Prescribed Burning in the Northern Rocky Mountain Area

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THROUGHOUT THE AGES, fire has been both a friend and enemy of mankind. Without it civilization would not have reached the advanced stage it enjoys today. Fire continues to be man's friend and man's enemy. Our forebears learned to use fire in an advantageous *manner*. This was fire as a friend. In recent times a philosophy has developed which recognizes the advantages of using fire in forest management. Through use of studied and planned application, "Prescribed Burning" has developed into an accepted and useful tool of management. The latest "Glossary of Terms Used in Forest Fire Control" now defines it as: "skillful application of fire to fuels under conditions of weather, fuel moisture, soil moisture, etc., that will allow confinement of the fire to a predetermined area and at the same time will produce the intensity of heat and rate of spread required to accomplish certain planned benefits to one or more objectives of silviculture, wildlife management, and grazing. The objective is to employ fire scientifically to realize maximum net benefits at minimum damage and acceptable cost."

In the period 1920-29 the use of fire consisted entirely of burning hand-piled logging slash and debris. Gradually this was extended to cover the broader uses of fire as a management tool. Currently, hazard reduction on timber sales is only a small part of the overall prescribed burning program in this area. Prescribed burning is now used to prepare sites for regeneration, either by planting or natural means,

for range improvement, for wildlife habitat improvement and for reduction of natural hazards.

Most of the current burning program is done for a combination of hazard reduction and site preparation benefits. This has resulted from the recent trend to manage forest stands on an even-aged basis. Such management requires clearcutting practices. In order to facilitate regeneration, these areas must be prescribe burned. Fire was first used in Region 1 for this purpose over 30 years ago. For many years, it was used only on an intermittent and limited basis. Some of this limited use was caused by the low timber cut and some by lack of knowledge of the subject. After the end of World War II the demand for National Forest timber increased. As more timber was cut, more need developed for the use of fire as a management tool. For nearly a decade the area annually treated with fire has approximated 40,000 acres.

Much of the current prescribed burning in Montana and Idaho is done in rough, mountainous country, on slopes up to 100 percent. Often fuel to be burned will be 3 or 5 feet in depth and will range from fine twigs and needles to large logs and trees 2 or 3 feet in diameter. Areas will range in size from 10 to 500 acres with an average of about 100 acres. Practically all burning is done in September or October, after the fall rains have broken the fire season. So much for the background information, now let's look at the operation itself.

PRE-PLANNING

Successful prescribed burning depends to a large degree on the type and quality of the pre-planning. The decision to treat an area with fire, first starts when a timber sale is being planned or a planting site is selected. This is the time when full consideration is given to fire behavior. Multiple use coordination is a must. Large scale use of fire, can and often does, affect resource management, such as: soils, water, range, and wildlife. The impact of fire on these resources must be considered in making the final decision on the area to be burned. Often this will result in changing boundaries, location, size or shape of the area planned for treatment by fire.

Fire behavior is another important factor which must be considered. Cutting boundaries or firelines must be laid out in a manner

