

The Use of Fire in the Management of Coastal Plain Loblolly Pine

Thomas Lotti

PRESCRIBED BURNING has a definite place in the silviculture of even-aged loblolly pine (*Pinus taeda* L.) stands in the Carolina-Virginia Coastal Plain. Fire is used extensively in young stands to reduce heavy fuel accumulations in order to minimize possible damage from wildfire; in immature stands, to kill or weaken undesirable hardwoods and shrubs which may later prevent the establishment of pine seedlings; and in mature stands, to remove heavy litter and any residual plant competitors which may interfere with natural reseedling at the time of timber harvest.

Researchers have studied the use of fire in southern pine types for many years. Present practice is largely backed up by research findings. Furthermore, any future modification of techniques or wider application of prescribed fire probably will be guided by research results. In this connection, we have the recently established Southern Forest Fire Research Laboratory, in Georgia, where prescribed burning research is among the priority projects. Also, a number of other research groups in the South have active projects to investigate uses of fire in various forest types.

In the Charleston Research Center's territory, located in the midst of the Coastal Plain loblolly pine type, some research began as far back as 1924. Current research at the center's Santee Experimental Forest, under the direction of the Southeastern Forest Experiment Station, dates back to 1946, and has served as a model for the adjoining Francis Marion National Forest.

A sizeable acreage is treated each year in the Virginia-Carolina Coastal Plain. In South Carolina alone the Francis Marion National Forest treats annually 40,000 to 50,000 acres primarily in the loblolly pine type; private interests in the state burn at least 30,000 acres per year, mostly on industrial forests.

Cost values are even more elusive

than acreage figures. The cost of burning may differ in relation to size of area, burning method, fuel type, or prevailing weather—to name a few variables. In 1958 the average cost on the Francis Marion National Forest was 45 cents per acre. There careful planning, the burning of large blocks, and long experience help to keep the costs down. Elsewhere, and on smaller areas, costs could easily reach \$1.00 per acre.

In a managed loblolly pine forest, a full schedule of prescribed burning requires only about 8 or 10 fires during the life of a stand. On a given site, the first burn, mainly for fuel reduction, takes place at about age 15; subsequent fires are spaced 4 or more years apart, as needed, to reduce accumulated fuels and/or to control woody, broad-leaved plants in the understory. Such a series of periodic fires suffices to keep understory stems small, or controllable, to the point where the seedbed can be prepared and competition reduced with fire or some other areawise treatment at the time of harvest.

Basic equipment for burning consists of a conventional back-firing torch and a tractor-plow unit. Fireline plowing may be done in advance of, or during the scheduled burning, as determined by a previously prepared plan. This prescribed burning "block plan" is based on a reconnaissance of an area to determine (1) month to burn; (2) desirable weather conditions for burning, including days since $\frac{1}{2}$ inch of rain, wind direction, and velocity; (3) type of fire to use (back, head, strip, or flank); (4) specific location of plow lines; (5) sequence in which to fire various lines; (6) whether to plow lines in advance or at time of burn. (1).

On the Francis Marion National Forest plans are afoot to set up a system of permanent units for burning (1). These will have permanently located 16-foot-wide fire breaks in lieu of the periodically plowed lines. Mop-up of old stumps and snags to a safe distance will be done as part of the firebreak construction. A basic burning plan will eliminate much of the

need for replanning each burning operation. The firebreaks will also serve as access lanes for 4-wheel drive equipment for general administrative and protection purposes.

In young stands, especially for initial burns, the usual technique requires a light backfire burning into a gentle but steady wind on cool days (6). The soil should be moist and the surface fuels only partially dried out whenever any burning is done. As the stand ages and becomes more open from thinnings, the need for understory brush control becomes more important. As the bark thickens with age and crowns reach higher into the air, susceptibility to fire damage decreases. Consequently, headfires are commonly used in pole-size and larger stands, especially when set to burn in narrow strips. To speed up burning in areas too risky for headfires, a flanking fire angling into the wind is often used. Decision as to specific method of burning may have to be made just prior to setting a fire. After the fire, the absence of any large amount of crown scorch is evidence that a proper decision was made.

