Let's talk about Fire
in Upland (Oak) Hardwood Forests

By Callie Jo Schweitzer, PhD
Research Forester, US Forest Service, Southern Research Station

Managing the upland hardwood forests of Alabama is nothing short of challenging. Beautiful and diverse, the forests are a result of unbelievable consequences. These forests came about after tremendous disturbance and they remain tied to disturbance, whether introduced by us, or by nature. At the turn of the previous century, these forests were subjected to a perfect storm of disturbances that resulted in the stand structure and species composition we have today.

Most are aware of the story of the American chestnut. This majestic species is purported to have occupied one of four dominant tree canopy positions in our upland forests. The death of these giants was unique, as the chestnut blight resulted in a 'death in place' scenario, and this created a peppering of dead trees and small open areas in our stands.

At the same time, human demographic changes were rampant, with the demise of Native American populations and the movement of Euro Americans to the South. Along with these changes came different expectations and uses of the forests, as the forests were exploited as an almost inexhaustible resource. We harvested timber to meet our needs as a growing nation, without regard to future forest composition and structure. We increased the amount of grazing by domestic animals and influenced the natural pressures from wildlife by hunting and habitat manipulation. Also, the people in the early 1900s used fire in ways that the Native Americans may not have; fire was a broad-based tool used to clear out underbrush, drive out varmints, and clear logging areas. Fire also was set accidently and allowed to run its course. Regardless, this perfect storm of disturbances resulted in our oak-dominated upland hardwood forests of today.

While forest managers are not suggesting returning to these more wild times, we do suggest that mimicking some of these disturbances may be beneficial to sustaining species composition (especially oaks) that we desire. This desirability is reflected by landowner preferences, but suffice to state that many landowners would prefer to keep oaks in their stands. The judicious use of fire in hardwood stands may assist with meeting these goals.

We know so little about the true history of fire in our systems that it is difficult to replicate it. For example, for any given stand, little is known about the species distribution by stem size class when a fire may have been introduced. Even less is known about the fire itself, characteristics such as the season of burn, fire intensity, fuel loading, and weather conditions. Many fires were set not for specific management goals, but for some general effect instead or by accident. Thus, the resultant stand composition may, or may not, have been influenced by any given fire.

The science behind fire in upland hardwood stands is advancing. For many years, fire was thought to be a detriment to the quality of timber, which was the primary forest product. The reasons behind this belief are myriad, including observation of increased rot and degrade in forests that were exposed to fire. What must be kept in mind is that these fires were not introduced as part of a silviculture prescription, and their impact to the residual stand was not considered. It is possible that the fires that resulted in degraded hardwood timber were set at the wrong time in stand development. Recent research on the effect of fire on the quantity and quality of red oak timber product value in Missouri showed that if the stand was harvested within five years of a prescribed fire, the amount of value loss was minimal (*Marschall et*

al. 2014). Conversely, in a study of the impacts of wildfire in Kentucky forests, an average value loss per acre was $404 (*Reeves and Stringer 2011*), while in West Virginia, multiple wildfires resulted in a 54 percent decline in stumpage values, with values decreasing as much as $619 per acre (*Wood 2010*). An examination of boards presenting defect attributable to the heat of prescribed fires showed that 2 to 16 percent of all boards sawn from butt logs were affected, with associated defects including mineral stain, decay, shakes, and checks (*Weidenbeck and Schuler 2014*).

Indiscriminate wildfire and prescribed fire applied at the wrong time in the stand's rotation can also result in higher percent cull in live total net volume, increased overstory mortality, and loss of vigor. Tree injury and mortality related to fire depends on species, size, and individual tree characteristics. Low-intensity, dormant season prescribed fires usually have minimal effect on overstory hardwood tree mortality. Smaller stems of all species are susceptible to damage and death with fire. In general, top kill of hardwood trees less than 4 inches in diameter at breast height (dbh) is common, and a proportion of stems up to 8 inches dbh will be impacted. This impact depends on each individual stem's species and general vigor. Hardwood stems will resprout, and the fire-in-oak-systems prescription is predicated on the biology of oaks, which have an advantage over competitors for surviving fire due to: preferential allocation of carbohydrates to root growth, and an abundance of dormant buds located on seedling tissue that is below the soil and thus insulated from the heat of the fire.

We have learned a few additional pieces of information related to the fire-in-oak forests prescription. Oak has an advanced growth-dependent reproduction strategy. In essence, a stand must have sufficient number of oak seedlings in a competitive position in order to regenerate the stand and sustain oak, prior to any introduction of disturbance (fire, harvesting). While the number and size of these oak seedlings are site- and stand-dependent, managers should error on the side of more seedlings and bigger seedlings is better. Fire will not magically create a plethora of large, competitive oak seedlings. Fire may have a larger impact on those species competing with oaks such as red maple, yellow-poplar, and sweetgum, especially if multiple fires are part of the prescription. Using fire as part of a regeneration prescription requires an assessment of the status and number of advanced oak reproduction, as well as any aggressive competitor species; some type of stand disturbance to open up the canopy and to allow more sunlight to the understory; and multiple fires.

The use of fire in hardwood forests can assist in meeting management goals. Timing of fire is of utmost importance. If using fire in a mature stand to meet aesthetic or wildlife goals, and timber production is desired, harvesting trees within five years may minimize degrade. Prescribed fire at this time will also open the understory, enhancing light and growing conditions for all species, including oaks. Additional fires may promote oak dominance in the seedling and sapling layer over other species, provided the oak advanced reproduction present is large and numerous before harvesting. At some point, burning must stop to allow recruitment of the seedling sprouts of oaks into the overstory, which may take 10 to 30 years. A fire-free period is crucial to permit this recruitment. If a vigorous sprouting response from competing species persists, herbicides can be used to release the oak crop trees without the risk of stem damage that fire would introduce.

Mimicking that perfect storm of disturbances that gave us our oak-dominated hardwood stands requires managers to pull out all their tricks.

References

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Left: Damage to the lower bole of white oak after a prescribed fire in north Alabama. Center: Minimal lower bole damage following several dormant season prescribed fires in north Alabama. Right:Oak seedling sprouts following dormant season prescribed fire.