

**Extension
Forestry**



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This long-lived, majestic species is historically and culturally important and provides a wide array of benefits and values in northeast forest ecosystems. Promoting its management will ensure its future

Habitat Values

- Especially nutritious acorns are highly sought by deer, turkey and other wildlife in season
- Large crowns are preferred nesting sites for cerulean warblers, hollow trees are used as dens, and forest-dwelling bats are known to roost under white oak bark.
- Hosts over 100 moth and butterfly species, important pollinators all, and critical protein sources for nesting birds
- High crown architecture allows a relatively large amount of sunlight to filter to the ground supporting a diverse understory



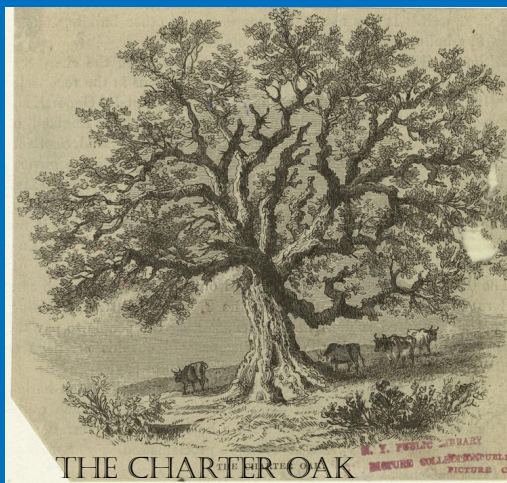
Cerulean Warbler
Photo: Andy Reago and Chrissy McClarren/Flickr (CC BY 2.0)

Economic Benefits

- Contributes billions to the wood products sector nationwide, \$6 billion in the distilling sector alone
- White oak is highly decay-resistant, water-tight, and suitable for a wide variety of products from railroad ties to fine furniture and is critical to the cooperage industry.
- White oak ranks high in engineering properties such as tensile strength and compression strength.
- Traditional artisans (Cherokee, among others) use small-diameter knot-free poles to create “splits”, used to weave baskets. Traditionally crafted white oak baskets are available through Native American Cooperatives, online retailers, and specialty markets.

Long-Lived and Culturally Important

- State tree of three states (Maryland, Illinois, and Connecticut). Connecticut officially recognizes one specific white oak, the Charter Oak, said to be 500 years old when used to hide the State Charter in 1662. It fell during a storm in 1856, but offspring or “scions” grow in several locations.
- A component of remnant old-growth forests and a suitable candidate to favor when managing for old forest characteristics.
- White oak acorns are high in carbohydrates, and sweeter than most other acorns but still bitter tasting. Native Americans leached tannins from nut meats and ground them into a flour.
- Early European settlers pressed oil from white oak acorns used to alleviate joint pain. Dried bark was used to treat a variety of ailments.



The Miriam and Ira D. Wallach Division of Art, Prints and Photographs: Picture Collection, The New York Public Library. "The Charter oak" The New York Public Library Digital Collections. 1880.



<https://visitskylinedrive.org/events/white-oak-basket-making-in-shenandoah-3/>
White Oak Basket Making

<https://visitskylinedrive.org/events/white-oak-basket-making-in-shenandoah-3/>

In an era of climate change

- White oak will sequester and store carbon from the atmosphere in high quantities over a long period, both in the forest and as durable wood products
- White oak is considered to have “low vulnerability” to anticipated climactic changes.
- A suitable and desirable substitute for beech, which is facing many disease issues in the northeast.
- White oaks are less susceptible to oak wilt than members of the red oak group

Why is White Oak Struggling?

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A Short History of White Oak Silviculture

- Prior to European settlement, oaks were widely distributed across North America, and dominant in some places.
- Indigenous North Americans used fire and other competition-reduction strategies to encourage oak trees, especially near their habitations.
- Prior to European settlement, fire dynamics encouraged vegetative regeneration of oaks. Oaks that grew large enough could withstand periodic fires, recruit into the overstory and express dominance.
- Oak benefited from land use patterns of the late 1800s and early 1900s:
 - Loss of the chestnut as a dominant forest species
 - frequent low-intensity harvesting and fire disturbance
 - coppicing for charcoal
 - over-hunting of acorn predators including deer and turkey all contribute to oak abundance
- But more recent diameter-limit and high-grading harvest activity, as well as suppression of fire, has favored shade tolerant species.
- By the 1980s inconsistent regeneration outcomes from even-age techniques were observed and the role of disturbances and managing competition was better understood. By this time deer, turkey and other acorn feeder populations had increased dramatically.
- Currently oak populations are skewed to older age classes, and while they are at peak acorn production ages adequate regeneration is not present to replace oaks as they age.