Up to now most prescribed burning has been done during the dormant or winter season. Activity reaches a peak during December, January, and February. In November the herbaceous vegetation may not be cured sufficiently for a general burning program. In March high winds and an approaching growing season limit burning efforts.

The winter fires are well suited for fuel reduction, especially in young stands. These fires consume flash fuels principally. Such light fuels consist mainly of pine needles draped on understory vegetation and of several years accumulation of surface litter. Because the soil and a compact layer of organic material lying directly above are generally moist, the prescribed fire seldom burns down to mineral soil. This minimizes the chance of direct damage to the soil and any roots lying close to the surface. Furthermore, a properly planned and conducted burn seldom results in a scorch line above shoulder height. On the occasionally

THE AUTHOR is with the Southeastern Forest Experiment Station, Forest Service, U. S. Department of Agriculture.

crown-scorched, dominant tree, damaged foliage is soon replaced through the dormant buds, which are highly resistant to heat damage.

Small stems in the understory are effectively girdled by the winter fires. On those up to about 1-inch d.b.h. the kill is high but rapidly diminishes as stem size approaches 2 inches, and is quite negligible among larger sizes. However, most rootstocks survive to bear sprouts early in the following growing season. On better sites, the recovery rate for the understory is about 5 years, and on the poorer sites up to about 10 years. Thus, periodic repeat fires are needed to maintain a desirable level of understory control during the life of a stand.

Burning in the winter for seedbed preparation has some handicaps. Ordinarily the loblolly pine seedfall begins in mid-October; however, over half the seed is down by November 15, 80 percent by December 15, and 90 percent by January 15 (5, 7). Consequently most, if not all, of the seed falling on a given area could be destroyed by a poorly timed burn. When this is followed by a harvest cutting, rather full dependence must be placed on the next seed crop for regeneration. In the meantime, the area may be taken over by hardwood and shrub sprouts or the space available for pine reproduction proportionately reduced. Thus, in stands scheduled for regeneration cuttings, it is best to burn before seedfall begins or as soon thereafter as feasible (4).

This leads up to a discussion of the possible use of summer, or growing season, fires in the management of loblolly pine. So far, there has been a limited use of summer fires except in areas being "cleaned up" in advance of planting. On the Francis Marion National Forest some pilot burns have been made in immature stands of loblolly pine because of promising results from plot studies and test burns made on the Santee Experimental Forest.

Our research shows that a short series of annual or biennial summer burns will practically eradicate heavy understories from loblolly pine stands (8). For example, the cumulative mortality of a common shrub, southern bayberry (*Myrica cerifera* L.) is about 90 percent after 4 successive annual fires (Fig. 1). A comparable level of kill is obtained with fires spaced 2 years apart up to about the third fire. For some unknown reason the fourth biennial fire is found not to be as effective as the fourth annual fire. Mortality among tree species in the under-

story follows a pattern similar to that for bayberry, although the kill is not quite so rapid. In any case, all survivors lose considerable vigor, and the net result is effective understory control. In managed stands this could be of long duration through a reduction of rootstocks by fire and the elimination of hardwood seed sources by a series of improvement cuttings.

It follows then, that summer fires can be used effectively as a regeneration tool. During the interim stages of stand development, periodic winter burning can be used for fuel reduction and as a means of keeping understory stems small, even though not reduced in number. As the stand approaches harvest, a short series of successive annual or biennial summer fires would serve to minimize the understory competition as well as to prepare the seedbed by reducing the accumulated surface litter. As a matter of fact, this procedure can establish reproduction even before the overwood is harvested.

