2013

# The status of White Oak (Quercus alba) trees at the Gordon Natural Area, Chester County, Pennsylvania

Rachel Stern
*West Chester University of Pennsylvania*

Gregory D. Turner
*West Chester University of Pennsylvania*, gturner@wcupa.edu

Gerard D. Hertel
*West Chester University of Pennsylvania*, ghertel@wcupa.edu

*Journal of the Pennsylvania Academy of Science 87(1): 16-19, 2013*

# THE STATUS OF WHITE OAK (*QUERCUS ALBA*) TREES AT THE GORDON NATURAL AREA, CHESTER COUNTY, PENNSYLVANIA[1]

RACHEL STERN, GREGORY D. TURNER, AND GERARD D. HERTEL

*Department of Biology, Schmucker Science North, West Chester University, West Chester, PA 19383*

## ABSTRACT

**A eld study was conducted in 2007 and 2008 to assess the population, distribution, size, and health status of white oak (*Quercus alba* L.) trees found in a forest at the Gordon Natural Area preserve in Chester County, Pennsylvania. A sweep survey was used to locate each oak, and then geographic coordinates, diameter at breast height (DBH), and crown vigor, were determined for each tree. Twenty-three trees were encountered in all, indicating a low density of < one tree per hectare, which was much lower than that of other co-occurring late successional species. Trees exhibited both clumped and linear distributions, likely resulting from acorn caching and past use of the species as a border around now reforested farmland. Trees were spread across most DBH size classes with a mean DBH = 57.4 cm. Most trees were relatively large and none occurred below 25 cm. Most trees were also healthy, though some were unhealthy. Overall, results suggest that white oak is an uncommon but widely dispersed species at the preserve, with a relatively healthy, but aging, population. Given these results, more studies of the species at the preserve are warranted, including new and periodic assessments of its recruitment status and canopy tree health, to better manage and ensure that white oak continues to have a presence in this forest and the region. [ J PA Acad Sci 87(1): 16-19, 2013 ]**

## INTRODUCTION

White oak (*Quercus alba* L.) is a medium-large sized deciduous tree reaching up to 24 m in height (Harrison and Werner 1984). It is shade tolerant and late successional (DeWitt and Derbey Jr. 1955), and a foundation species that facilitates forest stability and provides food for many animals. It occurs throughout eastern U.S. forests in both lowland and upland communities (Rouse 1986, Chapman and Bessette 1990), but prefers more mesic habitats (Minckler 1965). While it has dominated many eastern forests throughout the Holocene (Abrams 2002), it declined after European colonization due to deforestation meant for farmland (Abrams 2003). It rebounded in the nineteenth century due to farm abandonment (Yahner 2000) only to decline again in the twentieth century due to poor recruitment (Abrams 2003). As a result, efforts to sustain the species have been made by ecologists and foresters. The goal of this study was to assist those efforts by assessing its density, distribution, size, and health status in one suburban southeastern Pennsylvania forest. A comparison of the species with past densities and to those of other hardwoods at the preserve and in other local forests was also a goal.

## MATERIALS AND METHODS

We surveyed white oak in a forest at the Robert B. Gordon Natural Area (GNA), located on the West Chester University campus. The GNA is a 68 ha preserve containing early and late successional forest, serpentine grassland, and wetland habitats and is one of the largest open spaces in eastern Chester County. The forest is even-aged, 150-years old, and dominated by American beech (*Fagus grandifolia*), maple (*Acer*) and oak (*Quercus*) species, and tuliptree (*Liriodendron tulipifera*). From 2007-2008 white oaks were located in the forest using a sweep survey. Each tree was numbered, geolocated using a Trimble GPS Pathfinder Pro, and measured for size with a diameter at breast height (DBH) tape. The health of each tree was assessed using crown vigor (CV), which relied on observing the limbs of each tree to determine how many were healthy, damaged, or dead. A 0-3 scale was used to assign values of 0 (dead), 1 (unhealthy = many broken/dead limbs), 2 (healthy = few broken/dead limbs), and 3 (very healthy = no broken/dead limbs). Data were graphed and mapped to show size patterns and the distribution of all trees.

[1]Accepted for publication May 2013.


Figure 1. Map of the Gordon Natural Area showing the locations and distribution of white oak trees encountered in the study forest.

## RESULTS AND DISCUSSION

Twenty-three trees were found, with a density of 0.58 per ha. Their distribution varied with some clumped in a northern part of the forest, but most growing in a sinuous line in western and southeastern parts (Fig. 1), indicating that most trees were non-randomly distributed. Sizes varied from 30-81 cm (Fig. 2), with mean DBH = 57.4 cm. Most trees were moderately large-large and several were assigned to one large 66-75 cm class, while others were spread across smaller classes. No trees were found in the smallest 16-25 cm class or in a moderately large 56-65 cm class. Crown vigor assessments found that most trees were healthy (15, CV = 2), but more trees were unhealthy (5, CV = 1) than very healthy (3, CV = 3). No discernable white oak snags or logs were found.