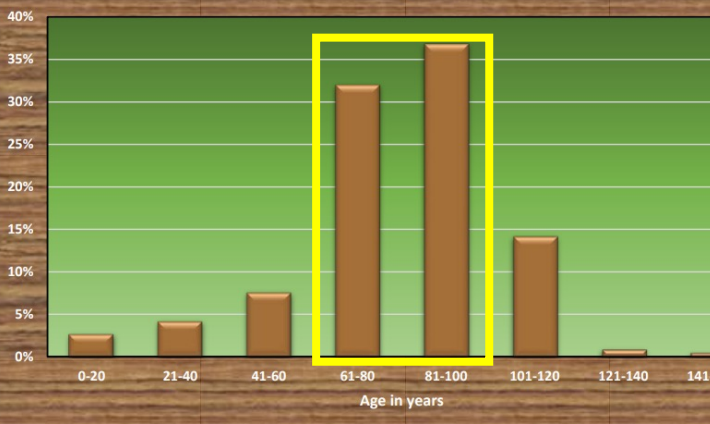
Most of the maturing oak stands in our area initiated in the early 1900s..

Around this time researchers were beginning to understand the dynamics of oak regeneration replacing chestnut forest ecosystems and that basal diameter could predict the future of a seedling. Even-age management seemed like the best way to promote oak.

Long term challenges to oak regeneration and recruitment:

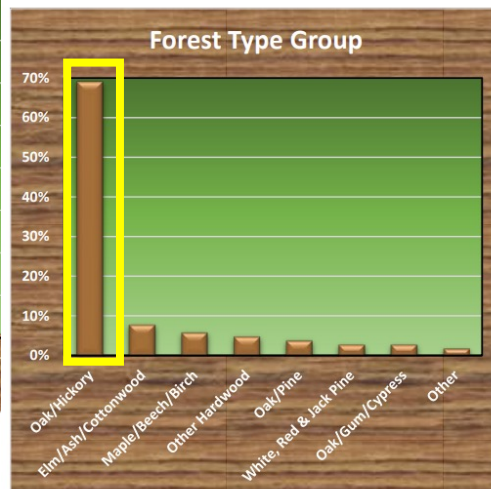
- Changes in land use have resulted in the absence of a fire regime, excessive deer browse, acorn crop predation and overstocking.
- Lack of forest management and indiscriminate harvesting of high-value oak trees encourages competing stems and poor specimens allowing lower-value species and lower-quality oak stands to occupy desirable oak sites.
- Widespread invasive plants, insects, and diseases influence regeneration success and growth rates.

Forestland Age Classes



Age Structure

Composition



Age class and forest type distributions across Connecticut suggest the majority of forest is of the oak/hickory type and is between 60 and 100 years old. This indicates a lack of younger age classes needed for replacement over time.

Plots from the CT Forest Action Plan, with data from USDA Forest Service, 2019.

To learn more about the Connecticut Forest Action Plan And explore the interactive Storymap Please visit: <https://portal.ct.gov/DE/EP/Forestry/CT-Forest-Action-Plan>



Understanding White Oak Silviculture

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Pillars of Oak Sustainability: Regeneration & Recruitment

Regeneration: Acorn germination can occur in the understory of a mature stand where seedlings can persist for several years becoming advance regeneration.

- White oak seedlings can remain at ankle level for decades due to browse and shade.
- During stand initiation following a disturbance newly germinated seedlings, advance regeneration and vegetative reproduction (sprouts) compete for light and space.
- Regeneration ends when stem density prohibits new seedlings and saplings self-thin as they compete for resources (stem exclusion).

Recruitment of oaks into the canopy occurs as stands develop into saplings, poles, and saw-timber-sized trees.

