

## Fire Ecology in the Southeastern United States

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Fire, whether naturally occurring or prescribed, has a vital function in the ecosystem. Fires, such as the one shown here at Kisatchie National Forest, eliminate dead or dying plant matter, stimulate growth of native plants, and suppress the invasion of exotic species and the succession to woody species in many natural plant communities.

Fire has played an important role in the structure of natural ecosystems throughout North America. As a natural process, fire

helps clear away dead and dying plant matter and increases the production of native species that occur in fire prone

habitats. It also reduces the invasion of exotic species and the succession to woody species in pitcher plant bogs, pine savannas, coastal prairies, marshes, and other natural plant communities of the southeastern United States.

Today we use fire as a management tool to maintain and restore the ecological structure of natural plant and animal communities. We study the effects of fire on native species to better understand the influence fire has on the structure of their communities and ecosystems.

Historically, human influences have dramatically altered fire effects on the North American landscape. Native Americans used fire to change vegetation patterns prior to European colonization. Following European settlement, fire became viewed as a natural force that should be controlled. Throughout much of



Historically, fire's destructive force has been viewed as an enemy of both humans and native species.

our Nation's history, fire has been aggressively suppressed in wildland areas to protect both public and private interests and prevent what was viewed as the destruction of grasslands, forests, and other ecosystems.

Tremendous resources have been expended in attempts to prevent and control wildland fire. Yet despite these massive suppression efforts, the potential for catastrophic wildfire continues to threaten millions of acres of America's wilderness.

The new Federal Wildland Fire Policy recognizes that past practices of aggressive fire suppression have led to conditions of historically unprecedented fuel loads, or



USGS researcher assisting in a prescribed burn at the Kisatchie National Forest. Prescribed fire is now a primary tool in land management and restoration efforts.

burnable plant materials, in many of our Nation's natural areas. This policy calls for the reintroduction of fire on an ecologically significant scale as a one of the tools for public land management. Reintroduction of prescribed fire as a land management tool is a proactive means of reducing the threat posed by wildland fire to both people and property.

For the reintroduction of fire to be ecologically effective, though, it must be based on the best available science. Researchers at the U.S. Geological Survey's National Wetlands Research Center are participating in the effort to better understand the role fires play in natural systems and the effects of fire and fire exclusion on certain species. Fire research at the NWRC focuses primarily

on the role of fire on the southeastern Coastal Plain.

**Fire on the Coastal Plain.** NWRC scientists are comparing the effects of fire in pine flatwoods and savannas by season in northeastern Florida. While traditional fire managers have used fall and winter burns in the belief that less harm would result while the trees were dormant, most natural fires tend to occur in spring and summer as the result of lightning strikes. This study seeks to determine whether the intensity or seasonality of fire is more important for a healthy forest system.

**Fire and Prairie Restoration.** The coastal prairie of Louisiana and Texas is one of the Southeast's most endangered ecosystems, with more than 99% of its historical range lost to human activities. Restoration and conservation efforts are now being focused on protecting what is left in order to preserve this ecosystem's diversity of native plants

and wildlife, including two endangered bird species.

Before the area became settled, fire was a sustaining force on the coastal prairie. Fires set by lightning fed on the dormant grasses and kept trees in check, while the roots and bulbs of the native prairie plants remained unaffected by fire at the surface. Fire suppression practices, grazing and mowing, and fragmentation of the prairie landscape through agriculture and urban sprawl have all but eliminated wildfire as a dominant factor in the modern coastal prairie ecosystem, however.

Since wildfire historically played a significant part in maintaining the prairie ecosystem, one aspect of management of the coastal prairie is concerned with studying the effectiveness of prescribed fire for controlling invading species and restoring the natural biodiversity of this highly endangered ecosystem by promoting growth of native plants, reducing fuel for wildfires, and regulating prairie productivity.

One of the most invasive exotic species in the coastal prairie is Chinese tallow (*Sapium sebiferum*). Chinese tallow resists both flooding and drought and also, to some degree, fire. Tallow does not burn easily and, because they shade out native grasses that do burn, tallow stands act as natural fire suppressants. Because of this, and also because they are highly invasive and quickly dominate an area once they have entered it, Chinese tallow is a

significant threat to the coastal prairie and elsewhere.

