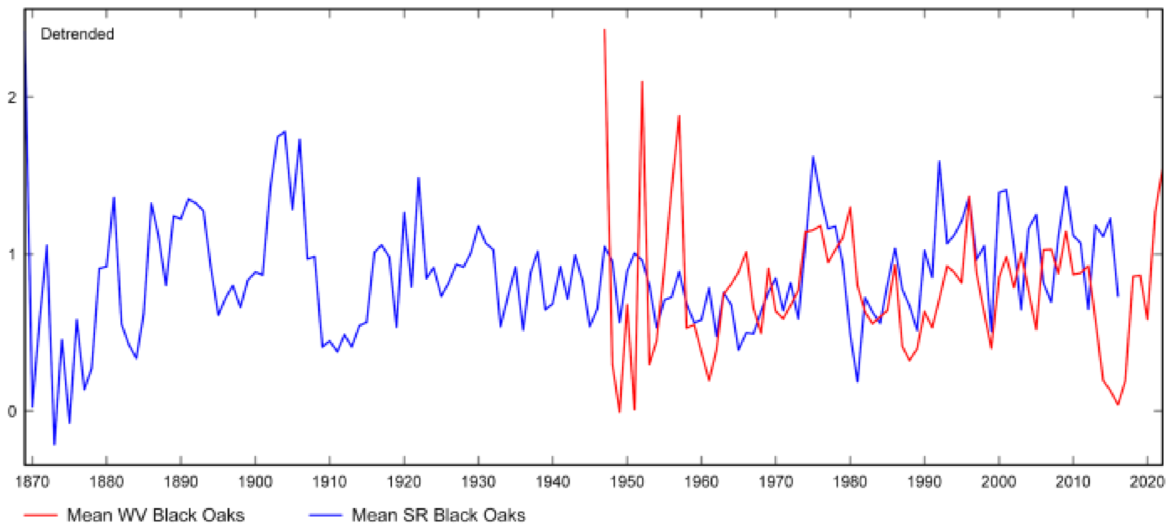

Figure 10. Detrended data for all average WV Black Oak chronologies vs SR Black Oak chronologies

The black oak chronologies were compared to the chronologies of five black oak samples taken by King on October 18, 2017. There are similar climate patterns between the two data sets, although the data does not perfectly align (Figure 10). Since the tree samples were not taken from the same property and thus are likely to have at least slight differences in growing conditions, it is reasonable to expect slight differences in chronologies. However, the overall chronologies align to a reasonable degree, suggesting black oak trees at both locations are healthy and able to respond to climate in a similar manner.

Further data analysis was conducted in February and March of 2023. In addition to further analysis of the living tree samples, analysis was conducted on samples taken from the barn (as seen in the bottom left of Figure 4) to determine tree species and relative age of the barn.