Oak Decline on the Ozark Plateau

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Over the past five years, an insect/disease complex has had major impacts on the forests of the Ozark Plateau. The immediate cause of this problem is a protracted regional drought, but this has only been the stage-setting event for the final act of a drama that has developed over a much longer period of time. A thorough understanding of the problem is necessary before a workable solution can be agreed upon.

Historic Perspecive

Oak-dominated forests have been a feature of the Ozark Highlands for as long as most living residents of the region can remember. In pre-settlement times, however, this area, spanning northern Arkansas and southern Missouri, was quite different. Open woodlands covered most of the region, dominated by shortleaf pine on ridges and southerly slopes, grading into pine-oak mixtures on northerly slopes and oak-hickory stands along streams and in bottomlands. Fire was a regular feature of this ecosystem, generally initiated by Native Americans and allowed to spread unhindered across the landscape almost on an annual basis. This regular burning kept the forest open and maintained a grass-forbs understory supporting a rich assemblage of wildlife. Early European settlers introduced cattle and eliminated most of the native predators, but continued the practice of burning the woods fairly regularly.

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As settlement expanded and agriculture began to dominate the landscape, woods burning declined in frequency and extent, and oaks began to spread from their more sheltered habitat into the understory of the pine woodland. The first two decades of the Twentieth Century witnessed an era of railroad logging that removed most of the mature pine timber from the region. Oaks filled the void, moving out of the understory and dominating much of the landscape. Organized fire control efforts eliminated the age-old mechanism for keeping the woods open, and a dense, multi-layered forest developed.

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Over time, species in the red oak group began to dominate as the forest matured. Individual trees grew to the limits of their resources, and began to lose vigor as competition intensified. By the late 1970s and early 1980s these trees, generally growing on lands with site indices for oak of 50 to 60, were beginning to senesce. (Site index is a measure of productivity defined as the average height, in feet, that a dominant tree can attain by age 50; site indices below 70 are generally considered unsuitable for growing high quality trees.) An extensive drought during that period produced a wave of oak mortality across the Ozark and Ouachita regions generally associated with hypoxylon canker and armillaria root disease. At the time, however, forest pathologists concluded that the apparent disease epidemic was actually the result of the drought, with the fungi simply colonizing trees that were already falling victim to lack of moisture and attacks by other fungi and insects. This drought-induced weakening and mortality of oaks on poor quality sites from a complex of different pathogens and insects was termed "oak decline."

Current Situation

Twenty additional years of static growth and gradual senescence have further weakened the aging Ozark oak forests. Beginning in 1998,

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another protracted drought began in the region, and a curious sequence of events followed.

In 1999 adults of the native red oak borer *Enaphalodes rufulus* completed their two-year life cycle and laid their eggs in tiny niches in the bark of the red oaks. Normally, the hatching borer larvae trigger the production of a sap flow when they begin to tunnel into the trees' cambium. The flowing sap, probably in conjunction with infection by naturally occurring bacteria and fungi, then kills the great majority of the larvae, limiting surviving borer numbers to relatively low levels. In 1999, moisture levels were so low in most oaks that they could not produce a defensive sap flow. As a result, most of the larvae survived, producing borer populations far larger than any that had previously been reported. The feeding larvae tunneled through tree trunks and branches, weakening them and causing extensive damage to the wood. In 2001, this greatly enlarged borer population again completed its life cycle, emerged as adults, mated, and laid eggs. The continuing drought again prevented the trees from producing defensive sap flows, and the population of surviving larvae exploded. Trees became riddled with larval galleries, often resulting in high rates of limb and trunk breakage from normal wind and weather events. People living in and near the forest reported window screens nearly covered with adult borers in the summer, attracted by indoor lights at night.

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While all of this was occurring, oaks were dying at alarming rates. Surveys of the Ozark region showed annual mortality rates as high as 20% among red oaks. The obvious conclusion, drawn by most of the public and widely disseminated by the media, was that the red oak borers were killing the oaks and destroying the forest that was a hallmark of the region. The only problem with this conclusion is that it is completely incorrect.

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The causes of the current Ozark oak mortality are fourfold: 1) the trees are poorly suited for the sites on which they are growing; 2) the trees are far too dense, creating excessive competition for moisture; 3) the trees have reached an age at which vigor has been lost and susceptibility to pathogenic bacteria, fungi and insects is increasing; and 4) the region has experienced a four-year drought. "Oak decline" is the best explanation for the dying trees. The borers are merely taking advantage of a bountiful food source and reproductive site deprived of its normal protection; they are destroying timber values and weakening the trees structurally, but developing larvae are feeding on the trees' dead interior wood, not vital tissue. They are destructive in their own right, but they are only a symptom of a much greater problem.

Management Implications

Perhaps the most important message for the people of the Ozark Plateau is that chemical treatments aimed at controlling the red oak borer will not solve the current problem, and could be highly counterproductive. Any insecticide capable of effectively killing borer larvae hidden deep inside the stems and branches of mature oaks will also kill hundreds of species of other insects, many of them beneficial, and will thus reverberate through the environment, creating unforeseeable impacts that may prove much more serious than the current problem. Borer populations will come back into balance soon after normal precipitation returns to the region. Chemical treatment of the borers is tempting to forest managers under pressure to "do something," but it should be scrupulously avoided.