NWRC scientists have been experimenting since 1996 with controlled burns in both the dormant season and the growth season to study the effects of timing of burns on Chinese tallow stands. Evidence so far indicates that burns conducted during the growth season are more effective in the long term than traditional dormant-season



Prescribed fire on coastal prairie at the Brazoria National Wildlife Refuge. Before the coastal prairie became settled, fire was a sustaining force in the ecosystem. Low-intensity natural fire kept woody growth in check, yet the roots and bulbs of the native grasses remained undamaged. Fire suppression practices allow the accumulation of plant litter and other flammable materials and therefore increase the likelihood of a destructive, high-intensity wildfire.



Chinese tallow being burned by winter fire.

burns, and that prescribed fire may indeed be a key in holding Chinese tallow at bay.

**The Role of Fire in the Restoration of Wet Pine Savannas.** NWRC ecologists are working with the Mississippi Sandhill Crane National Wildlife Refuge (NWR) to use prescribed burning to restore habitat used by the endangered Mississippi sandhill crane. The Mississippi sandhill crane (*Grus canadensis pulla*) is a critically endangered subspecies found nowhere else on earth in the wild but on and adjacent to the Mississippi Sandhill Crane NWR. Cranes use the open wet pine savannas for loafing, nesting, and roosting.

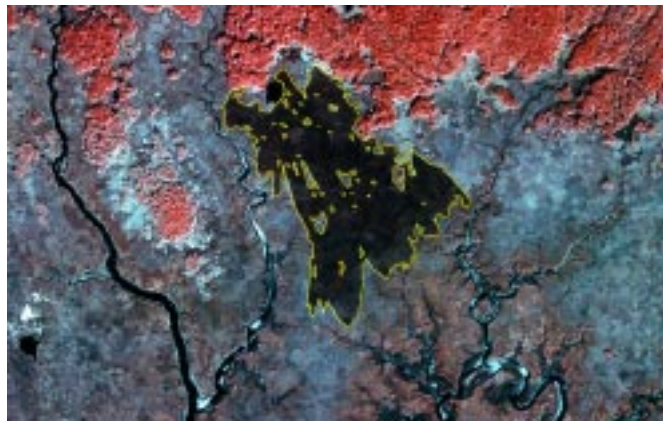
Historically, fire was a naturally occurring phenomenon in the wet pine savannas, shaping the appearance of the landscape by burning off grasses, shrubs, and pine litter frequently. Fire suppression has interfered with this natural process, allowing woody plants such as trees and shrubs to invade and shade out native sun-loving herbs in these plant communities. Wet pine savannas have been shown to contain the highest diversity of plant species per square meter than any other plant community throughout the southeastern United States. Frequently burned wet pine savannas are dominated by a variety of grasses, herbs, and sedges. In addition, wet pine savannas are host to more



At the Mississippi Sandhill Crane National Wildlife Refuge, fire is mainly applied in the fall and in the spring. Fall fire reduces overstocked planted slash pine and enhances crane nesting areas, while spring fire clears unwanted woody vegetation from overgrown areas on the savannas.

specialized plants such as pitcher plants and orchids.

Many of the plant species that make up the wet pine savanna habitat for the cranes are fire dependent, that is, they need fire to continue to reproduce. Some savanna grasses need fire before they will flower. NWRC scientists are studying the effect of prescribed burning on native species such as pitcher plants and wiregrass. In addition, NWRC scientists are studying the impacts of prescribed fire on the reduction



This color infrared photograph of a burned black needlerush marsh at the St. Marks National Wildlife Refuge shows a high contrast between the burned (black area) and nonburned surrounding marsh.

of exotic species and the encroachment of woody vegetation that is degrading existing potential wet pine savanna habitat to be used by cranes.

**Response of overwintering birds to prescribed burning in wet pine savannas of the Mississippi Sandhill Crane NWR.** The NWRC recently supported a study conducted by Georgia Southern University and the Mississippi Sandhill Crane NWR of the responses of overwintering birds to prescribed burning. Evidence indicates that prescribed burning during the growing season may benefit native forbs and grasses of pine savannas, which are important habitat for overwintering migratory grassland birds. Besides Mississippi sandhill cranes, wading birds visit the bayou in this refuge, and many songbirds, including the eastern bluebird (*Sialia sialis*) and Henslow's sparrow (*Ammodramus henslowii*), frequent the savannas.

