Prescribed Burning in Georgia and California Compared

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Prescribed burning is the use of fire in forestry for certain definite reasons where the conditions for firing are carefully planned in advance. Such burning may be done to improve grazing for livestock, to improve habitat conditions for game, to reduce wildfire hazard, to reduce hardwoods, to control disease, and to prepare seedbeds. In most cases a single burn will serve more than one purpose.

The author prescribed burned in the pine forests of Georgia from 1942 to 1947, and in second-growth ponderosa pine in California from 1951 to 1958. The purpose of this article is to compare experiences in the two places with the thought that they might be helpful in better understanding prescribed burning, particularly in California where it is hardly used at all. At present about one-half million acres are burned each year in the South and southeastern states, all the way from North Carolina to Texas.

In Georgia, the experiences were gained on the Alapaha Experimental Range, near Tifton. At that time the idea of burning was fairly new to me and I looked upon fire as the arch enemy of forests and forestry. But the work proved to be enlightening. Here burning was used under control as a most helpful tool in land management. It was back in the twenties that S. W. Greene, Animal Husbandman with the U. S. Department of Agriculture, had discovered the benefits of prescribed burning in range improvement; he also observed that fire might have values in forestry. As a result of this pioneer work, Greene wrote a most interesting article, "The Forest that Fire Made" (9). In this he pointed out clearly the role of continued light grass fires in developing and maintaining a vast pine forest. Among other early investigators were H. L. Stoddard, who advocated prescribed burning in upland game management (12), and H. H. Chapman, who studied its use in longleaf pine silviculture (6).

Since 1940 a large amount of burning has been done in the South and Southeastern states, where the use of fire wisely planned and supervised, under many and variable conditions of overstory and understory vegetation, has become an important phase of forest-land management (7, 8). During the early years this was pretty much confined to the longleaf-slash pine forests. But now it is widely used in the loblolly and shortleaf types; for example, about one-half of the 225,000 to 250,000 acres burned annually by the U. S. Forest Service in the past 8 years has been in these types (11).

Prescribed burning seems to become more useful and essential in the south as forestry increases in intensity. It is given much credit at present, but the possibilities of using it beneficially in management have by no means been exhausted (10). Heretofore, the thinking has been largely that of fitting fire into forest-land management, but those experienced in fire use are beginning to see that certain forestry practices might be altered to fit into prescribed burning, thus making better use of this tool than is possible under present management.

In California prescribed burning in second-growth ponderosa pine has been studied in two places: on the Teaford Forest in the Central Sierra Nevada, near North Fork, and at Hobergs in the North Coastal Range. Very few other studies of prescribed burning have been made in California. About the only one re-

A typical stand of second-growth ponderosa pine on the Teaford Forest in the central Sierra Nevada. This area was prescribed burned in November 1956, and the photo taken on May 14, 1957. An abundance of vetches and other forages followed the fire.

ported was that by the California Forestry Committee, published by Donald Bruce in the February, 1923, issue of the Journal of Forestry (5). At that time "light burning" was not found useful for numerous reasons. But great changes have taken place since then and some of the reasons advanced at that time for not burning are no longer valid, especially in the light of the information gained in the past 7 years.

The studies in California were started specifically to determine whether or not prescribed burning can serve as a means of manipulating brush covers to improve conditions for game, and if it will reduce the danger of wildfires in summer. The thinking was this: if it is used successfully over such wide areas and under such variable conditions as those found in the South and the Southeastern states, why could it not also be used in California? This idea was also developed from the fact that frequent light fires had probably been the most important force in molding the virgin forests of California. During the past few years several articles covering various aspects of prescribed burning in California have been published (2, 3, 4, 13, 14, 15).

The following points of comparison will show how the conditions of prescribed burning in California are similar to or different from those found in Georgia.

Tolerance of Trees to Fire

The principal trees on the study areas in Georgia are longleaf and slash pine; in California, ponderosa pine with sugar pine and California black oak secondary. Of the four pines, longleaf is the most fire tolerant. This species normally remains in the grass stage for three to five years and is extremely tolerant of fire after the first full year of growth. During the first year after germination, however, all of the seedlings will be killed by even the lightest ground fire. The two- to five-year-old seedlings withstand fire because the buds are well insulated against heat. In fact, fire can be very beneficial to longleaf seedlings by destroying brown spot needle blight which often attacks them, and by reducing the grass rough so that the seedlings are exposed to full sunlight. Longleaf is also fairly sensitive to fire from the time it starts height growth until it is about 6 feet tall—usually two or three years. After this the longleaf again withstands prescribed burning remarkably well. It should be mentioned, however, that even this most tolerant pine is killed by wildfire in summer in heavy rough.

