Landowners Guide to:

Sustainable Oak Management Practices

Dr. Jeff Stringer and Darren Morris,
University of Kentucky Department of Forestry and Natural Resources

FOR-149

Figure 1: A managed white oak stand.

Maintaining healthy oak forests often means ensuring that oaks continue to regenerate seedlings and saplings and existing oaks have room to grow. Even in forests where the number of oak seedlings and saplings (advance regeneration) is adequate, ensuring that competing species do not eventually reduce their growth or threaten their longevity is still a concern. Management is usually necessary to ensure oak seedlings are present and are able to grow into large saplings capable of eventually reaching the upper canopy of the forest. All of this indicates that oak growth and development is a management concern throughout the life of a forest. Every forest is different and offers specific challenges to oak regeneration and growth depending on soils, topography, history, and management objectives. However, the need to ensure regeneration and continued growth and development is universal. While the different species of oaks generally have the same issues and respond similarly to common oak management practices, these practices can be optimized to meet specific requirements for each species including white oak.

To aid in sustaining upland oaks, oak management practices have been developed by forest researchers and forestry experts to both regenerate and maintain oaks. Each of these practices is designed to address one or more of the problems upland oaks typically face. These practices work individually or in combination to ensure sustainability of all upland oak species. However, the practices also contain information and guidelines specifically developed to address white oak, one of the cornerstone species in upland oak forests of the central hardwood region. It is important to note even when taking advantage of the white oak specific guidelines other oaks in the forest will benefit.

The following is an abridged description of the individual practices, focusing on when they are used and how they help regenerate and grow oaks. They have been developed to use under a wide range of conditions from planting oaks in fields and forests devoid of oaks to culturing natural oak regeneration and improving oak growing conditions in native forests. Some of these practices include options for timber harvesting, and some are completed well in advance of a harvest. It is important to discuss harvesting, as funds can be gen-

This publication is part of the White Oak Initiative's (www.whiteoakinitiative.org) **Landowners for Oaks Series** designed to provide foundational information necessary for sustainable management of white oak and upland oak forests.

The **Landowners for Oaks Series** is produced by the Cooperative Extension Service, University of Kentucky, Department of Forestry and Natural Resources (http://ukforestry.org) in support of the White Oak Initiative.

Authors: Dr. Jeff Stringer and Darren Morris, UK Forestry and Natural Resources. Published as University of Kentucky's Cooperative Extension publication FOR-149.

Funding for the **Landowners for Oak Series** was provided by the Kentucky Division of Forestry through the Upland Oak Sustainability and Management Project sponsored by USDA Forest Service, State and Private Forestry, Landscape Scale Restoration Program.

Cooperative Extension Service

Forestry and Natural Resources Extension
College of Agriculture, Food and Environment

erated for forest management practices, and many times landowners need to implement a harvest to meet other ownership and management objectives. Each of the practices can be individually incorporated into a forest management plan but are often prescribed in combination or as a progression of practices to achieve long-term oak sustainability and meet forest management objectives. One of the practice descriptions, "Afforestation", provides information for establishing a new oak forest in fields and other areas not currently in forests. The remaining nine practices are designed to be implemented in forests. The figure below shows under what stage of forest development these nine practices are to be used, ranging from a newly regenerating age class to late maturity. See the figure at the end.

Enhancement Planting involves the planting of tree seedlings, and sometimes the scattering of acorns, in an existing forest to establish oak regeneration. This practice, also known as enrichment planting, is only done when there is not enough oak regeneration present and a harvest is eminent or has recently occurred. Enhancement planting may also be used to increase oak regeneration after a natural disturbance such as an intense ice storm or windstorm. The ultimate goal is to establish enough viable oak seedlings and saplings, often augmenting natural oak regeneration, to ensure hundreds of oaks are present in the newly developing age class. It is common for this practice to be completed in conjunction with other practices such as a mid-story removal practice to ensure proper light levels prior to harvest, or a site preparation for regeneration practice where additional reduction of undesirable vegetation is required to stimulate oak seedling growth and development.

Soil Scarification is the disturbance of the forest soil and leaf litter to establish adequate oak regneration in places where it is lacking or non-existent. This can be accomplished by using a tractor pulling a disk or bulldozer with a rake blade. Most oaks, including white oak only produce abundant acorn crops every few years. Also, acorns, particularly white oak acorns, are a favorite food for many wildlife species and insects. Sporadic reproduction and wildlife consumption mean that only periodically are there enough acorns to generate significant numbers of seedlings. If there are not a sufficient number of vigorous oak seedlings and saplings in a forest at the time of a harvest, oaks probably will not be a major component of the next mature forest.

