Joint Fire Science Program
Fire Science Digest
RESEARCH SUPPORTING SOUND DECISIONS
ISSUE 4 JANUARY 2009

Wildland Fire Use: Managing for a Fire-Smart Landscape

The promise of wildland fire use (WFU) is that, over time, the fires will play a more natural role, creating a jigsaw-puzzle pattern of burned and regrowing patches over a landscape and gradually moving it closer to the stand structure and species composition that prevailed before fire exclusion became the policy.

National Park Service

The Hoover Fire—A WFU fire in Yosemite National Park, 2001.

A hard-earned lesson

On a damp June day in 1994, lightning ignited a small forest fire in Glacier National Park. The fire, dubbed the Howling Fire after the resident wolves, stayed within about an acre for 6 weeks. Then in late July it roared to life, spreading to more than 2,000 acres. Some people, including the editors of several area newspapers, thought it should be immediately suppressed. But the superintendent, with the help of fire behavior experts, decided the fire was probably not a threat to human life or property. With his blessing, it was allowed to burn, carefully monitored, until the rains came 4 months later.

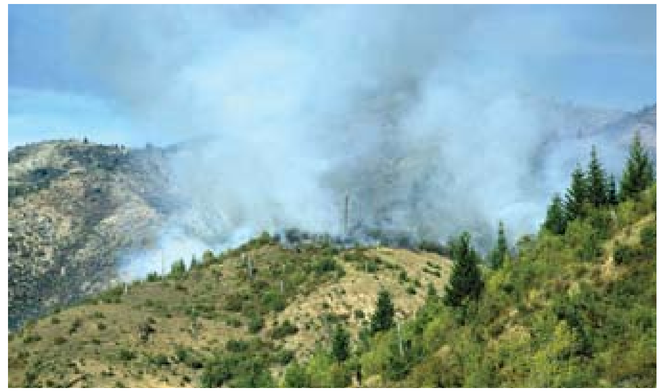
The Howling Fire represented a successful test of what was then called "prescribed natural fire"—proving that managing a fire for ecosystem benefits could work even in forest types characterized by large, stand-replacing fire. "It showed scientists and Park Service managers that the policy was valid," says Jan van Wagtendonk, a fire ecologist with the U.S. Geological Survey at Yosemite National Park.

The recent, intense wildfire seasons of the past few years seem to repeat a hard-earned lesson: trying to keep fire out of landscapes that thrive on fire is expensive, sometimes tragic, and ultimately futile. "It's like the old saying, 'You can pay me now, or you can pay me later,'" says Tom Nichols, chief of the National Park Service's fire and aviation division. "When California burst into flames [in the summer of 2008], I told folks, 'Well, this is the pay-me-later part.' You get blasted with thousands of [lightning] strikes, in fuels that have been untreated for years and years, and now everything is on fire."

For nearly a century, suppression has been the main strategy for dealing with wildfire on the Nation's public lands. The resulting accumulation of flammable biomass now hangs over managers' heads like an unpaid bill. The Howling Fire was a showcase for a different way of handling fire, one that has been tested and refined on national parks and wilderness areas for nearly 40 years now. First termed "prescribed natural fire," the strategy now is called "wildland fire use for resource benefits," commonly abbreviated to WFU.

In its simplest essence, WFU means managing lightning-caused fires as they burn naturally instead of putting them out. Managers shape, nudge, and corral the fire to accomplish the ecological and fuel-reduction objectives that have been identified for it, and at the same time protect people, property, and key resources. WFU is not the same as prescribed fire (defined as manager-ignited fire), although its effects may be similar. The term "wildland fire use" refers only to fires ignited by lightning, managed so that they burn in predesignated areas under a strict set of prescriptions.

The strategy now is called "wildland fire use for resource benefits," commonly abbreviated to WFU.


J. Briggs

The Bad Luck WFU fire, Selway-Bitterroot Wilderness, 1972.

"We like to emphasize that we are not just 'letting fires burn,'" says Tim Sexton, a Forest Service fire ecologist who's in charge of both WFU and prescribed fire across the Nation's 200 million acres (about 80.9 million hectares) of Forest Service lands. "Rather, we are actively managing fires—protecting values at risk while achieving resource benefits in those places where fire has a positive effect."

The promise of WFU is that, over time, the fires will play a more natural role, creating a jigsaw-puzzle pattern of burned and regrowing patches over a landscape and gradually moving it closer to the stand structure and species composition that prevailed before fire exclusion became the policy. In the process, the fires consume built-up fuels, making the landscape less susceptible to a more-severe fire later.

"What's happening is that these past fires are regulating the growth of future fires, so that fire behavior becomes much more benign," says Bob Mutch, a fire researcher who helped develop the Forest Service's first WFU program. "When a new fire starts, it burns into old fires and becomes self-regulating." The landscape, he says, becomes what fire ecologist Penny Morgan has called "fire-smart." Says Mutch: "I think that's a most appropriate description. The landscape adapts [to repeated WFU fires] in such a way that smart things happen—smart for the ecosystem and smart for society."