- Intermediate treatments (cleanings and thinnings) reduce density and competition, improving success rates of desirable growing stock.
- Two layers of shade exist in most even-aged stratified mixes, so mid-story removal can be a viable tool for promoting advance regeneration and young desirable stock.
- Variable retention shelterwood strategies are effective (as opposed to expanding gap), but subcanopy shade must be reduced also.
- Success is achieved when desired trees are co-dominant and dominant and reproducing.

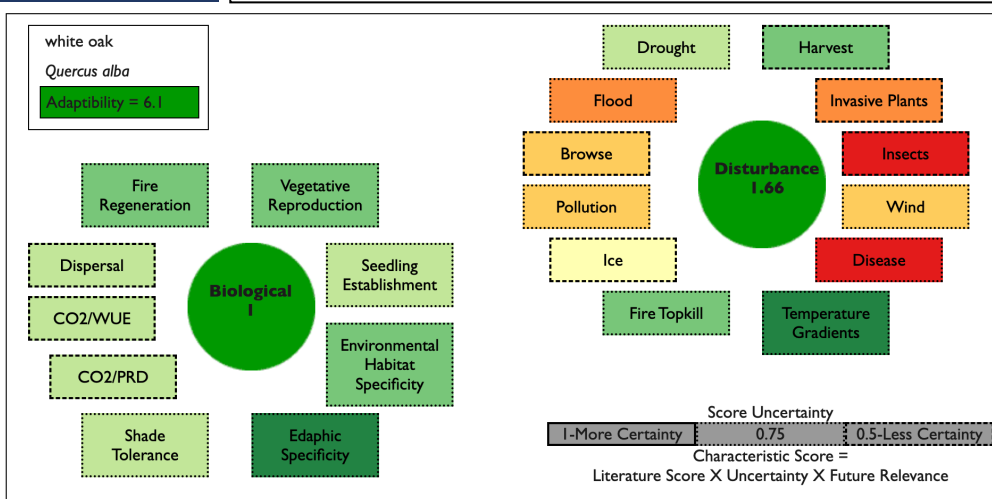
From: Dey, Daniel C. "Sustaining oak forests in eastern North America: regeneration and recruitment, the pillars of sustainability." *Forest Science* 60, no. 5 (2014): 926-942.

Research Highlight: Survival of advance white oak regeneration

Advance regeneration with the following characteristics were the most likely to survive in openings made from group-selection harvesting

- Basal diameters of >1cm
- Largest canopy openings with relatively short trees bordering the openings
- 6% slopes
- Southwest and northwest aspects
- Chemical treatment of cut stems of competition (a single iteration of mechanical control showed no advantage over no control)

From: Spetich, Martin A. "Survival of *Quercus alba* (White Oak) advance reproduction in small group and single tree openings." *Forests* 11, no. 8 (2020): 889.



The Climate Change Tree Atlas & White Oak:

- Suitable habitat for white oak may moderately increase over time (eastern US & into Canada)
- Drought tolerance makes the white oak highly adaptive with infill capability in suitable places
- However, models based on current abundance and distribution suggest white oak capacity to naturally colonize new northern habitat is limited.

Modification factors impacting the adaptability of white oak. From: Climate Change Tree Atlas: <https://www.fs.usda.gov/nrs/atlas/tree/802>



Deer Browse Pressure on Young Oak Trees

What methods have been shown to successfully protect trees (30 to 40 seedlings per acre) from browse?

- Individual wire cages around young trees
- Protective tubes around saplings
- Fencing (must be 7+ feet tall to prevent deer incursion)
- Slash walls – continuous stacks of tree tops and branches from harvesting piled 10+ feet tall and 15-20 ft wide can exclude deer. They remain a barrier long enough for trees to achieve heights where deer browse does not inhibit growth.

A doe and fawn outside the gate at the North Gate harvest. Note the livestock panel at the far edge of the mesh gate to exclude fawns from wandering into the access passage. - <https://blogs.cornell.edu/slashwall/>

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Crop Tree Release (CTR):

An intermediate silvicultural treatment providing density reduction at the individual tree level

- Enhances growing conditions for high quality trees sought by the market for whiskey barrels, etc.
- During stand initiation, CTR may foster oak seedling height development
- During canopy closure, CTR will foster upper canopy dominance and in turn increase diameter growth on selected (crop) trees,
- 3 and 4-sided release provides a growth advantage over only 1 or 2-sided for oak.
- CTR provides a growth advantage for white oaks over unmanaged white oak trees. Considered alongside other study results, 30-40 crop trees released per acre is a viable density
- White oaks at 8-18" DBH in late stand development (+/- 100 years), are the most promising CTR candidates.
- Despite concerns about excessive epicormic branching in white oaks, no such was observed with CTR treatments after 17 years. At 35 years a greater proportion of trees in treated stands reached max potential growth, suggesting treatment *improved* log quality.



