Modified Oak Shelterwood System in Appalachian Piedmont

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Regenerating oak is more of a process than an event. The probability of replacing an existing oak stand with a new one by just cutting it down and letting it grow back is zero or unacceptably low. If the timber harvest is not timed properly with the oak regeneration process, an oak forest will not replace the existing forest. An oak regeneration process may take up to 20 years to occur. First, acorns must be produced and in sufficient numbers to survive germination and establish new oak seedlings. These seedlings must survive long enough to develop root systems and stems that can compete successfully for dominant positions once a new forest is initiated by a timber harvest. If a harvest occurs before oak seedlings are established or are not able to build large root systems, then it is highly unlikely that a new oak forest will form. Forest managers must design a sequence of timed silvicultural treatments that will foster the development of small oak regeneration that will be at competitive thresholds so they can become a dominant component of the next forest following a timber harvest.

Is Oak Restoration Possible on Your Property?

A site must first meet these prerequisites to be able to apply this Modified Oak Shelterwood technique:

- The site must already be dominated by mature oaks (> 50 square feet of basal area per acre)
- Prescribed burning is possible, and the landowner is willing to use fire.
- The site must have adequate stocking of commercial timber to support several harvests.
- The site quality cannot be too productive (> 80 Site Index). Oak will have a hard time competing with other species, especially yellow poplar, if site conditions are too productive.

Where do you begin?

Steps in Modified Oak Shelterwood Process:

Preparatory Cut:

The objective of this treatment is to remove undesirable species, seed sources of aggressive competitors and poorly formed stems. This provides more growing space for desirable trees (oaks) that will produce the seed that eventually regenerates the stand. We start with thinning the upper-crown class trees, but we only remove about 20-25 percent of the upper main canopy. The upper-crown species we target for removal include sweetgum, red maple, American beech, pine and yellow poplar. We also target trees from suppressed, intermediate and weak codominant crown positions. We also remove as much of the understory and midstory as possible. This is the key to success in using this modified Shelterwood System and why we will try to contract with a logging company that has a chipper that can harvest and whole tree chip small diameter trees. This initial step will greatly improve the diffuse light to the understory that will help promote advanced oak regeneration. To be done correctly we marked the trees to be removed, but we later started marking trees to keep.

Types of low value trees marked and removed during the Preparatory Cut

We try not to harvest oaks that are good acorn producers or harvest trees that would create large gaps in the main canopy. Approximately 75 percent of the main canopy should be maintained. This may require you to leave non-oak species in the overstory to avoid canopy gaps that are too large. Creating too big of a canopy gap will put too much sunlight on the forest floor. The Preparatory Cut is designed to improve understory light levels, but not too much direct sunlight. If too much sunlight reaches the forest floor many co-occurring species will regenerate. Many of these species, especially yellow poplar, will germinate from seed and can quickly overtop small oak regeneration. The goal of the Preparatory Cut is to allow just enough diffuse light to encourage oak development but discourage the germination of competing species. Too much sunlight in the stand can also cause excessive side (epicormic) branching on the remaining trees.

Preparatory Cut

The advantage of a Preparatory Cut over a clearcut is that it allows filtered light to the understory instead of full direct sunlight or no sunlight from a forest with no thinning. Removing no more than 25 percent of the overstory allows filtered or diffused sunlight to reach the forest floor. This filtered sunlight favors the advanced regeneration of the oak species that we are trying to establish.

Herbicide Treatment: Following a Preparatory Cut many of the trees harvested will quickly stump sprout from their roots. If left to grow, they can quickly expand and take up a lot of growing space that interferes with establishment and growth of oak regeneration. Herbicides can be an effective, safe and economic technique for removing aggressive stump sprouts. A year or two following Preparatory Cut, large stump sprouts from undesirable trees (maple, sweetgum, beech, and poplar) should be treated along with any remaining midstory tree that are blocking needed sunlight. Basal treatments are usually recommended when stems are < 2" in diameter or cut and spray treatments on stems larger than 2" in diameter. We utilize basal

treatments with an herbicide that has no soil activity, like Garlon (triclopyr), because it will not harm the surrounding hardwood “mother” trees.

Without a market for small diameter tree (e.g., fuel chips/pellets) a Preparatory Cut may not be feasible for some landowners, so an herbicide release treatment may be the first step you use in this process. Start with the smallest trees that can be operationally treated (typically ½ to 1-inch DBH) and increase your treatment of larger diameter trees. Stop short of removing trees that would open too big of a hole in the main canopy. It is surprising what just treating the midstory and understory will do to significantly increase the diffuse light levels to the forest floor. These new diffuse light levels will help to promote the development of oak seedlings in the understory.