Based on results, white oak density was low as of study time, and has declined when compared to surveys made over the last century. Gordon (1941), for example, noted that the species was moderately abundant in the early twentieth century, which agrees with the forest's Red oak-mixed hardwood community classification type (Fike 1999) in which white oak can be co-dominant with red oak. Overlease (1973) found that the species was less abundant in 1970 than in previous decades, especially when compared to other oak species and tuliptree. However, it is important to note that their accounts were more qualitative, so it is hard to say whether the species was highly dense at the GNA during the last century, or that it was much more dense in comparison to our study. However, when compared to pre-colonial levels, when the species comprised up to 33% of trees in southeastern Pennsylvania forests (Black and Abrams 2001), and may have been co-dominant with red oak, our findings suggest that white oak density is now historically low, a trend that is not unique to the GNA since it was also found at low densities in other surrounding forests.

Recent contract surveys made in Chester County township forests, for example, found that white oak was sparse in each (J. Ebbert, pers. comm.). In addition, trail surveys made in 2013 at Ridley Creek and Edinburg State Parks, and at Valley Forge National Historic Park, in forests similar in area and composition to the GNA forest, found an average of 15 white oaks of similar sizes to those we found (G.D. Turner, pers. comm.). Also interesting was that in each township and trail survey, white oak was much less dense than other hardwoods. This is not surprising given that a comparative 1970-2003 GNA study found that American beech, red oak, and tuliptree were far more abundant than white oak (i.e., 35, 24, and 82 trees per ha, respectively, versus 0; Turner et al. 2007) and a comparison of surrounding Chester County forests in 1973 found that of eight sampled, white oak was relatively abundant in comparison to American beech, other oak species, and tuliptree in only one, was moderately so in two, and absent or sparse in five (Overlease 1973). Further, other timely regional studies report similar findings. Black and Abrams (2001), for example, found that white oak represented only 4% of dominant tree composition in Lancaster County forests while Abrams (2003) found that it represented just 1% in regional forests. Thus, it is reasonable to assume that white oak has not been abundant in area forests for some time, and that it is less common than other hardwoods.

While white oak recovered at the GNA following farm

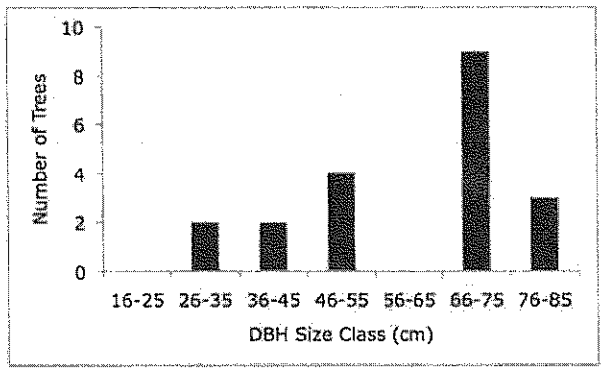


Figure 2. White oak frequencies per size class (cm) based on diameter at breast height (DBH).

abandonment (Overlease 1987), there is little evidence to suggest that it ever became abundant there, given that the forest is even-aged, 150-years old, and dominated by other hardwoods. It is possible that it was more abundant during that time in comparison to the time of this study, but declined more so than other hardwoods due to selective harvesting, given its high economic value (Abrams 2003). However, the lack of stumps or trees grown from root sprouts suggests that any harvesting, if it occurred, was minor. Further, given that chestnut blight (*Endothia parasitica*) decimated American chestnut (*Castanea dentata*) at the GNA (Overlease 1973), white oak should have increased in abundance, but there is no evidence that it did. Instead, other hardwoods were likely more abundant than white oak when the blight hit, and thus benefited accordingly.

We do know that white oak has declined at the GNA over the last century, regardless of its prior densities then, which raises the question of why it did. Many factors have been proposed, namely fire suppression and deer browsing, which have affected other hardwoods less (Abrams 2003). There has been no fire at the preserve for over 50 years, as there is no evidence of fire scars or charcoal, and only one minor fire has been reported since 1960 (Overlease 1973). White-tailed deer (*Odocoileus virginianus*) impacts were also likely, as their GNA population grew from a few in 1960 to 80 by 2012, which is far greater than is sustainable (G.D. Hertel, pers. comm.). Deer affect recruitment directly by consuming seedlings, and white oak seedling density declined from 1970-2003 (Turner et al. 2007), suggesting that deer were at least partly culpable since the decline coincided with their population growth. This trend was not unique to white oak, however, as other hardwoods experienced similar seedling declines during that time. The same seedling comparison, for example, found that only American beech and white ash seedlings were relatively dense in 2003, though both were lower than in 1970, while densities of the exotics Princess tree (*Paulownia tomentosa*) and tree of heaven (*Ailanthus altissima*) increased over that time (Turner et al. 2007). However, recent seedling surveys at the GNA have found few for any species, native or exotic, due to intense deer browsing (G.D. Hertel, pers. comm.). Only American beech, whose sprouts deer avoid, and white ash, which seeds prolifically, have shown any recruitment, though there are few saplings of either species. Thus, few species are replacing white oak, not even exotics, at the GNA.

