WHEN TO PRESCRIBE

Prescribed fire can be the most practical and affordable way to reduce dangerous accumulations of combustible fuels. At the same time, prescribed fire can help restore the ecological process of fire to fire-adapted ecosystems through its influence on soil nutrients, growth and mortality of plants, seedling establishment and regeneration, wildlife habitat and activity, and hydrological cycles.

Prescribing fire to achieve the seemingly diametrically opposed goals of restoring fire to fire-adapted ecosystems and protecting communities requires comprehensive, socially acceptable and science-based fire management plans. Two GIS-based tools have been developed by researchers at the Aldo Leopold Wilderness Research Institute in Missoula, Mont., to help land managers develop such plans. These innovative tools provide complementary analyses of potential fire effects and the probability of fire occurrence.

RISKS AND BENEFITS

Maps of fire hazards and values at risk can prioritize where fuel-reduction treatments are most-

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Where on the landscape should land managers spend their scarce time and funding to apply prescribed fire? What resource values can benefit from prescribed fire, and what values are at risk? By Carol Miller

needed. Such a risk-focused approach may be sufficient for land managers if reducing fuels and mitigating risk is their only objective, but if they're simultaneously trying to restore fire to fire-adapted ecosystems, they also need to know where fire may produce beneficial outcomes and where the need for fire is greatest. Effectively using prescribed fire to achieve multiple objectives requires a complete assessment of benefits as well as risks.

The Fire Effects Planning Framework is a GIS-based process that allows managers to systematically map and quantify where, and under what conditions, fire may create benefits or pose threats to important values of interest. This information can be used to identify where and under what conditions prescribed fire is desired and, just as importantly, where it isn't.

FEPF is used to create libraries of maps to assist off-season fire planning and to inform strategic and tactical decisions during the fire season. FEPF is not a stand-alone tool; it is a "metamodel" or decision framework that describes how to sequentially link state-of-the-art, publicly available analysis tools, data and knowledge to generate information for a variety of planning scales from long-range to site-specific. (*See "Fire Effects Planning Framework," page 19.*)

The basic process is straight-forward:

- Map existing conditions of each planning objective or value of interest, such as fish populations, wildlife habitat, vegetative condition, fuels and firefighter safety;
- Map expected fire behavior (surface versus crown fire, or fireline intensity) under different weather conditions to create a GIS map library of fire behavior;
- Identify how fire behavior is likely to affect values of interest resources (causing a move toward or away from desired ecological condition) and capture this in database "crosswalks," tables that map the relationships among multiple metadata formats;
- Use these crosswalks to build GIS data sets and additional map libraries that display expected effects of fire on social and ecological values.

The resulting map libraries can be applied in a variety of ways to improve fire and fuels management planning. Managers can compare fire effects under different weather scenarios to understand when and where prescribed fire, wildland fire use or mechanical treatments could be applied.

Maps showing undesirable fire effects can help identify areas for risk mitigation, while maps of desirable or neutral fire effects can identify potential prescribed fire or wildland fire–use treatment zones. For example, areas with negative fire effects under any weather scenario may benefit most from mechanical treatment, and areas showing positive fire effects during moderate fire weather may be most appropriate for prescribed fire. Alternatively, managers can examine the fire effects maps across multiple values of interest for a single prescribed weather condition, quantifying those effects for a prescribed fire project to establish measurable progress toward land management objectives.

FEPF was first demonstrated on the Bitterroot National Forest, where the resulting fire effects libraries exist as centrally served GIS data layers as well as in hardcopy form in each of the district offices. Other demonstrations include Yosemite National Park and the Beaverhead–Deerlodge and Custer National Forests. In each demonstration, the process was customized to address the specific needs of each site. A Forest Service General Technical Report is currently in press, outlining the procedures for FEPF and providing examples of its application.

National federal fire policy requires that fire management follows from land/resource

management plans. For effective fire and fuels management, fire managers must understand resource concerns in terms of fuels and fire behavior. Conversely, resource staffs need to be able to communicate about fire in terms of fire effects on resource values and progress toward desired future conditions.

