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Using Fire as a Management Tool for Ecological Forestry

forest WISDOM

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in this issue:

Prescribed Fire and Oak Regeneration

by Nate Wilson and Dr. Ken Smith

A firsthand account in Southeastern Tennessee at Sewanee

Eight a.m. on an April morning: After three weeks without rain, an inch fell on Sunday, and the Division of Forestry again began issuing burn permits. Though the forecast called for highs near 80 and relative humidity in the lower 30s, we still hoped that the morning's high humidity would keep the fire low and minimize damage and risk. This would be the largest prescribed fire on the Domain in at least 30 years, so the last thing we wanted was have it get too hot. The social ramifications for that would likely exceed the ecological ones, since fire had been largely missing from this community for the last 60 years.

As it turned out, the morning humidity also minimized the fire. Ten students in Sewanee's Forest Restoration class were skipping other classes to use the drip torches and carry backpack sprayers. They had already prepared for the fire by digging fire line where it was needed. Three hours later, we had managed to burn just 3 of the 22 acres on tap for the day.

However, as the day progressed, so did the fire. We had chosen a xeric site near a bluff adjacent to a rock shelter (historically used by Native Americans) that currently supported a mix of naturally regenerated oaks (*Quercus* sp.) and loblolly pines (*Pinus taeda*) planted in the 1960s. The pines had been removed commercially, as had small amounts of hardwood pulp. The larger-diameter oak and hickory (*Carya* sp.) that dominated the canopy were left intact. Advanced oak regeneration on the site (more than 4,000 oak seedlings per acre) was patchy, although patchy regeneration is better than none at all.

By midafternoon, things had started to heat up. Some of the mountain laurel (*Kalmia latifolia*)—near a popular hiking trail not included in the burn plan—were burned, and a couple of stray slash piles—not pulled apart by students prior to the fire—ignited, resulting in scorched tops on a few residual oaks.

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Photo above by Garrett Meigs

Dear Forest Guild members and friends,

On a late September morning, residents of Santa Fe, New Mexico, awoke to the smell of smoke in the air. The Santa Fe National Forest, in an ongoing effort to improve forest health within the city's watershed, was burning slash piles from past thinning treatments. Burning piles always generate a certain level of frustration among residents who struggle to deal with the smoke. It also brings up broader questions about the role of fire in managing forests. When is it okay to use fire as a management tool? What are the safety risks of burning and not burning? What are the air quality and carbon implications? For me, it reinforces the need for thoughtful, knowledgeable foresters to answer these questions and practice good stewardship.

In Santa Fe, a strong ecological basis exists for using fire as a management tool. The ponderosa pine forests within the watershed are fire-adapted systems; prior to 1900, fires occurred on the landscape every 5-15 years. Today, much of the watershed is comprised of stands with increased tree densities, fuel loads, and reduced understory species composition. A shift from commercial logging to grazing, urbanization, fire suppression policies, and changed public perceptions have all contributed to the current landscape conditions.

For forest managers, determining the ecological basis for using fire as a management tool or managing fire risk is only half of the equation. Managers, especially those working on public lands, must also identify and work within the social license that exists to practice forestry: What does the public think is right, and what are they willing to accept? Skilled practitioners are especially needed when the social parameters for managing forests do not coincide with the ecological or economic priorities.

As foresters, our role is not to just manage the land; it is also to provide the ecological, social, and economic basis for our decisions. It is the multidisciplinary nature of the forestry profession that equips foresters with the ability to account for diverse and often contradictory interests. In my time working for the Guild, I have been continually impressed by the dedication of Guild members to practice such a thoughtful brand of ecologically-based, responsible forestry.

This issue of *Forest Wisdom* explores forest management and fire and the challenges and successes experienced by managers. Whether it is determining the best use of fire to manage Western mixed conifer forests or understanding the carbon implications of frequent fires within Southeastern pine grasslands, forestry professionals play a vital role by seeking answers to management questions and translating best knowledge to responsible stewardship.

Sincerely,

Michael DeBonis, Executive Director

After the burn (and pre-burn thinning), students compared pre-treatment measurements to post-treatment and found that we had reduced basal area from $125ft^2$ to $64ft^2$/acre. Flame heights reached 15 feet in the hottest areas, and fire ran through an estimated 80 percent of the site. Preliminary results indicate that many of the 4,000 oak seedlings resprouted vigorously post fire, with first-year growth exceeding two feet even after deer browse.

Oak regeneration historically and today

Oak regeneration in the Southeastern hardwood forest really shouldn't be that difficult. After all, oak-hickory forests have historically been the dominant hardwood forest type throughout the Southeast, and many of those forests exist today without the benefit of forest managers versed in the latest in silvicultural training. But somehow, the laissez-faire forest management that produced the stands we have today doesn't seem to be regenerating them. There are many different hypotheses for this that vary with site and land-use history. In general, it seems that on our most productive oak sites, the sites trend away from oaks toward other forest types without multiple treaments.

Over the past decade, the use of fire to help propagate oak has been gaining interest from the research and management community. Delcourt and Delcourt, for example, examined historical plant distributions and land use across the Southeast and found that human use of fire has existed in the region for thousands of years. In fact, anthropogenic fire use was widespread until the 1950s, and since then the exclusion of fire from oak-dominated systems has changed forest dynamics throughout the Southeast.

In 2005, Brose and colleagues published an excellent review of the use of fire in oak dominated forests. It suggested that two to five fires spread out over a decade help oak's competitive advantage after a stand is opened up. Their overview also included mention of the growing problem of deer browse and the fact that none of the treatments used to promote oak regeneration totally excluded other hardwood species from growing on treated sites.

