Using Midstory Removal to Enhance Oak Development

by David L. Parrott, John M. Lhotka, Jeff W. Stringer

Managing for oaks is an objective shared by many woodland owners. Oaks are among the most valuable timber species within the region and serve as a valuable source of nutrition for wildlife. While a historically dominant tree species within Kentucky and other central hardwood forests, changes in disturbance patterns have created difficulties in maintaining oak dominated forests, particularly on medium and high quality sites. After clearcuts and other harvests that create open environments, fast growing species like yellow-poplar and understory species like maples are replacing oaks. Investigation of methods that can improve the regeneration of oak are needed to help woodland owners and foresters retain oaks in our woodlands.

Problem

Previous research has shown that the difficulties in keeping oak in our woodlands following regeneration harvests are due to lack of tall and vigorous oak seedlings being present in the woodlands prior to harvests. Oak seedlings should be at least 3 feet tall in order to be competitive after a harvest. Although some oaks, particularly white oak, can persist as seedlings in shade, they require intermediate levels of light in order to grow to competitive sizes. Because of changes in disturbances and the absence of fire, species that can grow in low light environments such as red maple and American beech have often developed dense understories in many woodlands, especially those of medium or high quality. Under these understories, light levels are extremely low and inhibit the development of oak seedlings. Therefore, management activities to improve the abundance of competitive oak seedlings must include increasing light levels while ensuring that too much light does not stimulate competitors such as yellow-poplar. This fine-tuning of the light allows oak seedlings that are present to grow in height and vigor so that they can compete when the stand is harvested. Studies have shown that removing the midstory can increase the growth and survival of various oak species. Determining how to implement these midstory removals is a necessary step to ensure the continued presence of oaks in Kentucky forests.

Photos courtesy: David Parrott

Oak seedlings are finding it challenging to successfully compete under heavy midstory canopies. Research is ongoing to find ways to ensure that oaks will be a part of Kentucky's forests in the future.

Research Project

In 2004, the University of Kentucky Department of Forestry began investigating the effects of midstory removal on intermediate quality sites within Berea College Forest in Madison County, Kentucky. This study, initiated by Dr. Jeff Stringer and Dylan Dillaway, was designed to monitor the impact removal of the midstory had on the survival and growth of natural and underplanted white and black oaks as well as red maple, which is an oak competitor. Plots were established throughout the forest, a number of them receiving a midstory removal where red maple and beech were killed (midstory removal treatment) and a number of them where these species were left in place (control). Midstory removal treatments were performed by removing sapling and pole-sized red maple, beech, blackgum and similar species. Trees were taken out by starting with the smallest trees with 1-inch diameters and working up to taking out larger trees until approximately 20 percent of the basal area was removed. This treatment did not remove any main canopy (dominant or codominant) trees. All stumps were treated with herbicide to prevent resprouting. Within each plot, white and black oak 1-0 bareroot seedlings were planted, and natural white and black oak and red maple seedlings were tagged, measured and followed. Initial research by Dillaway and Stringer found that oak seedlings responded in diameter and root carbohydrate levels, indicating that the midstory removal was working. However it would take time to determine if treatment was helping the oaks in a meaningful way. Seven years after this initial work, Dr. John Lhotka, Dr. Stringer, and David Parrott returned to these plots to measure the height, ground line diameter, and survival of the trees as well as the light levels in plots.

Results

Light measurements indicated that the midstory removal increased light levels from 5.3 percent of full sunlight in the control (undisturbed) plots to 14 percent full sunlight in the midstory removal plots.

A. Dense midstory canopies (a) limit light availability to oak seedlings below the midstory canopy.

B. The removal of the midstory (b) prior to the harvest increases the amount of light that reaches the developing oak seedlings.

C. Seven years following the midstory canopy removal (c) the oak seedlings a have responded and are much more likely to be a part of the dominant canopy following a harvest of the overstory trees.

Photos courtesy: Jeff Stringer

This change in light had a significant impact on the oak seedlings. Before midstory removal, all natural and underplanted seedlings were the same size, but after seven years, natural and underplanted white and black oak seedlings were 7.6 to 18.5 inches taller in the midstory removal plots. Within the treated areas, seedling heights ranged from 1.5 to 2.5 feet, and ground line diameters were 0.1 to 0.2 inches larger than in the control. In addition to size, treatment increased survival 16 to 32 percent among species and reproduction types.

When looking at potential competitors, red maple also exhibited a positive response to the midstory removal. While red maple continued to remain a potential competitor, seedling inventories showed that the light levels created in the midstory removal did not encourage an emergence of fast growing species that can take advantage of high levels of light.

Management Implications

Results from this study show that a midstory removal can increase the survival and growth of oak seedlings. Before performing a midstory removal, an abundance of oak seedlings must be present in order to take advantage of the treatment. As seen in this study, underplanting oaks is a viable option. This treatment is designed to be an initial step in a system to develop oaks that can be competitive and contribute to future stands. Since it can take 10 or more years for seedlings to reach competitive heights, implementation should occur several years before a final harvest. Following a midstory removal, seedlings should be monitored to ensure that oaks are responding to treatment. If further oak development is needed, removal of some overstory trees may be necessary in order to provide additional light. Once oaks have reached competitive heights, a final harvest can take place. Prior to or immediately following harvest, operations such as burning or competitor removal may be necessary to increase the probability of oak success.

About the Authors:

This research was conducted as part of a Masters research project by David Parrott (david.parrott@uky.edu), who is currently a technician in Dr. John Lhotka's silviculture lab at the University of Kentucky Department of Forestry. This research project was overseen and directed by Dr. John Lhotka (jmlhot2@uky.edu), Assistant Professor of Silviculture, and Dr. Jeff Stringer (stringer@uky.edu), Extension Forestry Professor, of the University of Kentucky Department of Forestry.