



Low-intensity fire plays a major role in supporting longleaf pine forests on the coastal plain.

Over 50 Years of Prescribed Burning on the South Carolina Coastal Plain

Summary

A long-term study has been done on the effects of repeated dormant season prescribed burns within a forested area on the South Carolina Coastal Plain, on plots dominated by mixed longleaf pine and loblolly pine. A recent report documents the effectiveness of this burning as a tool to reduce hazardous fuel loads. Repeated burns at intervals from one to four years help to return and maintain the forest in a state closer to its composition before European settlement.

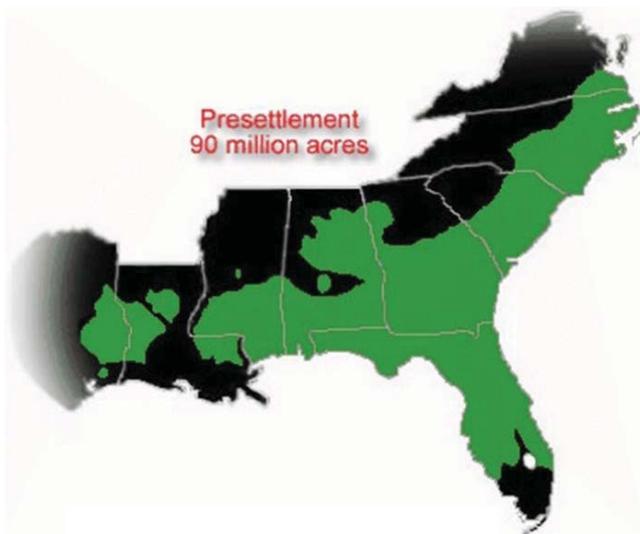
Prescribed burning here reduces the risk of overstory-killing wildfires, and helps maintain habitat for the endangered red-cockaded woodpecker. Further, it helps regeneration of longleaf pine as a dominant species. This project established an area accessible for public and scientific demonstration focused on the benefits of prescribed burning. The recent review of the longstanding prescribed burning project summarizes the results and notes the demonstration value of this site. Dormant season burning does not affect overstory pine longevity. With annual burns, grasses and forbs become the dominant understory species. Prescribed burning every three to four years is sufficient to reduce fuel loads and minimize wildfire hazard.

Key Findings

- Frequent prescribed burns during the dormant season are an effective tool to control growth of midstory hardwoods in a Carolina coastal forest dominated by longleaf and loblolly pines.
- These frequent, low-intensity burns support regeneration of the longleaf pine forest, which was historically dominant in this region.
- Prescribed burns will not adversely affect the longevity or health of overstory pines. This is important for maintaining suitable habitat for the endangered red-cockaded woodpecker.
- Prescribed burns at intervals as long as four years will effectively reduce fuel buildup in coastal pine forests.
- Shorter burn intervals further reduce the number and size of woody plants. By shortening the interval to two years or less, the woody cover generally gives way to grasses and forbs. The greatest variety of undercover species is found in plots that are burned annually.
- By placing the demonstration plots near densely populated areas, more members of the public, managers, and scientists can view the plots and can see first-hand the important role of prescribed burning in forests of this type.

Longleaf pines once ruled

Although today one of the most populated areas in the South, the Carolina Coastal Plain was once covered with forests dominated by longleaf pine (*Pinus palustris*). The terrain is a flat to gently rolling region of sandy marine deposits that reach as far as 150 miles inland. The entire region was adapted to and dependent upon frequent low intensity fires to maintain relatively open stands of pine with a ground layer of grasses, herbs and small shrubs. Longleaf pine is well-suited to thrive and regenerate under these conditions.



The South Carolina coastal plain encompasses about two-thirds of the area of the state and is itself divided into an Outer Coastal Plain, which reaches about 70 miles inland and is generally flat in terrain, and an Inner Coastal Plain, which is characterized by gently rolling hills and reaches to the foothills of the Appalachian Range. This project is located on the Outer Plain. Urban and suburban

development is widespread on the coastal plain, but there are still significant managed forest lands, both publicly and privately owned. Many are relatively close to population centers and serve as important resources for recreation and outdoor education.

Understanding the role of fire

Longleaf pine is a long-lived species that is highly resistant to fires. Periodic low-intensity fires in the forests remove competing loblolly pine and hardwood seedlings but the longleaf seedlings, which are adapted to fire, survive and flourish. The ideal environment for longleaf pine is open, park-like woodland—what some call “longleaf pine savannas.” This was the character of the land before European settlement, and was a result of frequent low-intensity fires started both by lightning and by Native American inhabitants.

With extensive logging and clearing for agriculture in the 19th and early 20th centuries, coastal longleaf pine forests were reduced to a small fraction of their original extent. After logging, uncontrolled high-intensity wildfires swept through many of the remaining forest lands. This led to a policy by local and state agencies to quickly extinguish all fires. However, elimination of the periodic low-intensity fires created a habitat that no longer favored the longleaf pine. Forest regrowth was dominated by loblolly pine, hardwoods and midstory smaller trees and shrubs. Longleaf pine forests continued to diminish.