Bob Mutch: A WFU Veteran Recalls the Early Days

Bob Mutch helped pioneer the Forest Service's first WFU program in Montana's Selway-Bitterroot Wilderness. The Wilderness Act of 1964, called for managing wilderness areas for their natural qualities, says Mutch, "but one of the most unnatural acts we'd been committing in the wild all these years was suppression of fire."

In the late 1960s, the National Park Service was experimenting with letting fire play its natural role. But no one in the Forest Service had tried it. Bud Moore, then director of fire for the Forest Service's Northern Region, and Bill Worf, regional director of wilderness and recreation, got funding from the national Forest Service office for a pilot project. Moore and Worf approached Orville Daniels, forest supervisor on the Bitterroot, and enlisted his enthusiastic support.

The men chose 100 square miles of the Whitecap Creek drainage for their study area. Whitecap Creek was both remote and diverse, representing a good cross section of topography and forest types. Dave Aldrich, a forester from Idaho, was chosen to lead the project. Mutch, a fire scientist from the Missoula Fire Sciences Laboratory, would be the team's co-leader and researcher.

In August of 1970, Aldrich and Mutch visited Sequoia-Kings Canyon National Park, where managers had started letting fires burn in higher elevations. "We got to fly the area, see a new fire they'd just detected," says Mutch. "The matter-of-fact way that the new fire was allowed to burn rather than being suppressed was a revealing opportunity for us."

B. Moore

Bob Mutch and Dave Aldrich hiking the Whitecap Creek drainage in 1970.

The following summer, the five men hiked the 9 miles from Paradise Guard Station to Cooper's Flat and pitched their tents. They built a campfire and talked late into the night about how to carry off "this radical idea of letting nature do its thing," says Mutch.

The team spent the next year thoroughly analyzing the study area—sampling vegetation, collecting evidence of fire history, studying records of past fires, and charting the effects of fire exclusion. By the summer of 1972, their plan was complete. Daniels and Mutch traveled to Washington, DC, and presented it to Forest Service Chief John McGuire, who approved it on the spot.

"Three weeks later I was back in the White Cap," says Mutch, "and an aerial patrol detected a brand-new fire in Bad Luck Creek. I did the initial assessment, and the decision was made to allow it to burn." The Bad Luck fire lasted 4 days and burned less than one-fourth of an acre, but in the following year there was a more significant incident. A prescribed natural fire in the Fitz Creek drainage burned about 1,600 acres—more than had been burned by all the previous fires of record in the Whitecap drainage.

The Fitz Creek fire lasted 43 days and attracted national media attention. It also escaped the bounds of the management area, "which caused some consternation," Mutch recalls. The escaped portion of the fire was suppressed after burning an additional 1,600 acres without causing undue damage. The Forest Service's new prescribed natural fire policy had passed its first test.

In the summer of 2001, Mutch met Moore, Worf, Daniels, and Aldrich for a 30-year reunion hike to Cooper's Flat. Back at Paradise, they held a public anniversary celebration for an experiment that is proving to have far-reaching consequences for America's public forests.

WFU is playing an increasingly important role in restoring natural fire to fire-prone ecosystems, says van Wagtendonk. "As a fire ecologist, I'm interested in seeing fire play its ecological role wherever possible." In particular, wildernesses and parks, where the goal is to restore and maintain natural ecological processes, are areas where fire can be allowed, he says, "and it should be." Trying to exclude fire from these forests, he adds, is "sort of like trying to remove rain."

WFU is increasingly being applied to lands with other, non-wilderness objectives, including wildlife, timber, watershed, and recreation. There is much uncertainty surrounding its use, especially in these more-developed landscapes. Nearly a decade of JFSP-supported science is helping to reduce some of that uncertainty.

Rethinking suppression

The Federal Wildland Management Policy now directs managers to "allow lightning-caused fires to play, as nearly as possible, their natural ecological role in wilderness." Accordingly, WFU programs have been developed and expanded in many national parks and Forest Service wilderness areas.

Most of the natural ignitions on national forest wilderness lands are still suppressed, for a complex of operational and cultural reasons. Nevertheless, national forest managers of both wilderness and non-wilderness lands are working to increase WFU's use. "For example, the Krassell Ranger District, on the Payette National Forest, manages more than half of the lightning ignitions as WFU fires," says Sexton. "Similarly, the West Fork District of the Bitterroot National Forest also dominantly manages lightning ignitions as WFU."