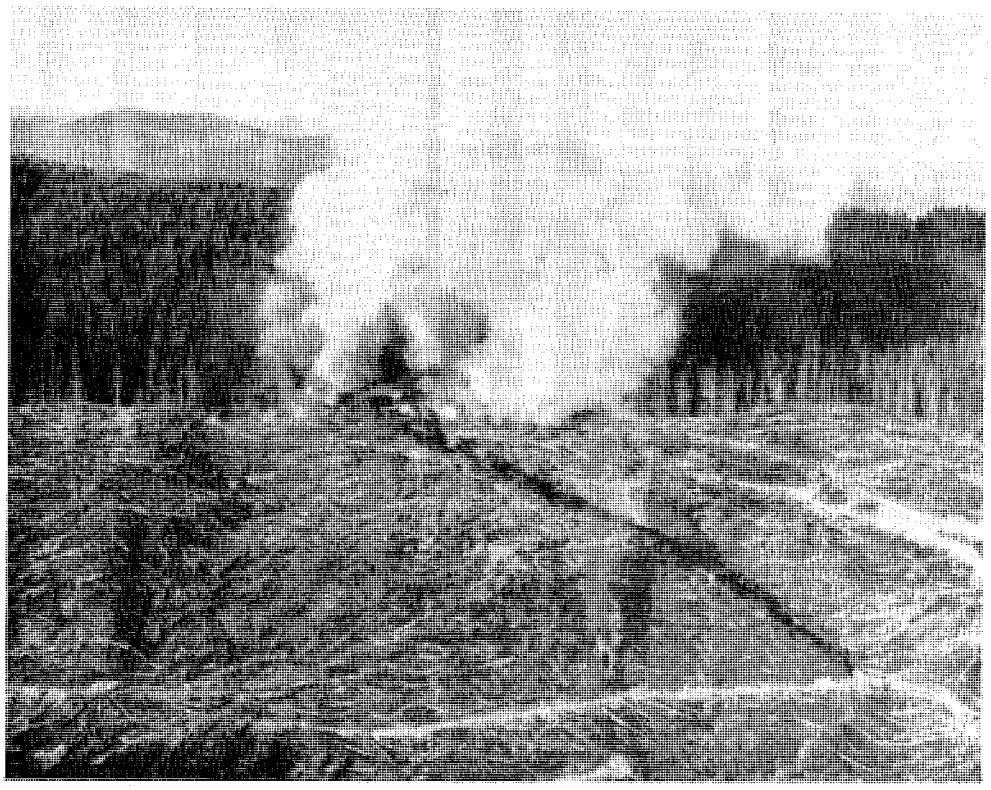

FIG. 1. Typical fuels on a prescribed burn for site preparation. Ignition of the area has just started. U. S. Forest Service photo.

that will minimize control problems. Irregular lines with sharp bends or kinks will give problems in radiation or spotting. Lines improperly located with respect to topography will also present problems. Upper lines should never be located below the brow of a hill or ridge on the fire side. Such location makes it extremely difficult to hold the upper edge of the fire under control. Preferable location of the upper line is either on or just over the top of the ridge. Lower firelines should never be located in the bottom of the draw. Radiated heat will create control problems on the opposite slope. These lines should be located above the bottom of the draw.

Aspect and slope must also be given consideration when planning an area for treatment by fire. Burning conditions on north and east slopes will be much different from those on south and west slopes. Each requires different burning conditions. Inclusion of all topographic aspects in the same plan will generally result in too much fire or too little fire on part of the area. The end result will often be an unsuccessful burn. Slope also has a material effect on the successful conduct of a prescribed burn. Fire will spread and burn differ-

ently on steep slopes versus flat ground. Therefore, slope must be considered when designing a proposed area for prescribed burning. Size of the area must also be considered. Small areas make it extremely difficult to utilize fire behavior characteristics as a means of controlling the fire. On the other hand, too large an area may result in not being able to complete the burning operations within reasonable time limits. Both can create control problems. Our optimum size area for prescribed burning lies between 100 and 200 acres.

The shape of the planned burn is another important factor to be considered. Long, narrow areas make it difficult to utilize fire behavior as a control measure. The optimum shape would be a perfect circle or square. Topography, ground cover, and/or management objectives seldom permit such conditions. Nonetheless, the planner should attempt, as much as possible, to meet the optimum shape.

Last, but far from least, is the objective or purpose of the burn. Timber regeneration requires a different type of burn from that of wildlife habitat improvement. In a like manner, range improvement requires another type of burn. Ground cover, slope, aspect, topography, size and shape of area, all have a bearing on the type of burn which will result. All must be considered in laying out a burning area in a manner that will meet desired objectives.

PREPARATION

Control of a prescribed burn often hinges on the amount and quality of advance preparation of the area. Poorly constructed firelines, inadequate snagging or fuel preparation, can result in escaped fires. Type and quality of preparation also influence quality of the burn. Green fuels will usually result in a poor or spotty burn.

Firelines should be constructed down to mineral soil, preferably by bulldozer. Handlines can be used on slopes too steep for dozer travel. Lines should be free of all fuels which will support fire for a width of at least 14 feet. All snags over 8 feet in height should be felled for a distance of at least 300 feet within the burn area and for at least 100 feet outside. This is needed primarily to minimize spotting problems. It also reduces the possibility of ignition of dead trees outside the area by radiated heat.