Successful use of soil scarification requires the existence of acorn producing trees, and implementation completed in a good acorn year immediately after acorns have fallen. If mature oaks are not present or if there are few acorns produced during the current season, acorns can be collected elsewhere and scattered in the stand directly prior to scarification. Machinery is used to mix the forest leaf litter into the top few inches of soil to ensure the fall-emerging root makes good contact with the soil and helps prevent acorn desiccation over the winter months. It also helps provide some protection of the acorns from predation by wildlife and insects. This will increase the germination rate and help the emerging oak seedlings develop properly. With proper timing, usually 5 to 15 years before an overstory harvest, and the use of a practice like mid-story removal, the oak regeneration will be vigorous and large enough to quickly develop after a harvest.

Mid-story Removal involves the removal of trees that are present below the upper canopy of the forest to benefit small oak seedlings and saplings. The main canopy trees are left intact and all, or the majority, of the other non-oak trees that occupy the mid-story and the understory are removed. This provides just enough additional sunlight to allow existing oak seedlings and saplings to increase in size and become more vigorous several years prior to an overstory harvest aimed at initiating a new regenerating age class dominated by oak. Keeping the overstory canopy initially intact allows just enough sunlight for oaks to develop into vigorous advance regeneration capable of maintaining oak dominance after the next harvest, without resulting in the rapid growth of competing

Figure 2: Forest leaf litter before soil scarification (top and bottom).

Figure 3: Forest leaf litter after soil scarification (right).

Figure 4: Mid-story removal helps to develop already existing small oaks into advance regeneration.

species like yellow-popular. White oak is a relatively slow grower, even compared to some other oak species, and the development of oak regeneration must be monitored. If it is becoming overtopped after the mid-story removal, further practices to ensure its development may be needed.

Site Preparation for Regeneration creates optimal growing conditions for regeneration following a harvest. The goal is to remove either trees that would be or have been left after a commercial harvest or undesirable vegetation stimulated by the harvest. In all cases the undesirable trees and vegetation are, or will, interfere with the growth of the oak regeneration. These interfering trees can be overtopping low quality or undesired trees that are un-merchantable and left after the harvest. The treatment can occur directly before or after a harvest or several years after. Trees and brush species targeted for removal or deadening commonly range from 1 to 12 inches in diameter, but larger trees may be targeted as well. Trees can be removed by mechanical methods such as a chainsaw or by herbicide through foliar or cut stump application or other spray and injection methods. Regardless of the method used, regeneration should be monitored for success.

Prescribed Fire, when properly applied and timed has the potential to aid in enhancing oak regeneration, and development. The successful use of prescribed fire is highly site- and stand-specific. Researchers are still working out the details of how and when prescribed fire can be used to overcome specific oak regeneration problems. Cool season burns conducted in late winter have shown the least amount of risk to damaging valuable mature oak trees and benefiting oak regeneration at the same time. Prescribed fire can potentially be used to reduce litter depth that at times can cause acorns to desiccate over the winter because the emerging root cannot easily reach the underlying soil. Fire has been shown to also reduce competing understory species, if the timing and application of prescribed burns is carefully determined. Oaks commonly sprout at higher rates than some non-oak species, especially if the prescribed fire is administered at the appropriate time, seasonally and relative to the size of the oak seedlings. If the oak seedlings are vigorous enough, oak sprouts have a much better chance of out-competing faster growing species. In some cases multiple burns over a number of years with sufficient time for oak regeneration to build in size and vigor between burns may be required. Prescribed fire can also be used after a harvest to remove logging debris and kill small undesired trees and other vegetation that can hinder growth of oak regeneration. Often this understory can be so dense that control by other methods such as chainsaw or herbicide is difficult. Prescribed fire must be administered carefully and by qualified and experienced professionals, as it has the potential to damage current and future tree values. Liability issues associated with unplanned spread and smoke also must be considered. Professional foresters and natural resource professionals that are familiar with oak management and trained in prescribed fire should be consulted to assess the potential for the use of prescribed fire for oak management.

Crop Tree Release means releasing the crown of pole and small to medium sawtimber trees by using individual tree herbicide treatments, mechanical treatments such as girdling or felling, or a combination in small diameter stands. In sawtimber-sized stands, a commercial harvest may be possible. The treatment is completed by first identifying crop trees. These are canopy trees that are of good vigor and meet management objectives, which may include providing acorns and habitat for wildlife or potentially being high value timber trees. Once identified, each of the individual crop trees is released by removing neighboring trees whose crowns are touching and impeding the horizontal growth of the crop tree crown. This is called a crown touching release. By releasing these crop trees on at least three sides, diameter growth rate will vastly improve as the crown of the croptrees can expand into the newly opened space. This treatment will not only increase the diameter and volume growth of the released oaks, it also ensures that oaks maintain a dominant canopy position. This practice

Figure 5: The pole-size tree in the middle of the photo is a red maple. The trees on the far left and right of the photo are white oaks. Removing the faster growing red maple will provide extra space and sunlight, allowing the white oaks a much better chance of becoming mature trees.

is unique in that it focuses the management effort and funds directly on trees that can respond well to the treatment and directly contribute to management objectives, thus maximizing resources.

