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Fuel Treatments on Rangelands

by

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Role and Mission. The Idaho Legislature created the Policy Analysis Group (or APAG@) in 1989 as a way for the University of Idaho to provide timely, scientific and objective data and analysis, and analytical and information services, on resource and land use questions of general interest to the people of Idaho. The PAG is a unit of the College of Natural Resources Experiment Station, administered by Kurt Pregitzer, Director, and Dean, College of Natural Resources.

PAG Reports. This is the thirty-second report of the Policy Analysis Group (see inside cover). The PAG is required by law to report the findings of all its work, whether tentative or conclusive, and make them freely available. PAG reports are primarily policy education documents, as one would expect from a state university program funded by legislative appropriation. The PAG identifies and analyzes scientific and institutional problems associated with natural resource policy issues. In keeping with the PAG's mandate, several alternative policy options are developed and their potential benefits and detrimental effects are analyzed. As an operational policy the PAG does not recommend an alternative.

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Executive Summary

Wildfires are an increasing management problem on Idaho's rangelands. Fire has always been a force affecting rangelands; however, today fires are occurring more frequently and have higher intensities with more adverse effects on range ecosystems. Rangeland fuel treatments lessen the amount of fuel available for burning and/or rearrange fuels to decrease the likelihood they will burn with adverse consequences.

Much rangeland in Idaho and throughout the western U.S. is publicly owned, by either the federal or state governments. Rangeland management practices, including fuel treatments, must conform with existing environmental and land management planning laws and policies.

This report is intended to introduce policy makers and citizens to issues related to wildfire management and fuel treatments on Idaho's rangelands. The report summarizes the findings of fuel treatment studies on rangelands in Idaho and comparable areas of the western U.S., examines the risks associated with fuel treatment alternatives, summarizes the policies that currently affect fuel treatment implementation, and suggests research and policy alternatives that may increase fuel treatment effectiveness. The report is formatted as responses to the following series of focus questions.

What factors influence wildfire frequency, severity, and extent on Idaho's rangelands? Wildfire frequency, severity, and extent on rangelands are influenced by fuels, weather, and landscape features and context. Fuel is the only factor that can be affected directly by rangeland management actions in the short term. In recent years, invasion of rangelands by exotic annual grasses, especially cheatgrass, and expansion of juniper woodlands have been driving forces in changing wildfire activity on Idaho's rangelands.

What alternative fuel treatments exist for Idaho's rangelands? Fuel treatments alter the amount and/or distribution of vegetation on the land in order to affect wildfire behavior. Fuel treatment methods for rangelands include mechanical and manual treatments, herbicides, prescribed burning, livestock grazing, and other biological controls. Combinations of treatments are often used to obtain desired results.

How effective are fuel treatments on rangelands? Fuel treatment effectiveness is difficult to measure because treatments are often just one part of an overall rangeland management strategy and effects may take a long time to appear because of arid environmental conditions. In addition, wildfire is a random event, and numerous factors affecting wildfire behavior are interrelated. Careful planning, high quality implementation using appropriate methods, and timely maintenance of fuel treatments are likely to increase effectiveness.

What are potential adverse impacts of fuel treatments on rangelands? Rangeland ecosystem components that can be adversely impacted by fuel treatments include soil erosion and loss of productivity, reduced water quality, disturbance of wildlife, and establishment of invasive species. In addition, treatment methods involving prescribed burning affect air quality. Careful implementation using treatments appropriate to specific site conditions can reduce adverse impacts or unintended consequences.

What policies currently guide the implementation of fuel treatments on Idaho's rangelands? The federal government is responsible for administering about 64 percent of the land in Idaho. Most of Idaho's rangelands are managed by one of two federal agencies: the Bureau of Land Management or the U.S. Forest Service. There is not a single, overarching federal law that guides fuels treatment implementation on federal rangelands. Instead a variety of laws, regulations, and other policy documents provide some guidance. In addition to land use planning laws and regulations, laws protecting air and water quality can affect implementation of some fuel treatment methods. States are responsible for implementing many requirements of federal clean air and water statutes, and states have primary responsibility for wildlife and laws that protect state and private rangelands from wildfire.

What policy options might improve fuel treatment effectiveness on Idaho's rangelands? Focusing more research resources on rangeland fuel treatment could improve effectiveness. More research is needed about wildfire behavior in various rangeland vegetation types, as well as effects of fuel treatment on other ecosystem components and processes, including invasion of unwanted plant species. Improved research-based implementation guidance is needed for fuel treatments that involve livestock grazing.

Alternative federal and state wildfire and fuel treatment policies also need consideration. Although federal wildfire policy has come to the forefront of the land management policy arena, it currently lacks specific statutory direction for fuel treatment. Also, federal National Environmental Policy Act (NEPA) procedures could be streamlined to increase and expedite fuel treatment implementation projects. Policies promoting increased coordination and cooperation between federal, state, and local agencies are needed. State policy changes that create fire protection authorities and responsibilities similar to that for Idaho's private forest landowners are an alternative. Dedicated funding for fuel treatment project planning at the federal level and project implementation funding at both the federal and state level is needed.

As Idaho's population continues to grow and its citizens continue to move into wildland-urban interface (WUI) areas, the effects of rangeland wildfires on human settlements and structures become more problematic. Local regulation of structural development in the WUI may be a helpful policy option.

Introduction

Rangelands are lands on which the native vegetation is predominantly grasses, grass-like plants, forbs, or shrubs (Society for Range Management 1989). Rangelands include grasslands, shrublands, woodlands, and deserts. Rangelands are usually characterized by limited precipitation, often sparse vegetation, sharp climatic extremes, highly variable soils, frequent salinity, and diverse topography.

Wildfires are an increasing management problem on Idaho's rangelands. In July 2007, the Murphy Complex fire in southern Idaho and northern Nevada brought many issues regarding range management and wildfire to the public's attention. These are highlighted in Chapter 5.

Fire has always been a force affecting rangelands, including shrub and grassland communities. However, wildfires and their effects are different today than in the past. In general, fires are occurring more frequently in areas invaded by annual exotics, and fires have higher intensities in areas converted to juniper woodlands with potentially adverse effects on rangeland ecosystems. The number of large fires (> 5,000 ha) on rangelands also has increased (Kuchy 2008). In addition, more people are living at the interface of urban areas and rangelands, which heightens the need to protect people and personal property.

Past management practices, including livestock grazing and fire exclusion, have changed rangeland conditions so that rangeland plant communities such as sagebrush are being negatively affected by exotic invasive species such as cheatgrass and native invasives such as juniper. In turn, these changes negatively affect wildlife species, such as sage grouse, and domestic livestock that depend on native forage. Vegetation changes also can affect soil productivity and water quantity and quality. The changes in vegetation also further exacerbate the cycle of increased fire frequency or intensity.

Recent wildfires across the western U.S. have raised questions about how rangelands might be managed to reduce the adverse effects of wildfires. The severity and extent of wildfires are influenced in general by weather, topography, and fuel. Fuel is the only factor that can be affected directly by rangeland management actions. Fuel treatments lessen the amount of fuel available for burning and/or rearrange fuels to increase the probability that they burn with less intensity. Potential fuel treatments include prescribed fire, mechanical or herbicide treatments, and livestock grazing strategies. Fuel treatments are not without risks, however, and reducing negative or unintended consequences from treating fuels is imperative.

Much rangeland in Idaho and throughout the western U.S. is publicly owned, by either the federal or state governments. Rangeland management practices, including fuel treatments, must conform with existing laws and policies. Some policy options may increase the feasibility of fuel treatments, while reducing the risks of adverse effects associated with them.

This report summarizes the findings of fuel treatment studies on rangelands in Idaho and in similar areas of the western U.S. to provide guidance on fuel treatment strategies that may be effective in reducing the detrimental effects of wildfires and restoring, rehabilitating, or maintaining desirable conditions on Idaho's rangelands. The report also examines the risks associated with fuel treatment alternatives, summarizes the policies that currently affect fuel treatment implementation, and analyses policy options or that may increase fuel treatment effectiveness. Because the research literature is sparse, the report also suggests a research agenda to increase knowledge with regard to improving fuel treatment effectiveness on rangelands.

The focus questions that guide this report are:

1. What factors influence wildfire frequency, severity, and extent on Idaho's rangelands?
2. What alternative fuel treatments exist for Idaho's rangelands?
3. How effective are fuel treatments on rangelands?
4. What are potential adverse impacts of fuel treatments on rangelands?
5. What policies currently guide the implementation of fuel treatments on Idaho's rangelands?
6. What policy options might improve fuel treatment effectiveness on Idaho's rangelands?

Each of these questions is covered in a separate chapter.

Chapter 2. What factors influence wildfire frequency, severity and extent on Idaho's rangelands?

Fires on rangelands in Idaho are influenced by the same factors that affect all wildland fires: fuels, weather, and landscape features and context (Figure 2-1).

Fire frequency describes the fire return interval, or the average time before fire re-burns a given area. Fire severity describes the effects of a fire's heat, or intensity, on biotic and abiotic ecosystem properties. Fire extent describes both the size and spatial homogeneity of burning (Brooks et al. 2004).

Fire is a natural feature of rangelands, but its frequency, severity, and extent vary by the type of vegetation, climate, topography, and other environmental factors. For example, native plant assemblages dominated by sagebrush in the Great Basin historically experienced fires every 30 to 100 years (Brooks and Pyke 2001). Along with low fuel loads, bare interspaces between widely spaced shrubs prevented fires from spreading very far from points of ignition (Colket 2003). In the northern Great Basin, drier juniper woodland communities experienced fire more frequently, every 8 to 20 years, but again for most rangelands, fire historically touched the land relatively lightly because fuels were scattered and patchy (JFSP 2008).

Historic fire patterns changed during the 1800s when human-induced fire suppression and fuel reductions by livestock grazing reduced fire frequency. Unsustainable levels of cattle and sheep grazing gradually depleted native bunchgrasses and perennial forbs and opened the way for invasive annual weeds such as cheatgrass, along with other non-native plants including halogeton, Russian thistle, and knapweeds. Woodland plant communities also expanded and matured in the absence of fire, becoming more susceptible to high intensity crown fires that were often followed by increased dominance of exotic invasive plants (Brooks and Pyke 2001). As a result, rangelands have become more susceptible to larger, more frequent fires (Miller and Tausch 2001, Brooks et al. 2004, JFSP 2008, Tausch et al. 2009).

Landscape features

The influence of landscape features (such as topography depends on the spatial scale at which wildland fires are examined (Kuchy 2008). For example, at small localized scales fire spread is significantly influenced by slope—spreading faster up a slope than on level terrain (Brown 1982, Rothermel 1983). Aspect also affects fires at smaller scales, with south-facing slopes receiving more direct sunlight and with more snow lost to evaporation, leading to drier and more fire-prone conditions than locations facing north and east (Kuchy 2008).