Fuel preparation is another important consideration, since most of our prescribed burning is done for silvicultural purposes. In these cases, all merchantable material is removed by sale from the area. Often there remains a heavy unmerchantable stand ranging from 6 inches to 3 feet in diameter. This material is felled prior to burning in order to accomplish the desired silvicultural objectives. It should be felled in time to permit drying of the fine fuels before burning. Normally, wildlife habitat development projects require chemical treatment of the brush before burning. This is done in order to provide dry fuel, thereby permitting a satisfactory burn. Spraying is usually done by aerial application from helicopters.

An accessible water supply is another factor to consider. Quite often this may require developing access to a running stream. At other times, it may be necessary to develop water storage at springs or in shallow streams. These facilities are used as a source of supply for pumper trucks and operation of stationary pumps.

FINAL PLANNING

A final execution plan must be developed prior to actual ignition of the area to be treated. This is the key to a successful controlled burn. It is a written plan and is used by all overhead involved in the burning operations. Quality and effectiveness of the plan depends entirely on knowledge of the area to be treated. A thorough examination should be made of ground conditions before preparing the final plan. Particular attention must be given to factors which will affect the ignition pattern and method. Normally these are slope, aspect, topography, size and shape of area. These elements determine whether strip or center fire ignition will be used. In turn, type of ignition affects all other aspects of the burning operation.

Center ignition is normally used on flat areas or those with high points in the middle of the area. With this method, initial ignition takes place near the center of the area to be burned. After sufficient heat and indraft has developed, firing proceeds in all directions toward the perimeter of the area. This is the desirable type of ignition, since it permits all heat and sparks to be drawn toward the center of the burn area by developing a large central convection column. The

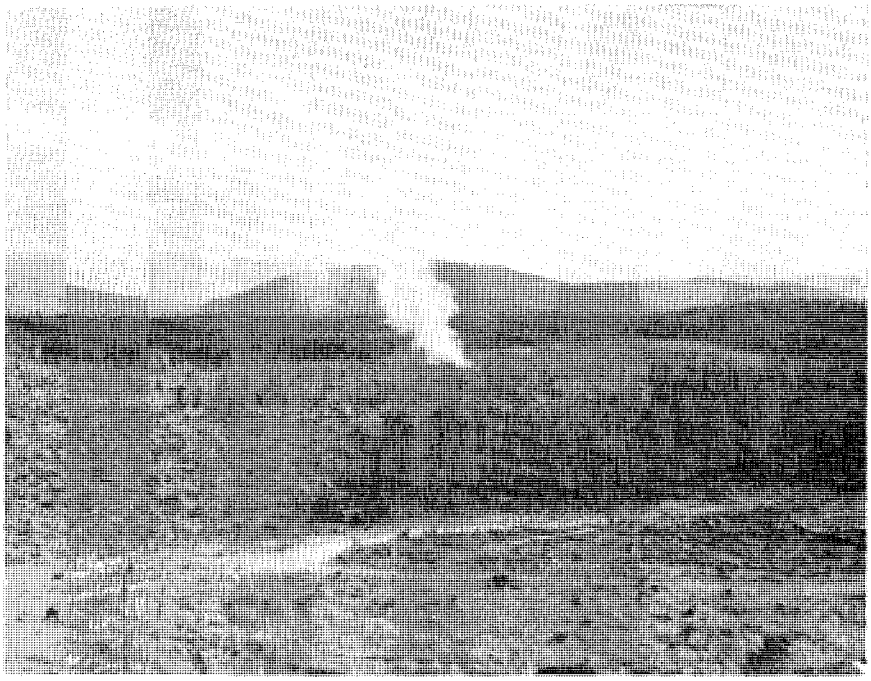

FIG. 2. Initial phase of center ignition on a prescribed burn for site preparation. U. S. Forest Service photo.

column sometimes rises to heights of 15,000 to 20,000 feet. Its strong updraft carries all sparks and burning embers upward. As a result, it minimizes the possibility of spot fires occurring outside the perimeter of the burn area.

Strip ignition is normally used on slopes and areas which are not suited for center ignition. It consists of igniting from the top down in a series of strips. The first strip is usually permitted to burn out fairly well before the next strip is ignited.