Group Opening (Gap) Harvest is a method of harvesting timber that creates a gap at least 150 feet across. These gaps or group openings are created and scattered across a forest stand, leaving unharvested areas in between. Research shows that openings approximately 150 feet across are the optimum size for recruitment and development of oak regeneration. This size creates a large amount of edge that is partially shaded by the adjacent trees, creating a semi-shaded area in the opening. It is too small to allow for a large amount of the area within the gap to be bathed in direct sunlight which would encourage oak competitors such as yellow-poplar. The 150 foot size is large enough that it allows a medium amount of sunlight required by upland oaks including white oak. The gaps also increase the amount of light penetrating the forest adjacent to the openings that leads to better conditions for oak regeneration developing in the unharvested forest next to the gap. If openings are designed with the unharvested edges containing residual acorn-producing oaks, they can take advantage of this environment and help build new seedlings next to the openings. Often after the gap harvest is complete, there will be additional undesirable sapling, pole, and maybe larger trees that will need to be removed within the gap, and a site preparation, liberation or cleaning treatment may be needed that can be administered with a herbicide or mechanical treatment. This will provide the best opportunity for the development of adequate upland oak and white oak regeneration.

Two-age Deferment Harvest is a harvest method where almost all merchantable timber is cut: a small number of overstory trees (called reserve trees) are left to promote oak recruitment. These reserve trees (white oak or other upland oak) are usually sawtimber size trees with crowns of adequate size to produce acorns. The resulting new regenerating age class and the scattered older reserve trees creates two age classes in the stand. Depending on the exact size of the residual trees, approximately 10 to 15 trees per acre are required. This treatment is particularly useful in oak stands where a harvest is required or anticipated and there is little current oak regeneration present. The latter indicates that there will be little oak that will regenerate. While the regenerating age class will have limited oak due to the lack of advance regeneration, the reserve trees help ensure that in the future there will be small seedlings developing beneath the younger age class. These seedlings (advance regeneration) can be cultivated when it is time to develop the next harvest. Without the reserve trees, oaks would be lost from the stand. The reserve trees act to "lifeboat" oaks in these stands. If all the oaks were removed in the harvest there would be limited chance of developing oak in the future. The maintenance for scattered oak reserve trees keeps oak around. Additional management work may be required to remove any undesirable saplings, poles, and larger trees left behind to ensure vigorous development of the newly regenerating age class.

Figure 6: This Two-age Deferment harvest left behind reserve oak trees which will act to "lifeboat" oaks in the stand. Future management will likely be needed to further develop the young oak regeneration.

Shelterwood Establishment Harvest is a harvest method that is designed to remove approximately one-half of the overstory trees. The half that is left provides approximately 50% shade for the development and growth of oak regeneration, but not too much sunlight that would create conditions where competing tree species that grow rapidly in full sun, such as yellow-poplar, will outgrow the oaks. The partial overstory acts to "shelter" the regenerating age class from too much sunlight. Once the regenerating age class has developed a second cut normally is used to remove the remainder of the overstory. For a shelterwood to work properly, it requires the presence of robust oak seedlings and saplings (advance regeneration). This may require practices such as a mid-story removal prior to the shelterwood cut. Also, it is common that a site preparation treatment or prescribed burn be used in conjunction with the shelterwood to remove the undesirable midstory and understory trees left after the harvest. While shelterwood is a common silvicultural practice, it is also common to find forest conditions unsuitable for the shelterwood establishment cut. Generally these are stands with no advance regeneration or where the timber markets and forest characteristics require the removal of a significant amount of overstory to make the harvest financially feasible.

Afforestation, often referred to as tree planting, is a way to artificially establish a stand of trees by planting them in open fields or other non-forested sites. These plantings can be installed by hand or mechanical planting using a medium size tractor to pull a planting machine. Trees are usually planted in rows that are commonly between 6 and 12 feet apart with a similar spacing of trees within each row. Tree plantations are considered to be most successful when a variety of tree species are included within the planting. Species diversity within the plantation ensures the best chance of surviving insect and disease outbreaks, environmental changes, and extreme weather conditions, such as extended droughts or excessively wet or cold springs. Species selection is also important, because every species prefers specific soils and site conditions. Trees properly matched to the planting site have a much better chance of out-growing other less desired com-

peting trees. Establishing a suitable cover crop prior to planting can also help with the early success of a tree plantation by keeping out unwanted vegetation that can overtake and eventually shade out young seedlings. Mowing may have to be done between rows to control less desirable trees and vegetative competition. This also provides access throughout the plantation, which is important for continuous monitoring and maintenance. Once seedlings are free-to-grow, mowing is not required unless access is needed.

