Success Stories

The Southern Fire Exchange and JFSP bring professionals together to improve outcomes

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> *Alachua Conservation Trust*
> *Land Stewardship Director*

Fire Science Exchange Network

Saving old trees: How fire science helped managers put fire back into the fire forest.

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The location

Picturesque longleaf pine savannas once covered more than 90 million acres in the southeast U.S. This remarkably biodiverse ecosystem experienced frequent, low intensity fires ignited by lightning and indigenous communities. The grassy understories and stately longleaf pines flourished with this fire regime, but with the advent of the timber industry and fire suppression, the landscape composition shifted to ecosystems dominated by less desirable hardwood species. Landowners and managers have been working to reclaim the land for the longleaf pine but returning fire to these long-unburned lands have proven challenging.

The issue

Land managers frequently observe high mortality of valuable overstory longleaf pines up to 24 months after applying prescribed fire in long-unburned stands. These canopy trees offer habitat for red-cockaded woodpeckers and other wildlife, represent substantial timber value, and act as a natural archive of environmental and cultural history. Although land managers recognize that frequent fires are necessary for the health of pine communities, the risk of tree mortality is a considerable obstacle to reintroducing fire into old-growth stands. A lack of information on the underlying mechanisms of tree mortality has stymied development of operational solutions.

The investigation

In the early 2000s, fire managers at Eglin Air Force Base in Florida recognized a challenge that many land managers were facing across the South: large scale mortality in overstory pines following the reintroduction of fire in long-unburned stands. They planned to restore their treasured tracts of old-growth longleaf pine but were hesitant to apply prescribed fire until the mechanisms behind the high tree mortality were identified.

SOUTHERN Fire Exchange

JOINT FIRE SCIENCE PROGRAM

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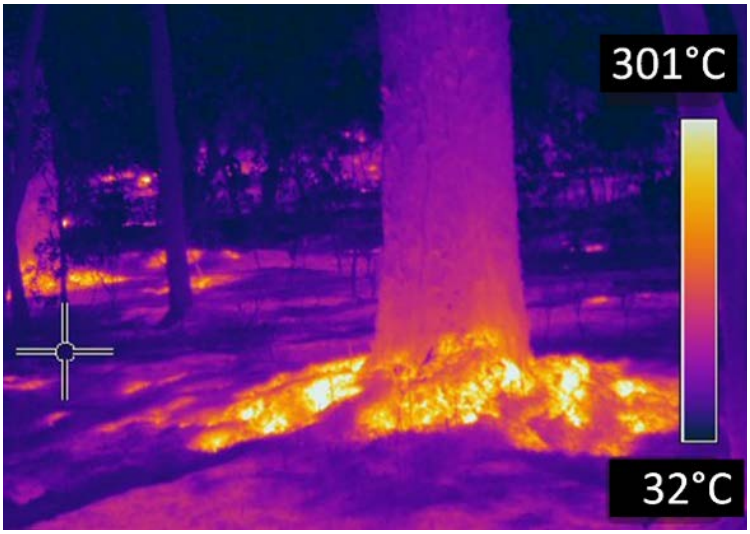
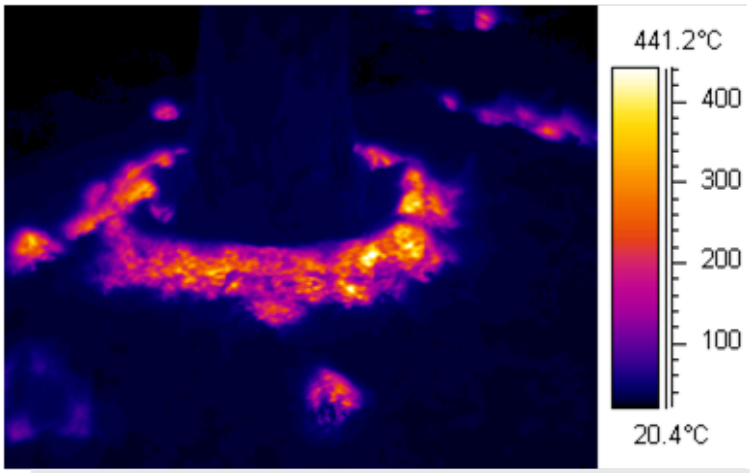
The mission of the Southern Fire Exchange (SFE) is to increase the availability and application of fire science information for natural resource management and to serve as a conduit for fire managers to share new research needs with the research community. The SFE is part of the Joint Fire Science Program Fire Science Exchange Network, a national consortium of 15 regional fire science exchanges.

Learn more about our partners, products, and activities at **southernfireexchange.org**.
Learn more about the Joint Fire Science Program and the Fire Science Exchange Network at **firescience.gov**.