FEPF can help establish common units for communication between fire and resource staffs and the public to design fire and fuels management activities consistent with long-term land management goals. Because FEPF helps managers consider fire's influence on multiple resources, it can facilitate management for multiple objectives.

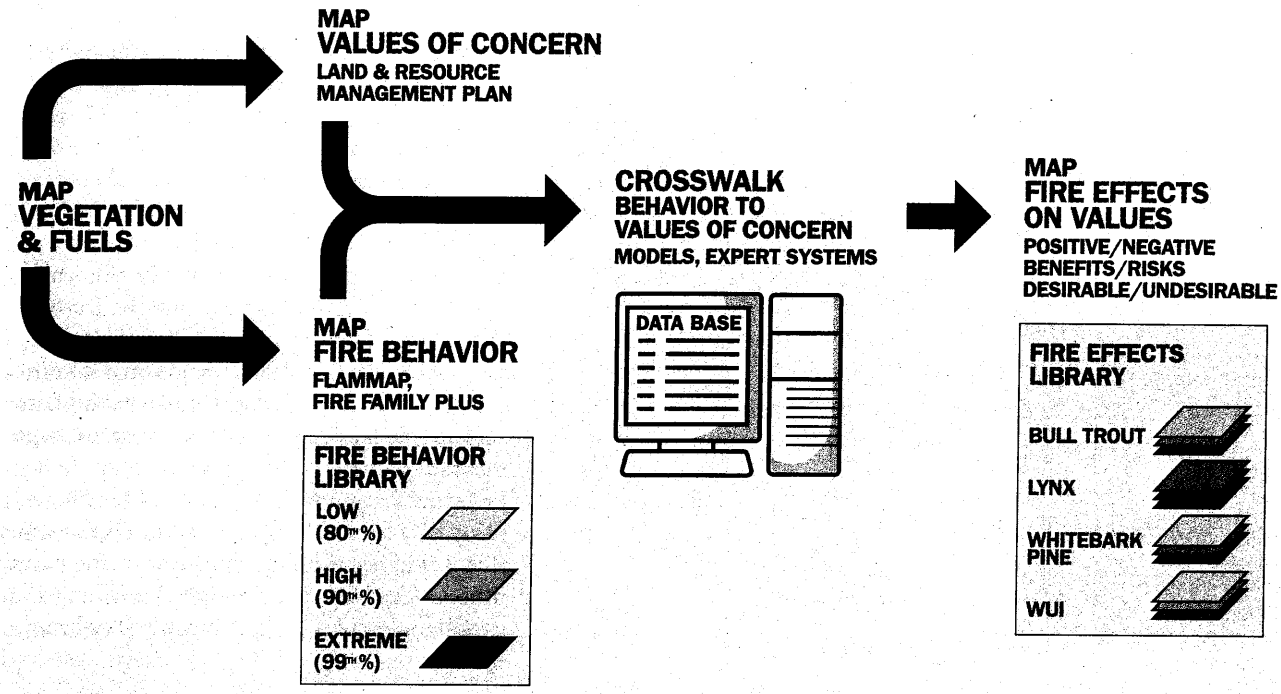
TREATMENT OPPORTUNITIES

While information about the expected effects of fire can help assess the trade-offs of prescribing or prohibiting fire, mapping fire occurrence probability also may guide strategic fuel treatment planning. Are some areas more or less prone to being burned than others? Information about where fire is most or least likely to occur on a landscape can greatly improve risk assessments and planning of prescribed fire treatments.

