

U.S. FOREST SERVICE AND PARTNERS INVESTIGATE

Fire and Thinning Effects on Oak Regeneration in Southern Ohio

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Oaks dominate a large percentage of the forests in southern Ohio. But, have you ever looked at the seedlings and saplings that are regenerating under these predominately oak canopies? Typically very little oak and often the seedlings and saplings are red maple, sugar maple and American beech.

Over time, as the trees in the canopy die or are removed in a harvest, they will be replaced by seedlings and saplings that are already established in the understory. Without a change in management on many of our privately owned forests, the future forests will be dominated by species other than oak. Whether or not this is a problem depends on your point of view. For blue jays, woodpeckers, squirrels, turkey, deer and many other wildlife species, acorns are a large part of the diet that sustains them through the winter months. Also, Ohio's forest industry, especially in southern Ohio, depends largely on the oaks to produce high quality lumber.

So why are oaks not regenerating in the understory of our oak forests? We know some of the answers, but we still have much to learn. We know for instance that American beech and the maples require as little as three to five-percent of full sunlight to survive and grow. They can become established and grow well under the dense shade of other trees. Most oaks on the other hand need a minimum of about 15 percent of full sunlight to become established and grow. Often red and sugar maple saplings develop a second layer of canopy under the main canopy that further shades the forest floor preventing oaks and hickories from getting established.

We also suspect that fire and past land use played a role in the establishment of many of our oak forests in southern Ohio. The fires served to keep the forests less dense thus providing the light conditions favored by the oak and hickory seedlings. Some species with thicker bark, including many of the oaks, can tolerate periodic fire better than other species like American beech and the maples. Oak seedlings have deep root systems, which allow them to sprout multiple times if they are

damaged by fire or other means. Maples and beech have shallow root systems, thinner bark, thus are not as likely to survive repeated exposure to fire. Also maples are pumping their sugar packed sap into their trunk and branches when many of our spring fires occur in Ohio. This makes them more vulnerable than the oaks, which keep their energy stored in their roots until after the spring fire season has passed.

Another possible explanation for the lack of oak regeneration could be white-tailed deer and other wildlife. In Pennsylvania and other Northeastern states deer have been shown to greatly inhibit the regeneration of oak and many other tree species. Deer populations in Ohio are significantly lower than those in many Northeastern states, and their effect on forest regeneration is less certain. However, we do know that when most of the oaks in our forests became established deer were virtually non-existent in Ohio.

The U.S. Forest Service (USFS) began looking at the effects of prescribed fire on the oak ecosystem in Ohio in the mid 1990s. A large study was conducted in Vinton and Lawrence Counties where scientists with the USFS, Ohio State University and Ohio University studied the effects of fire on various aspects of this ecosystem. They found that fire greatly reduced the numbers of maples and other non-oak tree species, but oak seedling and sapling abundance was not increased. They also found that soil fertility, native plant diversity, bird abundance and productivity, and insect populations were not harmed by repeated fire. The major conclusion of this study was that after more than 75 years of fire suppression, prescribed fire alone will not solve the oak regeneration problem.

In order to build on the knowledge gained from the initial study in Lawrence and Vinton Counties, the USFS, Forestry Sciences Laboratory in Delaware is coordinating the Ohio Fire and Fire Surrogate Study, which is a collaborative effort among the USFS, MeadWestvaco Company, ODNR-Division of Forestry, Ohio State University and Ohio University. This is part of a national study, which is funded by the U.S. Joint Fire Science Program, designed to look at the combined effects of fire and timber harvesting on forest ecosystems across the United States. The Ohio portion of the study is being conducted on Zaleski and Tar Hollow State Forests, and the Vinton Furnace Experimental Forest. At each site four, 50-acre treatment units were established in mature oak-dominated forests. These treatments are designed to evaluate the effects of harvesting, fire and a combination of both on oak regeneration.

Treatment units include:

- (1) Untreated control
- (2) Prescribed fire (two to three foot flame height) at four-year intervals
- (3) Thinning to remove smaller diameter canopy trees especially red maples
- (4) Thinning followed by prescribed fire.



Mopping up after a prescribed burn. Photo credit: USFS - Northeastern Research Station, Delaware, Ohio

Prior to harvest and burn treatments, plots were established and baseline data were collected. Harvests were conducted in the summer, fall and winter of 2000. Harvesting guidelines were developed by USFS personnel in conjunction with State foresters, and the harvests were administered by ODNR-Division of Forestry and MeadWestvaco foresters. An economic analysis was conducted on the harvesting operations by faculty from the Ohio State University School of Natural Resources to determine the economic feasibility of the operation. USFS researchers conducted a tree ring analysis of overstory trees removed in the thinning operation on these sites, which provides strong evidence that nearly all of the overstory oaks became established prior to 1925, while red maples in the canopy initiated after 1925. This is significant since fire intensity and frequency were greatly reduced on these sites when organized fire suppression began in Ohio in 1923.

Prescriptions for the burns on the study sites were developed by USFS and ODNR-Division of Forestry personnel. The first round of burns was conducted by fire crews from ODNR-Forestry, USFS and Hocking College, in late March and early April of 2001. A total of six units were successfully burned, and data was collected on fire behavior, fuel consumption and economics.

As part of this larger effort, Ohio State University Extension personnel with funding from the National Fire Plan began studying the effects of white-tailed deer on oak regeneration. Eight-foot tall fencing was installed on 36 plots to exclude deer. Unfenced areas are being compared to fenced areas to determine if deer are contributing to the oak regeneration problem by browsing oak seedlings and eating acorns. Early results indicate minimal effects of deer browse on existing oak seedlings in all treatments.

However, oak sprouts, and seedlings of many non-oak species including blackgum, sassafras, and red maple are more heavily browsed. As for acorns, the effect of deer is less clear. Since acorn crops vary greatly from year to year, we expect deer effects to be highly variable. After the first winter of the study, over two and one half times more acorns were found within the fenced areas, but in the subsequent years, when acorn production was much lower, acorn counts were essentially the same inside and outside of the fenced areas.

In addition to providing us with valuable insight on oak regeneration, this large replicated study also provides a unique opportunity to study fire and thinning effects on other aspects of the forest ecosystem. Some of the things that researchers are studying include: carbon sequestration; fire behavior; fuels; fungal populations; herbaceous and woody plant populations; insects and disease; light availability; overstory tree growth and mortality; soil moisture and water movement; soils and soil fertility; and wildlife including birds, bats, flying squirrels and other small mammals.

As we enter the fifth year of this study we are preparing for a second round of prescribed burns and much more data collection and analysis. We believe that the combined efforts of all of those involved in this massive study will help to put into place many of the pieces in the oak regeneration puzzle. For specific information about this effort visit the Fire and Fire Surrogate Web page (http://www.fs.fed.us/ne/delaware/4153/ffs/Ohio_Hills_Study_Site.htm) or contact Dave Apsley, Ohio State University Extension Center at Piketon (apsley.1@osu.edu; 740-289-2071) or Dan Yaussy, Forestry Sciences Laboratory, Delaware (dyaussy@fs.fed.us; 740-368-0101).