Making peace with fire

By 1950, the tools and organizations to extinguish wildfires were in place. However, with the re-growth of the forests and the increase in fuel stocks, wildfires continued to occur, especially during periods of prolonged drought. Rapid fuel accumulation is especially important in the South, where fuel stocks can reach high levels in four to six years. Alternate strategies were needed.

By the late 1950s, it was increasingly recognized that low-intensity fire could have beneficial effects for forestry and ecosystems when applied under controlled conditions. Interest was also growing in re-propagation of the formerly dominant longleaf pine stands. It was now understood that longleaf pine could thrive in an environment of periodic low-intensity fires. These would not only reduce competition from other species, but would promote re-propagation of the pine by fire-resistant seedlings. Periodic fire is the best friend of young longleaf pines.

Early use of prescribed fire

The 1950s saw the beginning of an era of application of prescribed fire by trained professionals to obtain desired forest and wildlife management objectives in South Carolina. Because the long-term effects of prescribed burning were still not completely proven, in 1958 a study was launched to determine those effects on fuels and forest composition, using burning at various frequencies.

One of the areas selected for study was on the Francis Marion National Forest, a coastal forest area encompassing 259,000 acres in a region just north of Charleston. Because of its immediate proximity to Charleston, and within easy driving distance from Savannah, Georgia; Columbia, South Carolina; and Wilmington, North Carolina, this national forest is an ideal demonstration area for forest management using prescribed burning and other techniques. In a typical year, the forest records 1,200,000 visitors. On one site in the forest, a research and demonstration project on the use of prescribed fire has persisted for 50 years.

A recent study on the results of this 50-year research and demonstration project was prepared in 2003 by Kenneth Outcalt from the Southern Research Station of the USDA Forest Service. The study looked at the history of the project, the evolving mission of the research, the documentation done on this site, and the implications for forest management in this part of the United States.

Started half-century ago

Since 1958, prescribed burns have regularly been conducted and documented on this site. It is about three miles south of Jamestown, South Carolina at the intersection of two Forest Service access roads. Prescribed burning has generally been done during the dormant season, November through March.

According to Outcalt, this dormant season burn was the normal practice from the beginning. He notes, "There are many days during that time of year when weather conditions are favorable for successful and safe burns." He explains that during this season, humidity is usually low enough for a good burn, temperatures are mild, and winds are steady. Outcalt adds that dormant season burns in this area are also better from a wildlife standpoint. "Concerns have sometimes been raised with growing season burns because of loss of nests for birds and the potential for fire to trap young mammals. These dormant season burns normally do not cause problems as this is a season when offspring are large enough to safely leave the area."



Dormant season burning, shown above during (left) and after (right) the burn, minimizes hazards to birds and mammals and can be done when weather is favorable for a safe and successful burn.

Fuel reduction and more

Burning has been performed in the individual plots at intervals of one, two, three and four years. Unburned control plots were also established and have been maintained over this 50 year period. The five treatments were replicated four times, each on a two acre plot. According to Outcalt, "The primary goal in the beginning years of the study was to evaluate prescribed burning as a tool to reduce fuel loads and the potential for high-intensity wildfires." He explains that since that time, additional weight has been given to forest type improvement and preservation of a specific type of wildlife habitat.

One continuing objective of the prescribed burning has been to maintain an open forest of longleaf and loblolly pines while suppressing midstory growth of hardwoods and understory growth of woody shrub species. The effect of these treatments on the composition and structure of the plant community has been tracked by periodic measurements and surveys. Because of their location along a well-traveled Forest Service road, the plots have frequently been used to demonstrate the effects of prescribed burning to the public as well as the scientific community.

Saving the red-cockaded woodpecker

An important goal of forest management in this region is to maintain suitable habitat for the red-cockaded woodpecker. A unique characteristic of this woodpecker is that it is the only North American woodpecker species that excavates its cavity exclusively in living pine trees. Preferred trees are often more than 80 years old.

The woodpecker has been on the Federal Endangered Species list since 1970. Its essential habitat is mature longleaf and loblolly pines, and less than one percent of this original habitat remains. For this reason, maintenance of the mature pines in locations such as the Francis Marion National Forest is critical, and prescribed burning is an important tool for that purpose. According to Outcalt, the red-cockaded woodpecker population in the region today

is growing. He notes that this is due to expansion of colony nest sites. This is partially a result of creation of artificial cavities, and partly through habitat restoration activities centered on frequent, low-intensity prescribed burns.

Effectiveness of burning confirmed

Over the long history of prescribed burning on these plots, the effectiveness of burning has been clearly demonstrated. These treatments have significantly reduced understory and ground fuel loads. The recent study confirmed that plots with annual burn cycles had the lowest fuel levels, but even the four-year plots had substantially less fuel than unburned controls.

Prior to the beginning of treatments in 1958, all plots were dominated by loblolly and longleaf pine with some pond pine in wetter areas. The unburned control plots have since developed a midstory layer of hardwoods that has changed very little since 1970. Outcalt confirms that these unburned control areas have seen the most change since the beginning of the study. He notes, "Some change is also apparent in the areas burned every one or two years. Here the understory has gone from woody-dominated to herbaceous-dominated."