At Sewanee and across the Southeastern U.S., there are millions of acres of oak-dominated forests that are slowly losing their older and larger oak component. With a lack of disturbance, shade-tolerant, mid-story species such as red maple (*Acer rubrum*) commonly replace several species of oak as they fall out of the overstory. Although oak seedlings may exist in the understory, they are never able to fully develop in the shade. In addition, forest managers often have a difficult time maintaining the oak component after silvicultural treatments, and frequently oak densities in managed stands do not equal the pre-treatment densities that existed in the overstory.

One of the most successful techniques to promote oak development following silvicultural treatment was adapted from studies conducted by Loftis et al. who worked on high-quality sites in the southern Appalachians. They found that moderate to high densities of advanced oak regeneration (less than 1 foot tall) in the understory before the initial silvicultural treatment increased the chances of growing an oak-dominated forest in the future. Unfortunately, many oak dominated and closed-canopy forests in the region have very patchy distributions of advanced oak regeneration, and there are questions about how well these older seedlings respond to sudden increases in light and other resources.

In Kentucky, Arthur et al. have examined fire use across multiple sites over several years and found that the use of fire without mechanical treatment reduces midstory densities of red maple and oak while stimulating red maple sprouting and oak seedling production. In a study published this year, they found that in 80-year-old oak stands fire use during mast years was an effective technique to encourage oak regeneration. These authors proposed that well-timed fall fires (before acorn and leaf drop) would allow the acorns to have access to mineral soil and be protected over the winter by the fresh leaf fall, thus increasing oak seedling recruitment. In a second study

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Nate Wilson
Nate curently works as the Domain Manager for the University of the South's (Sewanee) forest lands. Nate is a consulting forester, a Guild professional member, and serves as the Guild's Southeast regional coordinator.

Ken Smith
A Professor of Forestry and Geology at the University of the South, Ken is a member of the management team for the school's 13,000-acre forest. A Forest Guild professional member, he also serves on the Forest Guild Board of Directors and a variety of natural resource boards and advisory councils across the U.S.

Firefighters watching flaming front of the 2004 Taylor Complex.

Photo by Tom Kurth, State of Alaska Division of Forestry.

Sarah Trainor

Sarah is principal investigator for the Alaska Fire Science Consortium. Currently she is research assistant professor at the University of Alaska, Fairbanks. She holds an MA(1996) and PhD (2002) in Energy and Resources from the University of California, Berkeley.

Meeting Alaska's Fire Science and Climate Information Needs for Forest Managers

by Dr. Sarah Trainor, T. Scott Rupp, Jennifer Barnes

Wildfire is the dominant driver of ecosystem change in Alaska. The majority of annual area burned occurs within boreal forests in the interior region (north of the Alaska Range and south of the Brooks Range). See Figure 1 on page 5. Alaskan boreal forests are dominated by late successional black (*Picea mariana*) and white spruce (*Picea glauca*) and early successional birch (*Betula* spp.) and aspen (*Populus tremuloides*). Black spruce that grows on wet soils and permafrost is adapted to high-severity fire. However, white spruce generally occurs on well-drained soils in alluvial zones, riparian zones, and south facing slopes. Fire frequency in white spruce stands can be greater than 300 years, but averages 60 to 200 years. Mature forests of both species are often underlain by a carpet of feathermosses (*Hylocomium splendens* and *Pleurozium schreberi)* or peat mosses (*Sphagnum* sp.*)* and have deep organic soils (duff). Fire tends to create a mosaic of forest conditions that affect future fire susceptibility and species composition.

Within this system, burn severity strongly influences vegetation patterns and succession after fire. The amount of consumption of the organic mat can influence whether vegetation regeneration occurs through seedling establishment or re-sprouting post fire and can also impact stand type conversions. Both Canadian and Alaskan research have shown that fire danger, fire behavior, and fire effects in the boreal forest are related to the moisture content of the forest floor duff layers. In these ways, the structure and function of Alaskan boreal forest and tundra ecosystems and their associated fire regimes are fundamentally different than most fire-prone ecosystems in the United States. Consequently fire suppression and management strategy in Alaska follows a different model. For example, fire managers do not generally utilize the U.S. National Fire Danger Rating System; instead, they use the Canadian Forest Fire Danger Rating System for its applicability to Alaskan ecosystems and fire regimes.

Global climate models agree that the effects of climate warming will occur first and most severely at high latitudes. For example, Alaska has warmed significantly over the past several decades with an average increase in mean annual temperature of 3.4° F/1.9° C since 1950 and a 50 percent increase in the frost-free season in the boreal forest region during the past century. The amount of boreal forest in North America that burns annually tripled from the 1960s to the 1990s, and more than half of the severe (>1 million acres/>400,000 hectare) fire years on record have occurred since 1990.

Fire in Alaska is tightly linked to climate, and the average area burned per year in Alaska is projected to double by the middle of this century. Recent changes in growing-season precipitation regimes have been linked to changes in seasonal variations in area burned. Interactions between water availability, fire regime, permafrost, and vegetation suggest that changes in fire regime related to seasonality could result in substantial impacts on ecosystem structure and function. With the coupled trajectories of future climate and population growth, direct, near-term threats to human well-being (e.g., safety, air quality), and personal property from wildfire in Alaska are expected to increase.

