

The Quarterly Journal of the Florida Native Plant Society

Palmetto



No. 3 In The Series



On Fire

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Fire excites. We depend on fire but as we see open flames less and less, they threaten us more and more. In Florida, the Lightning Capital of North America, our natural ecosystems suffer as much from lack of fire as they do from bulldozing developers and invading exotics. While raging wildfires make the news, slow death due to fire suppression is hardly noticed. And the suggestion of conducting a controlled burn to restore a formerly fire-maintained ecosystem is still often greeted with shock and dismay as people lose touch with the role of fire.

Although various machines, herbicides, and herbivores can replicate many of the beneficial impacts of fires on native plants and associated animals, fire surrogates have their limitations and it is quite feasible to conduct controlled burns at a variety of scales and even in suburban settings. But before advocating burning, my lawyers advise me to suggest that you not mess with fire. Even the most carefully planned “controlled” burn might escape, burning down you neighbor’s garage with her Ferrari inside, and causing someone to think about suing me. Don’t! If you insist on burning, burn legally, get a permit, stay within your burn prescription, hire an experienced and certified burn boss, wear flame-retardant clothing, and never get over-confident.

If you are new to the burning business, start small. If you are trying to convert a lawn or small pasture into pine savanna, begin by burning patches only a few paces in diameter and have a hose handy. Given that wiregrass plants in a well-developed pine savanna are spaced at about one foot intervals, it will take a lot more planting material than you may have on hand to restore even an area the size of your dining room table.

Fig. 1 A typical pine savanna fire. Photo © Daniel W. Pearson.

Fire History

For millions of years, fires burned through Southern pine savannas at 1-5 year intervals. When fire frequencies are high, little fuel accumulates and fires are generally of low intensity. Pictures of raging conflagrations, burning Bambi, and post-fire desolation do not pertain to pine savanna-maintaining fires. Instead, the fires burn through the understory with flame heights seldom more than head high; Bambi could jump through such fires un-scorched. [Fig. 1]

People have been intimately involved with fire since they were people. The hearty souls who wandered into what is now the southeastern United States about 13,000 years ago brought hundreds of thousands of years of fire experience with them from the Old World. They burned to drive game, to expose poisonous snakes, to reduce populations of noxious invertebrates (e.g., ticks and chiggers), to protect themselves from noxious neighbors, to facilitate comfortable walking, for fun, and by accident. Although “natural” fires might have been frequent enough to maintain open, park-like conditions in some areas, the role of humans in shaping pine savannas should not be underestimated. Human participation in pine savanna ecology is now critical; with all the fragmentation that our landscape has suffered, augmenting natural fires with controlled burns has become a necessity.

The Amerindian tradition of burning pine savannas was maintained by settlers of European and African origin, much to the dismay of fire fighters during the early years of the U.S. Forest Service. Until fairly recently, woods burning was branded as a destructive practice. Successes in the 1930s of the Forest Service’s anti-fire evangelists, called the Dixie Crusaders, followed by Smokey Bear’s triumphal campaign, nearly killed the patches of pine savanna that escaped plowing and paving. Recently the stigma attached to woods burning has faded and well-intentioned restorationists can keep their day jobs while exercising their pyrophilic tendencies with less likelihood of reproach or indictment. And in really enlightened Firewise Communities (www.firewise.org), allowing fuel to accumulate is recognized as endangering both homes and natural ecosystems. [Fig. 2]

Some Fire Ecology

No two fires are alike, and all have unpredictable features, but they follow some general patterns. For starters, fires that burn with the wind (head fires) progress across the landscape



Fig. 2 – Surface fuel accumulation. Graphic © firewise.org.

faster than fires that burn into the wind (back fires). Fires burning uphill can also move at literally breath-taking clips. Under the conditions that most people choose to carry out controlled burns, savanna fires move slowly, rarely faster than a walking speed. Flame heights in frequently burned savannas are generally quite low, but where clumps of saw palmettos or wax myrtles are encountered, flames leap well overhead. And when a headfire and a backfire meet, watch out! The converging lines of fire desiccate and pre-heat the unburned fuel in front of them while creating local updrafts that serve to fan the fire further, sometimes sending firebrands of Spanish moss that can touch off spot fires far beyond the flame front.