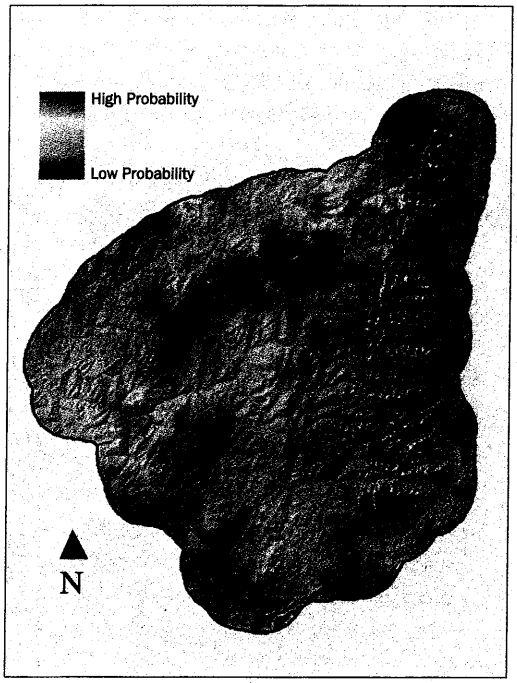
Where the primary objective is to reduce fuels and mitigate risks, the probability of fire occurrence can be overlaid with values of concern to identify priority areas for fuel reduction. The probability of fire occurrence also can help identify potential wildland fire–use areas that could be managed with natural ignitions. In addition to being useful for developing fire management plans, when the objective is to restore fire to fire-adapted ecosystems, this information can help identify places on the landscape where the need for prescribed fire is greatest.

BurnPro is a GIS model that estimates the annual probability of burning for every cell on a raster landscape. BurnPro uses topography, historic weather, fuel model data and historic ignition locations to estimate the likelihood of burning given the speed and direction a fire might spread from any ignition point.

Fire Effects Planning Framework



BurnPro Estimates



This map shows the average annual probability of burning for the Selway–Bitterroot Wilderness and surrounding lands, as estimated by BurnPro.

The probability that fire will travel from an ignition source to any point on the landscape depends on the time required for fire to travel the distance from the ignition to the target; the frequency distribution of fire-stopping weather events, such as heavy rains, within the fire season; and the time remaining in the fire season.

Many assessments have derived and used probability of ignition, whereby the number of ignitions per unit area is computed for a particular time period. The probability of burning estimated by BurnPro is very different from the probability of ignition. Probability of burning as estimated by BurnPro depends on the number of ignitions in a particular area, taking into account the landscape's specific spatial arrangement of ignitions, fuels and topography. BurnPro estimates annual probability of burning using data from many years and multiple events that would occur under a range of weather conditions. (*See "BurnPro Estimates" at left.*)

Still undergoing testing, BurnPro has been used to support fire and fuels management

planning in several national forests and national parks. Probability of burning estimates have been overlaid with maps of wildland-urban interface and other resource values-at-risk. Areas with high burn probability that coincide with a sensitive value might be prioritized for prescribed fire or other fuel-reduction treatments. Maps of probability of burning can help identify "leaky" boundaries where fire is most likely to cross, thereby identifying where prescribed fire may be used to shore up and make these boundaries more defensible.

BurnPro also has been used to evaluate the feasibility of restoring fire to fire-adapted ecosystems in wilderness. For example, to assess the feasibility of wildland fire–use strategies for restoring natural fire regimes, suppression of lightning-caused fires on lands outside approved WFU zones in wilderness was evaluated for its effect on the probability of burning within these zones. Suppression on adjacent lands potentially eliminates fires that otherwise would spread into the wilderness, thereby negatively altering the fire regimes inside the wilderness and preventing potentially beneficial fires. BurnPro analyses identified areas within the wilderness where eliminating imported fires had greatest effect. In these areas, prescribed fires may be warranted to successfully restore fire.

Effective fire stewardship requires that managers use the full suite of management strategies — wildland fire use, management-ignited prescribed fires, thinning and other mechanical techniques, and suppression — across the full spectrum from wilderness to the wildland-urban interface. Successful implementation of these strategies requires assessments of trade-offs among multiple objectives and creation of scientifically based fire management plans. Tools like the Fire Effects Planning Framework and BurnPro can prove invaluable to managers and planners who must assess and communicate these trade-offs to each other and to the public.

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For more info

To learn more about FEPF, visit *http://leopold.wilderness.net/research/fprojects/F005.htm*

For more on BurnPro, visit *http://leopold.wilderness.net/research/fprojects/F002.htm*