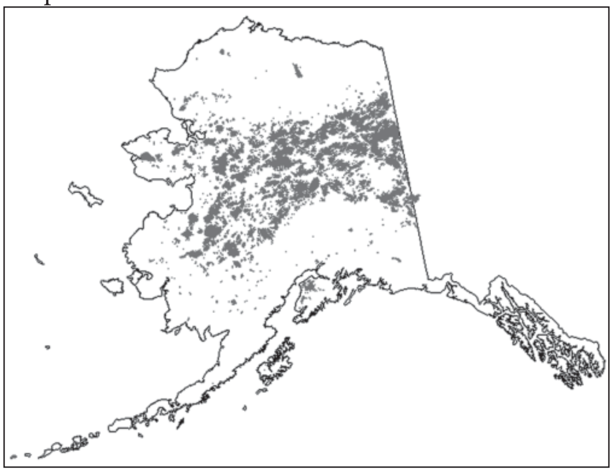

Figure 1. Map of Alaska showing wildfire perimeters 1942–2010.

As climate change alters the ecosystems and the species that depend upon them, land and resource managers in Alaska are starting to consider how climate change and fire management practices may fit into future land management practices. Many state and federal agencies are developing strategic plans for land management under changing climate conditions. Options to manage fire are myriad, depending on whether objectives are to reduce carbon emissions, maintain biodiversity, or manage fire suppression activities under increasing fire frequencies.

The Alaska Fire Science Consortium (AFSC) was established with funding from the Joint Fire Sciences Program in 2009. (http://frames.nbii.gov/alaska/consortium)

The Consortium's goals are to
1) coordinate current science delivery efforts;
2) create a formal outreach mechanism for two-way communication between fire scientists and a diverse community of fire and land managers;
3) provide an organized, centralized arena for effectively delivering available fire science information to fire managers; and
4) work with fire managers in an on-going forum to ensure that the science delivery and outreach mechanisms are both practical and readily implemented in the field.

AFSC serves as a model for building strong, interagency science delivery networks in the face of rapid and dynamic climatic and demographic change. At the University of Alaska, Fairbanks, AFSC is partnering with state-of-the-art science outreach and delivery organizations including the Alaska Center for Climate Assessment and Policy (ACCAP) (http://ine.uaf.edu/accap/), one of the National Oceanic and Atmospheric Administration's Regional Integrated Science Assessment Programs , and the Scenarios Network for Alaska Planning (www.snap.uaf.edu), which provides spatially explicit, scientifically credible projections of future conditions under climate change, including temperature, precipitation and growing season.

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> “Fire in Alaska is tightly linked to climate, and the average area burned per year in Alaska is projected to double by the middle of this century.”

“Should the time between fire return be increased to enhance the carbon storage of the ecosystem?”

Eddy flux tower.
Photo by Richard T. Bryant.

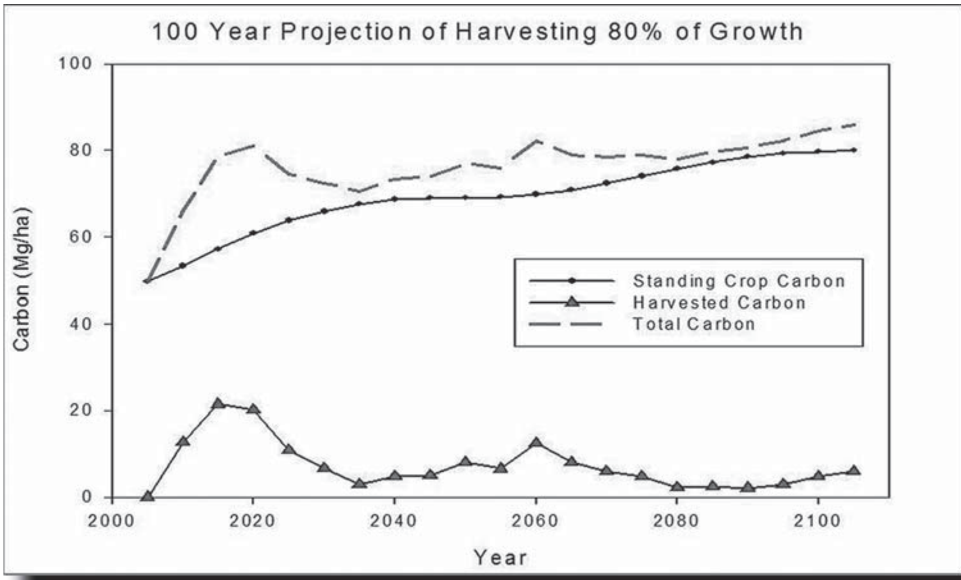
Ecological Forestry and Carbon Considerations in Frequently Burned Southeastern Woodlands

by Robert Mitchell, Constance Best, Jason McGee

The Southeastern U.S. is blessed with the frequently burned Southeastern pine grasslands, some of the most biologically diverse forests extant globally. These forests also provide rich timber and wildlife resources. However, all these resources are only sustained if fire is frequent and uninterrupted in time and space. These forests both fix carbon dioxide (CO_2) from the atmosphere (assimilation) and release it (respiration) into the atmosphere. At present three important areas remain largely unknown: the relative balance of these two processes, the form and function of carbon (C) storage when assimilation exceeds respiration, and how management influences key processes. Uncertainty about these issues leads us to ask should the time between fire return be increased to enhance C storage of the ecosystem?

The argument for maintaining a frequent, uninterrupted fire return interval in Southeastern forest grasslands is multidimensional. First and foremost, their structure and function are intimately related to disturbance. Long-term research show declines in plant diversity with fire return intervals lengthened just to three years as contrasted with annual or biannual burns. Second, depending on the length of increase in fire return interval, the risk of wildfire increases as fuels increase. Lastly, fires and their C consequences should be viewed as cycles, not individual events. Fire in these systems consumes the fuels in the understory and midstory (grasses, pine litter, hardwood seedlings and saplings, and a small but unquantified amount of downed woody material). During the fire-free period of the fire cycle, these fuels build up and are burned again in the next fire. Over time, this should result in no net release of C and some still-undetermined, long-term sequestration due to production of black carbon and its long residence time.