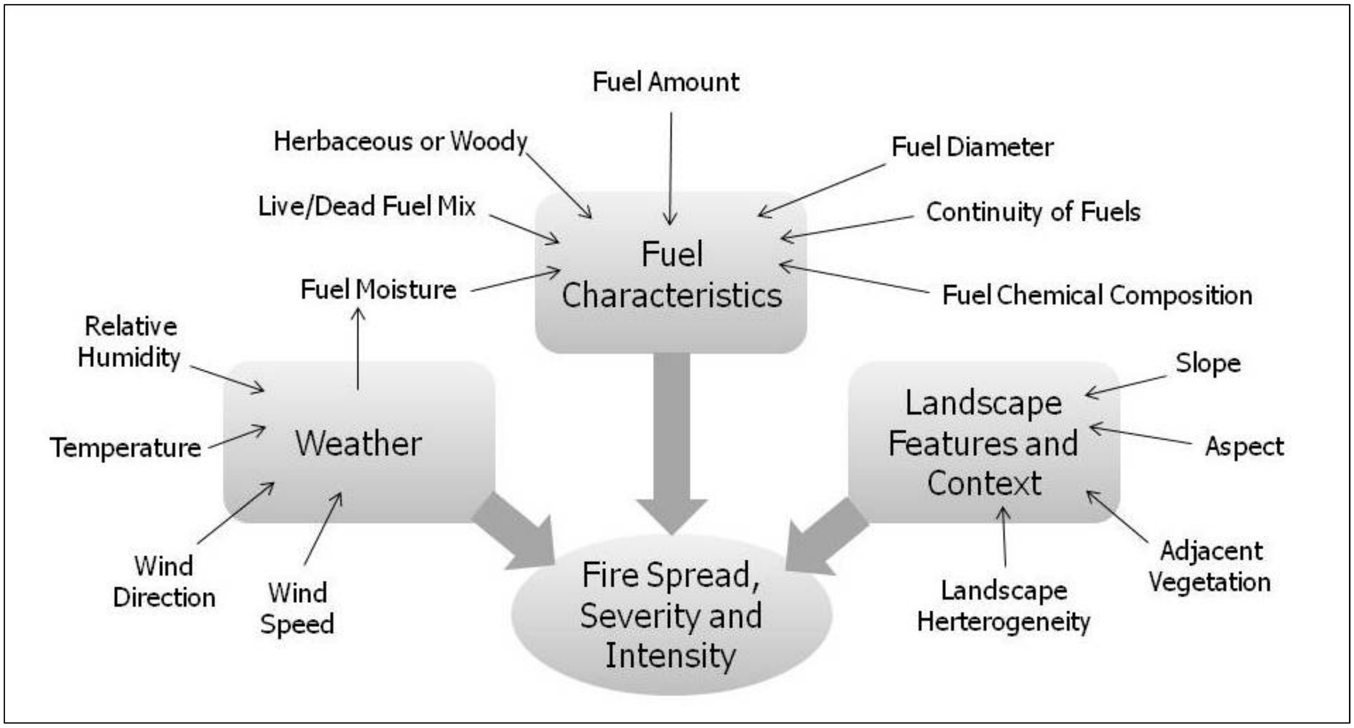

Figure 2-1. Factors that affect rate of spread, severity, and intensity of wildland fires (adapted from Strand et al. 2008).

Topography also affects vegetation that serves as fuel for fires. For example, aspect and elevation are contributing variables influencing woodland expansion across landscapes (Johnson and Miller 2006). At larger landscape scales, slope, aspect, and elevation may not be significant drivers of fire size or occurrence (Kuchy 2008). Regardless, topography is not easily influenced by rangeland management actions in the near term.

The interface between rangelands and human settlement, known as the wildland-urban interface (WUI), affects wildfire characteristics. When people move into the WUI, vegetation adjacent to rangelands is affected. Increased human access to wildlands via roads is associated with an increased number of human-caused wildfires (Connelly et al. 2004).

Weather, climate and atmospheric CO_2

Weather is the short-term mix of temperature, wind, humidity, and precipitation. It plays an important role in the severity and extent of wildfires on rangelands. Hotter temperatures and lower relative humidities dry out vegetation and this can increase fire intensity. Higher wind speeds can spread fires more rapidly. Climate change will affect long-term weather patterns possibly leading to longer, hotter, and drier fire seasons in Idaho.

Climate—or the long-term weather pattern—plays a dominant role in the vegetation dynamics of rangelands, and thus influences fire behavior. Water resources in arid environments are scarce and plant communities respond accordingly to precipitation increases and decreases. Periods of high precipitation increase herbaceous biomass which in turn creates additional fuel for fires where it later dries out. The pairing of dry years following wet years likely enhances the continuity of fuels, resulting in larger wildfires (Colket 2003).

Climate change will likely influence vegetation dynamics in both the absence and presence of fire, particularly in plant communities that are especially sensitive to climate patterns (Colket 2003, Connelly et al. 2004). Temperature changes will favor some plants and disfavor others, and the amount and timing of precipitation in a given region is likely to be altered. Water availability, always uncertain from year to year, is likely to become even less predictable (JFSP 2008).

Atmospheric carbon dioxide (CO_2) is increasing and, according to an untested hypothesis, may trigger more frequent rangeland wildfires. Additional CO_2 increases a plant's water use efficiency, which enhances growth and creates additional biomass and lignin—the coarse, woody part of the stem—which makes the plant less palatable to livestock and also slower to decompose. This results in higher levels of flammable biomass (JFSP 2008).

Fuels

Among the factors affecting fire frequency, severity, and extent, fuel can be influenced by management. That is the focus of this report.

Fuel is essentially vegetation. In addition to quantity, a description of fuel includes elements such as the vertical arrangement of fuels, live/dead fuel mix, fuel moisture, fuel diameter, fuel continuity, whether the fuel is herbaceous or woody, and the fuel's chemical composition. All these elements affect fire behavior (Strand et al. 2008).

Land use and management affect fuels in a variety of ways. For example, livestock grazing's effects on fuels depends on the types of vegetation, the types of livestock, and the intensity of grazing (Davies et al. 2009, 2010).

Two significant changes in fuels have increased wildland fire frequency, severity and extent in Idaho. First is invasion of exotic annual grasses, especially cheatgrass, and second is encroachment by juniper woodlands.

Cheatgrass. Invasion of exotic annual grasses has changed the environment of many rangeland ecosystems. Invasive annual grasses provide a dense and continuous source of fuel that has effectively lengthened the fire season and increased fire frequency. Frequent fires eventually eliminate native sagebrush, forbs, and grasses. These exotic annual grasses also change soil nutrients, especially carbon and nitrogen, such that invasive annual grasses have an advantage over the native plants (USGS 2002b).

Cheatgrass is widely recognized as a problematic exotic invasive plant. It is ubiquitous across many parts of Idaho and the western U.S. (Menakis et al. 2003, Connelly et al. 2004, JFSP 2008). Cheatgrass is a winter annual introduced from Eurasia. It competes for resources by starting vegetation growth earlier in spring than most perennial plants and by rapidly proliferating after fires. The dense accumulation of dried cheatgrass tillers in mid-summer creates conditions suitable for subsequent fires. In some areas, fires occur more frequently (less than every five years) and the fire season has been lengthened (Colket 2003). The shorter fire cycles are having a significant impact on native communities of plants and animals that often have few evolved defenses against fire and are unable to survive frequent successive burns (USGS 2003, Brooks et al. 2004, Epanchin-Niell et al. 2009).

Cheatgrass invades rangelands most readily after some type of disturbance creates the initial conditions for cheatgrass establishment. These disturbances include roads and other transportation corridors, excessive livestock grazing, construction, agriculture, and off-highway vehicle use (Brooks and Pyke 2001, Colket 2003, Connelly et al. 2004).

After cheatgrass has invaded an area, it perpetuates itself effectively (JFSP 2008, Einswerth et al. 2009). Fires burning in areas dominated by cheatgrass tend to be larger and less patchy than historical fires in sagebrush steppe. After the fire regime is altered, cheatgrass flourishes under the new conditions it creates (Brooks et al. 2004). For example, big sagebrush cannot re-establish after cheatgrass has taken over because big sagebrush seedlings are killed by the more frequent fires before they can mature and reproduce. Re-establishment of big sagebrush becomes unlikely as distances between big sagebrush remnants and burned areas increase due to larger fire sizes and greater connectivity of cheatgrass-dominated lands (Colket 2003). Few native grasses can successfully compete with cheatgrass (Colket 2003).

Juniper woodlands. The other significant fuels issue affecting wildfires on rangelands is encroachment of juniper woodlands onto former sagebrush and grassland sites. Closed canopy stands of juniper increase the risk of crown fires that typically are more severe and damaging than grassland fires (Roth 2004, Ansley and Rasmussen 2005).

The factors most frequently cited for the increase in both density and area of juniper woodlands are climate, the introduction of livestock, increases in atmospheric carbon dioxide (CO_2), and the reduced role of fire on rangelands (Miller and Rose 1999, Miller et al. 2005). Fire regimes on many rangelands changed at the beginning of the 20th century. Heavy livestock grazing between 1880 and 1930 removed herbaceous biomass, that previously had functioned as fine fuels that carried fires and kept juniper expansion in check. Overgrazing also weakened the competitive ability of grasses against emerging juniper seedlings. In addition, fire suppression, especially following World War II, further reduced the role of fire. The length of time between disturbances that kept juniper in check increased, and without fire, juniper woodlands expanded (Burkhardt and Tisdale 1976, Miller and Rose 1999, Miller and Tausch 2001). In addition, climate changes, including increasing precipitation in the 20th century, caused expansion of juniper at low elevations and on south-facing slopes. Higher water use efficiency caused by increasing atmospheric CO_2 in the 20th century also aided juniper expansion (Bradley and Fleishman 2008).

In addition to effects on wildland fire, juniper woodland expansion also reduces herbaceous production, increases bare ground and soil erosion, and reduces the availability of soil nutrients. Juniper domination also reduces habitat for wildlife species that depend on open spaces (Ansley and Rasmussen 2005, Reinkensmeyer et al. 2007). After juniper woodlands dominate, restoring grasslands and shrublands can be difficult and expensive, with unpredictable outcomes (Johnson and Miller 2006).

Summary

Wildfire frequency, severity, and extent on rangelands are influenced by fuels, weather, and landscape features and context. Fuels are the only factor that land managers can influence in the short term. Invasions of rangelands by exotic annual grasses, especially cheatgrass, and expansion of juniper woodlands have been driving forces in changing wildfire activity and characteristics on Idaho's rangelands.

Chapter 3. What alternative fuel treatments exist for Idaho's rangelands?

The objective for fuel reduction is to change fire behavior by impacting fuel bed depth, fuel loading, percent of vegetative land cover, and ladder fuels. Fuel treatments on rangelands generally fall into two categories: fuel breaks and landscape area treatments (Nader et al. 2007).

Fuel breaks are linear fuel modifications, often situated along a road or ridge and ranging from 30 to 400 feet wide. Fuel breaks are designed as a tool to slow the spread of fire and provide areas to facilitate fire suppression. Whereas most fuel treatments on forest lands involve removing vertical fuels that provide a fire ladder into tree crowns, most rangeland fuel break treatments remove horizontal fuels to provide space for suppression opportunities (Wagner 2004).

Landscape area fuel treatments are designed to reduce flame height, fire intensity, and change fire behavior over a large area. Long-term landscape treatment efforts are focused on changing the plant community to decrease fire severity when it occurs (Nader et al. 2007). The focus of this report is on landscape area fuels treatments.

Much of the research literature on landscape area fuels treatment for rangelands focuses on "restoration" rather than fuels management exclusively for the sake of controlling wildfire (e.g., Brooks 2008, McIver et al. 2010). One of the goals of rangeland restoration is to create more resilient fire conditions (e.g., BLM 2000), which may involve fuels management strategies. For example, restoring native sagebrush steppe without an invasive cheatgrass component is likely to result in fires burning less frequently with less intensity and reduced severity of effects.

Mechanical treatments

Mechanical treatments involve the use of vehicles such as wheeled tractors, crawler-type tractors, or specially designed vehicles with attached implements designed to cut, uproot, or chop existing vegetation. There are numerous mechanical treatments available, including chaining, tilling, mowing, mastication, and harvesting of woody biomass. The selection of a particular mechanical method is based on the characteristics of the vegetation, revegetation needs, topography and terrain, soil characteristics, and climatic conditions (BLM 2007b).

Chaining consists of pulling heavy chains in a "U" or "J" shaped pattern behind two crawler-type tractors. The chain is usually 250 to 300 feet long and may weigh as much as 32,000 pounds. The width of each swath varies from 75 feet to 120 feet. Chaining can be done on irregular, moderately rocky terrain, with slopes of up to 20% and is effective for crushing brittle brush and uprooting woody plants (BLM 2007b).

Tilling involves the use of angled disks (disk tilling) or pointed metal-toothed implements (chisel plowing) to uproot, chop, and mulch vegetation. Tilling works best on areas with smooth terrain and deep, rock-free soils (BLM 2007b).

Mowing is generally used in grass communities to drop fuel on the ground, where it has less contact with air and thus has lower combustibility (Nader et al. 2007). Mowing is most effective on annual and biennial plants (BLM 2007b).

Mastication involves the use of a large mechanized device for chopping, and is used in brush and trees to break up the fuel pattern and decrease combustibility by placing fuels on the ground. It changes fire behavior by reducing ladder fuels, which decreases potential for vertical extension of fire into tree canopies. Mastication can be used as a pretreatment followed by prescribed burning or grazing treatments (Nader et al. 2007).

In woodlands, trees can be thinned by harvesting woody biomass using mechanical equipment such as feller-bunchers. The harvested biomass can be chipped, ground, or masticated. The processed biomass can be left on site or transported off site for use, including energy production (BLM 2007b). Thinning can reduce ladder fuels and create desired crown spacing in one treatment (Nader et al. 2007).

