Forest Fuels Management in Theory and Practice

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Introduction

Forest fires are a natural phenomena that have shaped the forest ecosystems of Canada; however, in areas of social or economic significance (e.g., communities, recreational areas, mature or productive forests) it is desirable to minimize damage caused by wildfires. Over the last century fire management agencies have been created to prevent, suppress, and in some cases use fire to protect lives and property, and to achieve resource management objectives. Initially, it was believed that wildfire could be completely excluded from the forest through human intervention, but fire managers now realize that in many parts of Canada this is neither physically or economically possible nor ecologically desirable. Historically, a small percentage of wildfires (e.g., 2-10%) have accounted for the vast majority of area burned (e.g., 85-95%), and although the percentage of fires that escape initial attack has been decreasing in recent decades, there will always be some fires that exceed the capabilities of even the most advanced fire suppression organization. Accepting this fact, fire managers have begun using fuels management techniques to proactively alter the fire environment to reduce the fire behavior potential in and around high value areas. The purpose of this paper is to explain the basic concepts of fuels management, briefly describe how fuels management is being practiced, and discuss two key benefits of fuels management to forest management organizations.

Fuels Management Concepts

The characteristics or behavior of a wildfire (i.e., rate of spread, intensity, crown involvement, size, etc.) largely determines the ability to control wildfires and the damage that they cause. Wildfire behavior is governed by three general factors: fuels, weather, and topography. Of these factors little can be done to alter either the topographic features or weather conditions that influence a particular fire. Thus, the only option available to a manager who wishes to influence forest fire behavior potential is to modify the forest fuels. Fuels management can be defined as "the planned manipulation of forest vegetation to decrease the intensity and rate of spread of a wildfire" (Merrill and Alexander 1987).

There are three types of fuels management: fuel reduction, fuel conversion, and fuel isolation (Pyne 1984). Fuel reduction refers to actions taken to decrease the total amount of fuel in a given area. This includes the removal of dead and down woody surface material (e.g., logs, branches, and twigs), removal of coniferous understory trees, pruning, and overstory thinning. These activities decrease the total amount of fuel available for combustion and alter the vertical arrangement of the remaining fuel. This makes it more unlikely that high intensity, difficult-to-control crown fires will develop.

Fuel conversion is the process of replacing highly flammable coniferous fuels (e.g., spruce and pine) with less volatile deciduous species (e.g., aspen and poplar). Increasing the percentage of deciduous trees in a stand decreases the fire behavior potential in two ways. First, the period during which a stand is capable of sustaining wildfire spread is restricted to the early spring and late fall when the trees are in a leafless state. While in their green or full-leaf state, deciduous forests serve as a significant barrier

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to wildfire spread rather than a conductor. Second, the rate of fire spread in a leafless deciduous stand is significantly slower (e.g., 5 to 10 times) than what would occur in a coniferous forest under the same weather conditions (Forestry Canada Fire Danger Group 1992).

Fuel isolation involves fragmenting large areas of continuous flammable fuels in order to limit the horizontal spread of wildfires. Mechanically created fuel breaks ranging in width from 10 m (e.g., roads or cutlines) to over 1 km are a common form of fuel isolation. Prescribed fire has also been used in some areas to create discontinuities in vast areas of continuous coniferous forest. Fuel breaks can limit the spread of low intensity surface fires and serve as a point of defense on larger fires, but are generally not effective at stopping high intensity wildfires due to the occurrence of long-range spotting.

The primary objectives of all three fuels management techniques is to proactively alter the fire environment in order to increase the effectiveness of fire suppression resources (e.g., crews and airtankers) and decrease the likelihood of valuable commodities being damaged or destroyed by wildfires. It is, however, necessary to recognize that fuels management can only reduce the threat posed by wildfires and that it cannot eliminate it.

Fuels Management in Practice

Fuels management is not a new concept. Aboriginal peoples have been using fire to manage their surroundings for ecological and protection purposes for thousands of years (Lewis 1982). In the United States formal fuels management programs for fire protection date back to the 1930s when a large and relatively inexpensive work force made it possible to conduct projects in high values areas (Pyne 1984). Currently there are many localized fuels management projects across the United States as well as in Australia, Europe, and other parts of the world. In Canada, the number of fuels management projects is increasing but has generally been restricted to high value wildland/urban interface areas.