Actual burning operations are organized in the same manner as suppression of wildfire. Final planning should establish the organization needed in terms of overhead, equipment, manpower, transportation, and communication. Sectors should be marked on the ground. Water supplies, tool caches and ignition routes should also be marked. Placement and assignment of personnel should be set forth in the final burning plan. Plans also identify the amount and type of equip-

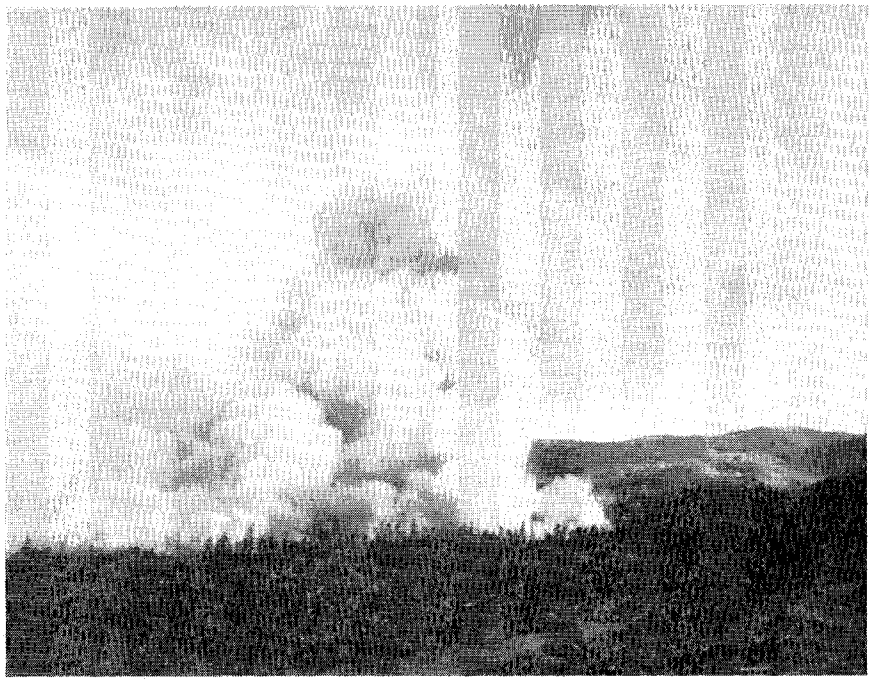

FIG. 3. Same area as Fig. 2 with ignition fully completed. U. S. Forest Service photo.

ment needed and where it will be located. Ignition points should be *marked* and *identified on the ground.*

Desired fire behavior is an *important factor* which must receive careful attention in the final plan. As mentioned earlier, *different resource objectives* require *different types of burn. Each kind* of burn must be done under *different weather* and *fuel conditions.* The final plan should recognize the overall burning objectives and spell out weather and fuel conditions which will result in a burn that will meet these objectives.

Careful consideration must be given to control problems. The final plan should determine the anticipated fire behavior and also identify any related critical control sections on the fireline. Recognition of these problem areas in advance permits planning counter measures to affect them. Failure to recognize them can easily lead to serious escapes beyond the area planned for burning. A final check should be

made of all firelines prior to developing the burning plan. This will help to identify any critical or problem sections of the line. Available reinforcements should also be determined and identified.

Safety is another very important factor which must be considered. Escape routes should be identified for use in case of unexpected fire behavior. Ignition should be planned so that personnel are never in danger from fire. Access roads should be identified and opened up. Transportation should be located at strategic points for removal of crew members. The ignition plan should specify equipment and methods which are known to be safe. Sufficient radio equipment should be planned to permit immediate notification of all personnel if emergencies arise. Adequate communication facilities also play an important part in the overall conduct of burning operations. Another important aspect to be considered in the plan is public relations. Methods and procedures for informing the public whenever prescribed burning is to be done should be recognized and spelled out in the plan.

EXECUTION OF THE JOB

First, and one of the most important aspects of conducting a prescribed burning operation, is determination of weather and fuel conditions. Recommended procedure is to establish a portable weather station on the area well in advance of burning. Normally, this should take place prior to the fall break in the fire season. As a minimum, the station should have a hygro-thermograph, a rain gauge and a set of calibrated fuel sticks. These will provide sufficient weather data to guide determination of when the burn should be conducted.

The management unit should also start obtaining daily spot weather forecasts about the time they feel conditions are suitable for burning. In the Northern Rocky Mountain area these can be obtained from the local fire weather forecaster at the Weather Bureau. Weather data from the portable weather station is provided to him as an aid in developing these forecasts. Prime importance of the spot weather forecast is to identify weather changes, such as precipitation, wind, or humidity, which will affect the burning operations.