Mechanical methods are effective for removing thick stands of vegetation. Some mechanical equipment can also mulch and scatter vegetative debris, so debris disposal is taken care of while the vegetation is removed. Mechanical methods may be appropriate where a high level of control over vegetation removal is needed, such as in sensitive wildlife habitats or near home sites, thus mechanical treatment often is used instead of prescribed burning or herbicide treatments for vegetation control near residential areas. Repeated mechanical treatments are often necessary due to sprouting of residual roots and seeds (BLM 2007b).

Manual treatments

Manual treatments involve the use of hand tools and hand-operated power tools to cut, clear, or prune herbaceous and woody species. Treatments include cutting plants above the ground level and pulling, grubbing, or digging out root systems of plants to prevent sprouting and regrowth (BLM 2007b). Manual treatments are labor-intensive and thus expensive, and may not be cost-efficient over large areas. However, this approach is suitable to smaller areas where environmental impacts need to be minimized, such as riparian areas or areas where prescribed burning or herbicide application would not be appropriate, or in steep areas where mechanized vehicles cannot be used (BLM 2007b, Nader et al. 2007).

Herbicide treatments

Herbicide treatments use chemicals that kill or injure plants. Herbicides can be categorized as selective or non-selective depending on whether they kill only a specific type of plant (selective) or all plants (non-selective). Herbicides are also classified by whether they prevent germination of seeds (pre-emergent) or affect plants after they have germinated (post-emergent). Pre-emergent herbicides keep fuel from forming on site, but post-emergent herbicides may not alter fuel patterns immediately because the dead plant biomass is still on site (Nader et al. 2007, Brooks 2008).

The application method chosen for herbicides depends first of all on whether the treatment objective is vegetation removal or reduction. Many other factors influence whether herbicide use is appropriate: accessibility, topography, and size of the treatment area; the characteristics of the target species and the desired vegetation; the location of sensitive areas and potential environmental impacts in the immediate vicinity; the anticipated costs and equipment limitations; and the weather and vegetative conditions of the treatment area at the time of treatment (BLM 2007b).

Prescribed burning

Prescribed burning involves the intentional application of fire to rangeland fuels under specified conditions of fuels, weather, and other variables (BLM 2007b). The intent is for the fire to stay within a predetermined area to achieve site-specific resource management objectives. Prescribed burning is used to change the fuel load and pattern (Nader et al. 2007) and also restoration of desirable plants (Ferguson 2001).

Federal land managers also use "wildland fire use" as a type of prescribed burning. This approach uses naturally-ignited wildland fires to accomplish specific resource management objectives in predefined designated areas outlined in fire management plans (USDA and USDI 2007). Letting wildfires burn can be controversial, and the Cohesive Wildland Fire Management Strategy currently under development (see USDA and USDI 2011) will provide policy guidance for the use of wildfires to achieve resource management objectives.

Prescribed burning may be used before other treatments in order to remove vegetation that would otherwise reduce treatment effectiveness. Conversely, other types of treatments may be conducted before prescribed burning to reduce the amount of biomass on site so that the subsequent prescribed fire will not burn as intensely and not kill desirable vegetation (BLM 2007b). Prescribed burning can be used in some situations where other treatment methods are not feasible due to soil rockiness, slope steepness, or terrain irregularity, although prescribed burning is limited to situations where adequate fuel is available to carry the fire (BLM 2007b).

Livestock grazing

Livestock grazing has the potential to be an ecologically and economically sustainable management tool for reduction of fuel loads (BLM 2003, Kerby et al. 2006, Taylor 2006, Nader et al. 2007, BLM 2010b). Livestock consume vegetation that otherwise can be fuel for fires, so grazing large areas typically reduces the extent and severity of wildfires. In addition, livestock tend to graze some areas more intensely than others, creating patchy vegetation that reduces the continuity of fuel loads and breaking up fires that might burn those fuels (Taylor 2006).

"Prescribed grazing" and "targeted grazing" are terms used to describe livestock grazing at a determined season, duration, and intensity to accomplish defined vegetation or landscape goals (Launchbaugh 2006, BLM 2007b). Targeted grazing practices can specifically target either fuel reduction or maintenance of desired plant communities (Taylor 2006, BLM 2010b). For example, targeted grazing on cheatgrass in the spring was found to be effective at reducing flame length and rate of spread during prescribed burns (Diamond et al. 2009), and prescribed grazing with sheep and goats has been used for fuel treatment and to control noxious weeds (Frost and Launchbaugh 2003, Chapman and Reid 2004).

There are two ways by which grazing impacts the fuel load: removal of vegetation, and hoof incorporation of fine fuels into the soil (Nader et al. 2007). Grazing is best used when addressing smaller diameter, herbaceous vegetation. It is a complex, dynamic tool with many plant and animal variables, and it requires sufficient knowledge of several critical factors to reach treatment objectives. Those factors include: the species of livestock grazed (cattle, sheep, goats, or a combination); the animals' previous grazing experience (which can affect their preferences for certain plants); time of year as it relates to plant physiology (animal consumption is directed by the seasonal nutrient content); animal concentration or stocking density during grazing; grazing duration; plant secondary compounds; and animal physiological state. Treatments either can be short-term to reduce flammable vegetation or long term to change vegetation composition by depleting root carbohydrates in perennials and reducing the soil seed bank for annual plants (Taylor 2006, Nader et al. 2007).

Other biological controls

Plant-eating insects, nematodes, mites, or pathogens affect plants directly, by destroying vital plant tissues and functions, and indirectly, by increasing stress on the plant, which may reduce its ability to compete with other plants. Often, several biological control agents are used together to reduce undesired vegetation density to an acceptable level. Thus, biological control agents could be used to change specific plants in the community, such as juniper or cheatgrass. Biological control agents need to be tested to ensure that they are host specific and will feed only on the target plant and not on crops and other desirable or protected plant species. Testing of biological control agents is time consuming and expensive (BLM 2007b).

Fuel break treatments

Although this report focuses on landscape area treatments it is important to note that fuel break treatments are an effective strategy for controlling and suppressing wildfires on rangelands. Fuel breaks are strips of land on which vegetation has been reduced or removed to slow or even stop the spread of wildfire. Fuel breaks also provide safety zones or escape routes for firefighters.

Almost any technique used for landscape scale fuel treatments can also be used to create fuel breaks. For example, sheep grazing has been used to create fuel breaks near residential areas, with the support of nearby homeowners (Smith and Davison 2001, BLM 2003).

Green strips are a specific type of fuel break where green plant growth serves as a break in fuel continuity and slows the spread of wildfires (Taylor 2006, BLM 2010b). Plants in a green strip are normally widely spaced, with little or no fuel growing in between; therefore, if one plant is ignited, fire cannot as easily spread to nearby plants (Miller 2006). Green strips can be created by planting late-maturing plants or by grazing strips at the end of the growing season right before the fire season to keep grasses in a green vegetative stage and delay senescence (Taylor 2006). Fire resistant plants can be used for green strips, but few native plants of the Great Basin region meet this requirement, so introduced species, such as crested wheatgrass, often are used. Additionally, green strip species must be highly competitive with alien annual plants to disrupt fuel continuity in cheatgrass-dominated sites (Miller 2006).

Brush and tree regrowth are a major problem for maintaining fuel breaks and need continual attention. Woody plants combined with grasses produce a fuel mixture that can spread fire rapidly. Livestock grazing has been shown to be effective at keeping the fuel load cropped closely enough to serve as an effective fuel break (Green and Newell 1982, Taylor 2006, Nader et al. 2007).

Integration of treatments

Integration of different fuel treatments may provide the best strategy for reducing the frequency, severity, and extent of wildfires on rangelands. For example, livestock cannot effectively control mature brush plants that either grow higher than the animals can effectively graze or have large diameter limbs. In such cases, mastication, prescribed burning, and/or hand-cutting can be used to manipulate larger diameter fuels, and grazing can be used as a follow up treatment for controlling resprouting species or shifting the species composition to herbaceous plant fuel material (Nader et al. 2007).

A specific scenario where an integrated fuels treatment approach might be appropriate is a mixture of volatile fuels, like juniper-dominated rangelands, along with enough herbaceous vegetation to provide a continuous fuel load (Taylor 2006). As described in Chapter 2, juniper encroachment into sage-steppe and grasslands may lead to decreased species diversity, loss of soil and seed banks, decreased aquifer recharge, increased soil erosion, and increased probability of high-intensity crown fires. Foraging animals usually avoid juniper; however, some breeds of goats are more tolerant than other domestic livestock of the terpenoid-laden foliage of juniper and can play an important role in integrated management plans. Even though goats consume more juniper than other species of livestock, individual consumption is still relatively low. Also, juniper foliage above the browsing height of goats continues to be a fire hazard. Mechanical treatment followed by goats might serve as an optimum management strategy. Prescribed fire might also be incorporated. Burning under cool, safe conditions following the mechanical treatment would keep the target species within the browsing height of goats. With this integrated approach, the fuel load from juniper would be reduced as would the frequency and intensity of goat browsing needed to maintain a desired plant community (Taylor 2006).

Summary

Fuel treatments alter the amount or distribution of vegetation on the land in order to affect wildfire behavior. Fuel treatment methods for rangelands include mechanical and manual treatments, herbicides, prescribed burning, livestock grazing, and other biological controls. Combinations of treatments are often used to obtain desired results.

Chapter 4. How is effectiveness of fuel treatments measured?

Ultimately, the goal of treating fuels is to moderate fire behavior (Hudak et al. 2011), but the reasons for wanting to affect fire behavior can be numerous and varied. Fuel treatments may be implemented to reduce wildfire severity (the effects of a fire's heat, or intensity, on biotic and abiotic ecosystem properties), to provide access for firefighters and aid in fire suppression, to protect human settlements and manmade structures, or a combination of these or other reasons. The effectiveness of fuel treatments can vary depending on the objectives of treatment.

Fuel treatment objectives, and therefore measures of effectiveness, may differ between undeveloped rangelands and the wildland–urban interface (WUI). Fuel treatments in wildland areas may be designed mostly to mitigate effects of large, severe wildfires and to restore rangeland ecosystems. Treatment objectives in the WUI often include reducing potential property loss as well as restoring or maintaining ecosystems, and are especially challenging because of the variety of ownerships and diversity of management objectives (Reinhardt et al. 2008). There is not always agreement about what fuel treatments are supposed to accomplish (Hamma 2011).

A common measure of the effectiveness of fuel treatment programs, used particularly by the federal land management agencies, is number of acres treated. However, the number of acres treated is not a satisfactory measure because it does not tell whether and how much fuel treatments mitigate severe fire effects, what types of fuel treatments are most effective, or how long fuel treatments remain useful as fuels accumulate over time (Hudak et al. 2011).

Much of the evidence of fuel treatment effectiveness is anecdotal (e.g., BLM 2005, BLM 2007a). Land managers generally assume fuel treatments will produce the desired effects on the next wildfire that burns through an area. Systematic post-wildfire evaluation of the effectiveness of fuel treatments is not done very often. There are no explicit examples in the literature of wildfires that burned across rangelands where fuel treatments have been done (Hudak et al. 2011). Reviews of fuel treatment effectiveness that are done tend to focus on immediate objectives of the treatment (e.g., percent reduction in fuel load, change in plant species composition), not whether the treatment ultimately led to the desired effects on wildfire. For example, a review of fuel treatment effectiveness conducted for the Wildland Fire Leadership Council (Hayes et al. 2008) did not evaluate enough grassland sites to reach any conclusions; however, sufficient samples existed for woodland (22 sites) and shrub land (16 sites) categories. Fuel treatment vegetation management objectives were met on 88% of the woodland sites and 100% of the shrub land sites (Hayes et al. 2008). However this evaluation did not address whether the fuel treatments modified wildfire behavior.

Chapter 5. How effective are fuel treatments on rangelands?

The effectiveness of landscape area fuel treatments at reducing the frequency, severity, and extent of wildfires on rangelands is difficult to assess for a variety of reasons. First, few management activities are used solely to treat fuels. Usually there are other objectives for management actions, such as rangeland vegetation restoration. Fuels treatment may be just a part of an overall restoration management strategy.

