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OAK REGENERATION PRACTICES: SMALL (GAP) OPENINGS

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Small, harvested openings can provide partial sunlight that would favor development of oak advance reproduction, if reproduction is present. The partial sunlight is from two sources. The edge trees will cast shade into the harvested opening. Side light also can penetrate forested edges, creating the partial light for oak regeneration and development.

The size of the harvested opening will affect the amount of sunlight received and thus influence the species that will regenerate based on species' light tolerance. Research by John Lhotka at the University of Kentucky1 followed for 48 years the species composition of various-sized openings. Harvest openings with diameters of 50 feet (0.05 acres) supported shade-tolerant species such as maples; 150 feet (0.40 acres) favored more shade-intermediate species such as oaks; and 250 feet (1.1 acres) advanced intolerant yellow-poplar. Opening size and shape can vary to promote oaks based on objectives and cost. For example, a larger opening would support intolerant species in the center of the harvest that is not being impacted from the shade cast by edge trees. More shade-intermediate species would emerge at the margin of the harvest opening under the influence of edge trees.

Gap openings are defined as an opening where the regeneration for the entire opening is affected by the edge trees, that is, no area receives full sunlight for the entire day. Opening size is generally 0.5 to 1.0 acres which provides the partial sunlight microenvironment that benefits oak. Harvest openings can be placed in areas where oak advance reproduction is present. If not present, measures should be taken before the harvest to establish advance reproduction. When harvests are larger than an acre, they are known as patch openings or patch clearcuts.

Another practice, expanding gap or femelschlag (German term), takes advantage of the side light that infiltrates from the edge of the harvest. This partial side light aids establishment (if oak seed trees are present) and growth of oak advance reproduction. Once the advance reproduction is large enough to be released, the gap is expanded through an additional harvest encompassing the 40+ feet perimeter where there was side light from the original harvest.

A regeneration opening about 1.5 acres in size. Direct sunlight in the middle of the opening supports shade-intolerant, sun-loving species such as cherry and yellow-poplar. However, the perimeter of the opening receives partial sunlight from edge trees that favors growth of oak seedlings. Photo Credit: *Wayne K. Clatterbuck*

This process would continue with development and subsequent release of advance reproduction by expanding the gap at each entry consisting of a small width, harvested swath around the perimeter of each opening. Harvesting expanded gaps with their limited areas and volumes is usually not economically feasible. Another disadvantage associated with expanding gap is that edge trees are phototrophic and will lean and bend toward the ample sunlight in the opening causing larger branches and crooked boles that diminish tree form and value. Additionally, although older edge trees will protect young, advance reproduction to a degree, the larger root system of older trees may adversely impact moisture relationships of young seedlings in their vicinity.

Partial sunlight in a small gap opening less than 0.4 acres in size with vigorous 4-year-old white oak seedlings. Photo Credit: *Wayne K. Clatterbuck*

The following example is an illustration of how gap openings could be systematically implemented in a stand. The structure would be an uneven-aged stand composed of several even-aged units distributed across the stand.

Example: Harvesting an 80-acre stand in four separate entries spaced 15-years apart, 60-year rotation

First Entry: Harvest 20 acres (25 percent of stand) in small gap openings

Second entry: Harvest another 20 acres in small gap openings after 15 years. Age of trees in opening from first entry is now 15-years-old.

Third entry: Harvest another 20 acres in small gap openings after 30 years. Age of trees in the opening from first entry is now 30-years-old, age of trees in openings created from second entry is 15-years-old.

Fourth entry: Harvest remaining 20 acres in small gap openings after 45 years. Age of trees in openings from first entry is now 45-years-old; age of trees in openings created from second entry is 30-years-old; and age of trees in openings from the third entry is 15-years-old. Entire 80-acre stand has been harvested in four entries.

Next entry in 15 years harvests trees that regenerated after the first entry that are 60 years old.

Benefits of progressively creating openings are that the stand is continually managed both within and between gaps at each entry to optimize stand growth of desired species. Frequent disturbances maintain open forest conditions in the stand that supply the partial sunlight to establish and develop oak advance reproduction during each entry in preparation for the harvest.

Harvest openings provide wide flexibility in regenerating oak. Smaller openings are more efficient for oak advance reproduction, but edges on larger openings can also regenerate oak with more intolerant species in the center. Larger openings may also retain some residual trees for acorns and shade similar to the shelterwood and two-age regeneration practices. Size and shape of opening can vary to capitalize on physical features of the land, ownership objectives, economics, as well as the presence of oak advance reproduction. Another concept not yet addressed by research is to retain groups or islands of trees rather than harvesting groups of trees, cutting between established groups.

Assorted options are available to apply different opening attributes to regenerate oak. However, each of these options is still a process that requires development of advance reproduction (advanced growth dependent) to successfully regenerate oak and partial light conditions through more open forests (disturbance dependent) to maintain development of shade-intermediate oaks.

BENEFITS

- Several opportunities to create partial light conditions advantageous to the development of oak advance reproduction in the small opening, on edge of larger opening, and in the intact exterior of the resident edge for 30+ feet (penetration of side light from the opening).
- The stand is disturbed frequently with different harvest entries. The area between harvested groups can be managed during each entry to benefit the growth of favored species (oaks) through thinnings and restricting undesired vegetation.
- Vegetation has greater diversity when applying openings with varied attributes.

WEAKNESSES

- Smaller harvest areas (many smaller groups) add more harvesting expense since each group will require a road or skid trail to the landing. Harvesting the same volume in many smaller openings is more expensive than in fewer and larger openings.
- Checkerboard impact of harvesting smaller groups in the stand causes non-continuous forest structures.

White oak advance reproduction in small gap opening. Photo Credit: *Wayne K. Clatterbuck*

FURTHER READING

LeDoux, C.B. 1999. An integrated approach for determining the size of hardwood group-selection openings. Forest Products Journal 49(3):34-37. (https://www.fs.usda.gov/research/treesearch/14450)

Lhotka, J.M. 2013. Effect of gap size on mid-rotation stand structure and species composition in a naturally regenerated mixed broadleaf forest. New Forests 44:311-325.

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