BOX 10.1

Prescribed Burning for Understory Restoration

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Role of Prescribed Burning. Because the longleaf ecosystem evolved with and is adapted to frequent fire, every 2 to 8 years, prescribed burning is often useful for restoring understory communities to a diverse ground layer of grasses, herbs, and small shrubs. This restoration provides habitat for a number of plant and animal species that are restricted to or found mostly in longleaf pine communities. Burning can also be used to reduce the midstory layer, which catches shed needles and serves as a ladder to carry understory fires into the crowns of the trees resulting in catastrophic wildfires that can kill vast areas of pines. Prescribed burning also recycles nutrients by releasing those tied up in litter and duff and significantly reduces brown spot needle blight, which attacks longleaf seedlings.

Terms and Techniques. Prescribed burning is the application of fire by trained professionals following a well-developed plan to obtain desired management objectives. Restoration is often done with understory burning or underburning, which is prescribed burning under a forest canopy (McPherson et al. 1990). The fuel for these fires is the understory rough that consists of the accumulated living and dead grasses, forbs and shrubs plus draped needles and the litter layer. The litter layer, the top layer of the forest floor, is composed of recently fallen and largely intact dead needles, leaves, twigs, and branches. A duff layer, composed of partially decomposed litter or fermentation layer and decomposed humus, lies between the litter and mineral soil.

Underburning can be done using heading, backing, flanking, or spot fires, or a combination of these techniques. Heading fires are fire fronts ignited to spread with the wind while backing fires are ignited so the fire front spreads against the wind. Flanking fires are ignited in a line into the wind and thus spread at approximately right angles to wind direction. Spot fires are a series of separate ignition points that are allowed to spread in all directions and thus contain heading, backing, and flanking fires at each spot. Both heading and backing fires can be set as a series of strip fires. Strip heading fires are used to control how fast the fire spreads and thereby the fireline intensity, i.e., the rate of heat energy release (Box A Fig. 1). Placing strips closer together reduces the rate of spread and intensity. Backing fires have low intensities but move slowly and therefore require a lot of time to burn each unit. In addition, backing fires under certain conditions may be quite severe, i.e., cause much of damage to the site, because of excess duff consumption. Internal firebreaks can be constructed for strip backing fires to significantly reduce time to complete the burn. An alternative is to use flanking or spot fires to reduce intensity but speed up the burn without internal fire breaks. These techniques require considerable experience, especially spot firing as you must continually adjust both the spacing and the timing between spots to obtain the desired intensity with changing fuel and weather conditions (Wade and Lunsford 1989).

Burning Prescriptions

Sandhills. Prescribed burning can be used for restoration across the range of sites that longleaf can occupy from dry sandhills to wet savannas. Burning prescriptions depend on the ecosystem type and its current condition. Reduced fire frequency in many xeric and subxeric sandhills longleaf areas has resulted in the development of a midstory layer of native scrub oaks: turkey (*Quercus laevis*), bluejack (*Q. incana*), sand

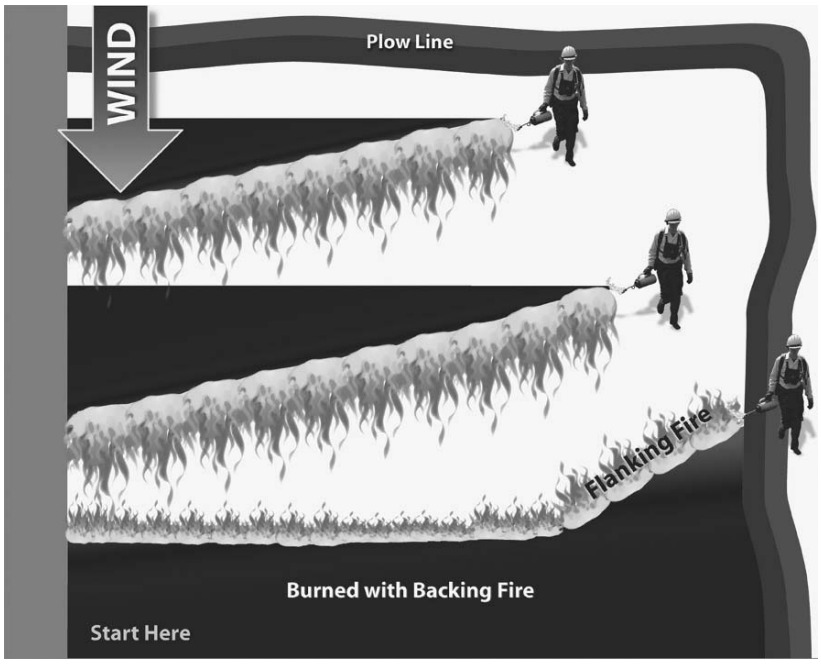

FIGURE 1. Schematic of typical strip heading fire showing securing downwind side with backfire followed by sequential ignition of strip heading fires with a flanking fire to widen fuel free zone along plow line.

live oak (*Q. virginiana* var. *geminata*), and sand post oak (*Q. stellata* var. *margaretta*). Because these sites are very droughty and nutrient limited, even in the absence of frequent burning, they do not develop a continuous closed canopy of midstory hardwoods. Therefore, although greatly reduced, some of the understory grasses do survive. These grasses along with needle litter from longleaf pines furnish sufficient fuel to carry at least a patchy prescribed burn. Repeated applications of prescribed fires during the growing season, i.e., beginning in March, in southern latitudes, and ending in July, can be used to restore these sites by gradually reducing the density of the midstory scrub oaks (Glitzenstein et al. 1995) and promoting the growth of understory grasses and herbs. Managers have found that fire causes wounds on the stems of hardwoods, which are enlarged by subsequent fires, and eventually the top breaks or the stem is girdled and the top dies. Sprouts emerge from the roots of many top-killed stems, but these can be kept in check by subsequent periodic burns.