Regardless of its status, white oak was present and distributed across the GNA forest as of study time. Some trees were clumped, likely a result of acorn caching, but most grew in a sinuous line through the forest, perhaps a legacy of use as field border trees. The species also ranged across size classes, suggesting some regeneration until recently. Interestingly, no trees were found in the 56-65 cm size class, suggesting that some factor(s), such as poor growth conditions or pests, hindered recruitment for many years during the last century. While most trees were healthy, more were unhealthy than very healthy, suggesting that its population may lose more individuals sooner than later. Other hardwoods, namely American beech, red maple, red oak, and shagbark hickory (*Carya ovata*) were healthier than white oak (C. Cummins and G. Turner, pers. comm.), though flowering dogwood (*Cornus florida*) and sugar maple (*Acer saccharum*) were less so due to disease and potential warming.

Overall, white oak was found to be a sparse but widely distributed and relatively healthy species at the GNA. Compared to other surrounding forests, this was typical. There were both younger and older trees based on a range of DBH sizes, but there were no young trees or saplings. Given this status, white oak could remain a minor component of forest composition at the GNA for many years, but only if recruitment improves and the current population stays healthy. Thus, new studies monitoring its recruitment and health status are needed, as are proactive plantings and deer exclusion. Such efforts could help sustain this important species in forest habitats at the GNA and across the surrounding region.

## ACKNOWLEDGEMENTS

We thank the WCU Department of Biology for facilitating this study, which was conducted as part of Rachel Stern's undergraduate research project. We also thank the WCU Department of Geography and Planning for providing us with the use of their cartography lab.

## LITERATURE CITED

Abrams, M. D. 2002. The postglacial history of oak forests in eastern North America. In: Oak Forest Ecosystems: Ecology and Management for Wildlife (W. J. McShea and W. M. Healy, eds.), pp. 34-45. John Hopkins University Press, Baltimore, MD.

Abrams, M. D. 2003. Where has all the white oak gone? BioScience 53:927-939.

Black, B. A. and M. D. Abrams. 2001. Influences of Native Americans and surveyor biases on metes and bounds witness tree distribution. Ecology 82:2574-2586.

Chapman, W. K. and A. E. Bessette. 1990. Trees and shrubs of the Adirondacks. North Country Books, Utica, NY.

DeWitt, J. B. and J. V. Derbey, Jr. 1955. Changes in nutritive value of browse plants following forest fires. Journal of Wildlife Management 19:65-70.

Fike, J. 1999. Terrestrial and palustrine plant communities of Pennsylvania. Pennsylvania Natural Diversity Inventory: Department of Conservation and Natural Resources, The Nature Conservancy, and the Western Pennsylvania Conservancy. Retrieved from the Terrestrial and palustrine plant communities of Pennsylvania Online: http://www.dcnr.state.pa.us/cs/groups/public/documents/document/dcnr_001872.pdf.

Gordon, R. B. 1941. The natural vegetation of West Goshen Township, Chester County, Pennsylvania. Proceedings of the Pennsylvania Academy of Science 15:194-199.

Harrison, J. S. and P. A. Werner. 1984. Colonization by oak seedlings into a heterogeneous successional habitat. Canadian Journal of Botany 62:559-563.

Overlease, W. R. 1973. The structure of selected deciduous forests in southern Chester County, Pennsylvania. Proceedings of the Pennsylvania Academy of Science 47:181-197.

Overlease, W. R. 1987. 150 years of vegetation change in Chester County, Pennsylvania. Bartonia 53:1-12.

Rogers, R. 1965. *Quercus alba* L. White oak. In: Silvics of forest trees of the United States. Volume 2. Hardwoods. Agriculture Handbook 654. United States Department of Agriculture, Forest Service, Washington, DC. Retrieved from the Silvics of forest trees of the United States, Volume 2, Hardwoods Online: http://www.na.fs.fed.us/spfo/pubs/silvics_manual/volume_2/quercus/alba.htm.

Rouse, C. 1986. Fire effects in northeastern forests. United States Department of Agriculture, Forest Service. General Technical Report NC-105, St. Paul, MN.

Turner, G. D., R. J. Van Meter and G. D. Hertel. 2007. Changes in forest understory composition from 1970 to 2003 at the Gordon Natural Area, an urban preserve in Chester County, Pennsylvania. Journal of the Pennsylvania Academy of Science 81:8-13.

Yahner, R. H. 2000. Eastern Deciduous Forest: Ecology and Wildlife Conservation. University of Minnesota Press, Minneapolis, MN.