National forests and national parks that have developed successful WFU programs include Sequoia and Kings Canyon, Bandelier, Yosemite, Saguaro, and Grand Teton National Parks and the Selway-Bitterroot, Bob Marshall, Frank Church-River of No Return, Bridger-Teton, and Gila-Aldo Leopold wildernesses. Some national forests also have extended their WFU programs to lands outside wilderness areas; these include the Bitterroot, Boise, Gallatin, Gila, and Payette National Forests. Most Montana national forests and all those in Utah allow WFU across their whole acreage with minor exceptions, Sexton says.

In the eastern United States, the Great Smoky Mountains and Everglades National Parks have active WFU programs, as do the Ouachita and George Washington National Forests. More than half the national forest acreage in the Forest Service's Southern Region is available for WFU, according to Sexton. Other Federal agencies that practice WFU are the Bureau of Indian Affairs, the Bureau of Land Management, and the U.S. Fish and Wildlife Service.

Early Alternatives to Suppression

A suppress-all-fires policy was adopted by the fledgling Forest Service in 1910 after an unusually severe fire season, and it was subsequently adopted by the National Park Service. Other approaches were proposed as early as 1916, when Roy Headley, a Forest Service district forester in California, began letting low-intensity fires burn in remote areas of national forest lands as long as they didn't threaten valuable timber. In 1934, Headley, then chief of Forest Service fire control, proposed withholding some suppression resources from back-country fires. Wilderness advocates Bob Marshall and Aldo Leopold supported the proposal, but it was turned down.

Later, in 1950, the Park Service approved a research area in a remote, high-elevation area of Sequoia National Park that would be allowed to burn if it caught fire. The approval was for the one case only and was explicitly not to be taken as a policy change. At Yosemite National Park, assistant chief ranger George Briggs recommended allowing fires to burn in high-elevation areas once it was determined that sparse fuel and natural fire breaks would probably stop them before they did any damage. All these proposals rested on economic arguments, but Briggs's proposal also made an ecological case for letting wildfires burn.

The early 1960s produced the first glimmerings of an ecosystem-management philosophy for parks and wilderness areas. The Park Service was having difficulties with wildlife management, and the Secretary of the Interior convened a committee to look into the problem. The committee's chairman was Starker Leopold, son of Aldo Leopold. The Leopold Report, released in 1963, went beyond the wildlife problems to recommend that national parks be managed as ecosystems. In 1968, the Park Service changed its fire policy accordingly: fires were to be allowed to burn as long as they were likely to achieve predefined objectives and could be contained if necessary.

Programs to manage natural fire sprang up almost immediately at Sequoia and Kings Canyon National Parks, Saguaro National Monument (today a national park), and Yosemite National Park. In the Forest Service, WFU programs began in the Selway-Bitterroot Wilderness on the Bitterroot National Forest and the Gila Wilderness in New Mexico. These programs, then known as "prescribed natural fire," were very successful, and in 1978 the Forest Service mitigated its full-suppression policy to accommodate a new one encouraging wildland fire use, carefully prescribed.

USDA FS

Grasses recolonize a burned slope in the Bob Marshall Wilderness.

Chainsaw surgery

The notion of letting a fire burn itself out is simple in concept but complicated in execution. Wildfire is, by definition, wild—barely subject to human control. Even with the best reconnaissance and the latest planning tools, a manager can never know for sure that a WFU fire will burn as expected.

"It's chainsaw surgery," says Guy Pence, fire staff officer on the Boise National Forest. "I can't draw a line and promise the fire will stay on this side. I'm dependent on weather: wind, temperature, humidity." He can do a pretty good job of forecasting and predicting, he says. "But it's not scalpel surgery."

WFU requires extensive advance planning. First, the management plan for a park or forest—the publicly reviewed, NEPA-compliant document that governs all management activities for a span of years—has to permit WFU. Then the fire management plan—the execution document—has to spell out a detailed process for managing a WFU fire. Managers face a long checklist of considerations: Is it the right season of the year? Is the ignition in the right place on the forest? Are the winds likely to remain favorable? Are there natural barriers like talus slopes that will check the fire? Is the fire likely to burn into territory where it must be suppressed, or to escape the area altogether? Will it send large quantities of smoke into neighboring communities? If it gets out of hand, are there enough firefighters to fight it safely? Can people live with the blaze, the smoke, and the uncertainty for weeks or months, until the fall rains come?

Nerves of steel may not be strictly required, but they help. Many forest supervisors and park superintendents are understandably uncomfortable with making a "go" decision on a WFU fire. The ecological and fuel-reduction benefits won't accrue until later, but the risks are immediate—risk of the fire's escape, risk of heavy smoke, of accusations of mismanagement, of official disapproval and public wrath. "Nobody wants to be the supervisor on the next Yellowstone," says Pence—referring to the 1988 wildfire blowup that thrust WFU policy (then known as "prescribed natural fire") into national headlines. "It's tricky business," he says. "You get a hollow feeling in the pit of your stomach."