The other three pines—slash, ponderosa, sugar—are all sensitive to fire until 8- to 12-feet tall. Thereafter, all three species withstand prescribed burning, with the tolerance of ponderosa and slash pine about equal, and that of sugar pine slightly lower. California black oak is thin barked and is less tolerant to fire than sugar pine. Correspondence with those burning in loblolly and shortleaf pine indicates that loblolly might have about the same fire tolerance as sugar pine, and shortleaf pine even less tolerance. However, both loblolly and shortleaf pine withstand prescribed burning very well.

Fire Types

Both the longleaf and the ponderosa pine are fire types, *i.e.*, under pristine conditions both regenerated themselves in the presence of fires; in fact, nature's fires were beneficial to their existence.

Regeneration of longleaf pine was made possible by its high tolerance to fire. Any full year that fire failed to burn through an open spot there were possibilities of new seedlings becoming established. In the longleaf area, frequent fires were detrimental to all other trees because they required longer periods to become established. In this way fire was selective, favoring longleaf over all other species. In early days, slash pine was confined to the edges of swamps and other wet places that seldom burned. With protection against fire and with prescribed burning, slash pine has spread from the wet places to areas where formerly longleaf grew in almost pure stands.

Ponderosa pine under pristine conditions probably regenerated itself chiefly in burned-out spots where dead material had been created by insects or windthrow. Such spots were favorable seedbeds for pine, where the species regenerated itself in even-aged groups or stands. These areas were often missed by later fires — especially early summer fires — until such time that enough needles fell on the ground from the young trees to again carry fire. Thus, nature's frequent fires prior to fire protection favored re-establishment of ponderosa pine in even-aged groups and stands. Nature's fires were also helpful in killing seedlings of more shade-tolerant species that tended to invade ponderosa stands, or, if such seedlings became established among the ponderosa pine seedlings in the burned-out areas, these were still at a disadvantage because later on they were less fire tolerant than the ponderosa pine.

Fuels to Carry Fire in Prescribed Burning

The fuel that carries the fire is one of the most important items in successful burning. Ideally this is a material that burns readily and uniformly soon after a rain.

In Georgia, the fuel was mainly matured "wiregrasses—*e.g.*, pineland three awn, Curtiss dropseed, bluestems — and pine needles, with the grasses more abundant in the openings, and the pine needles under the trees. Generally a back fire will carry rather evenly through this fuel,

Left: Second-growth ponderosa pine at Hobergs before burning. Note the understory of dead manzanita and the extremely high fire hazard. *Right:* The area was broadcast burned, after which the dead manzanita was burned in small piles. The great reduction in wildfire hazard is apparent.

burning through the openings about as well as under the trees. The "wiregrasses" form a somewhat tall, loose cover that dries quickly and may burn satisfactorily within 1 or 2 days after rain. As late as 4 or 5 days after rain the fuel may be too dry sometimes to burn safely in heavy rough. The safe period for burning after each rain is shortened, therefore, by the rapid drying out of the fuel.

In California, cast needles of ponderosa pine form the principal fuel to carry fire in prescribed burning. These burn readily, whereas much of the coarser material remains unburned. The surface needles and those clinging to vegetation above ground dry quickly after rain. This characteristic makes it possible to burn through heavy roughs without creating so much heat that the trees are severely damaged. Openings between trees may be occupied by grasses or by species of brush such as manzanita and ceanothus. In the spring, when much of the burning is done, the grasses are green and the openings serve as barriers to fire. Green brush in openings will serve as fire breaks also, simply because the pine needles will burn at a time when the duff beneath brush is too wet to carry fire.

The yearly needle fall of ponderosa pine is 750 to 1,500 pounds per acre in moderately stocked stands. Since the needles decay slowly, they usually form a rather deep and compact ground layer. Although those on the surface dry quickly after rain, the lower ones next to the wet soil dry very slowly. This makes it possible to prescribe burn in clear weather for many days after rain.

Enough needles fall each year in a dense ponderosa pine forest to make annual burning possible. In fact, areas have been burned twice in one year where the first fire was set about October 25 when the needle fall was about half complete. Even though the needles can be burned annually, or twice yearly, seldom is there reason to burn more often than every five to ten years. Heavy roughs of logs, stumps, and dead brush should be burned first in the spring when wet, yet when the surface pine needles are dry enough to carry an even fire. Later burns can be made under progressively drier conditions to remove more of the heavy fuels and to attain other benefits.