Healthy, well-developed white oak seedlings grow after a midstory removal management practice.

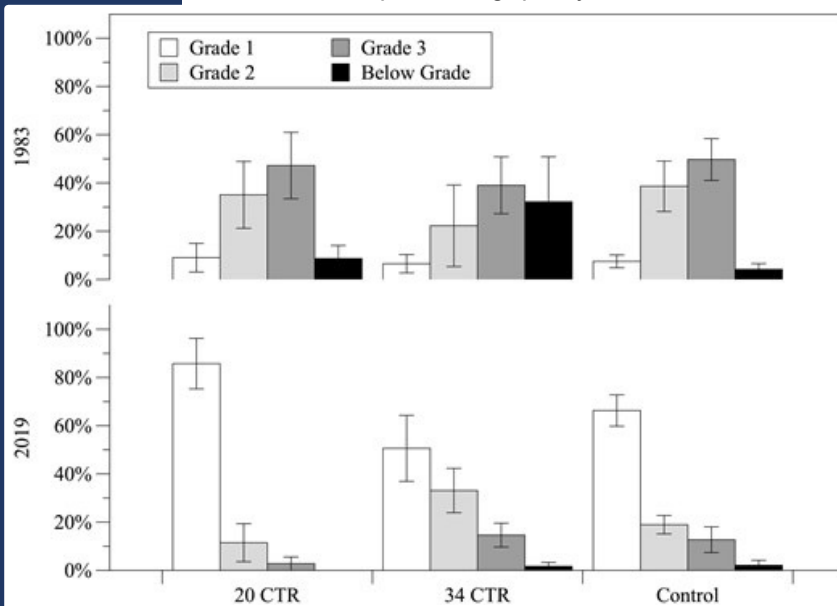
Mid-story Removal

In a study of a 100 yr old oak-dominated forest, where stems of all species were removed starting at 2.5cm dbh and increasing until 20% of BA was removed, understory light availability was increased. Black oak, white oak, and red maples, were tagged and evaluated at the start and after 8 years when a shelterwood was implemented, and 6 years after that. Overall regeneration was also evaluated.

- Where the mid-story was removed, all tagged seedlings (especially white oak) grew more in height and diameter than in untreated areas.
 - However, oak seedlings in treated areas were overtopped more often because competing species also took advantage of the treatment.
- White oak regeneration was generally greater in treated areas and doubled following shelterwood harvests in all areas.
 - However, abundance of oak regeneration compared to other species declined post-shelterwood. Mid-story removal stimulated growth of both shade tolerant and intolerant species

Mid-story removal ultimately produced abundant & desirable regeneration that could be cultivated towards recruitment. Some method of competition control (not fire, as such small oak regeneration would also be set back) before or after the shelterwood cut would greatly improve the likelihood of oak recruitment.

Full publication: Hackworth, Zachary J., John M. Lhotka, and Jeffrey W. Stringer. "Midstory removal facilitates growth but reduces competitiveness of oak reproduction prior to and after shelterwood establishment cutting." *Forest Science* 66, no. 3 (2020): 371-381.



Mean (± standard error) crop tree grade distribution based on Hanks (1967) hardwood tree grading specifications in 1983 and 2019 by treatment. 20 CTR, 20 crop trees per acre; 34 CTR, 34 crop trees per acre.

- CTR of white oak trees enhanced growth not only for crop trees, but also stand-wide. In one study mid-story canopy development, unaffected by treatment, continues to hamper oak seedling establishment and growth. Thus, while CTR treatment enhances oak crop tree vigor, lifespan, and seed production, it must be considered an intermediate treatment. Other strategies must be applied to foster regeneration.

See the full publication: Vogel, Philip J., John M. Lhotka, and Jeffrey W. Stringer. "Long-Term Effects of Crop Tree Release on Growth and Quality in White-Oak (*Quercus alba* L.)-Dominated Stands." *Forest Science* 68, no. 3 (2022): 343-352.