Pence, who started his career as a firefighter, is one of a growing number of advocates of implementing WFU across the entire Federal forest system. In his younger days, he says, "I suppressed many fires that probably didn't need to be suppressed." He has been managing fires for 40 years, long enough to see the benefits: a rejuvenated forest community, enhanced wildlife habitat, and reduced risk from a really big fire. "I hear people say after a fire, 'we lost it all,'" Pence says. "But it's not lost; it's just changed."

Yellowstone: Wildland Fire Reaffirmed

WFU has had setbacks, the most notorious being the Yellowstone fires of 1988. Based on a plan written in 1972, Yellowstone National Park allowed several lightning fires to burn in a remote corner of the park in late June. At the same time, Forest Service managers of the Absaroka-Beartooth Wilderness just north of Yellowstone were monitoring the Storm Creek Fire.

By the end of July, unusually dry conditions coupled with high winds convinced managers of both agencies to suppress all fires that were currently burning as well as all new starts. Human-caused fires from outside of the park added to the problem. In fact, the North Fork fire, which threatened Old Faithful Village, was started by a woodcutter's chainsaw on the adjacent Targhee National Forest.

Of the nine major fires that burned almost 1.4 million acres, six were ignited outside the park and four were human-caused. Accusations of irresponsible management were common, and the National Park Service was left with a serious public relations problem.

Nevertheless, the team that reviewed the Yellowstone incident reaffirmed the ecological value of allowing fire and recommended several measures to strengthen fire management. A few years after Yellowstone, it was plain even to the untrained eye that the park's landscape had been invigorated and renewed. The ecological benefits of WFU in fire-adapted landscapes have been consistently confirmed.

BLM/NOFA Collection

Lightning strike.

Catching up with the biomass

Between 1998 and 2006, more than 1.4 million acres (about 579,000 hectares) have burned in WFU fires on lands managed by all five of the Federal agencies with WFU programs. The Forest Service leads in both numbers of fires (1,854) and area burned (950,211 acres; 384,538 hectares) during that period. The tally for 2008 so far is 133 fires and about 172,000 acres (69,606 hectares) burned, according to Sexton.

Some scientists and managers worry that WFU isn't being applied as widely as it needs to be. Even the most successful WFU programs, they say, are not working fast enough to restore the fire patterns that prevailed before European-American settlement. For example, as of 2000, only one in five of the 400 Forest Service-managed wilderness areas in the lower 48 states permitted WFU in its fire management plan. A more recent survey of wilderness managers revealed that only one-fourth of the lightning-caused fires on their lands between 2002 and 2004 occurred in areas that had been approved for WFU. Of those ignitions, only 40 percent were actually managed as WFU fires. In short, many acres that could benefit from WFU are not yet covered by a WFU program, and even within those areas, most fires are still suppressed.

Sexton argues for a more positive outlook. "The number of fires is not so meaningful as area burned," he says. "The total area of Forest Service lands where WFU is permitted has increased by more than 20 million acres since 2000. Yes, there's still room for improvement—but we are making progress."

Barriers and facilitators

Some of the reasons managers might hesitate to make a "go" decision were revealed in a recent survey of National Forest wilderness fire managers. The study was led by then-graduate student Dustin Doane, a Forest Service smokejumper, with the help of Jay O'Laughlin, Penny Morgan, and Carol Miller.

Building on earlier, JFSP-supported work by Carol Miller and Peter Landres, Doane and his colleagues identified a host of factors that influence a "go/no go" decision. These include constraints within the organizational culture (for example, a strong bias toward suppression), political boundaries (for example, concern that the fire would burn too close to neighboring lands), organizational capacity (lack of time and resources to plan for WFU), policy directives (for example, a blanket suppression order at the regional level), and public perceptions (potential

USDA FS

The Papoose WFU fire on the Payette National Forest in Idaho, 2007.

negative reactions to smoke or the risk of damage to private property).

The managers also suggested ways the Forest Service could achieve more "go" decisions: supporting WFU at all levels of the organization, giving managers greater flexibility for managing WFU in wilderness, increasing awareness of the national directive to manage ignitions as WFU, increasing land areas available to WFU, and increasing the organization's knowledge about WFU.

Scientists are working hard to add to that body of knowledge. Thanks to many studies funded and disseminated by the JFSP, managers now have a better understanding of what a wildfire can do, what it is likely to do, and what the odds are that it will do something unmanageable. "Those managers whom we might characterize as 'risk-averse,'" says Sexton, "might not be risk-averse if they have a better understanding of what the real versus perceived risks are. JFSP research is providing better ways of assessing those risks. That's the real payoff of JFSP work."

WFU works

First of all, much observation and study over the 35-year history of WFU have confirmed its ecological benefits. WFU is clearly doing what it is supposed to do: restoring fire as a natural process and mitigating hazardous fire conditions resulting from past fire exclusion.