Prescribed burning at regular intervals eliminates growth of woody understory and stabilizes an environment for healthy longleaf pine forest. Here a plot with one-year interval burning in 1970 (left) and in 2004 (right) shows modest change in the understory, with most cover today being grasses and forbs.

Keeping the hardwoods down

All of the burn treatments have kept hardwoods from growing into the midstory, although there are a few hardwoods taller than two meters in the four-year burn plots. This result confirms that burning every three or four years will keep pine stands open enough for red-cockaded woodpecker habitat and will promote continuing propagation of longleaf pine. The long history of prescribed burning has also demonstrated that these low-intensity burns will not endanger longevity of the large overstory pines. Thus dormant season burning has been shown to be a useful tool for forest management, especially for woodpecker habitat, and for the purpose of reducing high-intensity wildfire risk.

The composition and richness of understory vegetation is influenced by the length of the interval between burns. With longer return intervals of three and four years, there is some recovery of understory woody vegetation and woody cover from tree sprouts and shrubs dominate the understory. With annual or biennial burn intervals, grasses and forbs become the dominant understory species, although some woody species are still present. The greatest diversity of understory species has been observed to occur on areas burned annually. Diversity decreases as the burn intervals increase and woody plants begin to dominate.



For over 50 years, demonstration plots have been burned at intervals of (starting from top left) one, two, three, and four years. Photos show the characteristics of each burn interval versus (bottom) an unburned control plot.

Telling the world

A major goal of this project has been not only to develop data on the benefits of prescribed burning, but to demonstrate those results to managers, researchers, and the public. Public outreach activities included placement of permanent signs on the research plots along the major roads. These describe the prescribed burn activity and the related forest and wildlife management results. A permanent display board with additional information on the ongoing research activity was constructed at a road intersection adjacent to all plots. A take-home sheet with similar information is provided at the display sign area.

Web pages have been created to describe the area and to explain research results. The pages describe the project history, methods, benefits and results. The pages also includes a realistic discussion on potential negative aspects of burning, including smoke as a possible traffic hazard, esthetics and wildlife displacement and possible jeopardy and includes steps taken to help mitigate these effects. The website can be viewed at <http://www.srs.fs.usda.gov/fm>.

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Chance to see the results

In November 2004, the Forest Service research team conducted a half-day field day at the project site, where stakeholders had an opportunity to view the results, learn about continuing research activities, and ask questions about this research program and related issues. Outcalt has also taught a one-day course on the research results, and has made poster presentations at professional conferences.

Outcalt feels that the work done over the years on this

site has been influential on forest management practices in the Southeast. "The information from this study, along with that from others, and the results of adaptive management tools, has led to widespread regional use of prescribed burning for forest management." He indicates

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that the long history of research and demonstration work on this site makes it particularly important in confirming the value of prescribed burning. The unprecedented long history and complete documentation of this prescribed burn demonstration site make it a great forestry treasure.

Management Implications

- Repeated dormant season prescribed burning in areas such as coastal Carolina forests at intervals as long as four years can effectively reduce fuel supplies.
- Repeated prescribed burns also support a continuing longleaf pine and loblolly pine overstory by suppressing midstory growth of hardwoods and reducing growth of understory shrubs.
- Using shorter burn intervals of one or two years further reduces woody undergrowth and promotes growth of a diverse population of grasses and forbs.
- The benefits of dormant season prescribed burns extend over periods of 50 years or longer if burning is done on a repeating basis.
- Additional demonstration value is achieved by locating projects at accessible locations and following public information strategies to explain the multiple benefits of prescribed burning in a particular forest regime.

Further Information: Publications and Web Resources

- Brockway, Dale G., Kenneth W. Outcalt, Donald J. Tomczak, and Everett E. Johnson, Restoration of Longleaf Pine Ecosystems, USDA Forest Service, Southern Research Station General Technical Report SRS-83, 2005.
- Campbell, Joshua W., James L. Hanula, and Kenneth W. Outcalt, Effects of Prescribed Fire and Other Plant Community Restoration Treatments on Tree Mortality, Bark Beetles, and Other Saproxylic Coleopter of Longleaf Pine, *Pinus palustris*, on the Coastal Plain of Alabama, *Forest Ecology and Management*. 2008.
- Outcalt, Kenneth W., Final Report, Joint Fire Science Program Project 01B-3-1-03, Dormant-Season Prescription Fires to Reduce Hazardous Fuel Loads on the South Carolina Coastal Plain: Establishing a Demonstration Area on a 40+ Year Study.
- Red-Cockaded Woodpecker Restoration on the Carolina Coastal Plain, available online:
<http://www.fws.gov/nc-es/birds/rcwood.html>

Scientist Profile

Kenneth W. Outcalt is Research Ecologist with the USDA Forest Service, Southern Research Station in Athens, Georgia. His research, which focuses on fire and longleaf pine ecosystem structure, function, and processes in the southern United States, has been supported by the National Fire Plan and Joint Fire Science Program. He received the Chief's Award for Natural Resource Stewardship in 2006 for significant contributions to the restoration and management of the longleaf pine ecosystem.



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