

Hemlock woolly adelgid effects on mesic understory communities in the old growth forest

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Introduction

Did you know that even protected forests are changing all the time? In June and July of 2020, I worked at Lilley Cornett Woods (LCW) in Letcher County, Kentucky, studying how an invasive pest called hemlock woolly adelgid (HWA) affected the understory of the beech and hemlock communities in Shop Hollow and Whittaker Branch. LCW is a perfect place to study the effects of HWA because it is an old growth forest, which means the only disturbance is from natural causes and from anthropogenic, meaning human caused, disturbances such as climate change and invasive species. Another benefit of working at LCW is the data dating back fifty years for the tree species living in the plots established by Dr. William Martin in 1971 (Martin, 1975). The data collected during my time at LCW shows a decline in species richness in the last ten years, a decline in total density of trees in their respective communities, and an increase in beech importance as hemlock importance decreases.

Methods

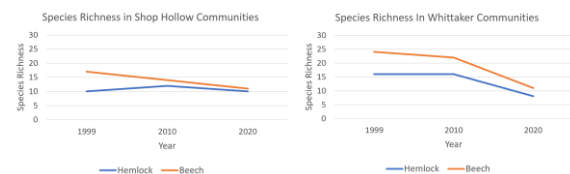
To see how the understory is changing and to add to the already established data set, I worked with the team of researchers to visit plots in two locations in LCW: Whittaker Branch and Shop Hollow. In each plot, each tree was identified to species level and the diameter was measured using a diameter at breast height (dbh) tape. The plots have a radius of 16 meters (1/5 of an acre total), so range finders were used to determine the boundaries and to account for slope (Martin, 1975, Galbraith and Martin 2005). Understory tree species data was collected in the inner 8 m radius of the plots while overstory data was collected throughout the entire plot. Understory trees were any tree that was 2.5 cm dbh to 12.5 cm dbh. Any tree greater than 12.5 cm dbh was considered overstory. This data was compared to

the data collected in 1999 and 2010. The data sets from 1999 and 2010 were selected because land managers at LCW began treating for hemlock woolly adelgid in 2006, meaning the 1999 data would not see signs of infestation while the 2010 and 2020 data would.

The response variables we used to evaluate forest change over time were species richness, total density, and relative density, relative basal area, and importance values. The response variables were evaluated in Excel and R. Species richness and total density were calculated for the beech and hemlock communities in Shop Hollow and Whittaker for each of the time periods. Relative density, relative basal area, and importance values were determined for the most important species in beech and hemlock communities in Shop Hollow and Whittaker since 1999.

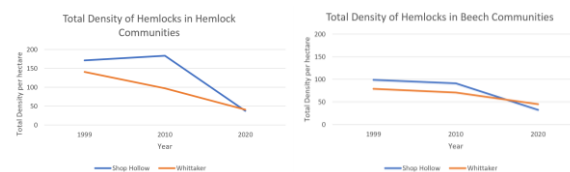
Results

Species Richness



Species richness is the total number of species that occur in each community in each hollow per year.

Total Density



Total density is the average number of a tree species per hectare. Total density was determined in both communities in both locations across the years.

Importance Value

Unlike species richness and total density, which are absolute values, relative density, relative basal area, and importance values are relative to the populations studied. Importance values take into account density of each species in a community and how much space the species takes up in order to determine how dominant the species is. Importance values were determined for the most important species in both communities in both locations for the years studied. The graphs below only show the top five species per community per location.



Discussion and Conclusions

Species Richness

Over the last twenty years, the understory has seen a decline in species richness, particularly in the beech communities, especially in Whittaker. Whittaker's species richness declined by 50% over the last ten years in each community. While some of this can be explained by species moving to the overstory and losing some species to fungal infection, it is still a startling development.

Total Density

Over the study period, total density of both beeches and hemlocks declined across communities and locations, with stronger decline in the species' respective community. We are seeing a much higher

rate of decline in hemlocks in hemlock communities and beeches in beech communities.

Importance Values

In Shop Hollow's hemlock community, it is evident that as the hemlock importance values decrease, beech importance value increase, especially in the last ten years. The relative values of the beech community of Shop Hollow are not changing as much in comparison to the hemlock community of Shop Hollow. In Whittaker's hemlock community, the relative importance of hemlock is staying stable, but the relative importance of beech is still increasing, perhaps due to the decline of species diversity. In Whittaker's beech community, the relative importance of beech is increasing while the relative importance of the other important species is staying stable or decreasing. This shows that species composition is changing more in the understory in Shop Hollow's hemlock plots and Whittaker's beech plots, as those are the communities with the most importance value change. While beech is still increasing in Whittaker's hemlock community, the other two locations did not see the same amount of change over time.

My time at Lilley Cornett Woods helped me grow as a researcher and was overall an amazing experience. As an old growth forest, LCW is a perfect opportunity for those of us interested in learning more about nature and how the world around us changes. Its location in Letcher County makes it easily accessible to anyone in the central- eastern portion of Kentucky, and it is a wonderful place to hike and explore the Appalachian beauty and your interest in biology.

References

- Martin, William H. (1975) "The Lilley Cornett Woods: A Stable Mixed Mesophytic Forest in Kentucky." *Bot. Gaz.* 136, no. 2: 171–83.
- Galbraith, S.L., and W. H. Martin. "Three Decades of Overstory and Species Change in a Mixed Mesophytic Forest in Eastern Kentucky." *Castanea* 70, no. 2 (June 2005): 115–28.