We have tested the foregoing technique and have had no trouble obtaining excellent catches of seedlings. In the illustrated 50-year-old stand of loblolly pine, our burning schedule called for an initial winter fire to reduce the heavy 13-year-old rough. This was followed by a succession of three annual summer fires. The result was a nearly perfect condition for regenerative purposes (Fig. 2). In this particular stand we purposely deferred the harvest cut and now we have what amounts to a 2-storied pine stand. Elsewhere we have obtained catches of seedlings as high as 90,000 per

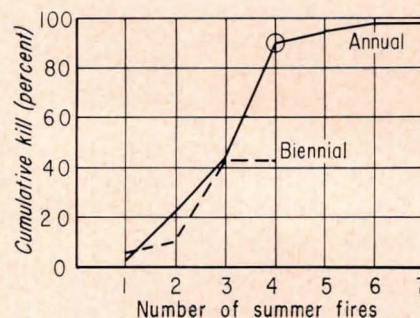


FIG. 1.—Cumulative mortality of southern bayberry resulting from a succession of annual summer prescribed fires.

acre—obviously too many seedlings but at least indicative of the maximum efficiency of a series of summer burns for regeneration.

So far we have observed no ill effects from well planned or executed prescribed burns. Our evaluations involve plot areas which have had from several to as many as 13 fires, including summer as well as winter treatments. In addition, measurements have been made in managed stands where fire was an integral part of the silvicultural treatment. As an example, let us observe the trend in the average annual radial growth of dominant trees in the 50-year-old loblolly pine stand where we used the combination of one winter fire and three summer fires for hardwood control and seedbed preparation (Fig. 3). Note the upward trend in growth after the first and second summer fires. On the other hand, observe the sharp decline in growth during the years when rainfall was deficient during the first 6 months of the year. This



FIG. 2.—After 4 prescribed burns, the understory is no longer a problem in this 50-year-old stand of loblolly pine.

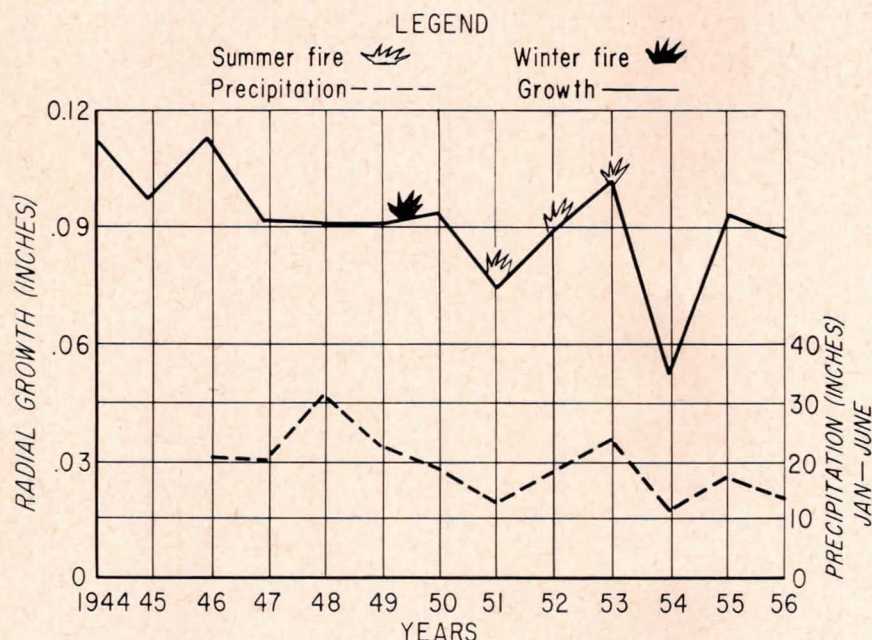


FIG. 3.—Trend in average annual radial growth of dominant trees of stand illustrated in Fig. 2 as affected by prescribed burns and precipitation.

and other studies on the Santee Experimental Forest would indicate that the growth of loblolly pine is a lot more sensitive to the amount of soil moisture available early in the growing season than it is to fire.

It should be pointed out that summer fires are more dangerous than those of winter. In the absence of dormant buds during the growing season, crown scorch of loblolly is a serious matter. Trees may be killed outright or so weakened that they fall easy prey to pine beetles. Lethal temperature for pine needles falls within the range of 130° to 140° F. depending on length of exposure (2, 3). Thus the chance of crown scorch becomes greater during the hot days of summer than in winter. For example, it requires twice as much heat to raise the temperature of pine needles to 140° F. when the initial vegetation temperature is 50° F. as when this initial temperature is 95° F. Likewise the height of the scorch line would be about 6 feet on the cool day as compared to about 16 feet on the hot day.