In addition to the above considerations, the relationship between C and conservation management is often confusing because of a failure to separate two fundamentally different, aspects of C management. The first is the challenge of developing a rational, rigorous, but operationally practical method for landowners to measure the C storage of their woodlands, and how that changes over long periods of time in order to document the C stores relative to a baseline of what would have



occurred on the site absent their C project. Second, there is the challenge of developing a greater understanding of the forest C cycle as influenced by climate and management. This is particularly critical given the Supreme Court's 2007 ruling that gave the federal Environmental Protection Agency the authority to regulate CO_2 as a pollutant.

Our current work at the Joseph W. Jones Ecological Research Center at Ichauway (Jones Center), in Newton, Georgia, is a collaboration with many partners including the Pacific Forest Trust, Emory University, The Dobbs Foundation, the University of Alabama, and Edinburgh University in Scotland. Next, we summarize our collaborative attempts to address these challenges.

Climate Action Reserve protocol and carbon sequestration of frequently burned longleaf pine grasslands

The carbon market, wherein emissions reductions are traded as a means of mitigating CO_2 sources, is diverse both in supply and demand. The market is dynamic (two-thirds of the global market has developed since 2007) and appears to be changing from voluntary to compliance. The Climate Action Reserve (CAR) forestry protocol has been adopted by the state of California as the standard for voluntary projects that meet the state's greenhouse gas (GHG) reduction goals, and is considered the leading candidate for a compliance standard in the U.S. As such, credits operating under this standard are currently widely purchased by entities seeking to offset CO_2 emissions.

The CAR current forest project protocol can be viewed by visiting:
http://www.climateactionreserve.org/how/protocols/adopted/forest/current/.

To learn how C standards could be applied to manage longleaf pine (*Pinus palustrus*) forest, Jones Center, its partners, and an advisory group of forest managers have initiated a project to apply the CAR forestry protocol to the demonstration forest at Ichauway, a second-growth longleaf pine forest with average tree ages of 75 to 95 years.

The demonstration forest's longleaf pine C stores have been modeled assuming 80 percent of the growth will be periodically harvested over the 100-year project period. We are using the rules established under the CAR protocol version 3.2 to compare the projected C stocks against a baseline estimate of what would have occurred under more typical forest management of longleaf pine forests in the vicinity of Ichauway.

In addition to on-site forest C, we will also assess other factors, including the relative production of forest products and the transfer of carbon stores off-site. The difference between the total carbon stocks under the demonstration forest management regime and those under the baseline scenario

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Dr. Robert J. Mitchell

Since 1999, Bob has worked as a scientist at the J. W. Jones Ecological Research Center. His research interests include ecophysiological limits to productivity, particularly below ground, and how natural disturbance processes can be incorporated into silviculture to conserve southern pine grasslands.

*At right -
Shaded fuel break near
Angel Fire, New Mexico
Photo by Arnie Friedt.*

Integrating Place-Based Knowledge and Research for Fuel Treatments in Mixed Conifer Forests

by Dr. Zander Evans

Dr. Zander Evans

As Director of Research for the Forest Guild, Zander is the principal investigator for the Mixed Conifer Forests research project funded by the Joint Fire Science Program.

For many residents in or near Western forests, living with fire is a fact of life, as evidenced by the recent Schultz Fire outside Flagstaff, Arizona. The fire burned more than 15,000 acres on the eastern slopes of the San Francisco Peaks in late June, 2010. It burned through ponderosa pine (*Pinus ponderosa*) and then into a mixed conifer forest of Douglas-fir (*Pseudotsuga menziensii*), white fir (*Abies concolor*), and ponderosa pine. Up to 70 percent of some watersheds burned at high severity, killing most trees. Though no structures were destroyed in the fire, the community of Flagstaff is now at risk from flooding and debris flows.

Fuel treatments are designed to reduce fire hazard. This is accomplished by manipulating or removing trees, brush, or dead woody material to reduce the likelihood of ignition, help reduce potential damage, and facilitate wildfire control. While fuel treatment practices for some forest types such as ponderosa pine are well established, managers face more uncertainty with mixed conifer forests.

To help address some of the challenges facing managers, the Joint Fire Science Program is supporting a team from the Forest Guild, University of California, Berkeley, and US Forest Service to write a guide to fuel treatment practices in the mixed conifer forests of California, the central and southern Rocky Mountains, and the uplands and plateaus of the Southwest. A central goal for the guide is to combine existing peer-reviewed literature with information gathered from dozens of interviews with managers. Our interviews with a wide range of federal, tribal, state, and private managers aim to share place-based experience not codified in scientific journals.

When compared to those for the ponderosa pine forest type, fuel treatment practices are less well established for the mixed conifer forest type because it is

- more difficult to define
- more heterogeneous in structure and composition
- home to a greater number of endangered species
- the focus of fewer scientific studies
- more varied in fire frequency
- affected by more complicate suite of insects and diseases

The first challenge in describing fuel treatment prescriptions and techniques for mixed conifer forests is that "mixed conifer" is difficult to define. The term is used to describe forests along a broad continuum of climatic zones that include many different assemblages of species.