Wind and Topography

The study area in Georgia is nearly level, while the areas in California are mostly on gentle to steep slopes. Wind direction and intensity deserve much attention in prescribed burning on level ground but on slopes they are not so important. The reason is this: on level ground a wind that shifts to the back of a fire will change it to an intense, fast-running and damaging head fire which will crown through the trees. On slopes, however, where the fire is made to burn down hill, shifting of the wind is not so likely to cause crowning. Furthermore, on level ground one does not burn when the wind is calm for the flames will go straight up, where they may seriously injure small trees. On slopes there seems to be enough updraft and shifting of wind at all times to keep the flames from going straight up. Experience has shown that slopes of 15 to 20 percent gradient are about ideal on which to burn.

On the level ground in Georgia it was wise to burn against a northerly wind of 3 to 10 miles per hour. In the winter, the winds from the north, northeast or northwest are usually steadier in direction and speed than others. After rainstorms the wind usually shifts to a northerly direction for a few days making

conditions favorable for burning. For these reasons all burns are planned to take advantage of favorable winds, the occurrence of which limits the number of days suitable for burning. On the slopes in California, winds have not limited burning much, but care has been taken to avoid heavy winds.

Preparation of Fire Breaks

An essential part of prescribed burning is to have adequate fire breaks, both natural (*e.g.*, creeks and roads) and artificial, to prevent the fire from escaping. In Georgia, the artificial breaks were usually put in with a fireplow or a disk in an east-west direction to take advantage of the northerly winds. On large areas, additional cross breaks were plowed through the tract to assure better control, but primarily to shorten the burning period. At the touchoff moment, fire was strung down all the cross breaks at the same time and in this way the fires burned on a long front. One can figure that fire will back against wind at the speed of about 60 to 100 feet per hour. Since it was wise to limit burning to not more than 10 hours per stretch the cross breaks were never placed more than 600 feet apart. Also, in flat country one must keep a constant watch for "slow burners." These are areas that for one reason or another, burn more slowly than the rest of the line of fire. Burning of these should be hastened with a torch to prevent their burning around and then developing into a head fire.

In California, sloping land provides more natural firebreaks than level. Direction of slope is important, also; for example, north slopes usually will not burn when conditions are best for burning on south slopes. Later, the burned south slopes can serve as breaks when north-facing exposures are being burned. Usually fires are set at the tops of ridges and are permitted to burn down hill, thus lessening the number of artificial breaks needed. Cross breaks are not established and may not even be desirable because a fire escaping across one of these will burn intensely up hill and may do damage if the rough is heavy. Again, since wind is not so important on slopes as on level ground, a fire backing down hill may be permitted to burn day and night for two or three consecutive days without excessive danger.

"Slow burners" are not so likely to develop on slopes as on level ground since a fire backing down hill has greater tendency to burn to the sides than fire on level ground. However, slow-burning spots do occur and it is desirable to be on the lookout for them.

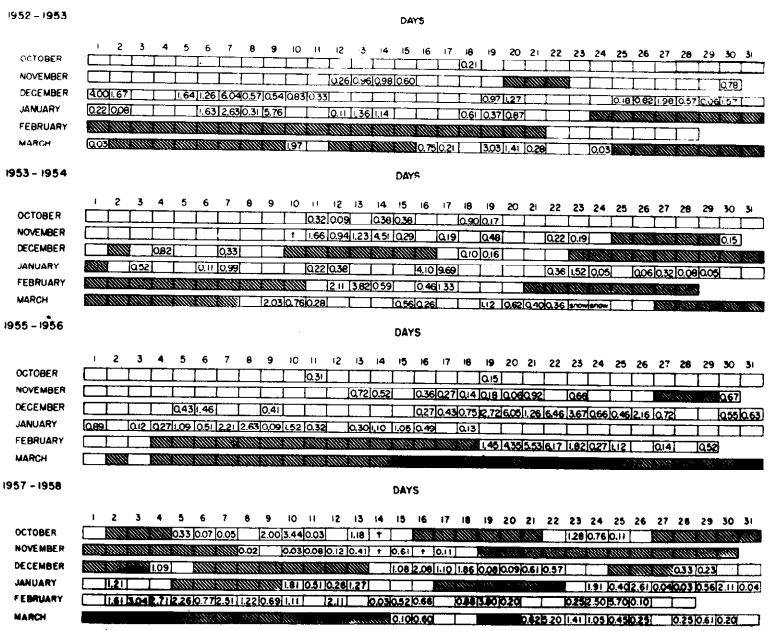
Small fire breaks in ponderosa pine needles may be prepared with a hand tool without difficulty. The needles are simply raked to the side for a couple of feet. In "wiregrasses," however, this is nearly impossible because the tough fibrous grasses are difficult to scrape off in wet soil, hence draft equipment is needed.