Second, the effectiveness of fuel treatments on rangelands is difficult to assess because of the variety of time frames involved (Tausch et al. 2009). For example, in arid environments, woody plant growth and decay processes are slow so seeing the effects of fuel treatments may take decades. On the other hand, in more moist environments, herbaceous fuel treatments such as mowing or grazing may only last a short time before plant re-growth. Wildfires also are random events so it may be years before a fire ignites in a treated or untreated area.

It is also difficult to assess the effectiveness of fuel treatments because the factors affecting fire are inter-related. Because fire behavior, fire extent, and level of vegetation consumed result from many interacting factors, the specific role of fuels treatments on wildfires is difficult to ascertain (Launchbaugh et al. 2008).

General observations about fuel treatment effectiveness

An important determinant of treatment effectiveness for many methods of fuel treatment is time since treatment implementation (BLM 2007b, Nader et al. 2007). Maintenance and repetition of fuel treatments may be required for them to remain effective. For example, many rangeland plant species resprout from their roots and require retreatment to prevent plant regrowth and subsequent reduction in treatment effectiveness. Treatments that remove or kill roots may be more expensive to implement and cause more site disturbance initially, but they may be more efficient and effective and result in less site disturbance over the long term because they require less retreatment (BLM 2007b). For biological control agents, such as insects or pathogens, effectiveness also may be reduced over time because the biological control agents reduce pest plants, which are also host plants, resulting in declining populations of the desirable agent (BLM 2007b).

Time since treatment may have a different relationship on effectiveness for herbicide treatments because dead vegetation remains on site immediately after treatment (BLM 2007b, Nader et al. 2007). In the short term, herbicide treatments may increase flammability, but as the dead plant material decays treatment effectiveness increases.

The effectiveness of any fuel treatment depends on the conditions under which it is implemented. For example, prescribed burning is most effective at reducing surface fuels up to three inches in stem diameter. If fuels on site are larger than that, effectiveness is reduced. Prescribed burning also requires appropriate weather conditions (wind, air, and plant moisture) to be most effective. Air quality concerns are also a factor. There is usually a narrow time period in the season during which prescribed burning can be done. Prescribed burning treatment effectiveness is somewhat unpredictable because the fire may burn hotter or cooler than planned (Taylor 2006, Nader et al. 2007).

The effectiveness of fuel treatments can be increased with better understanding site conditions, careful planning, and good implementation (Taylor 2006). The first step in planning a fuel reduction project is to inventory the current amount and condition of herbaceous and woody vegetation. The current status (i.e., species composition, amount of fuel, fuel type, etc.) will determine the type and possible combination of treatments to apply. By understanding plant composition and fuel characteristics, a manager can match the treatment to vegetation conditions (e.g., Brooks 2008). For example, in areas dominated by large woody plants, prescribed burning in combination with mechanical techniques might be required, followed by grazing to maintain appropriate vegetation levels. An appropriate and effective fuels reduction strategy requires land managers to determine specific goals and objectives (Taylor 2006).

Effectiveness of livestock grazing treatments

More rangeland research attention has been focused on the effectiveness of livestock grazing fuel treatments than other methods. This is probably because livestock grazing historically has been a major use of rangelands in the western U.S. and has significant economic value. Recent policy decisions have reduced the amount of domestic livestock grazing on many federal and state rangelands in the western U.S. Grazing reductions have led some people to blame increased wildfire frequency and negative effects from wildfires on these reductions (see e.g., Miller and Narayanan 2008).

Grazing effects on herbaceous fuels and fire behavior vary by site and situation (Launchbaugh et al. 2008). The size of the area to be treated, the types of fuels modified, and other management goals and objectives all impact effectiveness of livestock grazing fuel treatments (McAdoo et al. 2007). Results are dependent on the vegetation community, type and amount of livestock, and fire weather conditions (McAdoo et al. 2007, Strand et al. 2008, BLM 2010b).

Some research suggests that livestock grazing is an effective tool for fuels management (e.g., Davies et al. 2010), while other research suggests that grazing promotes wildfire because it promotes invasive annual grasses (Pickford 1932, Knapp 1996). The establishment and expansion of cheatgrass are affected by fire and grazing. The response of cheatgrass to grazing varies with the timing and intensity of grazing in relation to plant phenology and the extent of cheatgrass present. Research in sagebrush steppe ecosystems shows that grazing can either promote or suppress cheatgrass depending on how and when grazing is applied (Strand et al. 2008).

The effectiveness of livestock grazing at reducing fire hazard is somewhat unpredictable because many fire-related variables on the landscape act largely independent of livestock grazing (McAdoo et al. 2007, Launchbaugh et al. 2008, Strand et al. 2008). The use of livestock as a tool to manipulate vegetation for fuel reduction objectives across hundreds of thousands of acres is a difficult challenge. The undesirable impacts of grazing at high enough levels to make a difference in fuel levels may adversely affect other resources. Some researchers feel that trying to attain landscape-scale fuel reduction using livestock grazing is unrealistic (McAdoo et al. 2007).

Other researchers suggest that opportunities to reduce burned area at the landscape scale with managed livestock grazing exist in areas dominated by herbaceous vegetation relative to shrubs (e.g., sagebrush) under low to moderate fire weather conditions (Figure 5-1; Strand et al. 2008, BLM 2010b). In areas with high shrub cover, livestock grazing by cattle is less effective for fuels management; however, fall grazing by sheep or goats can reduce shrub biomass. The combined effects of grazing under conditions of moderate fire weather could lead to fires that burn at lower intensity, with increased patchiness, decreased rate of spread, and improved survival of plants after fire. However, under severe fire weather, the potential for livestock grazing to affect fire behavior is likely limited (Strand et al. 2008).

Managed livestock grazing can be effective for establishing and/or maintaining fuel breaks or green strips (BLM 2010b). Appropriate grazing strategies will vary by plant community and fuel management objectives.

Murphy Fire Complex investigation. One of the most in-depth investigations of livestock grazing's effects on wildfire took place after the Murphy Fire in 2007 burned 650,000 acres of rangeland in southern Idaho. A team of researchers from federal and state agencies and academic institutions investigated the interactions between vegetation type, wildfire behavior, and livestock grazing (Launchbaugh et al. 2008).

The team used on-site observation, fire behavior modeling, and remote sensing to evaluate the effects of livestock grazing had on vegetation and how Murphy Fire Complex was affected by pre-fire grazing. Observations of pre-burn vegetation conditions, levels of grazing use, and on-site observations of fire behavior by livestock operators in the Murphy Fire

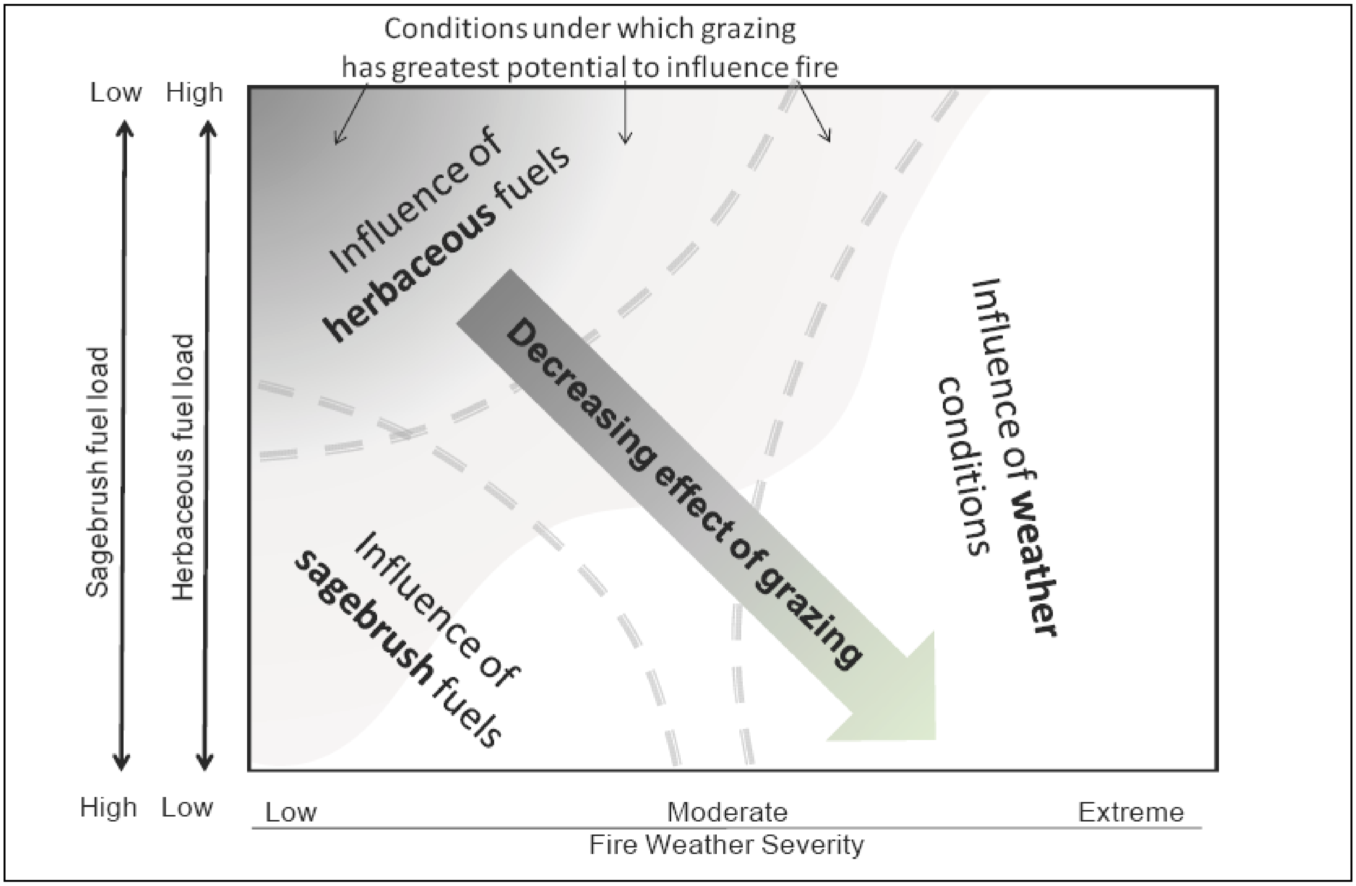

Figure 5-1. The potential for grazing to influence fire behavior occurs along continuums of fuel and weather conditions. In this conceptual model, fuel consumptions is displayed on the y-axis and severity in fire weather is displayed on the x-axis. Low fire weather severity values are characterized by high fuel moistures, high relative humidity, low temperature, and low wind speeds, while high fire severity weather is characterized by the opposite. The potential for grazing to be effective in reducing the risk of fire initiation and spread is largest when the sagebrush cover is low and fire weather severity is low to moderate (Strand et al. 2008).

Complex area supported the possibility that livestock grazing resulted in a mosaic burn or observable fence-line contrasts that could be attributed to differences in vegetation utilization levels created by livestock grazing (Launchbaugh et al. 2008).

For the fire behavior modeling approach, the team used the BEHAVE Plus system (Andrews et al. 2003) to examine how varying the amounts of current-year and residual herbaceous biomass and fuel loads would affect fire behavior in sagebrush steppe and grasslands under various environmental and fuel-moisture conditions. The modeling results indicated that under the extreme conditions that characterized most of the Murphy Fire Complex, grazing levels probably had little effect on fire behavior over much of the area. Within the larger fire area, however, there were sites where less-extreme conditions occurred and grazing-induced reductions in herbaceous biomass were likely an important determinant of fire behavior. Under less-extreme fire weather conditions, reductions in herbaceous fuels resulting from livestock grazing may influence fire behavior, making a fire in these shrub and grassland plant communities easier to contain (Launchbaugh et al. 2008).

The team also used a recently developed technique to examine fire-induced changes to vegetation amount and structure by creating a variable called delta Normalized Burn Ratio (dNBR). Values for dNBR were calculated based on ratios of the difference between the pre-burn and post-burn reflectance in two spectral bands of Landsat Thematic Mapper satellite data at (30 meters-per-pixel resolution). The difference in the spectral reflectance before and after a fire for a specific piece of land (or, more specifically, a pixel in the image) indicated how much the fire changed vegetation and soil on that unit of land. A comparison of fuel consumption (that is, dNBR) across vegetation types supported a general conclusion that the plant community occurring on a site before a fire influences the amount of fuel consumed and the changes in plant community structure caused by the fire. These data confirmed well-known relations between vegetation type and level of fuel consumed. For example, less fuel was consumed on grasslands than on shrublands, and therefore burn severity was lower on grasslands. However, the team did not conduct an analysis of the relationship between grazing and dNBR because a complete data set characterizing the level of grazing was not available within the time frame of the project (Launchbaugh et al. 2008).

