PRESCRIBED BURNING FOR HABITAT IMPROVEMENT USING THE HELITORCH

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ABSTRACT

The use of prescribed fire as a management tool for wildlife habitat improvement has gained increasing attention in recent years. The Helitorch is an example of the new technology available to wildlife biologists for use in prescribed burning. This device offers greater mobility and effectiveness than traditional firing methods, plus fewer safety hazards associated with actual firing operations. It can be as cost effective as traditional methods, such as hand firing, when used over a large areas. It does, however, have certain drawbacks and limitations, such as greater logistical problems and safety considerations associated with the heliport and mixing operations. When planning for a prescribed burn, the prescribed fire manager must assess the burn objectives, the physical and biological characteristics of the burn area, and the availability of funding and personnel in order to determine whether or not the Helitorch would be a useful tool.

INTRODUCTION

The use of prescribed fire as a management tool for improvement of wildlife habitat has gained increasing attention in recent years. Concurrently, technology has provided new tools to aid prescribed fire managers in accomplishing the task of prescribed burning. The use of fire to manage vegetation is really nothing new. Native Americans used fire on what appears to be a regular basis to clear brush, thereby improving game habitat, hunting and food gathering (Burcham 1973). When white settlers arrived on the scene some 150 years ago, they viewed fire as a totally destructive force. This idea persisted as more and more people settled and built homes in areas of high fire hazard. Modern fire suppression efforts become so effective that fire, as a recurring natural force, was excluded from most plant communities.

Just across the border in Baja California there has been considerably less urban development, fewer restructions on the use of fire and less fire suppression. Large expanses of even-aged, over-mature chaparral brushfields, common to much of present day California, are the exception rather than the rule (Minnich 1981?). Instead, uneven-aged "mosaics" of vegetation are common.

Many ranchers were among the first to realize the benefits of controlled burning years ago. However, most land management agencies have only recently begun to actively use fire as a management tool.

In the past, prescribed fire managers were limited to a few traditional methods of firing such as driptorches, flamethrowers, fusees, and the common match. The Helitorch is a relatively new tool available to wildlife managers involved in the use of prescribed burning for improving wildlife habitat.

DESCRIPTION OF THE HELITORCH

The Helitorch is an aerial ignition device, sometimes called the "flying driptorch," that drops a burning mixture resembling napalm. The mixture is a combination of regular gasoline and a powdered thickening agent called alumagel (usually 10 lbs/40 gal of gas). The Helitorch consists basically of a light-weight aluminum frame (or sled) on which is mounted a 55-gal barrel containing the mixture of gasoline and alumagel, a positive displacement pump and ignitor (which uses a coil system similar to an automobile ignition) to provide a spark to ignite the mixture as it drops from the torch. Fully loaded, the Helitorch weighs about 500 lbs. and is suspended beneath a helicopter by cables. A Bell 206B or Hughes 500D are commonly used helicopters.

THE PRESCRIPTION

Prescribed burning is the application of fire to wildland fuels under such conditions of weather, fuels and topography so that specific objectives are accomplished safely. Green (1981) provides an excellent discussion of prescribed burning in chaparral from planning through implementation. Perhaps the most important aspect of prescribed burning is the prescription, or conditions under which the prescribed burn will be accomplished. When weather and fuel conditions fall within the desired range of the prescription and other factors, such as manpower requirements and safety considerations, have been met, then the burn may be conducted. It is important to develop the prescription narrow enough to achieve the desired objectives of the burn, but not so restrictive as to remove all flexibility in decision making on the part of the prescribed fire manager. A typical prescription for winter burning using the Helitorch might be:

		Optimum
Temperature	60° to 80° F	65-70°
Relative Humidity	20% to 40%	25-30%
Wind Speed (mph)	0 to 8, gusts to 12	4-6
Live Fuel Moisture	60% to 100%	60-80%
Dead Fuel Moisture (represented by the 10-hour fuelstick)	4% to 10%	7-8%

In order to understand the prescription, it is useful to discuss each factor in more depth.

Most of the prescription factors are interrelated; factors that are particularly interrelated are temperature and relative humidity (RH). The vapor holding capacity of the air is greatly influenced by temperature. At 80°F, the air can hold twice as much water as it can at 60°. In other words, the absolute humidity at 80°F is twice that at 60° when the RH is 100% at both temperatures. When the temperature increases, RH usually decreases but always relative to the absolute moisture content of the air. Temperature by itself is not an important indicator of burning conditions, although warm fuels will burn better than cool moist fuels. Relative humidity as an indicator, is one of the most significant and is easily measured in the field using a sling psychrometer.

Relative humidity also influences the moisture content of dead fuel which serves both as an ignition source and to sustain the fire. Dead fuels are divided into four classes:

1-hour - 0 to ¼ in. diameter
10-hour - ¼ to 1 in. diameter
100-hour - 1 to 3 in. diameter
1,000-hour - 3 to 8 in. diameter

The fine fuels (1 hour) and 10-hour fuels are usually the most important in prescribed burning of chaparral brushfields since they are the most predominant. The moisture content of 10-hour fuels is easily measured in the field by using a "fuelstick" (Constructed of ½ in. wooden dowels) and a fuel moisture scale.