For example, a case study conducted by Matt Rollins of the Forest Service and Penelope Morgan and graduate student Zack Holden of the University of Idaho as part of a comprehensive JFSP research project (JFSP 01-1-1-06) assessed the effects of 30 years of wildland fire use programs on the 230,800 acres (about 93,401 hectares) Gila Wilderness in New Mexico and the 29,500 acres (about 11,938 hectares) Saguaro Wilderness in Arizona. The timing and extent of fires in the ponderosa pinedominated forests of these two wilderness areas have been richly documented since early in the 20th century. Rollins, Morgan, and Holden sampled in areas burned 0, 1, 2, or 3 or more times in 25 years, collecting data on age, size, and height of trees and structure and composition of forest stands.

Repeated WFU fires have restored forest resilience.

They found that, in general, repeated WFU fires since 1972 have reduced the density of small-diameter trees without significantly affecting the density of larger trees. In other words, the WFU fires have tended to push the forest toward a condition closer to that of the ponderosa pine forests of pre-fire exclusion days, with forests of many large trees and snags and some small trees and logs.

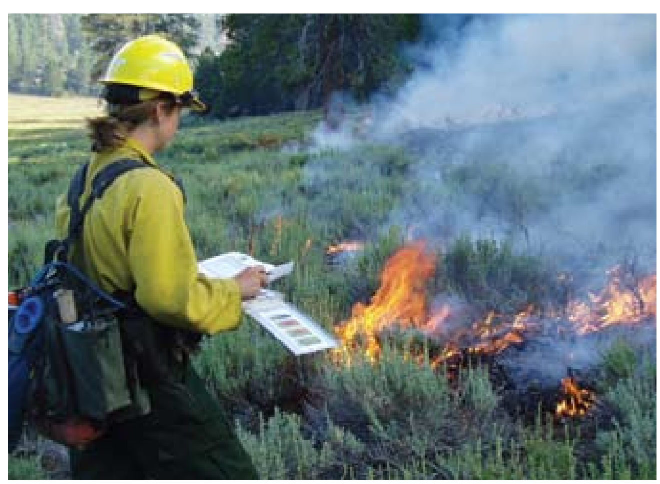
Along with the structural changes has come an increase in the resilience of these forests to severe fire. "Ponderosa pine forests in the Gila Wilderness and Saguaro Wilderness are structurally diverse and resistant to fires burning during the natural fire season," say the authors in a 2007 article in the journal *Fire Ecology*, "suggesting that repeated WFU fires have restored forest resilience to fire." Says coauthor Penny Morgan: "Not just big trees survived, but there were lots of logs, small trees, and spatial variability. It looked beautiful, and I assume such a diverse structure would be useful to wildlife, although our study didn't look at that aspect."

JFSP-supported research such as this offers valuable guidance to fire managers in making a WFU decision, says Dave Bartlett, fire management officer on the Sequoia and Kings Canyon National Parks. "Research is the basis of our decision process," says Bartlett. "We use what we know about the fire return interval along with local inputs like slope, aspect, terrain, and so on, to analyze our landscape and determine why we should burn and what the priority for treating a given area is." Like all agencies with WFU programs, Sequoia and Kings Canyon parks have a research officer, fire ecologist Tony Caprio, who sees to it that management decisions are informed by the latest research. "He's our conduit for the science," says Bartlett.

Recently published results from a JFSP study (JFSP 01-1-1-06) illustrate the long-term benefits of WFU. In this study, the authors examined the effects of successive naturally occurring fires in the Illilouette Creek Basin in Yosemite National Park. They found that fire "can exhibit self-limiting characteristics," meaning that as fire consumes fuel over time, fire-induced effects of subsequent fires are lessened. This information helps fire managers better anticipate the effects of allowing fires to burn and improves their ability to manage WFU programs.

Morgan, Holden, and the others did look at the implications of severe fires for fish in another JFSP-funded study on the Gila Wilderness (JFSP 05-2-1-101), which examined the effects of WFU fires on imperiled Gila chub and trout species in the Gila River and its tributaries. Fish biologists were concerned that the fires were causing landscape changes that might threaten the fish. They needed a map of areas where fires, if they occurred, were likely to burn the most severely.

Morgan and her colleagues used pre- and post-fire satellite images and field data to map fire severity, and then developed statistical models of where fires had burned severely over the last 20 years. They then worked with Forest Service researchers to modify a decision support tool developed earlier for the Boise River drainage (with JFSP support) by Forest Service researchers. "We adapted it to the Gila Wilderness to help managers identify areas where the likelihood of severe fires overlapped areas where the vulnerable fish populations were," says Morgan. Also included was a component to help identify where landslides were most likely to occur and where channel morphology made fish populations particularly vulnerable. The researchers delivered the tool to Gila managers in the fall of 2008.



USDA FS

Another WFU fire in the Sequoia National Forest, the Broder-Beck fire.