Summary

Fuel treatment effectiveness is difficult to assess for many reasons. Treatments are often only a part of an overall management strategy, effects may take a long time to appear, and numerous factors affecting wildfire are interrelated. Careful planning, high quality implementation using appropriate methods, and timely maintenance are likely to increase effectiveness regardless of methods chosen.

Chapter 6. What are the potential adverse impacts of fuel treatments on rangelands?

All land management actions involve risks of adverse impacts that diminish the beneficial effects of active management. Because of arid and extreme environmental conditions, rangelands can be particularly slow to recover from disturbances and adverse impacts of management actions. Understanding the potential for adverse impacts can help managers reduce them as fuel treatments are planned and implemented.

In general, fuel treatments can affect many rangeland ecosystem components, but the adverse impacts can be reduced by careful fuel treatment planning and implementation. For example, fuel treatments remove vegetation and can affect soil. Soil erosion from rain and wind may increase depending on the type of fuel treatment and local site conditions. Treatments can alter soil chemistry. Treatments that reduce organic matter cover can reduce the productivity of soils by reducing carbon and other nutrient inputs, and by reducing moisture-holding capacity. Erosion can result in the transport of organic matter and nutrients off site. Adverse effects can be reduced by re-establishing or maintaining some vegetation on the site and maintaining organic matter at the soil surface that buffers or reduces negative impacts (BLM 2007b, Bates et al. 2007).

Fuel treatments also can harm or kill soil microorganisms. Mechanical and manual treatments can disturb soil, exposing soil organisms to desiccation and predation. Some herbicides are toxic to soil organisms. Treatments also can disturb biological soil crusts. The extent of effects depends on the intensity and kind of disturbance and the amount of area covered by the fuel treatment. The duration of the effects varies, but biological soil crust recovery rates typically are much slower than the recovery of vegetation (BLM 2007b).

Fuel treatments that result in soil compaction also may contribute to a short-term reduction in water infiltration into soils in some areas. Removing vegetation can also reduce evapotranspiration, allowing more water to leach soluble nutrients from the soil (BLM 2007b). Although treatments can have short-term effects on soil condition and productivity, disturbance effects resulting from fuels treatments tend to be manageable so that they will be less severe than the effects from wildfires (BLM 2007b).

Fuel treatments also can affect both surface water and groundwater quality and quantity. For example, removal of vegetation can affect surface water by increasing surface runoff, promoting erosion and sedimentation, reducing shading and increasing water temperature, and limiting the amount of organic debris entering water bodies. Sediment increases turbidity and contributes to reduction in dissolved oxygen. Removal of vegetation also can temporarily affect water flows by altering the magnitude of low flows and the frequency and magnitude of peak flows, as compared to pre-treatment conditions (BLM 2007b).

Fuel treatments may indirectly create risks for some wildlife species that depend on the vegetation being removed. For example, sage grouse are sensitive to disturbances in sagebrush habitat (Connelly et al. 2000, 2004).

Perhaps the risk of most concern with fuel treatments is that of detrimental invasive plants replacing native plants after fuels are treated. Careful planning and implementation of fuel treatments are required to avoid the spread of invasive plant species after fuel treatments (Brooks and Pyke 2001, BLM 2007b, Eiswerth et al. 2009).

Mechanical treatment impacts

Mechanical treatments impact ecosystem components as discussed above for fuel treatments in general. For example, chaining causes soil disturbance, but plant debris can be left in place to minimize runoff and erosion, shade the soil surface, and maintain soil moisture and nutrient recycling (BLM 2007b).

In addition, mechanical treatments may reduce air quality by creating dust and combustion engine exhaust. However, these effects are small in scale, temporary, and quickly dispersed throughout the treatment area. Practices to minimize emissions associated with the use of mechanical treatment methods include maintaining equipment in optimal working order, conducting treatment activities during wetter seasons (to minimize fugitive dust production), using heavy equipment under soil moisture conditions that will reduce erosion, reduce vehicle speeds on unpaved roads, and reduce dust impacts to the extent practical. These practices can improve air quality over both the short and long term (BLM 2007b).

Mechanical treatments also may increase risk of wildfire ignition during treatment. For example, if mowing is done when grasses are dry, a mowing blade can strike a rock and spark a fire. Mowing when grasses are greener can reduce this risk (Nader et al. 2007).

Manual treatment

Manual treatments can affect worker safety because of the sharp tools and the difficulties associated with working conditions (e.g., steep terrain with slippery ground cover). Some weeds may contain potentially toxic or hazardous compounds that can increase the risks of illness for workers (BLM 2007b).

Risks of herbicides

Herbicide fuel treatments do not impact soil as do mechanical and manual treatments because the soil is not disturbed. However, herbicide use may adversely impact water and aquatic organisms if toxic levels are reached. Herbicide use also may lead to short-term increases in fuel flammability because dead vegetation remains on site (Nader et al. 2007). The impacts of herbicide use can be reduced by appropriate application.

Prescribed burning impacts

Prescribed burning has impacts similar to other fuel treatments methods, including increased runoff and erosion (Moffet et al. 2007), increased erosion by wind (Sankey et al. 2009), and reduced site productivity due to effects on nutrient cycling and availability (Bates et al. 2007). Prescribed burning also can impact wildlife populations. For example, fire has been shown to negatively affect avian populations on rangelands (Earnst et al. 2009), so the timing of prescribed fire treatments is important to reduce negative effects on birds.

Prescribed burning comes with the possibility of the fire getting out of control and damaging property and endangering human life. Other treatment methods may be more appropriate near human communities or recreation areas (BLM 2007b).

Prescribed burning can negatively affect air quality primarily due to smoke. The total volume of smoke produced from a fire depends primarily on the amount of fuel consumed and the temperature of the burn. Factors influencing smoke production include fuel type, fire behavior, fuel moisture, particle size, particle arrangement, and fuel weight per unit area (Cook and O’Laughlin 2004, BLM 2007b).

Carefully planned and implemented prescribed fires result in less smoke effects to air quality than uncontrolled wildfires. The effects of smoke from prescribed fire, unlike those from wildfire, can be managed. Where effects of smoke from prescribed fire are of concern, fuel accumulations can be reduced by other treatment methods prior to, or in place of, prescribed burning. Smoke effects can also be reduced by implementing burns during optimal weather conditions, such as when the wind is blowing away from smoke-sensitive areas and during good dispersion conditions. Scheduling prescribed burns before new fuels accumulate can reduce the amount of emissions produced. Fire managers can also reduce the amount of area burned, increase the combustion efficiency of a burn, and increase the plume height in order to reduce smoke effects to air quality (BLM 2007b).

Prescribed burning may result in more variation than other types of treatment (e.g., Seefeldt et al. 2007). The burn may be hotter or cooler than planned, and the results are not as predictable as with some other types of treatment.

Land managers also must be cautious when using prescribed burning because it may promote the establishment of other fire-tolerant invasive species (Brooks and Pyke 2001, BLM 2007b, Nader et al. 2007). For example, low-elevation sagebrush can be replaced post fire by cheatgrass (Nader et al. 2007). Predicting a plant species reaction to prescribed burning requires information on a plant's life history, location of perennating buds relative to lethal fire temperatures, and seed dispersal and longevity (BLM 2007b). The period immediately following a prescribed burn is also a window of opportunity for breaking the fire–invasion–fire cycle by seeding species less prone to burn, but is not guaranteed to be successful (Hilty et al. 2004, Eiswerth et al. 2009).

Livestock grazing impacts

Fuel treatments using livestock grazing share many of the same potential adverse impacts as other types of fuel treatments. Any grazing plan designed for fuel reduction needs to consider the grazing impacts on parameters other than just simply fuels reduction (Nader et al. 2007).

Domestic animal grazing can affect water quality depending on the intensity and duration of grazing and the location of the treatment site relative to a given water body. Domestic animals can affect surface runoff as a function of trampling, soil disturbance, and soil compaction. Caution is necessary whenever grazing is prescribed near riparian areas, in steep topography, or in areas with highly erodible soils. Livestock grazing near aquatic systems also can affect water quality as a function of nutrient loading (e.g., nitrogen and phosphorous) and increase in bacterial and fecal coliforms (BLM 2007b).

Grazing animals can generate odors and dust, but these emissions are usually minor, localized, and short term in duration. Odors and dust associated with grazing animals can be reduced by limiting the density of animals confined to an area (BLM 2007b).

The potential for unwanted or invasive plant species is prevalent with livestock grazing fuel treatments (Popay and Field 1996, McAdoo et al. 2007). Grazing animals themselves can stimulate a shift from grassland to woody species by overgrazing or by selectively grazing some pasture species and avoiding others. Animals grazing rangelands can influence plant species either directly by eating or damaging them, or indirectly by conditioning soil and other site factors to create conditions more prone to invasive plant invasion. In addition, plant seeds may still be viable after passing through the digestive tract of animals or can travel on the animal's fur (BLM 2007b). Restricting grazing to only one type of stock (e.g., cattle) leads to a particular unwanted species problem because some plants are less palatable than others. Introducing a different type of stock can help to control species which have become predominant. Grazing timing and duration are often key to controlling invasive species (Popay and Field 1996, BLM 2007b).

Despite potential adverse impacts, fuel treatments using livestock grazing may produce some benefits not associated with other types of fuel treatments. For example, grazing may have lower direct costs than other types of fuel treatments, and livestock convert fuels into animal protein that has economic value (Popay and Field 1996).

Social acceptability

In addition to the environmental impacts of fuel treatments, public acceptance of fuels treatments also needs consideration and may vary geographically as well as by the type of fuel treatment being proposed (Brunson and Shindler 2004, Shindler et al. 2011). People perceive risks and benefits differently (Cheng and Becker 2005). Understanding the social dimensions of fuels management is important.

Summary

The potential adverse impacts to rangeland ecosystem components from fuel treatments include soil erosion and loss of productivity, reduced water quality, disturbance of wildlife species habitats, and invasive species. In addition, prescribed burning adversely impacts air quality. Careful implementation using treatments appropriate to each site can reduce adverse impacts.

Chapter 7. What policies currently guide the implementation of fuel treatments on Idaho's rangelands?

Policies guiding rangeland management and the implementation of fuel treatments in Idaho vary depending on who owns and manages the rangelands. In Idaho, about 66% of all rangelands are publicly owned and managed by one of two federal agencies, the U.S. Forest Service (USFS) and the U.S. Bureau of Land Management (BLM). Most other publicly owned rangelands are managed by the state of Idaho through the Idaho Department of Lands (IDL). About one third of Idaho's rangelands are owned by private individuals, families, and American Indian tribes (Figure 7-1; UI CNR 2010). The focus of this report is publicly managed rangelands; therefore, our focus is on the policies of the BLM, USFS, and IDL.

Federal agencies

Bureau of Land Management (BLM). About 23% of Idaho's rangelands are managed by the BLM under the authority of the Taylor Grazing Act (43 USC 315-315(o)). The BLM is responsible for the protection, administration, regulation, and improvement of grazing districts on federal public lands administered by the agency and must protect the land and its resources from destruction or unnecessary injury.

The Federal Land Policy and Management Act of 1976 (FLPMA; 43 USC 1701-1782) outlines the functions of the BLM, provides for administration of BLM public lands, provides for management of BLM public lands on a multiple-use and sustained-yield basis, and requires land-use planning, including public involvement, and a continuing inventory of resources (BLM 2010a). BLM public lands are to be managed in a manner that will protect the quality of numerous environmental values and provide food and habitat for fish and wildlife and domestic animals. Land-use plans required by FLPMA must comply with state and federal air and water pollution standards and plans, which may affect the implementation of some types of fuel treatments.