DUFF consists of decomposing organic material that lies between the mineral soil and the fresh layer of leaf litter. Because the litter layer accumulates when fire is suppressed, long periods without fire can lead to heavy duff accumulation, particularly around the bases of large trees. Over time, mature trees can grow roots at very high densities into the surrounding duff.





Thermal images captured following prescribed fires reveal high temperatures at the bases of trees caused by burning duff.

"That's where it started: it was a management question," said Kevin Hiers, wildland fire scientist and former Eglin AFB fire manager. Prescribed fire strategies at the time focused primarily on moving intense fire through the stands to clear out unwanted mid-story vegetation and restore the more characteristic open structure of the pine savanna. Although this strategy achieved some of the desired conditions, it also frequently led to the death of mature and old-growth longleaf pines.

In response to this issue, the Joint Fire Science Program (JFSP) funded an investigation to understand the causes of tree mortality resulting from this management approach. In 2001, a collaborative study led by fire scientists Kevin Hiers, Dale Wade, and Dr. Joe O'Brien investigated the interactions between fire, the forest floor, and tree physiology. Dr. Morgan Varner, another collaborator, found that the amount of duff on the forest floor and its moisture content were a strong influence on post-fire tree mortality.

They discovered that under certain circumstances when duff was very dry and flammable, it could ignite and burn slowly for hours. This increased and prolonged heat could injure and even kill roots, prompting trees to respond to the damage with energy that is needed for other important functions and stressing them to the point of mortality.

These findings suggested that an appropriate course of action was to remove the thick layers of accumulated duff more gradually with multiple low intensity burns during moderate condition to avoid killing too many roots at one time. "It changed the focus to fuels first, and ecosystem structure later," said Hiers. "[In addition,] this work identified how little we knew about fire-caused stress and mortality," Varner pointed out. "This research was one of the first projects to identify duff consumption as a major driver in tree mortality models. It spawned several papers on mortality, stress, and pushed reviews of the topic forward."

The outreach

Now that researchers had found the source of tree mortality, they recognized the need to share findings with other land managers experiencing this same problem. As part of the JFSP Fire Science Exchange Network, the Southern Fire Exchange (SFE) worked with fire scientists to share information through a 2016 workshop and field tour in Florida. The group discussed formulating burn prescriptions based on rainfall and drought index conditions, assessing duff moisture with electronic moisture meters or a simple "touch test," and site preparation techniques such as removing coarse fuels and lightly raking the duff. The popularity and success of the event led to 4 more sold-out duff-centric workshops. Attendees represented a variety of occupations and **collectively managed 5.7 million acres**, an area roughly equivalent to state of New Jersey. The research results were also disseminated through publications, prescribed fire council meetings, a video, conferences, and field tours, reaching an even larger and more diverse audience.

"We checked every box from grassroots, manager-to-manager outreach to publishing in the peer-reviewed literature," said Varner. Brett Williams, lead wildland fire manager at Eglin Air Force Base, noted that fire managers were, as a

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> *Tall Timbers Research Station and Land Conservancy, Director of Research*

result, more likely to consider duff issues when writing management prescriptions and to actively evaluate weather and fuel conditions (specifically of duff) prior to a fire.

Ivor Kincaide, the land stewardship director for Alachua Conservation Trust in Florida and SFE duff fire science workshop participant, affirmed this change in management strategy. "The challenges that duff fires present are the perfect example of the benefit of connecting academic research to land managers," said Kincaide. "Duff fires used to be pretty routine on our burns. Today, we follow 'days since rain' as well as the amount of rain on our burn units much more carefully. We don't have expensive moisture meters or other new equipment, but we have good 'rules of thumb' based on real quantitative science and that makes a big difference."

Duff is composed of bark, needles, leaves, and other organic material that can accumulate at the base of trees

Victor Doig, fire manager at Lower Suwannee National Wildlife Refuge, emphasized the support and direction the workshop gave for managers who were wrestling with the duff problem. "Our technique has been to use winter burns with high soil moisture... to 'peel' off layers of duff.... The workshop seemed to reaffirm our conservative approach, and also indicated just how prevalent the problem seems to be for Coastal Plain land managers."

The impacts

Research findings brought awareness to the complexity of fire and forest floor interactions, refocusing prescribed fire objectives from reducing mid-story vegetative cover to gradually removing the duff layer on top of sensitive roots. The JFSP-funded research also encouraged models of fire-induced tree mortality to include not only fire effects on the tree canopy (i.e., crown scorch), but also forest floor influences on tree physiology.

Equipped with these findings and resources, land managers across the region are now able to make more sound fire management decisions when restoring their stands of longleaf pine, protecting trees that have stood on the land for centuries.