Wind speed and direction are also important factors that should be assessed relative to the topography of the burn area. Generally, a slight wind is necessary to sustain the fire. High winds (usually over 10 or 12 mph) are not desirable. On steep slopes, characteristic of most wildland situations, little or no wind is necessary due to the natural "drafting" effect of the slope itself. Orientation of the burn area to population centers should be a consideration in the development of the prescription (a wind direction that will carry smoke away from populated areas is desirable).

Live fuel moisture (LFM) is expressed as a percentage of the moisture content of living twigs up to 1/8 in. (0.3 cm) in diameter and attached leaves in relation to their dry weight. Countryman and Dean (1979) outline standardized procedures for determining LFM in chaparral. Most shrubs will have a LFM of about 60% when dormant. As they begin to grow, LFM increases until at the peak flowering stage, it may be as high as 200% or more. During the dormant period (late summer through late winter), the live fuels will behave essentially as dead fuel. When LFM is high (over 100%) fire intensities are generally lower because of the added energy required to drive off the high moisture content of the life fuels; high LFM values can, however, be offset by higher dead fuel content.

Weather stations (on-site), belt weather kits and other instruments previously mentioned are relatively simple devices used to measure and calculate prescription factors. Prescribed burners can, through experience, develop a "feel" for the right conditions. It is important to remember that the prescription is not a "recipe" and that many of the factors tend to offset or compensate for each other. This is the "art" of prescribed burning.

It is also important to consider the physical and biological characteristics of the burn site when selecting an area for burning and developing the prescription. Such factors as the local fire history and fire ecology are especially important. Chamise (Adenostoma fasciculatum) chaparral, for example, ordinarily burns in a natural cycle of every 25 to 30 years. Immediately following fire, chamise will resprout from a root burl usually within several weeks and independent of precipitation. The first several years following fire are characterized by a proliferation of herbaceous annual vegetation. It is at this point that plant species composition is most diverse and browse and herbaceous annuals are most available to wildlife (e.g., deer, seed-eating birds and rodents). After about 30 years the stand is considered over-mature, is dense and continuous, containing a high amount of dead material and little or no herbaceous understory. At this point the stand will once again sustain fire. This is why over-mature stands of chamise are well suited for winter burning, more so than any other species.

Other important physical and biological site characteristics to consider are: plant species composition, prevailing winds and weather patterns, percent slope, soils, fuel loading, fuel continuity, fuel arrangement, and live-to-dead fuel ratio. The last four are directly related to the fire history of the area (i.e., time of last burn).

USE OF THE HELITORCH

After performing the necessary planning for the burn (including developing the burn plan, environmental analysis, acquiring air pollution and burning permits, etc.) the next step is to accomplish the burn. On the day of the burn, after assembling all personnel and equipment and conducting necessary briefings, the mixing operations usually begin. The gasoline and alumagel powder are mixed in the barrels and then transferred to the Helitorch sled. The mixing operation is the most hazardous aspect of using the Helitorch. Care must be taken to ground all metal objects. Nylon clothing should never be worn around the mixing operation to prevent static sparks. Wooden paddles are used to stir the mixture. Only the helicopter and authorized personnel should be allowed on the heliport. A fire truck should be stationed nearby with a charged foam line in case of a crash, fire or explosion. At least one Emergency Medical Technician should be present in the immediate area.

The mixing operation is important to the effectiveness of the Helitorch. The thickened mixture, if properly mixed, resembles jello in its consistency. As it drops from the torch, the gelatinous consistency of the mixture causes most of it to drape over the brush canopy instead of falling through to the ground, which is usually bare under dense chaparral. Most of the burning mixture is golfball to softball-sized when it contacts the target fuel and continues to burn, building up heat for several minutes.

These characteristics, combined wiht the speed and mobility of the helicopter, make the Helitorch a very effective firing device. Firing operations can also be conducted in a much safer fashion because there are no ground personnel in the fire area.

Firing patterns with the Helitorch will vary with the desired results and actual burning objectives. Factors such as wind speed and direction will dictate air speed and safe operating height for the helicopter. Wind direction will also influence where to start firing. Generally, firing should begin at the end of the burn opposite to the direction of the wind to prevent smoke from shading the burn area, affecting fire behavior, and generally reducing visibility.

Most mosaic burning involves upslope-strip firing from the upper one-third of the slope, progressing downhill in a zigzag fashion. Depending on burning conditions, the pilot may have to continuously activate the torch, or he may have to fly a distance between one burn spot and the next before reactivating the torch.

If the desired results are to obtain larger openings, for instance on deer winter range or for the primary purpose of fuels reduction, the Helitorch can be used in a broadcast firing pattern along the lower portion of the slope. Care must be taken to avoid drainages and riparian areas. Unburned vegetation directly adjacent to these areas should be retained as a buffer to protect wildlife and watershed values. In most cases, burning during the winter period will prevent the spread of fire into these sensitive areas because they will be too cool, moist, and shaded to carry fire. In the summertime, pretreating these areas with a low-intensity backing fire will eliminate fuels that could carry fire into them.