Mixed conifer forests in California, the Central Rockies, and the Southwest tend to include a mix of ponderosa pine, Jeffery pine (*Pinus jeffreyi*), Douglas-fir, white fir, blue spruce (*Picea pungens*), and aspen (*Populus tremuloides*), depending on the region and site. They may also include sugar pine (*Pinus lanbertiana*), giant sequoia (*Sequoiadendron giganteum*), incense cedar (*Calocedrus decurrens*), Engelmann spruce (*Picea engelmannii*), subalpine fir (*Abies lasiocarpa*), limber pine (*Pinus flexilis*), lodgepole pine (*Pinus contorta*), southwestern white pine (*Pinus strobiformis*), and several oak (*Quercus spp.*) species. Some managers find more specific plant association or habitat type delineations to be useful for implementing the project and predicting treatment effects, while others break the continuum of mixed conifer forests into either a warm/dry type or a cool/moist type.

Historically, before 20th century fire suppression policy, fires in mixed conifer forests generally varied in severity from surface fires to patchy (or passive) crown fires across relatively small geographic areas. Warm/dry and cool/moist mixed conifer types intermingled to present a mosaic of structures and densities. Usually the warm/dry mixed conifer type was characterized by a low-severity, frequent fire regime, while the cool/moist type was more prone to less frequent but more severe contained fires.

For example, the LANDFIRE National Vegetation Dynamics Model for Sierran mixed conifer assumes about 15 percent of fires at stand-replacing, 70 percent are surface fires, and 17 percent are mixed severity fires. In this model, surface fire have a mean return interval of about 15 to 20 years, while mixed severity fires occur every 30 to 50 years on average. On a regional scale, climate patterns such as El Niño-Southern Oscillation also influence extent and timing of high severity fires.

Since the late 1800s, population increases, large-scale mechanized logging, fire suppression, road building, and livestock grazing have dramatically changed mixed

Mixed Conifer forest type in San Juan National Forest, CO. Photo by Zander Evans.

conifer forests by both reducing the frequency of fire and increasing tree densities. One impact of reduced fire frequency in mixed conifer forests has been to make them more homogeneous.

Currently, many fuel treatments seek to restore heterogeneity, i.e., the mosaic of openings and stands of varying densities across the landscape. Rather than just removing trees to create evenly spaced crowns, managers are experimenting with creating gaps and openings to change fire behavior. Fires naturally create some heterogeneity since they burn with different severities because of variation in

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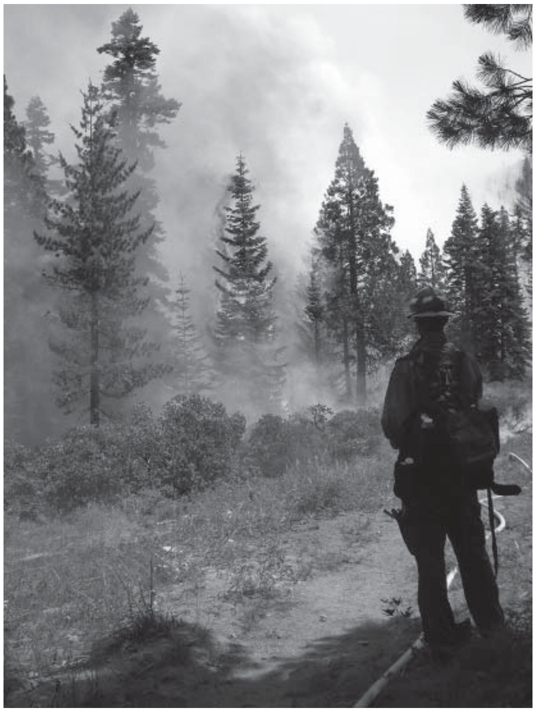


Mixed Conifer forest burning in the 2008 Whiskeytown Fire. Photo by Jen Gibson.

Returning Prescribed Fire to the New Jersy Pine Barrens

by Michael Mangum and Robert Williams

> "Some forest stands are now in what may be called a recovery stage: pines of one hundred years or older growing in more open conditions with a more diverse understory."

Photo at top - An even-age stand of pitch pine and shortleaf pine in the Cloverdale Farm County Park. Courtesy of OCP.

Introduction

Much of Ocean County in southern New Jersey is located within the pine barrens ecosystem of the Pinelands National Reserve. The Ocean County Department of Parks and Recreation (OCP) manages the county's approximately 14,000 acres of open space, the bulk of which is forested and undeveloped. OCP faces many forest management issues. In recent years, hazard tree management in public areas (i.e., trails, roads, picnic areas, etc.) has become a major issue. A devastating outbreak of gypsy moths in combination with the lingering effects of a drought eight years ago has caused a major oak (*Quercus sp.*) die off. However, the biggest challenge remains the greatly increased intervals between fires and the impact this continues to have on the forest.

History

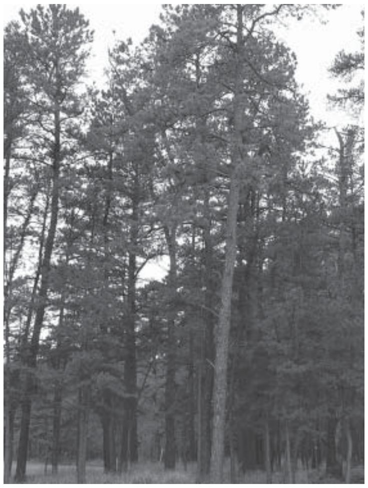
The Pine Barrens in southern New Jersey is a unique forest ecosystem that has evolved with fire over the millennia. The primary pine species is pitch pine (*Pinus rigida*) – one of the most fire-adapted tree species on planet earth. Additionally, shortleaf pine (*Pinus echinata*), another fire-adapted pine, grows throughout the southern coastal plains. Prior to European influence and settlement, the Pinelands region was sustained by a fire ecology that was dependent upon both natural lightning strikes and Native Americans, who managed almost all of North America with a fire regime. According to the National Interagency Fire Center's *Wildland Fire*, "The earliest European settlers to North America noted indigenous peoples' use of fire for clearing land, hunting and gathering activities, and in warfare."