All personnel are thoroughly briefed immediately prior to ignition. This briefing serves three purposes. First, it acquaints each individual

with his responsibilities. Second, it acquaints each individual with the planned overall conduct of the operation and his place in it. Thirdly, it provides opportunity for a thorough and detailed safety briefing. Men and equipment are then dispersed to their assigned locations.

Burning operations are under the supervision of a fire boss. Via radio, he controls ignition progress and placement of men and equipment. Occasionally, it may be necessary for him to adjust initial ignition time in order to adjust for actual weather conditions. He is in constant radio contact with all phases of the operation. As burning progresses, he quite often adjusts the ignition pattern or manpower assignments. The main objective is to ignite as rapidly as fire behavior permits. Final objective is to ignite the entire area in one operation. Quite often this may result in burning 300 or 400 acres in a matter of 2 or 3 hours. The accumulated fuels on some acres will exceed 100 tons. This often results in high intensity level fires. Control operations are seldom hindered by this intensity as the fire is usually pulled toward the center of the burn by indrafts caused by the convection column.

Patrol and mop-up of the burned area are a necessary and customary procedure. Most prescribed burning occurs in late afternoon or early evening. Usually, it is only necessary to leave 3 or 4 men on patrol during the first night following the burning operation. A larger crew is needed the next day to patrol for spot fires outside the line and conduct mop-up operations. The amount of mop-up done is governed by anticipated weather conditions. Seldom is the entire fire mopped up. However, all fires must be mopped up inside the fireline far enough to minimize any possibility of sparks going over the line.

GENERAL CONSIDERATIONS

Prescribed burning in the Northern Rocky Mountain area is a highly developed art and not a science. For this reason, it is essential that it be conducted by a person well qualified in fire control. This applies to all phases of the operation from initial planning to final mop-up. Experience in Region 1 of the Forest Service indicates the following general guides should be used in determining when to ignite:

Wind—5-mile maximum
Humidity—40 percent minimum and on a rising trend
Fuel moisture—12 percent within the burn

These are only general guides. They can be, and quite often are, adjusted to fit local on-the-ground conditions. Adjustments should, however, be based on a thorough analysis of fire behavior and its related control problems.

Various types of ignitors are used with local preference governing the final selection. Types most predominantly used are fusees and propane torches. Drip torches and portable flamethrowers are used occasionally, but not to the extent they are used in other areas. Soil erosion control is given careful consideration in all burning operations. Little or no sheet erosion occurs on the undisturbed area within the burn. Careful precautions must be taken on firelines and access roads. Erosion on these facilities is normally prevented by constructing water bars and dips.

Prescribed fire is recognized as a very necessary and useful tool in the management of our forests. It may also be said that fire is used in some manner in all of the functions of forest management. Our knowledge of fire is increasing. We are continually learning more about when, where, and how to use fire in management.

Prescribed burning is not an exact science. Much of it is an art and will probably always remain so. However, *continuing* research in this field is badly needed in order to refine the measureable factors inherent in any burning project.

Head Fires in Southeastern Pines

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IN SPEAKING of the use of head fires in southeastern pines, my personal experience is limited to some half million acres in south Georgia and north Florida that have a history of almost continuous burning. A great portion of this land is in optimum condition due to the very frequent fires that have been used there. However, we have enough examples of different types to know what will happen with the exclusion of fire, or simply the reduction of the frequency of burning to almost any interval. With these examples we have also learned what to expect by using fire for the first time on those areas that have gotten out of condition.

My knowledge of the remainder of the southeastern pine belt is limited to observation, discussion, the literature, and in being fortunate enough to draw firsthand from the knowledge of others who are truly experts in the practical application of fire; some of this knowledge gained by personal experience and going back to the late 19th century.

My remarks concerning the use of fire will pertain directly to the land with which I am most familiar. However, I strongly feel that the principles involved can be applied throughout the southern pine area, with modifications to meet local conditions, and if applied correctly the results will be equally as good.

The two basic fires that can be used are head fires and back fires, with others being variations of these. On the properties we are working with, economics alone forces us to use head fires on most of the land, with back fires used only under unusual conditions or circumstances. We have also found that if correctly applied head fires are easier and safer to use.