Defining the target

If the goal is to restore natural fire patterns, managers need to know what those patterns looked like. Studies of fire scars on trees are widely used to reconstruct the occurrence and extent of historical fire regimes; these reconstructions suggest the forest's structural, species-composition, and successional patterns through time. However, because wildfire is so variable in its effects, fire-scar sampling yields an incomplete record, and so it's uncertain how much can be inferred from a given set of samples.

In another study within the comprehensive project mentioned previously (JFSP 01-1-1-06), graduate student Brandon Collins and and Scott Stephens of the University of California at Berkeley sampled fire scars in two California national parks where WFU has been practiced since 1973. They looked at Illilouette Creek basin in Yosemite National Park and Sugarloaf Creek basin in Sequoia and Kings Canyon National Park. They calculated the fire rotation and extent suggested by the fire scars and compared them to known data from the WFU fires, derived from fire atlases and satellite images of burn severity.

In most cases, they found, the fire-scar based estimates greatly underestimated the actual extent of the fire. In other words, the actual fire was larger than the fire-scar sample said it was, often much larger. On the other hand, some fires didn't show up in the fire-scar record at all. What this means for managers is that tree-ring studies tell only a partial story about fire extent or size, and the story may be less reliable in forest types characterized by short burn intervals. Because the data are still inconsistent, it's not time to propose a correction factor, say the researchers. "Rather, we intend for this study to serve as an initial step in attempting to meaningfully understand uncertainty in fire-scar based reconstructions."

Assessing progress

Managers also need to know whether their burning program is actually moving the forest closer to the desired condition. In another JFSP-funded study (JFSP 03-1-1-07), Carol Miller, a fire ecologist at the Aldo Leopold Wilderness Research Institute in Missoula, computer-simulated five fire regimes on the Boise National Forest. "My goal was to evaluate the consequences of increasing burning with WFU in terms of the land management objectives," she says, "and to determine if there's a threshold where there's too much fire."


USDA FS

The August 2006 Tamarack WFU fire in the Sequoia National Forest.

Miller chose a modeling tool called TELSA (Tool for Exploratory Landscape Scenario Analysis), which is a "state-and-transition" type of fire succession model—that is, it illustrates how patches of vegetation on the landscape move from one successional state to the next across space and time. She modeled the effects of five different fire regimes on forest structure and composition. The first fire regime was based on the actual fire record for the landscape from 1908 to 2003. The next four represented successive increases in the frequency of fires and the frequency of large-fire years. Effects of the simulated fires were folded into subsequent simulation runs, so that the modeling simulated the cumulative effects of fires across the landscape over 1,000 years.

Miller found that the scenarios with more fires resulted in a younger forest characterized by earlier successional stages. She also found that these younger forests were much more variable in structure and composition than management plans called for. The middle fire-regime, scenario 3, turned out to produce the landscape conditions that were closest to those desired (even though these too showed a lot of variation from desired conditions from time to time). On the other hand, scenario 5, with an average 33-year fire rotation, ended up moving the landscape away from desired future conditions, probably because it provided too much fire.

The TELSA simulation offers a way for managers to refine their assessment of how much fire is enough to meet their goals.

All models necessarily simplify real-life processes. Even so, the TELSA simulation offers a way for managers to refine their assessment of how much fire is enough to meet their goals. "In wilderness areas and parks," Miller writes, "there has been little discussion about how much fire is appropriate, probably because any and all lightning-ignited fire is viewed as being commensurate with land management goals." Miller's study promises to help managers take a more nuanced view.

The enhanced maps help managers identify those areas most need fuel-reduction treatments.

In a subsequent study (JFSP 04-2-1-110), Miller and her colleagues are modeling the behavior of past WFU-suitable fires that were suppressed, reconstructing them as if they had been allowed to burn. "It's a Monday-morning-quarterback way of assessing progress, or lack thereof," she says. "We ask where specific WFU candidates would have spread if we hadn't suppressed them." Results from this study will supplement the fire-regime analysis that managers are already doing, enabling them to better quantify the costs and benefits of managing a fire for WFU.

Decision support tools

Managers also need to quantify the tradeoffs of wildland fire use at landscape scales, so they can make well-calculated decisions about when and where to apply it. There are several good planning and modeling tools available. Fire-behavior models such as BEHAVE and FARSITE (developed at the Missoula Fire Sciences Laboratory by Patricia Andrews and Mark Finney, respectively) can be combined with accurate fuel maps to help managers make reasonable predictions about the behavior of a WFU fire not only immediately after ignition, but throughout the weeks and months it will burn.

However, says Anne Black of the Aldo Leopold Wilderness Research Institute, some of the planning and decision-support tools available to managers tend to focus on fire as an immediate, short-term risk at the stand level, rather than an unfolding long-term ecological benefit at the landscape level. Thus, they don't support WFU as well as they might.