Oak regeneration one year after Preparatory Cut

Even with spraying, we still have quite a bit of regeneration in the understory of these thinned stands. This regeneration significantly increases the available browse for deer. Thinning also increases the understory complexity and nesting structure which benefits songbirds such as Swainson’s warbler, white-eyed vireos, Kentucky Warblers, Worm-eating Warblers and Hooded Warblers. It also increases brooding cover for wild turkeys and improves soft mast production from blackberry, blueberry and pokeberry that germinate from their seed bank in the soil after

the thinning. We try to maintain some mid-story species for their fruit production such as black cherry, blackgum, persimmon and dogwood. This will benefit fruit-eating birds such as Thrushes.

Inventory: For this process to work there must be competitive sources of oak regeneration established in advance of either a Shelterwood Harvest or final overstory harvest. It is recommended that you inventory oak regeneration four to eight years following the Preparatory Cut and/or herbicide treatment. Inventories will enable you to recognize when individual stands meet key thresholds that indicate readiness for specific follow-up silvicultural prescriptions. **Competitive oak** are stems that are highly likely to be dominant or codominant at crown closure of the new stand following harvest of the overstory. These are stems more than 3 feet tall or with a root collar diameter (RCD) greater than 0.75 inches. All oak stump sprouts are also tallied as competitive oak regardless of height. The next type of oak regeneration to look for is **established oak reproduction**. These are oak seedlings and sprouts that are too small to compete for a dominant or codominant canopy position after an overstory removal but are large enough to take advantage of silvicultural treatments designed to help them develop to a more competitive size. Established oak regeneration is defined as stems 0.5 to 3 feet tall or with a RCD of 0.25 to 0.75 inches. The last category of oak regeneration is **new oak,** which are oak seedlings that are too small to be in the other two established oak category. This process is what we sometimes refer to as “growing the oak garden”.

Understory response following Preparatory Cut

How do You Tip the Scales in Oaks Favor?

Release Burn:

We use prescribed fire to free oak from its competition with other woody regeneration. Following the Preparatory Cut, the increased sunlight to the forest floor will stimulate a flush of new growth from all types of woody and non-woody vegetation in the understory. Non-oak species, such as yellow poplar, red maple, sourwood and pine are very aggressive in responding to this increased sunlight. To out-compete their neighbors during this initial increase in sunlight many of these non-oak species will concentrate much of their early development to shoot (height) growth so they can overtop and shade out their neighbors. In contrast, oak responds by spending most of its early development on root development. This inherent difference in initial growth patterns usually leads to oaks demise because they are shaded out by the strong shoot growers. But this strong initial root development can also be an advantage because they are more fire tolerant than many of their competitors. They have a greater ability to survive fires because they have a better-established root system.

But the oak seedlings must be of sufficient size to survive a fire. It may require three to six years following a Preparatory Cut and/or herbicide treatment for the oak seedlings to be in place and of sufficient size before a prescribed burn is recommended. Oak seedlings should have a root collar diameter (RCD) of greater than 0.5 inches before they are likely to survive a prescribed growing season burn. Studies have shown that 70 percent mortality occurs in oak seedlings that have a root collar diameter less than 0.25 inches but just 5 percent mortality in oak seedlings greater than 0.5 inches. This means that you may have to wait three to six years for the oaks to reach this root collar size. If allowed to get this size, fire will select for the oak and against the other woody species.

Growing-season burn

At this stage it would be nice to have a stocking of at least 100 competitive oaks (3-4 feet tall) per acre before conducting the release burn. Release burning is done in mid to late spring, which is April through mid-May. The burning window is from bud swelling on the non-oak hardwoods to full leaf expansion of the canopy trees. Generally a release fire should be moderate to high intensity with flame lengths of more than 2 feet to ensure complete top kill of the understory layer. Summer fires can also be used from mid-August through September when relative humidity is low enough (20 to 35 percent) to allow the fire to carry through the understory. Done properly, release burning can dramatically change the species composition to one that favors oak. It is important to understand that winter burns (dormant season) have very little impact on changing the species composition, because they are not effective at killing the non-oak competition.