The Helitorch can also be used for perimeter firing if conditions are such that it is necessary to "black-line" the fire perimeter before conducting the main burn.

MOSAIC BURNING

The Helitorch has greatly expanded the opportunity for "mosaic" burning, especially in the winter (or green) period when there is no need for firelines. The objective of mosiac burning for habitat improvement is to create small scattered openings of ¼ to 20 acres, maximizing edge effect and maintaining uneven-aged brushfields. This can be accomplished by burning a portion of the project area periodically (e.g., 5 to 7% every year for 10 years, 20 to 30% every third or fourth year or whatever is deemed appropriate for a given area).

Most habitat improvement projects in chaparral areas have been done for or emphasized the benefits to deer. Although mosaic burning will maintain and/or increase deer populations (Ashcraft 1979), it is also a means of ensuring habitat diversity. Longhurst (1978) reported that few bird or mammal species were totally dependent on mature chaparral for their existence and that most animal species tend to increase where chaparral is interspersed with grassland. Simovich (1979) stated that management for high reptile diversity in chaparral should be directed to maintaining a mosaic of habitats. Quinn (1979) suggested that small mammal diversity and density could be maximized by breaking up chaparral into small areas of different ages, maximizing ecotones and leaving islands of older, undisturbed vegetation. Although fire may eliminate some avian species temporarily in post-fire seral stages, most chaparral species can quickly re-invade burned areas (Wirtz 1979). This is probably due to increased seed and insect availability in the burned habitats (Lawrence 1966).

PROBLEMS AND LIMITATIONS

As with all technological advances, there are inherent problems and limitations associated with the use of the Helitorch. The Helitorch is not some kind of "magical wand." The problems associated with using the Helitorch are real. Briefly they are:

1. Logistical problems associated with assembling the necessary personnel for ground support of the Helitorch operation.

2. Safety considerations associated with helicopter operations and handling of flammable fuels.

3. Lack of qualified personnel to perform critical, specialized functions in the Helitorch operation (includes pilot experience).

4. The overall probability of problems arising with the helicopter (e.g., mechanical or radio system) or other equipment (Murphy's Law).

A common mistake, especially in winter burning, has been to choose sites that would not burn except under extreme conditions. The tendency to make this mistake is greater when using the Helitorch, believing it possible to burn almost anything. An example of this is a north slope. North slopes receive much less direct heating from the sun in winter and as a consequence are much colder and moister. In addition, the vegetation often consists of oakbrush (Quercus sp.) or other species of "mixed" chaparral which usually have a much lower dead to live fuel ratio. In this case, the burn should either be conducted in the summer and/or the brush pre-treated (where slope and soil allow) by crushing or chaining in order to increase the dead to live fuel ratio. The dead fuel can then be burned in the winter (or green) period using the untreated vegetation as an effective natural "firebreak."

Other common mistakes include selection of sites where the brush stand is too young to contain enough dead material or where the fuels are too spotty or discontinuous to sustain fire. In order to successfully burn standing brush, especially in the winter period, it must be fairly continuous (60% or more crown cover) and contain a high amount of dead material (30% or more). Here, again, a local knowledge of fire history and ecology is essential.

The advance planning and number of specialized personnel required to conduct a Helitorch operation is far greater than that required for hand firing operations. Current state-of-the-art procedures involved in using the Helitorch do not allow the flexibility associated with a small "low-technology" effort such as the small crew with driptorches who are able to take advantage of burning conditions at a moment's notice. This is particularly critical in the winter period when the required lead time to organize a Helitorch operation can squander "burn days" when prescription windows are narrow (usually two or three days).

COSTS

The Helitorch can be as cost effective as traditional firing methods when used over large areas. Due to the high cost of helicopter rental (averaging $400/hr.) and gasoline, it is simply not cost effective for use on small areas (less than 500 acres). Firing costs, on burns in the Bakersfield District (U.S. Bureau of Land Management), have run from as low as $2-3/acre to as much as $200/acre (ranging from fuel reduction or range improvement burns to some small wildlife burns). The average cost is probably somewhere between $5-10/acre based on number of acres burned. The Mendocino National Forest, on the Grindstone Project, has reported an average cost of $5-7/acre using the Helitorch (Bungarz 1982). Costs for wildlife burns should probably be based on acres of habitat improved rather than simply number of acres burned.

CONCLUSION

When planning for a prescribed burn, the prescribed fire manager needs to assess the objectives of the burn, physical and biological characteristics of the burn area and the availability of funding, qualified personnel and equipment in order to determine whether or not the Helitorch would be a useful tool.

As more and more personnel are trained in the use of the Helitorch, as new methods such as closed mixing systems become more common, and as agencies develop the confidence to reduce the cumbersome organizational requirements, the Helitorch will become a safer and more flexible tool.

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