One of the most active fuels management programs in Canada is being conducted in Banff National Park. The primary purpose of their program is to reduce the threat posed by wild-

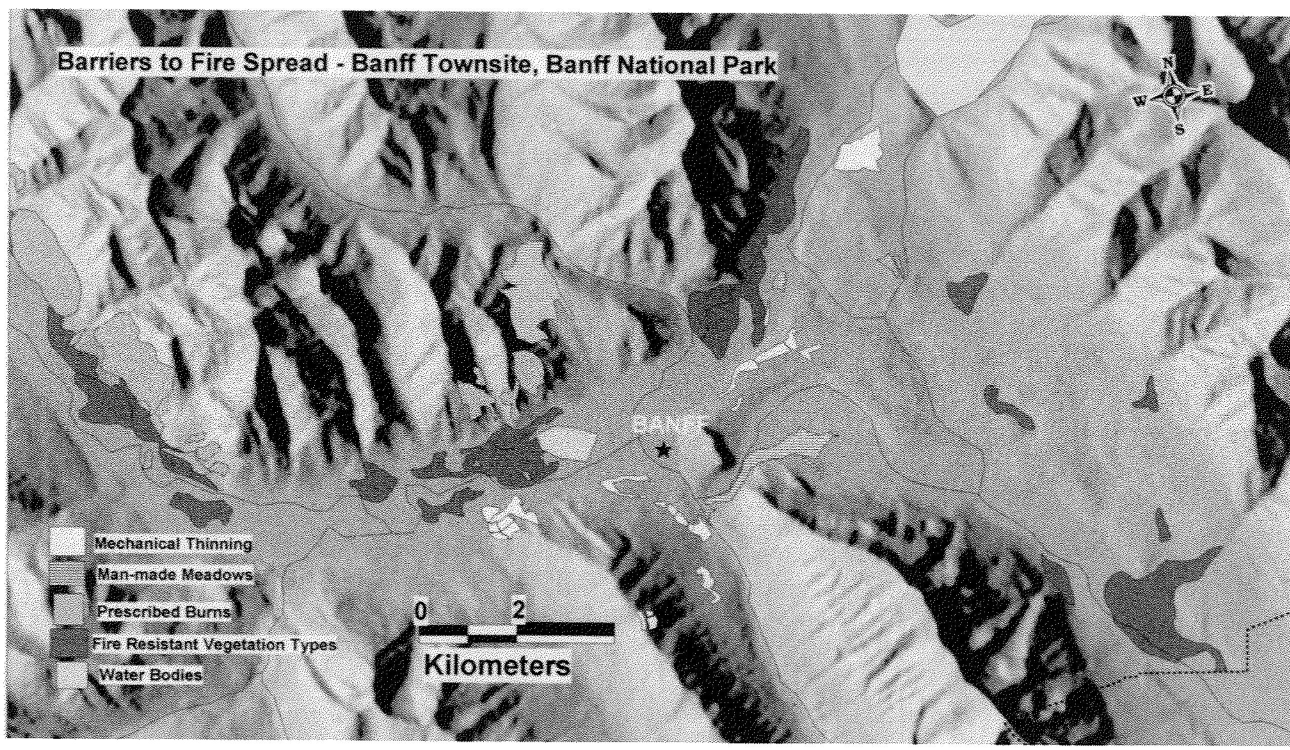

Figure 1. Fuels management activities near Banff, Alberta.