Typical fires in well developed pine savannas are carried primarily by wiregrass and pine straw, both of which will burn even shortly after a rain. Bahiagrass and broomsedge also carry fire well and for that reason might be tolerated in your restoration area until you can establish a sufficiently dense sward of wiregrass or other pyrophilic natives. Dense patches of small pines, low-hanging branches festooned with fallen needles, and catbrier vines can all serve as “ladder fuels,” carrying the fire up into the canopy and sometimes causing the fire to “crown out.” In contrast to fires in well-maintained pine savannas, the risk of starting a crown fire is substantial in densely planted pine plantations that never see the torch. Law-abiding and otherwise responsible restorationists more typically face the opposite challenge – getting the darn stuff to burn. The flammability problem is particularly severe where hardwoods have shaded out the ground layer of fire-carrying grasses, and where fallen leaves from broadleaved trees have formed a smothering and not-so-flammable layer of leaf litter across the surface of the

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Photo by Sandy Woiak.

ground. Under these conditions, fires may only carry around pines or where the canopy has been opened, for example, by prior herbicide treatment or girdling of unwanted hardwoods.

Fires vary greatly in their intensity, duration, and the quantities and qualities of their smoke. Intensity varies with a number of factors including air temperature and humidity, fuel quantities and types, wind speed, and type of fire. Pine savanna fires generally have fire fronts only yard or so wide, and produce large quantities of smoke only where logs and stumps are allowed to smolder. Smoke from smoldering fires contains substantial quantities of the 5-10 micron particles that are a serious health concern, so you should keep fires burning swiftly and douse stumps. Generally the soil is not greatly affected by savanna fires, except where fallen logs ignite and burn completely. Where the soil is sterilized in this fashion, plant regeneration is relatively slow and quite different in species composition from the resprouts that usually dominate. Such hot spots are also about the only places you are likely to find several species of fire-following algae and mosses. Other than under burning logs and piles of brush, the soil is such a good insulator that even an inch below the surface changes in temperature are hardly detectable as a fire passes.

Fire impacts vary with species and season. Most pine savanna species resprout, even after being top-killed. Rosemary (*Ceratiola ericoides*) is an exception to this rule insofar as fires kill it outright, but before widespread fire suppression, it probably was restricted to scrub sites that burn cataclysmically but at decadal intervals. Large trees with thick bark typically survive all but the most intensive fires, but may suffer butt damage that will lead to their eventual demise. As for seasonal effects, warm season burns are more effective at controlling hardwoods and are more likely to stimulate flowering and seed set of wiregrass and several other native species. That said, in most restoration areas, any fire is better than no fire.

Of necessity, animals native to longleaf pine savannas are adapted to fire. A large number of species, nearly 300 at last

count, find refuge during fires in the burrows excavated by gopher tortoises. Another large number of species climb up to the canopy to escape. Larger animals like deer just move out of the way of the approaching flames.

Getting It To Burn

When restoring pine savanna in hardwood-dominated areas where grass, fallen pine needles, and other fire-carrying understory species are scarce, burning piles of cut and stacked hardwood brush can further the cause of restoration in several ways. In the hot spots under burn piles, roots, rhizomes, mycorrhizae, and buried seeds are killed while soil organic matter is oxidized leaving a proverbial clean slate and a great place to plant seeds and seedlings of many native pine savanna species. I hardly ever burn piles in the same place twice and thereby create new planting sites as the piles rove around my bahiagrass and laurel oak infested restoration area. Sometimes I pile and burn brush around hardwoods that I am too lazy to girdle or fell – back in Stone Age, this practice was likely common, and the woodpeckers appreciate my efforts. When burning a brush pile, stand ready with a garden hose while the fire burns outwards towards your well prepared fire breaks. Do not be surprised if you have trouble getting your burn pile to burn; strategically placed pieces of “fatwood” (resin-impregnated longleaf pine heartwood) definitely help. It also helps to stack the stems parallel to one another and to pile the brush while the leaves are still attached and to provide some readily ignited fuel.

A less labor-intensive approach to restoring pines in hardwood-dominated stands is to “brown and burn.” This technique involves herbiciding lots of hardwood trees and then burning soon after leaf drop. The additional litter, coupled with increased wind and light penetration through the canopy enhances the likelihood of running a successful fire.