Under FLPMA, standards and guidelines for managing rangelands must be consistent with the following fundamentals of rangeland health, as described in BLM regulations:

(a) Watersheds are in, or are making significant progress toward, properly functioning physical condition;

(b) Ecological processes, including the hydrologic cycle, nutrient cycle, and energy flow, are maintained, or there is significant progress toward their attainment;

(c) Water quality complies with state water quality standards and achieves, or is making significant progress toward achieving, established BLM management objectives such as meeting wildlife needs;

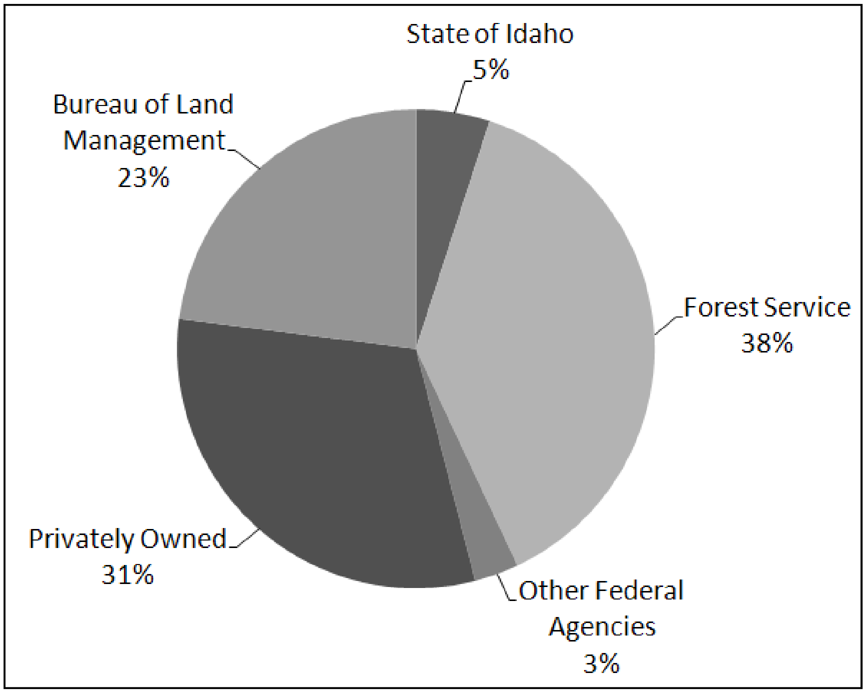

Figure 7-1. Rangeland ownership in Idaho (UI CNR 2010).

(d) Habitats are, or are making significant progress toward being, restored or maintained for federal threatened and endangered species, federal proposed or candidate threatened and endangered species, and other special status species (43 CFR 4180.1).

BLM state directors are responsible for developing state or regional rangeland health standards in consultation with Resource Advisory Councils (BLM 2001). The only mention of fuel treatments or wildfire in Idaho's rangeland health standards and guidelines for grazing management is to include the use of "grazing management practices, where feasible, for wildfire control and to reduce the spread of targeted undesirable plants (e.g., cheatgrass, medusa head, wildrye, and noxious weeds) while enhancing vigor and abundance of desirable native or seeded species" (BLM 1997).

Under FLPMA regulations, when BLM determines that vegetation, soil, or other resources on public lands are at substantial risk of wildfire due to drought, fuels buildup, or other reasons, the BLM may undertake fuels reduction or treatment projects using prescribed burning or mechanical, chemical, or biological thinning methods (43 CFR 4190.1). The "biological thinning" method could include grazing.

BLM's efforts to reduce the risk of wildfire are primarily the responsibility of the Wildland Fire Management program, which is part of BLM's programmatic implementation of "land health" standards (BLM 2007b). The program provides technical assistance and policy guidance for implementing land health standards related to fuel load management. The BLM recognizes that fire has a role in the natural ecological process (BLM 2009a). The BLM's

Wildland Fire Management program is guided by national-level policies (see Federal Wildland Fire Policy section below).

U.S. Forest Service. The National Forest Management Act (NFMA) is the primary law under which the U.S. Forest Service (USFS) manages its rangelands. NFMA requires that national forests develop land and resource management plans, and rangelands must be managed in accordance with those plans (36 CFR 222.2). NFMA regulations allow the USFS to install and maintain structural and nonstructural range improvements needed to manage its rangelands (36 CFR 222).

In general, USFS rangelands fuels treatments could fall under range improvements. "Range improvement'' means any activity or program on or relating to rangelands which is designed to improve production of forage; change vegetative composition; control patterns of use; provide water; stabilize soil and water conditions; and provide habitat for livestock and wildlife. The term includes, but is not limited to, structures, treatment projects, and use of mechanical means to accomplish the desired results" (43 USC 1902).

USFS managers can use cultural, mechanical, biological, chemical, or prescribed fire to eliminate, reduce, perpetuate, or otherwise alter vegetation composition and density. Managers are to use methods in the combinations that most effectively achieve objectives as established through resource planning processes (FSM 2243.34). Range improvement specifications must consider cost effectiveness and state-of-the-art technology (FSM 2243.03).

USFS managers integrate fuel management and fire management programs in support of resource management objectives provided in NFMA land and resource management plans (FSM 5150.3, FSM 5152). Fuel treatments are to be prioritized in the NFMA plan and initiated in accordance with the plan and its attendant fire management action plan.

USFS managers are required to use economic analysis in the decision process for evaluating proposed fuel treatment programs and activities (FSH 5109.19), and for selecting the practices used to perform fuel treatment. The objective of USFS fuels management is to identify, develop, and maintain fuel profiles that contribute to the most cost-efficient fire protection and use program in support of land and resource management direction in the NFMA plan (FSM 5150.2).

Federal wildland fire policy

Federal wildland fire policy has been described as unclear and inconsistent (Keiter 2006), a complex patchwork (Wishnie 2008), and bipolar (Dellasalla et al. 2004). To outline its application to rangeland fuel treatments is challenging, especially because at this writing a

National Cohesive Wildland Fire Management Strategy is being developed to meet the requirements of the Federal Land Assistance, Management and Enhancement Act of 2009 (FLAME Act).

The wildland fire policies of the federal land management agencies have been evolving over the past 15 years. Most of the first-generation land/resource management plans required by FLPMA and NFMA did not address wildfire or fire control; however, current plans routinely integrate fire management goals and standards, including restoring fire-adapted ecosystems (Keiter 2006). Federal land managers are required to prepare fire management plans that are tiered to land/resource management plans and establish explicit operational guidelines for managing wildland fires (USDI and USDA 2010).

The first comprehensive statement of wildland fire policy coordinated between the Departments of the Interior (i.e., BLM) and Agriculture (i.e., USFS) was adopted in 1995 in response to 1994's severe fire season that resulted in the deaths of 34 wildland firefighters across the U.S. (USDA and USDI 1995). The policy recognized that fire is a natural part of many ecosystems, that hazardous fuels build-up was an increasing problem on many wildlands, and that fuels treatments were needed in many areas.

National Fire Plan. Several severe fire seasons in the early 2000s resulted in a series of reports and plans designed to further improve federal fire management planning and coordination (Keiter 2006). In 2000, the President asked the Secretaries of the Departments of Interior and Agriculture to prepare a report on how best to respond to the severe fires, reduce the impacts of wildland fires on rural communities, and ensure sufficient firefighting resources in the future. The resulting report became known as the "national fire plan" (USDA and USDI 2000). Many of the national fire plan's recommendations were about reducing hazardous fuel accumulations and increasing the amount of hazardous fuel reduction treatments, particularly on lands at the wildland-urban interface (WUI).

Congress later supported the national fire plan through language in the FY2001 Interior and Related Agencies Appropriations Act (P.L. 106-291) and other written direction. Congress mandated several reporting requirements including the creation of a coordinated, national 10-year comprehensive strategy (USDA and USDI 2001b). Congress called on the federal agencies to work collaboratively and cooperatively with states in the development of the strategy and as full partners in planning, decision making, and implementation. The federal agencies, state governors, and other partners released the strategy in August 2001 (USDA and USDI 2001b) and subsequently approved the implementation plan for the strategy in

May 2002 (USDA et al. 2002). (The implementation plan was subsequently updated in 2006 (USDA et al. 2006)).

Two of the goals of the 10-year strategy were to reduce hazardous fuels and restore fire adapted ecosystems (USDA and USDI 2001b). Implementation actions for hazardous fuels reduction included:

- Reduce the total number of acres at risk to severe wildland fire;
- Ensure communities most at risk in the wildland-urban interface receive priority for hazardous fuels treatment;
- Expand and improve integration of the hazardous fuels management program to reduce severe wildland fires to protect communities and the environment;
- Incorporate public health and environmental quality considerations in fire management activities undertaken for the hazardous fuels management program;
- Develop smoke management plans in conjunction with prescribed fire planning and implementation;
- Develop strategies to address fire-prone ecosystem problems that augment fire risk or threaten sustainability of these areas;
- Assure maintenance of areas improved by fuels treatment by managing activities permitted on the restored lands to maintain their resiliency;
- Conduct and utilize research to support the reduction of hazardous fuels in wildland urban interface communities and environments; and
- Ensure local environmental conditions are factored into hazardous fuels treatment planning (USDA et al. 2002).

Healthy Forest Initiative (HFI) and Healthy Forest Restoration Act (HFRA). In 2001, President George W. Bush introduced a series of administrative reforms to assist the federal agencies in more effectively dealing with hazardous fuels. This series of reforms became known as the Healthy Forest Initiative (HFI). Its provisions applied to federally managed forests and rangelands. HFI included new "categorical exclusions" that allowed certain fuel treatment projects to proceed in full compliance with NEPA, but without lengthy environmental documentation, and new guidance on conducting environmental assessments for fuel reduction projects and restoring fire-adapted ecosystems (USDA-FS and BLM 2004).

In 2003, Congress enacted the Healthy Forest Restoration Act (HFRA; P.L. 108-148; 16 U.S.C. 6501 et seq.). Despite its name, HFRA applies to federally managed rangelands as well. HFRA was enacted "to reduce wildfire risk to communities, municipal water supplies, and other at-risk Federal land through a collaborative process of planning, prioritizing, and implementing hazardous fuel reduction projects."

HFRA authorizes the BLM and USFS to conduct hazardous fuel reduction projects on federal lands in WUI areas and on certain other federal lands using expedited procedures (BLM 2010a). HFRA speeds up the approval process for hazardous fuel reduction projects by establishing a "predecisional administrative review," which is the sole means by which administrative review of a proposed authorized hazardous fuel reduction project may be sought (73 FR 53712). Only individuals and organizations who have submitted specific written comments during the opportunity for public comment provided during preparation of a NEPA environmental assessment or environmental impact statement for the proposed authorized hazardous fuel reduction project may file an objection. In addition, HFRA restricts judicial review of hazardous fuel reduction projects to those issues raised by the plaintiff's submission during the objection process.

HFRA has resulted in numerous hazardous fuels projects have been implemented in Idaho and across the U.S. However, HFRA has also been criticized on numerous fronts including: reliance on vague and indeterminate collaborative approaches, lack of direction for evaluating tradeoffs between projects, few community planning requirements, no links between agency plans and community plans, and little guidance on how to measure progress (Colburn 2008).

As a result of HFI and HFRA, the USFS and BLM were able to use NEPA categorical exclusions for hazardous fuels reduction activities using prescribed fire that did not to exceed 4,500 acres, and mechanical methods for crushing, piling, thinning, pruning, cutting, chipping, mulching, and mowing, not to exceed 1,000 acres, provided that: the areas were in the WUI or Fire Regime Condition Classes 2 or 3 outside the WUI; were identified through a collaborative framework as described in *A Collaborative Approach for Reducing Wildland Fire Risks to Communities and the Environment 10-Year Comprehensive Strategy Implementation Plan* (USDA et al. 2002); were not conducted in wilderness areas or did impair the suitability of wilderness study areas for preservation as wilderness; did not include the use of herbicides or pesticides or the construction of new permanent roads or other new permanent infrastructure; but were allowed to include the sale of vegetative material if the primary purpose of the activity is hazardous fuels reduction (68 FR 33814). However, as a result of a legal settlement (Western Watersheds Project (WWP) v. Lane, No. 07-cv-394-BLW), the BLM discontinued use of the HFI/HFRA categorical exclusions in August 2009 (BLM 2009c).

HFI and HFRA were in part a result of the federal land management agencies reviewing the 1995 wildland fire policy (USDA and USDI 1995) in the early 2000s. The *Review and Update of the 1995 Federal Wildland Fire Management Policy* (USDA and USDI 2001a) re-emphasized the need for fuels treatment on many federal lands, but cautioned that implementation of fuels reduction strategies was hampered by limited resources. HFI and HFRA provided more resources.