The Developmental Stages of a Forest

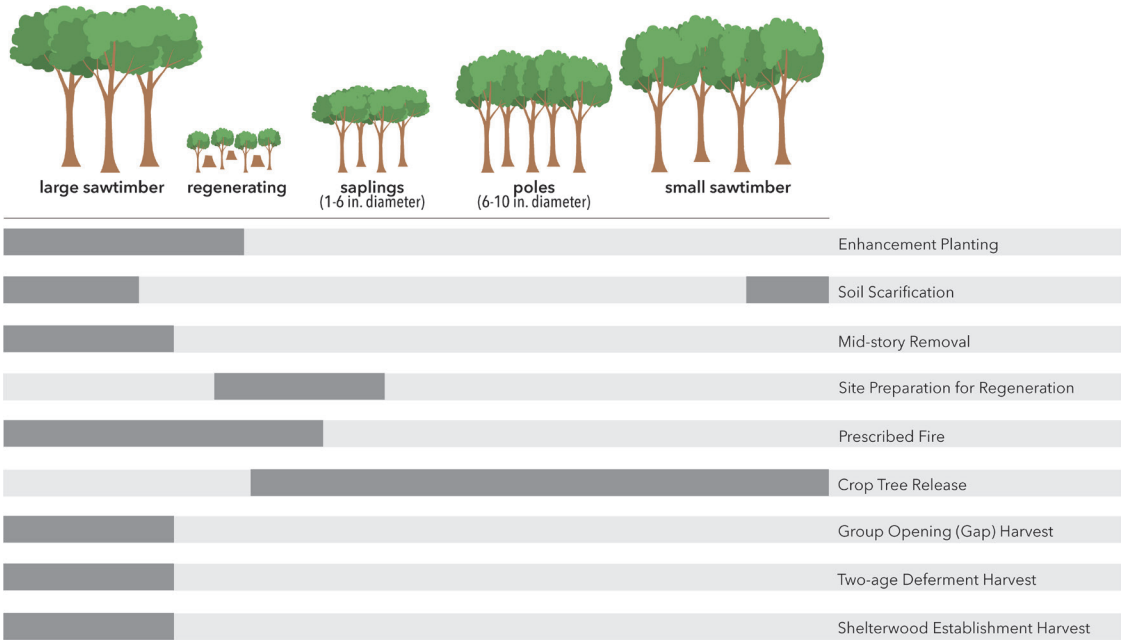

Figure 7: The figure shows a range of developmental stages of a forest, with a mature forest on the far left progressing through regeneration that occurs after a harvest and then growing to sawtimber size over time. While this figure is designed in a manner that indicates an intensive harvest of a mature forest, it is not meant to imply that all forests are to be managed in this manner. It does however provide the range of forest conditions that are likely to be encountered and indicates what practices are typically prescribed for a specific developmental stage. The figure shows each of the management practices (excluding afforestation) and when they occur during each development stage of a typical upland hardwood forest.

For more information about upland oak forest management, refer to White Oak Initiative – Landowners for Oaks Series publications, specifically Landowners Guide to: Challenges Of Upland Oak Regeneration which delves deeper into the complex processes necessary for successful oak regeneration. Professional foresters provide management assistance to forest landowners. For forest management assistance, including a forest management plan specific to your property, contact your state forester or private consulting forester. A forester can visit your property, discuss your goals and objectives, answer questions, and provide management assistance necessary to achieve your forest management goals. The first step in this process of forest management, usually the development of a forest management plan, can lead to a healthy and sustainable forest. To learn more about the White Oak Initiative and the Assessment & Conversation Plan, visit www.whiteoakinitiative.org/assessment-conservation-plan.

The photos at the top of page one represent a few of the many benefits and uses of white oak, making it one of the most important tree species in the Eastern United States. Photos and images courtesy of the authors or the University of Kentucky Department of Forestry and Natural Resources unless otherwise noted.

Stringer, J., and Morris, D. 2022. Landowners Guide to: Sustainable Oak Management Practices. Cooperative Extension Service, University of Kentucky, Department of Forestry and Natural Resources, FOR-149. 5pp.

Issued 10-2022