FIRE AND THE OAK REGENERATION PROCESS

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PURPOSE AND SCOPE

Oak species and fire have a long and generally positive relationship. For thousands of years, where there was a frequent, mixed-severity fire regime, oaks prospered. Oaks have a suite of adaptations to fire including thick bark on larger trees, high vegetative sprouting capacity in young growth and small-diameter timber, ability to develop numerous large advance reproduction in sufficient light, preferential carbon allocation to root growth important for rapid sprouting after fire, periodic acorn masting, highly flammable litter in some species, drought resistance and tolerance of xeric site conditions, and seed that is often dispersed and buried in soil by mammals and birds. Loss of oak in eastern forests has been attributed, in large part, to the removal of fire from ecosystems and other changes in disturbances and management practices. This presentation provides an overview of fire-oak interactions throughout the life cycle of oak as it impacts oak regeneration success. Managers and scientists now seek to understand and manage the role of fire in silvicultural prescriptions to restore and sustain oak forest ecosystems (i.e., forest, woodland, savanna).

METHODS AND APPROACH

Fire affects oak regeneration, including acorn production, seedling establishment, and advance reproduction growth. Recurring fire over time may indirectly influence acorn production by promoting crown growth in surviving mature oak trees. Fire conducted before acorns drop can help reduce deep litter layers that may inhibit oak seedling establishment, reduce acorn predator habitat and competing vegetation in the understory, deplete competitor seed in the soil seed bank, and release nutrients for oak sprout growth. Once acorns are on the ground, they are highly vulnerable to mortality by surface fires, as are new oak germinants and young seedlings, but larger and older oak stems can persist following topkill by fire through sprouting. Probability of topkill declines with increasing stem diameter. Repeated fire increases understory light by reducing overstory and midstory density, which promotes oak advance reproduction growth.

FINDINGS AND IMPLICATIONS

To sustain oak stocking in future forests, oak reproduction must be able to grow up into the overstory. Use of frequent fire may be good at increasing oak abundance and competitiveness as advance reproduction, especially when used with stand thinning or shelterwood harvesting, but its continued use truncates

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oak recruitment and locks oak in a long-term cycle of fire topkill and sprouting. Oak stems must grow to sufficient diameter with thicker bark to persist intact after fire and continue growing into the overstory, and this requires a sufficient fire-free period at the individual tree level.

There are no complete surrogates for fire in managing oak forests and other fire-dependent ecosystems. But fire alone is seldom the solution to restoring and sustaining these ecosystems, especially in the early stages of restoration, where novel vegetation conditions and threat of invasive species demand the combination of fire with other practices (mechanical and chemical). It is the combination of fire with other practices and the sequencing of treatments over time that are fundamental to prescription design and management success. Fire can benefit oak regeneration and stand development, but its role varies with life cycle and developmental stage of the oak forest, initial vegetation conditions, site conditions, threat of invasive species, other disturbances and management objectives.