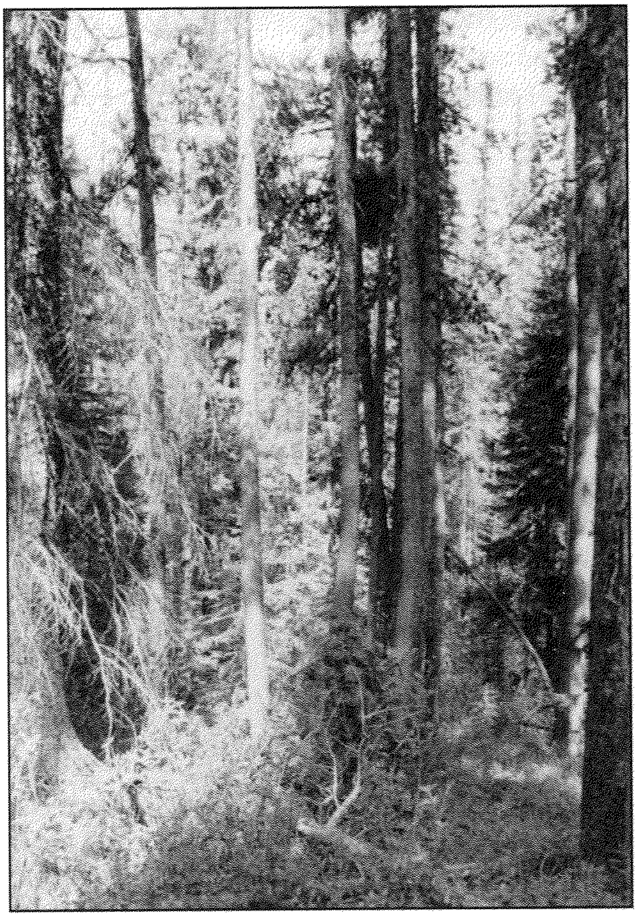

Figure 2.
Photograph of a stand in Banff National Park prior to any fuels management treatments.

Figure 3.
Photograph of a stand in Banff National Park after fuel reduction treatments have occurred.

fires and prescribed fires (planned and lightning ignited) to the people and structures in the park and values beyond the park boundary on provincial crown land (Pengelly 1992). Both fuels reduction and fuels isolation projects have been conducted over the last few years, primarily in the Bow River valley near the Town of Banff (Figure 1). Relatively large fuel isolation projects (e.g., 200-2000 ha) have been conducted using prescribed fire. These areas have been strategically linked to natural areas of fire resistant vegetation to reduce the chance of a wildfire making a long and rapid run towards the Banff townsite.

Closer to and within the town boundaries, fuel reduction projects have been conducted in order to create a defensible space (Western Fire Chiefs Association 1991) around homes and commercial structures (e.g., hotels, gondola, campgrounds facilities). Mature and over-mature forests (Figure 2) are being mechanically manipulated to create stands with significantly lower fuel loads and vertical fuel discontinuities (Figure 3). To date, about 160 ha of land has been treated at a cost of $2000-8000 per ha, and more projects are being planned.

Implications for Forest Management Organizations

Wildfires are sometimes viewed by forest management agencies as natural disasters that cannot be avoided, but it is clear that fuels management can reduce the threat posed by wildfires. These actions have numerous benefits to forest management organizations and two examples are presented below.

(1) Improved Fire Protection in Multiple Fire Situations

Fire management organizations have a limited number of suppression resources that they must allocate to wildfires. When multiple fires occur there may be insufficient resources to send to every fire, in which case the fire manager must allocate the resources on a priority basis. In almost all situations, suppression resources will be sent to protect lives and property before they will be used to protect natural resources (Cortner and Lorensen 1997). This situation is becoming more common in Canada because of the increasing amount of urban development within and adjacent to wildlands. One way to offset this problem is to conduct fuels management in and around communities and remote structures. This will reduce the number of suppression resources required to protect a structure or community making more resources available to suppress those wildfires threatening valuable natural resources.

(2) Potential Reductions in Area Burned

The inclusion of fuels management criteria into forest management activities (such as harvest scheduling, cut block design, reforestation, and stand tending) could reduce the probability of extremely large fires. For example, strategically located discontinuities in large tracts of contiguous coniferous forests could serve as possible fire breaks. Conversion of these key areas to deciduous dominated forests would further enhance their potential as barriers to fire spread. The benefit of reducing the large fire potential within a forest management area is that it will increase the resource management options. For instance, a reduction in area burned would allow areas to be designated for alternative resource management uses without a loss in timber supply. Or, if timber supply limitations are a concern, small reductions in area burned (e.g., 1%) have been shown to yield significant improvements in annual allowable cut (e.g., 35%) (Van Wagner 1983, Reed and Errico 1986, Martell 1994).

Concluding Remarks

Fuels management is based on the recognition that forest fires are going to occur and that fire suppression efforts will be ineffective in some cases. Therefore, actions must be taken to minimize the potential for damage resulting from escaped wildfires or prescribed fires before they occur. Currently, fuels management is used primarily to protect structures and communities, but the opportunity exists to incorporate fuels management considerations into stand and forest level management planning, which could have significant benefits to forest management organizations in Canada.

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