In the post-Native American period, abuse of the forest and poor forestry practices led to catastrophic wildfires. Witnessing this devastation, Gifford Pinchot mistakenly advocated that the state of New Jersey develop a system to exclude fire from the forest. Thus, lack of forest management, longer fire intervals, and an increasingly fragmented forest has increased fuel loads to critical levels in many areas. In addition, repeated high grading, cuttings, and the gleaning of shortleaf pine out of many stands have dramatically changed the forest dynamics. Frequency of fire has also been lessened due to the need to protect life and property from uncontrolled wildfire in the wildland urban interface. This, in turn, has resulted in an unnatural building up of forest fuels, resulting in increased risk and concern for catastrophic wildfires.

Returning to a fire-dependent ecology

Research on the impact and effects of fire in the Pine Barrens was pioneered by Dr. Silas Little, a prominent silviculturist who spent more than 45 years studying the effect of fire in that ecosystem. Working closely with the State of New Jersey Forest Fire Service (NJFFS), Little was a pioneer in researching prescribed burning in Pine Barren forests to reduce forest fire risks. Thanks to those managers who took Little's extensive research and applied selection cutting silviculture, some forest stands are now in what may be called a recovery stage: pines of 100 years or older growing in more open conditions with a more diverse understory.

Yet these forests still require fire to sustain them. OCP actively manages many of its forested acres with prescribed burning in cooperation with the NJFFS. A burn plan is developed for each site. The first objective is always hazard reduction that meets the legal requirements for prescribed burning in New Jersey. Secondary objectives include improved



From top to bottom -

Pitch pine and shortleaf pine are among the few pines that sprout after fire.

Paramount Fire 2010. Photo courtesy of the NJ Forest Fire Service.

Mixed pitch pine/shortleaf pine with prescribed burn intervals 1-3 years.

forest health, habitat improvement, invasive species control, and endangered species habitat enhancement. Burning occurs from late fall through winter.

The burn process

OCP's process begins with selecting, mapping, and developing a plan submitted to the NJFFS for approval and permitting. The proposed burn will include anchor lines to control the perimeter of the fire. Additional plow lines will be established parallel to each other in a north-south alignment to control the fire and expedite the burn. Most burns in New Jersey are conducted with a west wind. NJFFS and OCP work together on the burn. Once a day with suitable conditions is chosen, that day begins with a meeting reviewing safety, burn limits and expectations, and job assignments of all involved. The incident management model is used to conduct the burn. Local agencies and neighbors are notified, and signs are placed on any highways. A test fire is lit to insure the conditions are within prescription. Then drip torches are used to begin lighting the burn. After the lines are set, most of the staff is used to monitor the burn. NJFFS brush trucks may patrol the perimeter and are available to chase any fire that jumps a line. Smoke management is important to minimize accidents. Once the fire is burned in, crews put out any burning snags that may present a hazard or are visible from a road. Should conditions change outside of prescription, the prescribed burn will be terminated. In reality, there may be very few suitable days to burn within prescription. During the 2009 to 2010 burn season, OCP was unable to burn any of its sites due to prolonged snow cover and record-breaking precipitation. Burn cycles are generally two to five years, depending on conditions and objectives for each burn block.

Sometimes wildfires have also brought opportunities to implement secondary management strategies. As a result of the Warren Grove Fire in 2007, which burned 17,270 acres, destroyed four homes, and damaged 37 others, an initiative was launched by NJFFS and the New Jersey Pinelands Commission to develop wildfire fuel breaks. Ocean County is the largest landowner along their planned Pancoast Road fuel break. The 200-foot-wide, 5-mile-long break will consist of a selective thinning with a 50-percent canopy reduction and removal of understory vegetation including ladder fuels. NJFFS will act as agent on behalf of the county and solicit proposals this fall for timber harvesters to conduct a thinning harvest. The objectives will be accomplished with no out-of-pocket expenses and limited staff time. The long-term management of this area will focus on both prescribed burns and mechanical removal with 2 to 3 year intervals. The fuel break will meet both its primary objective of hazard reduction in the wildland-urban interface and its secondary objective of improving forest health and

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Michael Mangum

Michael Mangum is Director of Parks for Ocean County, New Jersey. He has 33 years experience studying Pine Barrens and managing public lands. Michael is also a member of the New Jersey Forest Fire Service Incident Management Team and holds a BS in Park Management from the University of Vermont.

Robert Williams

A professional Forest Guild member and certified forester, Bob currently consults with a wide range of private and public landowners for their forest management needs, primarily in New Jersey. He is Vice President of Forestry Operations for Land Dimension Engineering in Glassboro, NJ.

MEMBERSHIP

Professional Membership in the Forest Guild is open to all forest professionals whose work is directly related to the stewardship and protection of forests, whether that work occurs through on-the-ground management, policy, advocacy, or research.

Other individuals who share a concern for forests and forestry are invited to participate as **Supporting** or **Sustaining Members**.

Students are also encouraged to join and become involved.

JOIN TODAY
www.forestguild.org

At top - Beaver Photo by Bruce Bauer

Prescribed Fire in the NJ Pinelands, from page 11

moving towards a more historic forest.