If the current situation had been anticipated and understood early enough, some preventive action could have been initiated in the form of silvicultural thinning, regeneration harvesting, and prescribed burning. A more sparse, open forest with little woody understory vegetation would have been better able to tolerate the current drought without

serious injury, as would a forest of younger, more vigorous trees. A different species mix, notably shortleaf pine and members of the more drought-tolerant white oak group, would also have demonstrated substantially better survival under the existing conditions. Unfortunately, this knowledge does nothing to alleviate the current crisis.

The greatest current concern should be for public safety. Standing oaks, dead and alive, are riddled with larval galleries and are at considerable risk of breaking or falling during periods of wind, rain and ice, or perhaps without any warning at all. The coming borer emergence of 2003 will be the largest ever seen, and even if the drought has ended and the oaks are again able to resist attack, it is inevitable that their structural weakness will continue to be increasingly compromised over at least the next two to three years. All forest users, as well as travelers on forest-lined roads, are at significantly greater risk of injury or death from falling trees and limbs. Over time, the removal of hazard trees from high-use areas can reduce these risks, but given the size of the area involved, no quick or inexpensive solution is possible. A major public information effort is needed to increase awareness, encourage the avoidance of high-hazard areas, and highlight the need to remove damaged trees from areas around homes and driveways. This is not a short-term problem; interior stem and branch damage to trees is not readily visible, and the borer galleries also form entry routes for decay organisms that will continue to weaken surviving trees structurally over time. The forests of the Ozarks will be risky places in which to work and play until most of the existing overstory canopy has fallen and been replaced by healthy trees.

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From a long-term management perspective, a change in strategy is clearly in order. What is needed is a widespread program of forest regeneration, although this will probably meet significant resistance on public lands due to a lack of general understanding of the problem and a common bias against tree cutting. On upland sites, red oaks should be replaced by mixed stands of shortleaf pine and native members of the white oak group (white, post and bur oaks); individual red oaks may be retained where micro-site conditions are generally better, such as the bottoms of ephemeral and intermittent drainage channels. During harvest operations, white oaks should be evaluated and left standing where practical to mitigate the effects of removing other trees. Red oak stands may continue to be grown on the more mesic sites found on lower north slopes and bottomlands, although in many cases it would be best to restore health to these stands by cutting existing damaged trees and replacing them with vigorous new sprout growth. Unfortunately, most such treatments will not produce commercial harvests due to the condition of the damaged trees. On all sites, stand densities should be reduced to levels that foresters often characterize as sparse, generally in the range of 30 to 60 square feet of basal acre per acre, with regular thinnings to prevent overstocking. As these stands approach maturity, silvicultural

systems should be employed that will provide for the regeneration of individual trees or small groups without producing major canopy removals that are considered unacceptable by the public. Where practical, regular prescribed burning should be utilized to maintain open understory conditions. Where burning is impractical, other methods of understory management, including selective herbicide treatments, commercial grazing, or the reintroduction of bison or other native grazing and browsing species, should be investigated.

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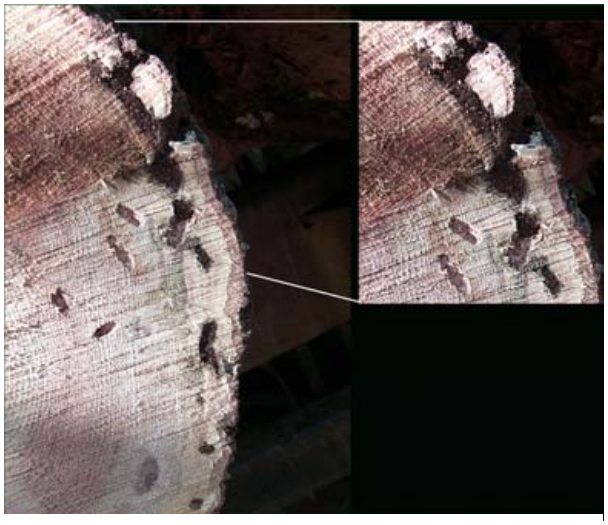
Individual high-value urban and suburban oaks can best be managed by avoiding root injury, minimizing the use of lawn chemicals designed to favor grasses, and providing additional water during periods of drought. In many cases, managing the area inside of the drip line of such trees in a naturalized state that excludes grasses will improve their health and longevity. Urban forestry guidelines for landscape tree selection and for water management during dry periods, as well as for the identification and treatment of common insect and disease problems, should be developed and distributed.

Whether local residents of the region like it or not, the end of the "red oak era" in the Ozarks is rapidly approaching. What will follow it depends upon the actions taken by forest owners and managers, which in turn will depend in large measure upon the attitudes and opinions of the public regarding forest management practices. It is hoped that management decisions can at least be made with an understanding of the causes of the current problem, so that it will not be repeated in the future.



Red Oak Borer Damage

Authors:
James Brown, Forester, R-8, FHP
Manfred E. Mielke, Plant Pathologist, NA FHP