The Duff Issue

Many of the trees that grow on the deep coarse sands of the coastal plain produce leaf litter that decomposes extremely slowly. Where fires are suppressed and fallen leaves and sloughed bark is allowed to accumulate, a “duff” layer of partially decomposed organic material builds up on the soil surface. Duff can be several inches to more than a foot thick, and is especially abundant around the bases of large pines. Fine feeder roots and the hyphae of mycorrhizal fungi proliferate abundantly in the lower layers of duff, recycling nutrients that never make it down to the mineral soil. Duff holds moisture pretty well and is hard to ignite, but when it does burn, even large longleaf pine trees may be fire-girdled by hours of smoldering. If you have duff I suggest raking around the bases of your pines and extinguishing duff fires swiftly.

Firebreaks

In olden days, wildfires stopped when it rained or they reached a river, wet swamp, ocean, or an area with little fuel. For controlled burns, firebreaks need to be created. There are many types of firebreaks, and the appropriate type varies with site and burning conditions.

The most environmentally disruptive firebreaks are those that are plowed with a disk harrow. The exposed mineral soil serves as an effective firebreak, but the plowlines are an eyesore and need to be regenerated if they aren't to be used as farm roads or paths. In some areas, just raking or mowing and raking works well; even a 3 foot wide raked line is often sufficient to stop a ground fire [Fig. 3]

Often the easiest way to create firebreaks is by burning strips of vegetation around the area to be torched. Lines can be “blackened” early in the morning or at night when the air is cool, still and humid, making fire escape less likely. Blackened lines need only be a few yards wide to stop all but the most raging head fire. If you are burning near your house, I recommend subscribing to the FireWise Program of the National Wildland-Urban Interface Program (<http://www.fire-wise.org>) and keeping up your insurance payments.

Know The Law And Act Responsibly

Burning can be legal if properly conducted by the right people, at the right time, and under the right conditions. It pays to know the relevant laws because if one of your fires escapes and does damage or if your smoke is implicated in a traffic or respiratory incident, the extent of your liability depends on whether you have followed the rules. In addition to state laws, many subdivisions have regulations prohibiting “open” fires. If you are trying to restore pine savanna where such restrictions pertain, I suspect that you are already having

to convince people that what they perceive as an unkempt yard is an intentional effort at restoration and not the result of sloth. While educating your neighbors about the multitude of benefits of restoration, you probably might also negotiate a waiver on the open fire rule.

Rules of law and rules of thumb governing fires depend to some degree on the sizes and types of burns that you intend to run. The best course of action, especially if you are going to burn more than a fraction of an acre, is to contract a certified burn boss. But if you are going to conduct your own burn, here is some advice:

- Get a burn permit from the Florida Division of Forestry (www.fl-dof.com).
- Watch the weather. Thunderstorms and associated changes in wind direction and speed can occur very rapidly.
- If the weather starts to change, reassess your situation. Consider extinguishing your fire.
- Scout out the area you are going to burn. Develop an explicit contingency plan in case the fire escapes.
- Develop a safe burn plan and follow it.
- Don't burn alone and keep your crew well informed.
- Warn your neighbors that you will be burning.
- Make sure your firebreaks are well established and continuous.
- Conduct a test fire to assess fuel conditions and wind effects.
- If there is any slope in the area you are going to burn, remember that the speed of advance of the fire line goes up with the square of the slope. Be especially careful on slopes and if in doubt, burn down hill.
- If your fire escapes, think about alternatives before attempting a frontal assault. Remember to have a contingency plan.
- Don't get cocky – even small fires can get away.



Fig. 3 Effective firebreaks include such things as swimming pools, sidewalks, raked lines, plowed lines, black lines and roads. *Photo by Sandy Wojak.*

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Not By Fire Alone

As a natural ecosystem gardener, your drip torch may become as important as your hoe, but do not expect to achieve full restoration with just one or even a few controlled burns. For one thing, it is difficult to kill large hardwoods with fire alone. Once hardwoods are more than a foot or so in diameter, their bark is generally thick enough to protect them from all but the hottest fires. And when you do manage to damage the base of a large tree, it may take a succession of fires over many years to finally kill it.