Benefits of fire

The need for controlled fires in the New Jersey Pine Barrens is self-evident. Fire benefits forest health, wildlife, and endangered species. Many wildlife species that thrive in the coastal plain pine ecosystem require fire to sustain optimum habitat suitability for their survival. Species can also be indicators of fire regimes. The U.S. Fish and Wildlife Service records indicate red-cockaded woodpeckers (RCW) were once found in the New Jersey Pine Barrens. This woodpecker species requires large, healthy, and mature living pines growing in open conditions. As the pine forests recover and fire is applied as part of the management process, these optimum RCW habitat conditions are developing after many decades of forest abuse.

An ecosystem-wide approach is needed. Both state and county employees and private foresters work every winter in spite of limited resources to conduct prescribed burns throughout the region. However to do what is needed will require more resources. The time to get on with the return of fire and management to these Pinelands forests is here. The New Jersey Pine Barrens need forest management that includes controlled fire for its continued survival. ■

Fire and Carbon Implications, from page 7

will be measured, and the potential "carbon reduction tons" for a CAR-compliant project will be determined. The project findings and implications will be published for two
different audiences: a landowner manual describing how the process can be implemented on private lands; and scientific journals with detailed data analysis for professionals, policy makers, and scientists interested in carbon.

Understanding spatial and temporal patterns in C sink source strength of frequently burned longleaf woodlands

As mentioned above, understanding and predicting (simulating) C dynamics require that we document patterns of temporal and spatial variation and understand their controls.

What we do know is the following:

- The C cycle in longleaf pine wiregrass systems varies tremendously based on the water holding capacity of the site. Extremely dry (xeric) sand hills or flatwoods (also known as pine flats or barrens) that contain a balanced supply of moisture (mesic) vary more than twofold
in productivity.
- Drought interacts with the site in complex ways. Mild drought seems to affect xeric sites first. As drought becomes more severe, mesic sites become much more impacted due to differences in rooting depth and plasticity in hydraulic conductivity of trees in xeric and mesic sites as well as differences in demand due to greater leaf area index accumulated in flatwoods.
- Wiregrass, due to its C_4 anatomy and physiology, has different phenology and sensitivity to drought as contrasted to C_3 overstory. Also, the oak component may differ from pine depending on site (xeric sites tend to have greater oaks and past fire management).
- C dynamics of the soil will respond in fundamentally different ways to the environment than do dynamics of the overstory or understory.

In addition to these considerations, the interaction of climate and management (both fire and timber management) across site types will have to be included in any C simulation model. The first complete data sets are starting to emerge. The data were derived from measurements by eddy flux towers that use a micro-mereorological approach to study fine-scale fluxes of C, water, and energy at ecosystem scales. The model was driven by observed meteorology, leaf photosynthetic parameters, and measured leaf area index. Respiration rates of other C pools were set using local measurements and parameters from the research literature.

We will have more to say on this projet over the next year. For those interested in learning about this work, email Bob Mitchell. We will be happy to keep you updated. (rmitchel@jonesctr.org). ■

Editor's note: *A copy of the complete article including references and endnotes may be downloaded at www.forestguild.org/publications/forest_wisdom/FW16_Mitchell_et_al.pdf*

Alaska Fire Science Consortium, from page 5

Managers engage in a lively exchange of ideas at the 2009 Alaska Fire Science Consortion workshop.

Leveraged funding from ACCAP through the National Integrated Drought Information System (NIDIS, www.drought.gov) helped to create an experimental forecast for area burned in Alaska, a prototype decision-support tool, and the first statistical model forecasting area burned based on strong connections between weather, climate, and fire (http://ine.uaf.edu/accap/research/season_fire_prediction.htm). The tool provides a forecast of the magnitude of the upcoming fire season for interior Alaska as a whole and gives an estimate of certainty associated with the forecast. In its first two years, the forecast has been fairly accurate and fire managers in Alaska report it to be useful. In 2010, for example, as of September 24, about 1,117,000 acres have burned. The corresponding forecast predicted between 500,000 and >1,500,000 acres.

Our first Alaska Fire Science workshop, in fall 2009, had more than 60 participants from 10 different organizations. The workshop format included presentations of results from fire science research, open discussion on fire science delivery methods and communication, and a written survey. Overall, there was strong support for increased and improved communication between and among fire scientists, fire managers, and land managers in Alaska. Electronic distribution of fact sheets and newsletters in combination with an annual in-person workshop were indicated as the most effective means of fire science delivery.

The AFSC is one of eight regional fire science consortia nationwide funded by the Joint Fire Science Program (JFSP) (www.firescience.gov/). JFSP created these consortia to enhance the delivery and adoption of fire science findings by developing a national network of regional partnerships. These consortia are based on principles of being inclusive, impartial, end-user driven, collaborative, innovative, and facilitative.

The consortia offer new opportunities for managers to influence the direction of future research through dialogue with scientists and to put new research results into practice more rapidly. Other JFSP fire regional consortia include the Southwest region (the Forest Guild is a partner), California, the Great Basin, the Central Rockies, the Great Lakes, Appalachia, and the Southeast. See map below.

Readers can get involved with their local consortium by visiting www.firescience.gov/JFSP_Consortia.cfm. ■

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***Editor's note:** A copy of the complete article including references and endnotes may be downloaded at the Forest Guild website at www.forestguild.org/publications/forest_wisdom/FW16_Trainor_et_al.pdf.*

MISSION

The Forest Guild promotes ecologically, economically, and socially responsible forestry as a means of sustaining the integrity of forest ecosystems and the welfare of human communities dependent upon them. The Guild provides training, policy analysis, and research to foster excellence in stewardship, to support practicing foresters and allied professionals, and to engage a broader community in the challenges of forest conservation and management.