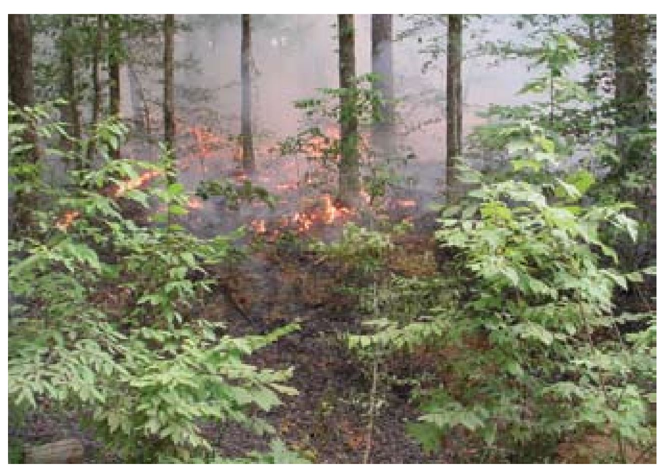
In a JFSP-funded effort to fill that gap (JFSP 99-1-3-16), Black and her collaborators, including Carol Miller, developed two tools to help managers weigh the risks and benefits of various treatment options, including WFU, over both the short and long term. The first tool, Fire Effects Planning Framework (FEPF), is a "meta-model" that links publicly available analysis tools, data, and knowledge to generate information for planning at a variety of spatial and temporal scales. FEPF guides managers in systematically mapping and quantifying the likely effects of fire. These effects are determined from the expected severity of the fire and the desired future condition for the landscape in question.

The second tool, a GIS-based model called BurnPro, enables managers to estimate the annual probability of burning in a given landscape. Fire risks and benefits can be calculated by overlaying BurnPro output with fire-effects maps created by FEPF. The enhanced maps help managers identify those areas that most need fuel-reduction treatments. They also help them weigh the risks and benefits of various treatment options over both the short and the long term.

In the course of developing these tools, Black and her collaborators embarked on an intensive technology-transfer program. "We recognized that success goes beyond achieving recognition and adoption by a few research-minded managers," she writes. "Success required institutionalization of the knowledge and models." The team's outreach program included determining managers' needs early in the development process, enlisting managers as partners in developing the planning tools, and providing ongoing support for users. In a subsequent JFSP-funded project (JFSP 05-4-1-20), Black and her colleagues developed more and better ways to disseminate and teach these tools, including Internet outreach, workshops, and in-person consultations.

Getting the public on your side

One of the biggest public concerns about WFU is smoke. When a fire is suppressed, the smoke dies with it, but when it lingers on as a WFU fire, people



USDA FS

A mixed hardwood forest burns in a WFU fire on Sulphur Mountain, Arkansas.

have to live with the smoke until autumn rains put the fire out. The smoke can add to already-polluted skies, potentially pushing them over Federal thresholds for air quality. (Sometimes a good potential WFU ignition has to be suppressed, says van Wagtendonk, because air-quality authorities have determined that the smoke would raise air-pollution levels past legal limits.)

Several JFSP-funded studies have addressed different aspects of smoke management, including improving the reliability of models that forecast wind patterns, estimating how much smoke a fire will produce, tracking the spatial patterns of smoke dispersal, and improving estimates of the contribution of WFU fires to regional air pollution.

Studies now in progress include improvements to the BlueSky smoke model to provide real-time predictions of surface smoke from fires, both wild and manager-ignited. Narasimhan Larkin of the Forest Service Pacific Northwest Research Station is measuring smoke produced by WFU fires and comparing the measurements with predictions from BlueSky to improve the model's predictive capability (JFSP 06-1-1-12). WFU fires are good for this kind of study, he notes, because they burn for a long time, producing a lot of smoke and a lot of data.

In another study (JFSP 08-1-6-09), Shawn Urbanski of the Forest Service Rocky Mountain Research Station is using both a ground-based LIDAR and airborne instruments to measure the composition and movement of smoke plumes from wildland fires over 3 years. Results will help improve the accuracy of smoke-plume models.

A broader range of landscapes

The ecological benefits of fire are well known, and the fuel-treatment benefits of WFU are documented by many examples. The Forest Service's Tim Sexton is optimistic about recent progress in applying WFU to a broader range of landscapes. "We've made great strides in the past 5 years," he says. "We were at 40 million acres [about 16 million hectares available for WFU] in 2003, and we're now at 60 million acres. And every year more acres become available through land management plan revisions."

He is constantly prodding managers in every Forest Service region to increase WFU acres burned. "My goal is not to have anywhere in the 200 million acres of Forest Service lands where WFU is prohibited," he says. "That doesn't mean every fire will be managed as a WFU fire. But if WFU is allowed on every acre we manage, then there'll be no restrictions on a local manager taking that strategy should the opportunity arise."

Bob Mutch cautions that "One size does not fit all" when it comes to WFU. It's most appropriate for large expanses of land that can accommodate a spreading fire without undesired side effects. In smaller landscapes, he says, the needed treatment is often better accomplished through prescribed burning rather than WFU.

