Managing oak forests in the Eastern United States: when and where should fire be applied?

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The use of fire to manage eastern deciduous forests has been embraced by forest managers due to increasing knowledge of historic disturbance regimes. However, oak forests occur across a range of ecological settings, and fire may not always be the most effective tool for accomplishing specific ecological or silvicultural management objectives. Arthur et al. (2012) conducted a literature review to explore the physiological and ecological basis for burning in oak-dominated forests in the Eastern United States. Although the authors did not focus on oak forest responses in the Lake States region, their publication discusses differences between white oak and red oak groups and therefore can provide valuable information to managers in this region. Specifically, the literature review addressed the limitations of using prescribed fire in oak-dominated forests, considered oak life history to determine stages when fire could be most useful in enhancing regeneration, and recommended questions for managers to consider to help determine when and where to use fire as a management tool. We refer our readers to the original publication for more details about the guiding questions for managers presented in Table 1 (Page 2 of Brief).

MANAGEMENT IMPLICATIONS

1. Fire is not a one-size-fits-all management tool in oak forests, and many factors must be considered when deciding whether or not to burn.

2. The purpose of the literature review was to help managers select the best management tool for accomplishing specific management objectives in eastern oak forests.

Reference

Arthur MA, Alexander HD, Dey DC, et al (2012) Refining the Oak-Fire Hypothesis for Management of Oak-Dominated Forests of the Eastern United States. J For 110:257–266. doi: 10.5849/jof.11-080

Want to learn more?

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Table 1. Fifteen questions for managers to ask to assess the potential use of fire for managing oak forests, with management recommendations for each response, shown by oak life stage (adapted from Arthur et al. 2012).

Flowering, pollination, and acorn production **1. Would a reduction in stand density improve the canopy position of large seed-bearing trees?**	
YES: Fire could lower the density of competing fire-intolerant species.	NO: Fire may not be useful.
Acorn germination and seedling establishment **2. Is forest floor depth hindering seedling establishment?**	
YES: Fire could enhance acorn germination by consuming a portion of the forest floor and preventing acorn desiccation prior to germination.	NO: Fire may not be useful.
3. Is the litter layer dry enough to be consumed by fire?	
YES: Plan burning when conditions are conducive to forest floor combustion.	NO: Delay fire until litter dries out.
4. Is the forest floor covered with leaf litter from species known to have flammable litter?	
YES: Plan burning when conditions are conducive to forest floor combustion.	NO: Fire may not be useful.
5. Can fire be timed to coincide with dissemination of seeds of competitor species (but not of oaks), thereby reducing competition from non-oak species?	
YES: Time fire with this goal in mind.	NO: Fire may not be useful.
6. Was there a recent oak mast crop?	
YES: Delay fire to avoid burning acorns.	NO: Not a consideration for decision to burn.
7. Is there evidence of a mast crop in the canopy?	
YES: Consider timing burning to precede mast crop where forest floor depth is potentially limiting to acorn germination or to set back competitors.	NO: Not a consideration for decision to burn.
Seedling development **8. Is forest stand density limiting the availability of light to oak in the understory?**	
YES: Fire could reduce mid- and overstory competitors and provide increased light to oak seedlings.	NO: Fire may not be useful.
9. Are oak seedlings present in the understory in significant numbers and large enough sizes to survive fire?	
YES: Fire could reduce competitors while allowing oaks to resprout.	NO: Fire may not be useful.
CONSIDERATIONS: If existing oak seedlings are of sufficient size to survive multiple fires, repeated fire may be used to control competitor species. Oaks need adequate light to grow between fires.	
10. Are competitors in the understory present in sufficiently small numbers and sizes to be killed by fire?	
YES: Fire may reduce competitor abundance, but will only have positive implications for oak regeneration if oaks are of sufficient size and numbers (see previous question).	NO: Fire may not be useful.
CONSIDERATIONS: If competitors are likely to resprout, consider repeated burning or other alternatives to burning such as cutting and herbiciding to reduce competition.	
11. Do competitors have a seed bank strategy?	
YES: A single fire may "release" these species leading to an abundance of newly germinated seedlings that will compete with oaks.	NO: Not a consideration for decision to burn.
CONSIDERATIONS: Repeated fire may be useful to release, but then kill, newly germinated competitor seedlings.	
12. Would large competing trees withstand multiple fires and continue contributing to the seed bank?	
YES: Fire may not be useful to address this goal.	NO: Not a consideration for decision to burn.
CONSIDERATIONS: Thinning or timber harvesting may be good alternatives to reduce the density of seed bearing competitors.	
Release from competition and recruitment into the canopy **13. Is oak advance regeneration sufficient to achieve desired stocking after fire?**	
YES: Fire could reduce stem density and increase light availability.	NO: Not a consideration for decision to burn.
14. Will fire aid in the creation of canopy gaps?	
YES: Fire could increase light availability for oak release.	NO: Fire may not be useful.
ALTERNATIVE: Mechanical or herbicide methods may be used to open gaps.	
Maintenance of oak dominance **15. After burning, are oaks maintaining dominance in the canopy and are they regenerating in the understory?**	
YES: Continue monitoring to ensure oak regeneration success.	NO: Use fire, other means of thinning or crop tree release, and/or competitor suppression.