RESEARCHING EFFECTS OF PRESCRIBED FIRE IN HARDWOOD FORESTS

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ABSTRACT

The Upland Hardwood Ecology and Management Research Work Unit (RWU 4157) is a group of research teams located across the South, strategically placed to conduct research in physiographic sub-regions of the upland hardwood ecosystems including the southern Appalachian Mountains, the Cumberland Plateau, the Boston Mountains, and the Missouri Plateau. Our RWU is one of 16 maintained under the Southern Research Station by the U.S. Forest Service.

Our mission is to develop and disseminate knowledge and strategies for restoring, managing, sustaining, and enhancing the vegetation and wildlife of southern upland hardwood forests. Through experimental studies and modeling, our research program focuses on learning and predicting how upland hardwood-dominated forests and wildlife are affected by natural disturbances or silvicultural activities, and how plant and animal responses differ across environmental gradients such as elevation, moisture, and fertility.

One of our focal research areas is fire ecology and fire effects on hardwood forests and the wildlife communities they support. Understanding how fire affects upland hardwood forest communities will help land managers to develop scientifically-based methods to meet their management and restoration goals. Here we highlight some of our current studies on fire ecology.

FIRE ECOLOGY STUDIES

Historical Fire Frequency

We are using tree cores and fire scars to assess the frequency of fire in upland hardwood ecosystems prior to fire suppression efforts starting in the 1930s. For instance, in the Boston Mountains of Arkansas, we found that widespread fire occurred more often during drought years in the 1700s with fires likely achieving sizes unprecedented during the last century. Early transitional (1810-1830) settlement by Cherokees at population densities under 0.26 humans/km^2 was highly correlated ($r = 0.90$) with the number of fires per decade in the interior region of the Boston Mountains. Multiple regression analyses further implicated humans as well as short- and long-term climate variability such as forced by the El Niño/Southern Oscillation (ENSO) and Atlantic Multidecadal Oscillation (AMO). Understanding presettlement fire frequencies will help land managers in ecosystem restoration efforts.

Fire and Fire Surrogate Study (FFS)

Scientists with RWU 4157 are participating in the wildlife component of the national collaborative Fire and Fire Surrogate Study (FFS). This long-term study is assessing how ecological components or processes may be changed or lost if fire surrogates, such as cuttings and mechanical fuel treatments, are used instead of fire or in combination with fire. Virtually no comparative data exist on how these treatments mimic ecological functions of fire, or how bird, reptile, amphibian, or small mammal communities respond to prescribed fire or fire surrogate treatments.

Regional Oak Study

Scientists within our RWU have partnered with the North Carolina Wildlife Resources Commission, the Stevenson Land Company, the Northern Research Station, and the Mark Twain National Forest in a regional study of how hardwood tree species respond to prescribed fire and other silvicultural treatments across a productivity gradient and across the Central Hardwood Region. We and our collaborators are also studying the response of herbaceous plants, seed banks, acorn viability, artificial northern red oak regeneration, fuels, bat, bird, reptile, amphibian, and small mammal communities to prescribed fire and other oak regeneration treatments. This regional oak study includes three independent, fully replicated study areas representing different physiographic areas of the Central Hardwood Region including the Southern Appalachian Mountains (NC), the Cumberland Plateau (TN), and the Ozark Highlands (MO). University collaborators with our regional oak study include the University of Tennessee, Alabama A&M University, North Carolina State University, and the University of Missouri.

Indiana Bats and Prescribed Fire

Scientists in our RWU are looking at the compatibility of prescribed fire in the Southern Appalachians with the conservation of the federally endangered Indiana bat. In cooperation with the Nantahala National Forest, Cherokee National Forest, and Great Smoky Mountains National Park, we are examining the effects of prescribed fire on snag population dynamics, Indiana bat roost tree availability in relation to fire history, and Indiana bat roost tree selection in relation to fire history and stand and landscape characteristics. This study will provide land managers with the information they need to manage Indiana bats and restore pine-oak habitats throughout the southern Appalachians.

Using Prescribed Fire to Restore Oak-Dominated Upland Hardwood and Hardwood-Mixed Pine Systems

Scientists are studying the use of regeneration and intermediate silviculture prescriptions coupled with fire to manage and restore upland hardwood systems. We have implemented a large-scale silvicultural assessment designed to examine the efficacy of stand-level prescriptions in reducing the potential impacts of gypsy moth infestations and oak decline on upland hardwood forests on the Daniel Boone National Forest, Kentucky. Early assessments showed a slight increase in tree vigor as determined by crown cover and position of residual trees in shelterwood with reserves, thinning, and oak woodland treatments. In a process to move a mixed-pine hardwood forest towards hardwood-dominated stands on the William B. Bankhead National Forest in Alabama, scientists found that following the initial thinning and burning treatments there was a 30 percent reduction in percent canopy cover, and light penetration through the canopies ranged from 5 to 25 percent pretreatment to 29 to 60 percent posttreatment. The cool, slow-moving burns had no discernable effect on the overstory trees. Avian and herpetofaunal population dynamics appear to be influenced more by the thinning than the fires.

Amphibians and Prescribed Fire in Longleaf Pine-Wiregrass Sandhills

Scientists are studying amphibian and reptile use of isolated sinkhole ponds in both regularly burned and long-unburned Florida longleaf pine-wiregrass sandhills. This study will help land managers assess how prescribed fire affects herpetofaunal populations in the long term.

Artificial Regeneration and Prescribed Fire

Scientists are studying how high quality seedlings of planted oak (*Quercus* spp.) and American chestnut (*Castanea dentate* [Marsh.] Borkh.) respond to prescribed burning. Preliminary results indicate that seedlings can withstand burning several years after planting if root collar diameters are relatively large when established.

Fire and Oak Decline

Scientists used LANDIS to model oak decline in the Boston Mountains of Arkansas 150 years into the future under two fire return intervals. The analysis delineated potential oak decline sites and established risk ratings for these areas. This is a further step toward precision management and planning.