Number of Days Suitable for Burning

The number of days suitable for prescribed burning varies from spot to spot depending on combinations of objectives and fuel conditions. A day suitable for burning one area may not always be suitable for another.

In Georgia, records were never kept of the number of days suitable for prescribed burning on the Experimental Range. However, there were never more than 20 to 25 days per winter when all favorable conditions combined for safe effective burning in any one spot.

In California, however, records have been kept for four seasons of the days suitable for prescribed burning at Hobergs. These records extended over the period from the time the duff and upper soil were first thoroughly wet in the fall to April 1 of the next year. The number of days varied from 47 to 74 per season for the four periods. Once ponderosa pine needles are thoroughly wet the lower layers dry out slowly, providing long periods for prescribed burning. For example, in January and Febru-



The days cross-hatched were those suitable for prescribed burning at Hobergs, in the North Coast Range. The figures are the amount of precipitation.

ary, 1952-53, burning was possible for 29 successive days before the lower layers became so dry that much of the duff was destroyed. Again, in 1955-56 prescribed burning was possible on successive days for a full month. The greater number of days suitable for burning in California than in Georgia was due mainly to the slower drying out of the fuel next to the soil and less to the importance of direction and intensity of wind.

Cost of Prescribed Burning

Burning on a small scale is more costly than burning on a large scale. Recent burning by the Forest Service in the South and Southeastern states has been done at a cost of about 22 cents per acre; 2 cents for planning, 14 cents for fire lines and breaks, and 6 cents for the actual burning (11). At Hobergs, in California, a burn of about 300 acres was done at a cost estimated at not more than 5 cents per acre. This covered an area where the fire was set at the top of a hill and was permitted to burn to natural breaks below. In this particular case no fire break preparation was necessary. Generally, however, prescribed burning in ponderosa pine in California would cost considerably more than this figure, perhaps $1.00 or more per acre in many areas, varying tremendously with techniques and such factors as topography, need for fire breaks, and patrol. More burning must be done, and wider experience gained, before satisfactory cost figures can be established.

Summary and Discussion

This article compares the various aspects of prescribed burning in southern pine forests with those in second-growth ponderosa pine in California. It is based on several years of actual experience in each place. Prescribed burning is widely employed as a tool in forest-land management from North Carolina to Texas; on the other hand, it was scarcely tested in California before 1951. A principal reason for its use in California would be to reduce wildfire hazard and risk.

It must be remembered that California has a Mediterranean-type climate characterized by long, hot dry summers. The fuels for wildfire during this time become extremely dry and tinderlike. In recent years some of the wildfires have been large and destructive; for example, in 1955, 141,222 acres of timbered land burned in an 18-day period from August 27 to September 10 (1), killing nearly all of the trees over vast areas. Fires of these proportions not only cost millions of dollars but also do untold damage in accelerating floods and erosion, and in producing other ill effects. If prescribed burning will reduce the hazard and risk of wildfires, and lessen the damage on areas burned, it may be a highly worthwhile tool in forest-land management in California.

Studies on prescribed burning were begun in California in 1951. These include techniques and methods of burning, such as planning, fire-line preparation, weather conditions, strip burning, spot burning, right angle burning, frequency, effects of burning on soil fertility and soil nitrogen, duff removal and accumulation, runoff and erosion, forage and plant successions, fuel reductions and accumulation, forest wildlife and rodents, and costs.

A forest-land management plan is being developed for continuous low fire hazard and risk using prescribed burning as a tool. It considers the multiple-use aspects of management, such as timber growing, wildlife and recreation, livestock grazing, and regulated streamflow for low flood danger and high production of clear useable water.

This research is being done in two places — Hobergs, in the North Coast Range, and the Teaford Forest, near North Fork, in the Central Sierra Nevada. It has gone far enough to show promise for prescribed burning as a management tool. The work should be expanded in every direction to include more soil conditions and combinations of trees and brush species.

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