2009 Guidance for Implementation of Federal Wildland Fire Management Policy. In 2003, the federal agencies published a strategy for implementing the updated wildland fire management policy (USDA and USDI 2003). That implementation policy was updated with the *Guidance for Implementation of Federal Wildland Fire Management Policy* (USDA and USDI 2009). The guidance provides the philosophy, direction, and implementation of fire management planning, activities and projects on federal lands (USDI and USDA 2010) and is intended to "be used to provide consistent implementation of federal wildland fire policy."

BLM directed their state offices to adopt the 2009 *Guidance for Implementation of Federal Wildland Fire Management Policy* with some caveats, including: that a risk-free work environment is not a reasonable or achievable goal in fire operations, and that fire managers are expected to determine the acceptable level of risk; if land use plans and fire management plans do not clearly outline areas where and/or circumstances when wildfire would meet resource objectives the only option is to suppress the fire; all known human caused fires, except escaped prescribed fires, will be suppressed in every instance and will not be managed for resource benefits (BLM 2009b).

Federal Land Assistance, Management, and Enhancement (FLAME) Act of 2009. In late 2009 the Federal Land Assistance, Management, and Enhancement Act (FLAME) was passed (P.L. 111-88). The act required that the federal land management agencies submit a cohesive wildfire management strategy to Congress no later than one year after the bill's passage. Elements of the strategy were to include:

- identifying the most cost-effective means for allocating fire management budget resources;
- providing for reinvestment in non-fire programs by the Secretary of the Interior and the Secretary of Agriculture;
- employing appropriate management response to wildfires;
- assessing the level of risk to communities;
- allocating hazardous fuels reduction funds based on the priority of hazardous fuels reduction projects;

- assessing the impacts of climate change on the frequency and severity of wildfire; and
- studying the effects of invasive species on wildfire risk.

The strategy is to be updated at least once every five years.

The cohesive strategy required by FLAME is being developed by the Wildland Fire Leadership Council (WFLC). The WFLC is an intergovernmental committee of federal, state, tribal, county, and municipal government officials established by the Secretaries of Agriculture and the Interior in 2002 to support the implementation and coordination of federal fire management policy (WFLC 2010).

In March 2011, the WFLC released two documents: A National Cohesive Wildland Fire Management Strategy (WFLC 2011a) and The Federal Land Assistance, Management and Enhancement Act of 2009 Report to Congress (WFLC 2011b). The documents provide the framework for a three-phase, strategic effort to restore and maintain resilient landscapes, create fire-adapted communities, and respond to wildfires. The creation of the two documents is considered phase one and serves as the foundation for the remaining phases. Development of regional strategies is the next phase, and a national trade-off analysis is the final phase (WFLC 2011a). The documents broadly define wildfire management challenges, lay out some guiding principles and core values, provide some general national goals and performance measures, and address some governance issues related to the strategy, but most details of a cohesive wildfire management strategy are left to future phases.

Hazardous fuels reduction programs. The hazardous fuels reduction (HFR) programs within BLM and USFS have the purpose of reducing hazardous fuels and risks to human communities while improving the health of the land. To ensure these programs are coordinated, common priorities for fuel treatments have been established, although some programmatic differences are identified and serve as agency specific direction. Policy, planning, and implementation priorities and standards common to all USFS and BLM HFR programs are:

- The safety of firefighters and the public is the number one priority when planning and implementing HFR treatment projects;
- All HFR treatment projects will have plans that contain measurable objectives;
- All HFR treatment projects will comply with NEPA and all other regulatory requirements;
- All HFR management projects will be tracked and progress will be reported within required timeframes;

- All HFR treatment projects will be monitored to determine if treatment objectives were met and to document weather, fire behavior, fuels information and smoke dispersion; and
- All HF treatment projects will support resource management objectives as identified in their agency-specific land use plans (USDI and USDA 2010).

Prescribed burning. The BLM and the USFS operate under the same policy for implementation of prescribed burning, *Interagency Prescribed Fire Planning and Implementation Procedures Guide* (USDA and USDI 2008). The prescribed fire program goals for the federal agencies are to:

- Provide for firefighter and public safety as the first priority;
- Ensure that risk management is incorporated into all prescribed fire planning and implementation;
- Use prescribed fire in a safe, carefully planned, and cost-efficient manner;
- Reduce wildfire risk to communities, municipal watersheds and other values and to benefit, protect, maintain, sustain, and enhance natural and cultural resources; and
- Utilize prescribed fire to restore natural ecological processes and functions, and to achieve land management objectives (USDA and USDI 2008).

Federal agencies also are allowed to use "wildland fire use" or fires with unplanned ignitions, provided that they meet prescribed management objectives in the land/resource management plans and associate fire management plans.

State policies

Similar to the situation with federal policies, state of Idaho policies that potentially are related to fuel treatment projects on rangelands are spread across a variety of statutes and the responsibility of a variety of agencies. For example, if fuel treatments involve prescribed burning, they may involve the Idaho Department of Lands because of wildfire policy and the Idaho Department of Environmental Quality because of air quality policy. Livestock grazing treatments may involve the Idaho Department of Environmental Quality and the Idaho Soil and Water Conservation Commission because of water quality issues. Some fuel treatments may have impacts on wildlife, and their implementation cannot harm wildlife, whose management and protection is under the authority of the Idaho Fish and Game Commission (Idaho Code 36-102) and Idaho Department of Fish and Game.

Wildfire Protection. The Director of the Idaho Department of Lands (IDL) is required to organize fire response in the state to provide "adequate, effective and economical protection of forest and range lands" (Idaho Code §38-110). However, "range land" is restricted by definition to only non-forested land adjacent to or intermingled with forest land (Idaho Code §38-101 (b)). State statute declares uncontrolled wildfire a public nuisance and requires reasonable efforts to immediately suppress it (Idaho Code §38-107).

Unlike forest landowners in Idaho, owners of rangeland pay no fire protection assessment to the state even though a wildland fire agency (e.g, BLM, USFS, IDL) may respond to wildfires on their lands. Landowners also are not required by law to provide wildfire protection on their lands. Rangeland owners may attack wildfires on their lands, but are not required to do so unless they threaten forested land (IDL 2008). Since there is no legal requirement that wildfires on rangeland be suppressed, and because some local citizens in Idaho have not chosen to organize local fire districts, there are blocks of rangeland that have no organized wildland fire-fighting response (IDL 2008).

Wildfire Protection Planning. In 2000, Congress required every state and every community within a state to create a hazard mitigation plan as a condition of eligibility for emergency funding in the event of a federally declared disaster. Idaho complied with the state requirement by adopting a plan in 2002 and updating it in 2006 as the *Idaho Statewide Implementation Strategy for the National Fire Plan* (IDL 2006). The strategy creates a partnership between the state and the counties by: establishing the Idaho State Fire Plan Working Group (ISFPWG), emphasizing collaborative fire protection planning between the state and the counties, calling for the creation of County Wildfire Protection Plans (CWPP), and creating county wide collaborative groups made up of wildfire agencies, fire departments, emergency managers and other interested parties (IDL 2008).

The ISFPWG is a multi-agency collaborative body charged with assisting counties with their CWPPs and their associated countywide working groups, dissemination of information, and oversight and prioritization of grant assistance programs in order to facilitate the implementation of the national fire plan in Idaho. The ISFPWG focuses its efforts on the following activities:

- Collaboration between local, state, and federal partners;
- Prioritization of grant/financial assistance projects as requested by agencies;
- Alignment of hazardous fuels reduction work on non-federal and federal lands in order to more effectively reduce the risk of catastrophic wildfires at the wildland-urban interface;
- Integrate local, state, and federal program funds for the most effective outcomes; and
- Provide a scientific basis of decision making in the prioritization of hazardous fuels programs (ISFPWG 2010).

A CWPP is a document developed by an individual county that meets the intent of the federal requirement for a local hazard mitigation plan by identifying hazards and prioritizing treatments to reduce them. Federal agencies must consider priorities identified in the CWPP when developing fire management plans or when conducting hazardous fuels treatments (IDL 2008). The county-wide collaborative groups called for in the implementation strategy (IDL 2006) are responsible for updating and implementing the CWPPs. Every county in Idaho has completed a CWPP (IDL 2008). Each collaborative county working group annually submits to the ISFPWG a prioritized list of hazardous fuels projects to be conducted on non-federal lands to aid with the distribution of hazardous fuels reduction assistance funds on private lands and a prioritized list of hazardous fuels and restoration projects to be conducted by federal agencies on federal lands that helps better coordinate between projects performed on private and state or federal lands (IDL 2006).

Water Quality Policies. Rangeland fuel treatments that create potential adverse impacts to surface water quality, such as livestock grazing, mechanical treatments, and prescribed burning, are affected by water quality policies. Although the federal Clean Water Act (CWA) is the overarching law related to surface water quality, the CWA leaves much of the implementation of its requirements to the states (O'Laughlin 1996).

The CWA requires that states adopt water quality standards that identify designated uses for water bodies and provide water quality criteria based on those uses. In Idaho, the Department of Environmental Quality (IDEQ) has responsibility for assigning the designated uses, developing the water quality criteria, and determining if water bodies in the state meet the criteria to fully support the designated use. If a water body does not fully support its designate use, the state must develop a plan to bring the water body into compliance (O'Laughlin 1996, Mosley et al. 1997).

In Idaho, responsibility for developing and implementing the state's plan to address nonpoint source pollution from agricultural activities including livestock grazing is vested with both the IDEQ and the Idaho Soil and Water Conservation Commission (ISWCC). The *Idaho Agricultural Pollution Abatement Plan's* (IDEQ and ISCC 2003) mechanism for controlling nonpoint source pollution is the feedback loop process that evaluates the implementation and effectiveness of best management practices (BMPs) through follow-up monitoring and implementation adjustments. In Idaho, BMP implementation for livestock grazing is voluntary with a back-up regulatory program (IDAPA 58.01.02.350, Mosley et al. 1997, IDEQ and ISCC 2003).

Air Quality Policies. Air quality policies related to fuel treatments, particularly prescribed burning, and wildfires have been examined in depth in a previous PAG report (Cook and O'Laughlin 2004). The following summarizes that report.

The federal Clean Air Act is the basis for most air quality regulation nationwide. The U.S. Environmental Protection Agency (EPA) is the federal agency charged with implementing the Clean Air Act. Although the Clean Air Act is a federal law, the states are responsible for much of its implementation. States develop State Implementation Plans (SIPs) that define and describe customized programs that the state will implement to meet the requirements of the Clean Air Act. The state agency in Idaho responsible for implementing Clean Air Act provisions is the Idaho Department of Environmental Quality (IDEQ).

The EPA sets limits on how much pollution can be in the air through the National Ambient Air Quality Standards (NAAQS). NAAQS have been established for six air pollutants: particulate matter, sulfur dioxide, nitrogen dioxide, ozone, carbon monoxide, and lead. An area that IDEQ finds to be in violation of a NAAQS may be designated as a nonattainment area by the EPA. Nonattainment status has numerous implications for an area, including increased controls and limitations on the sources and amounts of emissions allowed.

Particulate matter (PM10 and PM2.5) is the primary pollutant of concern in smoke, whether from prescribed fires or wildland fires. Most of the particulate matter in smoke is PM2.5.

EPA policies that regulate particulate matter treat smoke from prescribed fire differently than wildland fire smoke. The EPA does not count violations of the particulate matter NAAQS that are caused by natural events toward nonattainment designation if a state can document that a violation was caused by a natural event and if the state then prepares a Natural Events Action Plan (NEAP) to address human health concerns during future events. Wildland fires are considered natural events, but prescribed fires are not.

Particulate matter NAAQS violations caused by prescribed fires are addressed through the EPA's Interim Air Quality Policy on Wildland and Prescribed Fires (EPA 1998). Under this policy, the EPA exercises its discretion not to designate a nonattainment area if the evidence is convincing that prescribed fires caused or significantly contributed to violations of the particulate matter NAAQS, and provided that the state develops and implements a smoke management program (SMP). An SMP works toward protecting public health and welfare by mitigating the impacts of air pollutant emissions on air quality and visibility.