Consequently, we usually do not recommend burning schedules that include an initial summer fire. In most cases, the rough should first be reduced with a winter burn a year or two in advance of a series of summer fires. The subsequent summer fires will be light but of sufficient intensity to kill any 1- or 2-year-old sprouts and reduce

the accumulated litter as needed. It is further recommended that experience in prescribed burning during the dormant season be obtained before attempting any fires in the growing season. If early attempts are confined to small plots or blocks, the accumulated experience will serve to make burning less difficult on larger tracts.

Favorable weather elements for these summer fires are: air temperature, 90° F. or more; relative humidity under 50 percent; wind, steady, 1-3 miles per hour; and at least several days since ½-inch or more of rain. Fuel moisture determined with sticks usually ranges from 3 to 5 percent. Most burning is done after midday.

From this short description of the general situation, it becomes apparent that prescribed burning has already achieved a definite place in the silviculture of even-aged loblolly pine in the Carolina-Virginia Coastal Plain. Through research and application, techniques are continually being refined.

To sum up salient points on use of fire in the management of loblolly pine in the Carolina-Virginia Coastal Plain:

1. Prescribed burning is a forestry measure, like planting, pruning and thinning, to be used only when and where needed.

2. Prescribed burning does not eliminate hazard, but reduces it.

3. Prescribed burning is primarily

a tool of even-aged management.

4. Annual prescribed burning is unnecessary. Good management seldom requires more than 8 or 10 fires in the life of a stand.

5. Dormant season fires don't kill hardwoods, as most resprout. However, by periodic prescribed burning, hardwoods are kept small so that adequate reseedling may be obtained with fire at the time of harvest.

6. Understory hardwoods and shrubs above 1-inch d.b.h. may require control measures other than fire.

7. A short series of summer fires will practically eradicate the small understory shrubs and hardwoods from immature stands of loblolly pine.

8. For loblolly pine regeneration the best timing is a prescribed burn before seedfall (June to October) and to log after seedfall (January to March).

9. Experience in dormant season burning is necessary before doing any summer burning. To avoid damage, burn light roughs and small blocks.

10. Extensive crown scorch is evidence of faulty technique and can be avoided in a carefully planned program of prescribed burning.

11. Last but not least—one man's prescribed burn can be another's wild-fire if it escapes fire or property lines.

Literature Cited

1. ANONYMOUS. 1958. Inter-Regional prescribed burning training meeting in South Carolina. Mimeographed rpt., U. S. Forest Serv. Francis Marion National Forest. 34 pp., illus.
2. BYRAM, G. M. 1958. Some basic thermal processes controlling the effects of fire on living vegetation. U. S. Forest Serv., Southeast. Forest Expt. Sta. Res. Note 114. 2 pp.
3. ——— and R. M. NELSON. 1952. Lethal temperatures and fire injury. U. S. Forest Serv., Southeast. Forest Expt. Sta. Res. Note 1. 2 pp.
4. CHAIKEN, L. E., and W. P. LEGRANDE. 1949. When to burn for seedbed preparation. U. S. Forest Serv., Southeast. Forest Expt. Sta. Res. News 5.
5. JEMISON, G. M., and C. F. KORSTIAN. 1944. Loblolly pine seed production and dispersal. Jour. Forestry 42: 734-741.
6. LOTTI, THOMAS. 1956. Growing loblolly pine in the South Atlantic States. U. S. Dept. Agric. Farmers Bul. 2097. 33 pp., illus.
7. ———. 1956. Good seed production from a young stand of loblolly pine. U. S. Forest Serv., Southeast. Forest Expt. Sta. Res. Note 97. 2 pp.
8. ———. 1956. Eliminating understory hardwoods with summer prescribed fires in coastal plain loblolly pine stands. Jour. Forestry 54:191-192.