Another reason that controlled burns do not result in “instant restoration” is that the native pine savanna species need to be present in the first place for there to be any positive response to the death of fire-sensitive invaders. Burning may create conditions appropriate for savanna species establishment and proliferation, but you may have to import seeds or seedlings after your fires.

Conclusion

Not to diminish the dangers involved, but if we are to maintain and restore the ecosystems and species that dominated the landscapes of Florida for the past millennia, we need more fires, bigger fires, and sometimes even hotter fires. For this we need people with fire knowledge and experience so as to assure that the fires stay in control while serving their restoration purposes. 

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A Burn Scenario

YOUR SITE: Less than an acre, and bordered by a driveway, an area that you burned a few weeks back, and a lawn. A slight downgrade slopes to a neighbor’s pasture. Together with your neighbor you have garden hoses that reach every corner of the burn area.

THE WEATHER: Perfect for a “fuel reduction burn.” The dispersion index is good and wind speeds are not anticipated to exceed 5 mph.

YOUR BURN PLAN: Most of the area is to receive a back burn, starting at the lawn

edge. After the blackline is a few yards wide, move into the center of the burn area and ignite the fuel pile you have ready to go. Once ignited, updrafts should help to pull the fire through a fairly thick patch of laurel oaks with few fine fuels on the ground.

SITE PREPARATION: You have prepared fire breaks and have a fire permit. To prepare your overgrown pasture for burning, you first thinned out about half of the 3-10 inch loblolly pines and cut down and piled hundreds of laurel oaks, including several that were encroaching upon the crown of the one formerly open grown live oak.

BEGINNING TO BURN: It’s 10 am, the dew has burned off, and if the fire is to be out by 2 pm as planned, its time to get started. You begin by lighting a test fire in a little pile of pine straw – it burns nicely as expected. Setting the backfire line takes two passes with the drip torch, but finally it’s sputtering along well. After 10 minutes, the blackline is as many feet wide and you go light the pile. It’s good that you planned ahead and put pine branches and some fatwood on the bottom, because the oaks are not seasoned and would otherwise be hard to ignite. After circling the base of the pile with the drip torch it ignites and is soon roaring.

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A Burn Scenario

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Smoke is rising nicely but still draws the attention of two other neighbors. They bring shovels, upon which they rest comfortably, and immediately ask about the availability of liquid refreshments. You don't expect them to do much work if all goes as planned, but if something goes awry, they are sure to jump into the fray.

Now that the back burn is creeping along, it's hard to resist playing with the drip torch and so you do, in the name of Science of course. When you light a short section of flanking fire and let it converge with the backing fire, the response is textbook, and only a bit unnerving partially because the flame fronts met over a wet spot with wax myrtles.

ON FIRE: The fire is spreading nicely but, as expected, isn't burning through the laurel oaks. The flames are only waist high, only sporadically jumping to above your head. You're circuiting the fire every few minutes to make sure that the fire lines are holding. The branches you piled around the base of one of the larger laurel oaks have ignited, and it looks like the hoped-for butt damage will be done. The flame front is progressing steadily but at less than a slow walk, so you light a strip fire about 10 yards in front of the backing fire. It works, so you do it a few more times. Now you understand why burning up slope can be hazardous – the gentle grade combined with the converging updrafts of the back and head fires causes some pretty startling fire behavior, but with so much of the area blackened and no nearby trees that warrant saving, you are not concerned.

TOWARD THE FINISH: After only an hour, three quarters of your plot has already burned. As the fire creeps down to the plowed line where your neighbor stands, hose in hand, you circuit the burn block once again and then start to mop up. Now is when you could use some help, but after putting out a few burning cat-faces with thrown shovels of sand, the shovel toters retreated to your back porch. Fighting the urge to join them, you continue on your rounds and find some smoldering duff, which you extinguish (or think you do), by stomping on it. Later you will have to pull out the hose and deal with the duff again, but now it's time for a rest.

ADMIRING THE VIEW: Over the next weeks, you might re-pile some of the branches and burn again, but you have plenty of hot spots on which to sow wildflower seed and a thousand wiregrass tublings ready to plant, so there's no shortage of follow-up work. The burn permit is good until 5 PM and you consider lighting off another pile, but your back tells you to take it easy and just admire your newly charred landscape. ⚙️