Two months after a Release Burn

<u>Shelterwood Harvest:</u>

This harvest is done after the oak regeneration is established and of adequate size. This will be determined by your inventories of oak seedlings following the different pretreatments. A Shelterwood is a harvest that will reduce the overstory stocking to between 40 and 60 percent relative density. The goal will be to maintain between 25 and 50 of the best quality mature oaks

(and hickory) per acre. We recommend that trees selected for saving should be marked prior to harvest, and the logger instructed to harvest everything else but these trees. Undesirable trees (e.g. maples, sweetgums, and yellow poplar) and poor quality oaks should be removed in this harvest. The Shelterwood Harvest will further increase the suitable understory light regime that will allow the established oak regeneration to further develop into the competitive size class. The increased understory sunlight will stimulate the existing oak seedlings, allowing them to develop stronger root systems and increase in height. Releasing the oaks from shade will quickly accelerate their growth. Doing a Shelterwood type harvest without competitive oak regeneration already in place will not work. If oak is not in place, there is little chance that oak will become part of the overstory of the next forest. Retaining mature oaks will also ensure that acorns will be available following the harvest to supplement the existing oak advanced regeneration. The other benefit is that it will maintain merchantable trees that will provide another commercial harvest (final harvest) within 5 to 10 years of treatment.

Shelterwood Harvest

<u>Release Burn (Following Shelterwood):</u>

It may be beneficial to conduct another growing season prescribed fire three to five years following the Shelterwood Harvest. The root collar diameter is again a good measure of an oak seedling's ability to survive fire and support new, vigorous shoot growth. Oak seedlings with a root collar diameter greater than 0.5 inches will resprout and develop into desired advanced reproduction. Unfortunately, the added light reaching the forest floor following a more intense

Shelterwood Cut will encourage competitors such as yellow poplar and red maple to germinate and stump sprout. A growing season fire will again tip the scales in oak's favor. By eliminating competitors, it will increase the relative amount and quality of oak in the regeneration pool.

Red oak seedling re-sprouting a week after growing season burn

Re-Inventory: Conduct additional inventories of oak regeneration two to three years following Shelterwood and release burn. At least 50 percent of the regeneration plots should be stocked with **competitive oak seedlings** (> 0.75 inches RCD) before a final regenerative harvest is conducted. A good target for successful regeneration is about 300-500 competitive oaks seedlings per acre.

Final Regenerative Harvest:

The final removal harvest is the last harvest in the oak restoration sequence. The final cut will create a high light environment that favors growth of the competitive oak regeneration already in place. To implement this practice, harvest all trees larger than 1-inch d.b.h. (diameter at breast height, i.e. 4.5 feet above ground). However, as much as 15 square feet of basal area per acre of residual oak trees can be left post-harvest to meet aesthetic, diversity or wildlife objectives without impeding oak regeneration.

If these final regenerative (clearcut) harvests are staggered out over time and kept to small sizes (< 25 acres) you can maintain mature canopy stands for longer periods of time. This will also stagger income-producing events and minimize the negative visual impacts of a large clearcut. The size, location and use of aesthetic buffers to break up these regenerative harvests can also help to minimize the negative visual impacts of a larger clearcut.

Post-Harvest Follow-up and Crop Tree Management:
Evaluating the success of oak reproduction is important after the final harvest. Follow-up evaluation should occur about 5 years after the final harvest. Oak reproduction should be evaluated for a Crop Tree Release treatment about 10 to 20 years after the final harvest. Crop Tree Release Treatments can further tip the scale in favor of maintaining oak in the future stand.

Summary:
A modified oak shelterwood system by far is one of the most difficult prescriptions to undertake and will require a forestry expert with knowledge of hardwood silviculture and site analysis to implement correctly. It will require proper marking of the trees and careful selection and oversight of the logging company that will perform this type of harvest to ensure that they do not damage future crop trees during the harvesting operation. A light touch, low impact harvesting method will be essential during the preparatory and shelterwood cuts. It will also require the use of an experienced burner to properly time and implement a "growing season" burn to tip the scales in oak's favor.

This modified oak shelterwood system promotes the types of objectives that most landowners want from managing their forest. It enhances and restores oak forests, which are on the decline state and region wide. It improves wildlife habitat by improving understory diversity, abundance and complexity. It creates multiple revenue producing events while still enhancing timber quality and production. And it helps improve and protect aesthetics by maintaining mature canopy trees, and it creates the visual appeal of a park-like forest. All of these objectives can be successfully met utilizing this system.

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