Idaho has both a NEAP and an SMP. Idaho's statewide NEAP was prepared in 2002, following violation of the PM10 NAAQS in Salmon, Idaho, during wildland fire events in 2000

(IDEQ 2002). Idaho's SMP was created and is administered jointly with the state of Montana by the Montana/Idaho Airshed Group (2010). The group is comprised of member organizations that conduct a large amount of prescribed burning and regulatory and health agencies that regulate this burning in the states of Idaho and Montana. The intent of the Montana/Idaho Smoke Management Program is to minimize or prevent smoke impacts while using fire to accomplish land management objectives. The SMP identifies the responsibilities of Montana and Idaho air regulatory agencies, federal, state, tribal, and private land managers as well as provides accurate and reliable guidance to the individuals conducting prescribed fires. In Idaho, land manager participation in the SMP is entirely voluntary.

Other Idaho policies that address air quality and prescribed burning include IDEQ's Air Pollution Emergency Rule that regulates activities when air pollution levels are high enough to cause a health emergency (IDAPA 58.01.01.550-562) and IDEQ's opening burning rule that regulates the types of materials that can be burned in the open (IDAPA 58.01.01.600). Prescribed burning is allowed provided it meet the following conditions (IDAPA 58.01.01.614):

- If a burning permit or prescribed fire permit is required by the IDL, USFS, or any other state or federal agency responsible for land management, the burner must meet all permit and/or plan conditions and terms which control smoke; or
- If permits from these other agencies are not required, burners must meet conditions in the Montana/Idaho Smoke Management Program. However, participation in the smoke management program is voluntary (Cook and O'Laughlin 2004).

IDL is responsible for the control and management of fire on private forest lands in Idaho, including "range lands" that are adjacent to forest lands, and requires permits for all open burning during the fire season (May 10 to October 20). IDL requires that burning be conducted in accordance with IDEQ's open burning rule.

Summary

Most of Idaho's rangelands are managed by one of two federal agencies: the Bureau of Land Management or the U.S. Forest Service. There is not a single, overarching federal law that guides fuels treatment implementation on federal rangelands, but rather numerous laws, regulations, and other policy documents. In addition to land use planning laws and regulations, laws protecting air and water quality play important roles for some fuel treatment methods. States are responsible for implementing many requirements of federal clean air and water statutes, and states have primary responsibility for laws that protect state and private rangelands from wildfire.

Chapter 8. What policy options might improve fuel treatment effectiveness on Idaho's rangelands?

Fuel treatments will never completely prevent rangeland wildfires because fire is a natural part of many rangeland ecosystems. The goal of fuel treatments on rangelands is not prevention but rather moderation so that fire frequency, severity and extent are within manageable parameters set by land managers. The effectiveness of fuel treatments can be improved by better understanding of the rangeland systems in which fires occur, the roles fire plays in maintaining those systems, and policies that stress coordination and cooperation between various rangeland management agencies.

Research needs

There is a lack of scientific research available to help land managers understand and manage the many variables that influence the outcomes of rangeland fuel treatments (Nader et al. 2007). For example, federal land management agencies have developed a geospatial data and modeling system, called LANDFIRE, to map wildfire hazards with greater precision and uniformity (GAO 2005a). Continuing development of wildfire hazard models, such as LANDFIRE, will permit better identification of the nature and magnitude of wildfire risks confronting different community and ecosystem resources. There also is a need for improved models of fire spread behavior for many rangeland vegetation types (Wilford et al. 2008, USDI and USDA 2010) and in the WUI, or wildland-urban interface (GAO 2005b).

The potential adverse effects of fuel treatments also need more study. For example, better information is needed for developing models that predict erosion following the use of prescribed burning (Moffett et al. 2007).

More information is needed about specific types of fuel treatments, particularly livestock grazing. Much of the literature about the use of livestock grazing as a fuels treatment method is anecdotal (Davison 1996). More research is needed on animal vegetation preference in order to direct the timing and intensity of grazing to reach fuels management objectives while maintaining desired site conditions. Also, seasonal variations in nutritional content of vegetation, particularly shrubs, need to be further defined (Nader et al. 2007). Research studies that examine effects of livestock grazing fuel treatments over a number of years are also needed. Treatments, particularly in shrub-dominated vegetation, often require several years to create and maintain a fuel profile (Nader et al. 2007). More information is needed on the long-term effects of livestock grazing fuel treatments (Nader et al. 2007, Epanchin-Niell et al. 2009). Monitoring of fuel treatments needs to receive high priority (JFSP 2008), and more research is needed on adaptive management for livestock grazing fuel treatments based on monitoring results (Davison 1996).

The effectiveness of rangeland fuel treatments at larger scales also needs more research. Better information is needed about how to place fuel treatments across the landscape to effectively manage wildfire (GAO 2005b, Miller and Narayanan 2008).

Fuel treatments often take place within the context of rangeland restoration, and knowledge about which restoration strategies are effective on rangelands is lacking (Brooks 2008, JFSP 2008). For example, the lack of information about seed bank longevity sometimes leads to conflicting management recommendations for controlling invasive weeds (DiTomaso 2000). Research programs such as SageSTEP (2010) that determine the most effective treatment or combination of treatments for restoring functioning sagebrush ecosystems that are resilient to disturbance and resistant to invasive species such as cheatgrass help fill the information gaps (JFSP 2008, Bourne and Bunting 2011). It is also important to recognize that some sites may have reached a point where rehabilitation of native plant communities is not economically possible, and research is needed to develop fuel treatments that reduce wildfire effects on these altered sites (Miller and Narayanan 2008).

Changes to federal policies

Although federal, state, and local agencies cooperate in wildland fire management efforts, more cooperation and policy coordination might improve wildland fire management effectiveness (Keiter 2006, Wishnie 2008). Cooperation between public and private rangeland owners is also necessary. Coordination and cooperation are essential, particularly given increasing costs and smaller work forces that require public agencies to pool their human resources in order to successfully deal with the ever-increasing and more complex fire management tasks (USDI and USDA 2010). An ongoing objective of the federal agencies is standardization of policies and procedures for effectiveness of fire and fuels management activities (USDI and USDA 2010).

Although National Cohesive Wildland Fire Management Strategy is under development, there is no comprehensive federal policy or overarching law addressing wildfire or fuels management (Franklin and Agee 2003, Jensen 2006, Keiter 2006.) Instead, a series of disconnected and sometimes contradictory policies add complexity to fire and fuels management implementation. Policy researchers suggest that unnecessarily complex and confusing policies tend to discourage public involvement in the decision-making process and lead to less effectiveness (Jensen 2006). A cohesive and comprehensive federal fire policy would consider all aspects of wildfire management, not just fuels and fire suppression. The policy would deal with long-term management of fuels and wildfire and consider the full range of ecological and social values, including issues related to rangeland health and the well-being of communities and people (Franklin and Agee 2003).

Federal land managers currently have strong incentives to focus on fire control rather than fire prevention (Wishnie 2008). Federal wildfire management policies recognize the ecological need to reintroduce fire into rangeland ecosystem processes, but managers are reluctant to accept the risk associated with allowing fires, wild or prescribed, to burn (Dellasala et al. 2004). Numerous commentators have argued that agency practices should accept some risk in the near term by allowing wildfires to burn within certain prescriptions of less severe weather, under the assumption that the future likelihood of larger and more intense wildfires, with their higher associated risks, will be reduced (Dellasala et al. 2004). Risks and uncertainties related to fire management activities must be understood, analyzed, communicated and managed as they relate to the cost of either doing or not doing an activity. Net gains in public benefits will be an important component of decisions (USDI and USDA 2010). One way to possibly encourage more use of managed fire is to restructure funding away from suppression (Wishnie 2008).

Accountability within the existing policy framework also needs improvement (Colburn 2008). For example, documentation and accounting for HFI and HFRA projects and results have been confusing and weak (Evans and McKinley 2007). Additionally, although federal policies, including the national fire plan, stipulate that WUI fuel treatment areas be prioritized, on the ground implementation has shown that the majority of treatments are not in or near WUI areas (Schoennagel et al. 2009).

The effects of National Environmental Policy Act (NEPA) processes on land management decisions have been addressed by numerous commentators. As in other land management policy arenas, NEPA's procedural requirements are sometimes cumbersome, less than straightforward, and do not always ensure that environmental considerations will be integrated into final fuels management project decisions (Keiter 2006). For example, under current NEPA regulations if the BLM has a cooperative agreement with a state agency to fund fuel reduction projects on private or state lands and the cooperative agreement describes the criteria to select the projects but leaves the specifics of project selection to the state agency, then NEPA is not triggered. On the other hand, if the BLM is making a decision to fund or not fund a specific project on lands not administered by the BLM, then NEPA is triggered (BLM 2008).

The effort and workload for project planning and NEPA compliance for a small project are often the same as those required for a larger project (BLM 2008). Land managers may increase effectiveness by considering landscape scale or multi-year projects.

As part of HFI/HFRA, the BLM was granted authority to use NEPA categorical exclusions (CE) for fuels reduction projects meeting specific conditions. The BLM discontinued its use CE's for fuel treatment projects in 2009 as part of a lawsuit settlement (BLM 2009c). While the CE process may not have been optimal, more efficient and effective NEPA procedures would be helpful.

FLPMA requires that the BLM set rangeland health standards for all its lands. The BLM's current rangeland health standards and grazing management guidelines for Idaho (BLM 1997) barely mention wildfire and fuels. There is a need for more extensive and effective guidance on fuel treatments within the standards.

Adequate funding for fuel treatments is always challenging, and federal resources are becoming more limited. The Taylor Grazing Act (43 USC 315-315(o)) authorizes the Secretary of the Interior to accept contributions for the administration, protection, and improvement of grazing lands, and establish a trust fund for those purposes (BLM 2010a). Private funding or dedicated sources of federal funding for fuel treatments are also possibilities.

Although federal policies tend to mention and apply to both "forests and rangelands," emphasis on the ground and in reporting is on forests, and fuels management therein, rather than rangelands. A sharper focus on federal rangelands may increase resources available to implement fuel treatments on public rangelands.

Changes to state policies

State fire protection policies treat Idaho's rangeland owners differently than its forest landowners, yet both face the possibility of wildfire and its effects when it occurs. Idaho's forest landowners belong to forest protective associations, pay a fire protection assessment fee, and have statutory responsibilities for preventing and suppressing wildfires on their forest lands. Rangeland owners have no such associations, required fees, or responsibilities (IDL 2008). Creating a state-based formal organizational and legal structure for rangeland fire protection seems prudent.

WUI and development regulation

Wildfires in the wildland-urban interface (WUI) are an increasing problem due to expanding human settlement in the WUI as well as the increasing frequency and extent of wildfires. Wildfires in the WUI pose the highest risk to structures and people and are expensive to suppress. Policies addressing structural development in the WUI are needed.

Landscape-scale risk and hazard assessments that identify values at high risk, prescribe preemptive actions to protect the values, and set priorities for implementation are needed (Miller and Narayanan 2008). Community or County Wildfire Protection Plans (CWPP) provide an opportunity to do such assessments and share them between federal, state, and local agencies, and with the general public, to raise awareness of fire hazards and potential fuel treatments (Colburn 2008). In addition, numerous commentators have suggested adopting and enforcing ordinances for structural developments in high fire threat locations, such as requiring structural features that increase resistance to ignition, implementation of funded long-term fuel management programs, and infrastructure characteristics that facilitate safe fire suppression action (Miller and Narayanan 2008).

Summary

One policy option would be to focus more research resources on rangeland fuel treatment effectiveness. More research is needed about wildfire behavior in various rangeland vegetation types, as well as fuel treatment effects on other ecosystem components and processes, including invasion of unwanted plant species. Research-based implementation guidance is needed for fuel treatments that involve livestock grazing.

Alternative federal and state wildfire and fuel treatment policies also need consideration. The FLAME Act of 2009 requires a National Cohesive Wildland Fire Management Strategy. It is currently under development. Whether it will change emphasis in fire management policy from control to prevention is unknown at this time. Also, NEPA procedures could be streamlined to increase fuel treatment implementation effectiveness. Policies promoting increased coordination and cooperation between federal, state, and local agencies are needed. State policy changes that create fire protection authorities and responsibilities similar to that for Idaho's private forest landowners are an alternative. Dedicated funding for fuel treatment implementation at both the federal and state level would help increase their implementation and effectiveness.

As Idaho's population grows and people inevitably move into the WUI, the effects of rangeland wildfires on human settlements and structures become more problematic. Local regulation of structural development in the WUI may be helpful in creating fire-adapted communities that are a goal of the National Cohesive Wildland Fire Management Strategy.

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