At top - Lake Tahoe mixed conifer forest, Photo by Zander Evans

Mixed Conifer Fuel Treatments, from page 9

fuel loads and weather conditions. Innovative managers are creating more landscape heterogeneity by implementing prescribed burns across large mixed conifer forests, such as early season prescriptions using aerial ignition to burn upslope where remaining snow can control the fire.

One common refrain from mixed conifer managers is the need to build confidence in prescribed fire treatments. Fire in today's mixed conifer forest often burns with an intensity and severity that can be uncomfortable for people used to low-severity fires in ponderosa pine or longleaf.

"Fire in today's mixed conifer forest often burns with an intensity and severity that can be uncomfortable for people used to low-severity fires in ponderosa pine or longleaf."

Managers have reported that they can build support for prescribed fires deemed risky by their superiors by carefully laying the groundwork through mechanically thinning or pre-burning the surrounding stands, or a combination of the two, thereby minimizing the threat of a fire jumping out of the prescribed area. Mastication of fuels is another new way managers have found to begin forming a landscape in which they have the confidence to prescribe burn mixed conifer forests.

Another key to building confidence is to ensure that the fire threat in the wildland urban interface (WUI) is reduced to near zero. Treatments that remove all trees and ladder fuels on 16-foot spacing may not restore mixed conifer forest to a pre-settlement condition, but they may give managers the confidence to try a fire prescription that includes patches of high-severity fire.

Of course, numerous other challenges, from air quality regulations to climate change, still face managers of mixed conifer forests. For example, in California restrictions on prescribed fire from Air Quality Management Districts have been shrinking the time windows for burns. Endangered species also present a challenge for managers of mixed conifer forest types.

The spotted owl likes to build nests in patches of dense mixed conifer, and those nest sites need to be protected to ensure the survival of the species. Managers have found ways to work with wildlife experts to bring prescribed fire to spotted owl sites. For example, in a cooperative landscape burn near Magdalena, New Mexico, no active ignition was permitted in the core owl habitat, but the team was able to ignite areas above the owl habitat from the air. The burn reduced both fuels and the risk of an unplanned fire eliminating the core owl habitat.

Additionally, from an ecological perspective, the trend toward a warmer and drier climate (warmer spring and summer temperatures, reduced snowpack and earlier snowmelts, and longer, drier summer fire seasons) will increase fire activity in mixed conifer forests.

The Forest Guild will release the final version of the Comprehensive Fuels Treatment Practices Guide for Mixed Conifer Forests: California, Central and Southern Rockies, and the Southwest in April 2011. The final guide will expand on the ideas presented here and provide full citations for the science behind the report. Managers, scientists, and others interested in mixed conifer forests should contact Dr. Evans (email: zander@forestguild.org; or phone: 505-983-8992 x36). ■

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Prescribed Fire and Oak Regeneration, from page 3

also published this year, they found that multiple prescribed fires reduced the density of red maple and improved the growth of chestnut (*Quercus prinus*) and scarlet oak (*Quercus coccinea*) seedlings, but the surviving red maple had greater basal diameters than oak after 8 years (and multiple fires). Wang and Van Lear also recently reported that first-year white oak seedlings benefited from a site prepared by fire. The reduction in forest-floor depth and increased understory light intensity were both key to encouraging oak recruitment.

What this means for Sewanee

Eighty years ago, the conditions at Sewanee were ideal to regenerate the stand that has become our current condition. It is clear that anthropocentric forces were central to regeneration then as well as now. Although our first controlled fire was during late spring, students are now looking at regeneration and tree mortality this fall in order to follow the stand behavior. We plan to burn the site

a second time in the fall of 2011, just before acorn and leaf drop, to eliminate unwanted loblolly regeneration and to encourage acorn germination success. As hardwood competition develops, we may shift again to spring burning. We view the reintroduction of fire to be an excellent teaching and management tool for oak regeneration, one we hope to continue for years to come. ■

Editor's note: *A copy of the complete article including references and endnotes may be downloaded at the Forest Guild website at:* www.forestguild.org/publications/forest_wisdom/FW16_Wilson_and_Smith.pdf.

"It is clear that anthropocentric forces were central to regeneration then as well as now."

Forest Guild JFSP Mixed Conifer Sister Project

Mixed Conifer in Interior West, Eastern Cascades, and Klamath/Siskiyou Mountains

An interdisciplinary team of scientists from USFS Rocky Mountain Research, Humboldt State University, and University of Montana are creating a complementary guide covering ponderosa pine-mixed conifer forests within the Interior West, Eastern Cascades, and Klamath/Siskiyou mountains. There is substantial documentation on appropriate hazardous fuel management practices for pure ponderosa pine forests in this region. However, practices borrowed from the pure ponderosa type may be inappropriate for mixed conifer because of the differences between the two forest types as discussed on page 8 of this issue. Land managers' input and feedback are a primary component of the project, and initial interviews have revealed many emerging themes that all managers face when trying to plan, implement, and evaluate fuel treatments in dry mixed conifer forests. The team found that successful fuel treatment planning and implementation occurs when objectives are clearly defined for resource specialists before planning. Another finding of great concern is the lack of overlap between experienced practitioners and the newly hired practitioners. If you are interested in participating or have any questions, please contact Dr. Mike Battaglia (mbattaglia@fs.fed.us). ■

Photo at left by Nate Richardson.

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At right - Guild student member Deanna Wolford uses drip torch to ignite slash.