Flatwoods. On flatwoods and wet lowland pine types restoration means increasing understory diversity in longleaf communities that have been captured by woody species and in many cases developed a substantial midstory layer. The goal is to reduce woody understory and midstory species and allow the grasses and forbs to increase and eventually become at least co-dominant. Prescribed fire can be used to accomplish this transition. Research shows that although growing season burns are sometimes more effective, dormant season burns can also be used to readjust understory composition (Waldrop et al. 1987). For areas not burned for 10 years or more, a couple of dormant season burns should be used to reduce fuel loads before switching to growing season burns. In addition, it is usually best to have these burns close together, i.e.,

2 years or less, to minimize fuel accumulations between burns. Miller and Bossuot (2000) recommend these initial burns be conducted when the drought index is below 250. On sites dominated by saw palmetto (*Serenoa repens*), if burning alone is going to be used for understory restoration, then a series of closely spaced prescribed burns is required. Frequency of burns is more important than season with annual burns the most effective but biennial burns will reduce palmetto-dominance and increase the herbaceous component. It is important not to miss a burn, as this can result in a significant regrowth of palmetto.

Uplands. There also exist upland longleaf types, mostly in Alabama, Mississippi, Louisiana, and Texas, and montane sites in Alabama and Georgia, which have developed unnaturally dense hardwood midstories, and suppressed and impoverished understories. Because these are the most productive longleaf sites, they change the most rapidly, quickly developing midstory layers in the absence of frequent fire. In addition to a very dense midstory and a shrub-dominated understory, these sites also accumulate significant quantities of fuel. As noted for other longleaf ecosystem types, a series of dormant season burns is often necessary to gradually reduce fuel levels before switching to a growing season regiment. However, frequent and multiple growing season burns will be required to reduce the hardwood rootstocks (Boyer 1990), thereby providing conditions favorable to understory grasses and forbs.

Potential Negative Impacts. As with all burning, there is the potential for negative impacts. The most obvious damage is direct tree mortality that can result from excessively hot burns that are too intense and kill tree crowns, including the buds. Tree mortality can also occur with low-intensity but high-severity fires that slowly consume accumulated forest floor duff, and because of their long residence time heat root and stem cambial cells beyond the lethal temperature. Trees suffering from such injury often retain a healthy-looking green crown for some time following the burn, but will eventually die. Longleaf communities needing restoration burning rarely have many seedlings. If significant numbers of seedlings are present, however, excessive seedling mortality can result from burning during the bolting stage. If burning must be done with seedlings at this stage, then burning should be done in the dormant season or early spring prior to the candle stage when seedlings would be most susceptible to fire-caused damage and mortality.

Precautions. In all longleaf types that have not been burned for 10 years or more, there is an excessive buildup of litter and duff around the base of trees. Reintroduction of burning in these stands without excess mortality is best accomplished by a series of dormant season burns. Apply burns when only the litter is dry enough to burn and the duff is too wet to ignite. On upland or sandhills sites, fast-moving heading or flanking fires pushed by a good wind are better than slow backing fires that may dry the duff layer and promote smoldering combustion. Flatwoods sites with palmetto-dominated understories should be burned with heading fires, but will also require a light wind, cool temperature, and higher humidity for the first burn. The objective on all sites is to consume the dry top litter layer while the wet lower duff layer will protect the roots and root collar. Space burns as closely together as fuel to carry the fire will allow. Be cautious in your prescriptions because a patchy burn is preferable to a more complete hot burn that could result in excessive tree mortality. The objective is to gradually reduce the duff layer at the base of trees over a cycle of four or five fires and keep tree mortality at an acceptable level. Once the excess duff layer is removed, apply a growing season burn, again as soon as there is sufficient fuel to carry a good fire.

The most important factor in accomplishing the goal of successful restoration with fire while minimizing the negative consequences is experience. Only through training and practice can you become proficient at selecting proper conditions of temperature, humidity, wind, fuel moisture, and firing techniques keyed to existing fuel types and loads that are likely to produce the desired outcomes. This means obtaining a contract burner from a consulting forestry business or an experienced crew from a nonprofit or government agency until you gain knowledge and experience needed to be a certified burner. A source of information is the U. S. Department of Agriculture, Forest Service, Southern Research Station (http://www.srs.fs.usda.gov), which has a number of relevant publications. Considerable advice and guidance is also available from state forestry agencies, forestry units of southern universities, and local extension agents.

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