**Fire detection and fire danger monitoring with a satellite system.** Direct assessment of the effects of fire on a region often is constrained by time, personnel, and cost. To decrease reliance on direct assessment methods and add to the little information that currently exists regarding the effects of fire on marsh ecosystems, the NWRC is helping to develop remote sensing techniques for detecting evidence of wildland fires and for monitoring fire extent and intensity and resource recovery or change, with an emphasis on coastal ecosystems. Researchers seek to determine which current and future remote sensing tools address the needs of resource managers dealing with fire management.

Studies at various sites in Florida and Louisiana have assessed the value of such remote sensing tools as satellites and polarized radar in monitoring marsh burn recovery.

One such project has taken place over a 3-year period at St. Marks National Wildlife Refuge (NWR) in Florida in a black needlerush (*Juncus roemerianus*) coastal saltmarsh. Black

needlerush is a dominant vegetation in most marshes on the northeast gulf coast. Canopy reflectance spectra and canopy light penetration measurements, taken with multipolar metric radar, were examined as tools for monitoring long-term burn recovery at this site. Another study used various optical instruments and satellite data to detect and monitor short-term burn recovery in an area of pine savanna in Florida.

At another study site, a freshwater coastal marsh in Louisiana, short-term burn history maps were generated using Thematic Mapper imagery. These maps cover winter preburn, spring recovery, and summer regrowth of



Although catastrophic fires like the ones in Florida in 1998 may have devastating impacts on timber resources, they may also prove to have ecological benefits. This photo shows catastrophic fire where torching and crowning are common.

the marsh over a 1-year period.

#### **Fire modeling for fire management.**

Prescribed fire is a central element of the new Federal Wildland Fire Policy, but for it to be an ecologically useful management tool, land managers need to know how fire will react in specific ecosystems. Ecosystem modelers at the NWRC are working to create improved fire behavior models that will more accurately predict fire behavior related to the vegetation and conditions of the marshes, wet pine flatwoods and savannas, and coastal prairie systems of the Southeast. These models will be extremely helpful tools in conducting prescribed burns.

To conduct a prescribed burn, land managers or researchers must first compare habitat conditions of the area to be burned to the expected behavior of the fire predicted with a fire modeling system. The current fire modeling system, however, often does not reflect the vegetation and fire conditions encountered on the south-

eastern Coastal Plain. The research in the NWRC project seeks to collect data that can be used to modify the current fire modeling system to more accurately predict fire behavior related to the ecosystems of the Southeast.

**Studies of the 1998 Florida Wildfires.** In the fall of 1998, an interagency research team was formed under the leadership of NWRC and U.S. Forest Service scientists to evaluate the ecological effects and economic ramifications of the 1998 Florida wildfires. These fires, while catastrophic, provided a rare opportunity to study extreme fire behavior in natural and human ecosystems in Florida.

The 1998 Florida wildfires were the culmination of a combination of natural though extreme conditions. Unseasonably warm weather and copious rainfall during the winter of 1997-98 resulted in more plant growth than usual while limiting the use of prescribed fire to reduce the hazard of wildfires. Record-breaking rainfall

turned to record-breaking drought conditions in the spring of 1998, again restricting the use of prescribed fire to reduce potential hazards. Lightning activity picked up in May of 1998 but without the usual attendant rains. The end result of these events was a series of over 1,700 high-intensity, very destructive wildfires that ranked as one of Florida's worst disasters.

The interagency team made up of federal, state, private, and academic institutions was formed with support from the Joint Fire Science Board to study nine ecological and economical impacts of the wildfires. This project will create a post-fire data base that will provide information about the immedi-

ate impacts of catastrophic wildfires.

NWRC scientists are assessing the status and the post-fire response of known populations of plant species of special concern in areas burned by the wildfires. NWRC scientists are also collecting information on the extreme fire behavior presented by the wildfires. The computer model BEHAVE is being used to compare actual and predicted behavior of the wildfires to determine if models are adequate under extreme conditions. In addition, other agencies are studying insect response, economic impacts, forest structure changes, and assessing home protection strategies following the wildfires. The results of this interagency team's efforts will provide vital data to land use and forest managers, home owners, policy makers and other researchers towards future planning to protect against such catastrophic wildfires in the future.