In sum, through practice, research, and continuous learning, WFU is becoming a viable alternative to the blanket paradigm of wildfire suppression. Concurrently, as fuels build up, as firefighting becomes more expensive, and as firefighters continue to be sent into harm's way, the reflex to suppress all wildfires is being increasingly challenged. "We can keep pouring money on large fires if we want," says the Park Service's Tom Nichols, "But we have to think in terms of the future. It may feel safer to put the fire out now. But that just means someone else will inherit the problem down the road."

It may feel safer to put the fire out now. But that just means someone else will inherit the problem down the road.

USDA FS/B. Baldwin

The Warm Fire, Kaibab National Forest, Arizona, 2006.

Suggested Reading

Journal Articles

Collins BM, Kelly M, van Wagtendonk JW, Stephens SL. 2006. Spatial patterns of large natural fires in Sierra Nevada wilderness areas. Landscape Ecology 22:545-557.

Doane D, O'Laughlin J, Morgan P, Miller C. 2006. Barriers to wildland fire use: a preliminary problem analysis. International Journal of Wilderness 12(1): 36-38.

Miller C. 2006. Wilderness fire management in a changing world. Journal of Wilderness 12(1): 18-21 (jump to 13).

Miller C, Landres PB. 2004. Exploring information needs for wildland fuels and fire management. RMRS-GTR-127. Fort Collins, CO: USDA Forest Service, Rocky Mountain Research Station. 36 p.

Parsons DJ, Landres PB, Miller C. 2003. Wildland fire use: the dilemma of managing and restoring natural fire and fuels in United States wilderness. Pp. 19-26 in Proceedings of Fire Conference 2000: the First National Congress on Fire Ecology, Prevention, and Management, K.E.M. Galley, R.C. Klinger, and N.G. Sugihara, eds. Tallahassee, FL: Tall Timbers Research Station.

Proceedings and Special Publications

Brown JK, Mutch RW, Spoon CW, Wakimoto RH. 1995. Proceedings: Symposium on Fire in Wilderness and Park Management. General Technical Report INT-GTR-320. Ogden, UT: USDA Forest Service Intermountain Research Station.

The following papers are of particular interest:

Agee JK. Alternatives for implementing fire policy.

Bunnell DL. Prescribed natural fire planning considerations: negotiating conflicting goals.

Mutch RW. Prescribed fires in wilderness: how successful?

Pyne SJ. Vestal fires and virgin lands: a reburn.

Van Wagtendonk JW. Large fires in wilderness areas.

Cole DN, McCool SF, Freimund WA, Borrie WT, O'Loughlin J, eds. 1999. Wilderness Science in a Time of Change Conference, vol. 5. Proceedings RMRS-P-15-CD. Missoula, MT: USDA Forest Service Rocky Mountain Research Station.

The following papers are of particular interest:

Agee JK. Wilderness fire science: a state of knowledge review.

Arno SF, Parsons DJ, Kean RE. Mixed-severity fire regimes in the northern Rocky Mountains: consequences of fire exclusion and options for the future.

Caprio AC, Gruber DM. Returning fire to the mountains: can we successfully restore the ecological role of pre-Euroamerican fire regimes to the Sierra Nevada?

Landres PB, Brunson MW, Merigliano L, Sydoriak C, Morton S. Naturalness and wildness: the dilemma and irony of managing wilderness.

Parsons D. The challenge of restoring natural fire to wilderness.

Rollins M, Swetnam T, Morgan P. Twentieth-century fire patterns in the Selway-Bitterroot Wilderness Area, Idaho/Montana and the Gila/Aldo Leopold Wilderness Complex, New Mexico.

Fire Ecology Special Issue: Wildland Fire Use. 3(2), 2007.

The following articles are of particular interest:

Collins BM, Stephens SL. Fire scarring patterns in Sierra Nevada wilderness areas burned by multiple wildland fire use fires.

Holden ZA, Morgan P, Rollins MG, Kavanagh K. Effects of multiple fires on ponderosa pine stand structure in two southwestern wilderness areas, USA.

Miller C. Simulation of the consequences of different fire regimes to support wildland fire use decisions.

Miller C. Wildland fire use (introduction).

Van Wagtendonk JW. The history and evolution of wildland fire use.

JFSP *Fire Science Digest*
is published several times a year.
Our goal is to help managers
find and use the best available
fire science information.

Credits

Writer – Gail Wells
Gail Wells Communications

Managing Editor – Kathy Rohling
Kathy_Rohling@blm.gov

Design and Layout – Jennifer Kapus
Jennifer_Kapus@blm.gov

Tim Swedberg
Communication Director
Timothy_Swedberg@nifc.blm.gov
208-387-5865

AN INTERAGENCY RESEARCH, DEVELOPMENT, AND APPLICATIONS PARTNERSHIP

Learn more about the Joint Fire Science Program at

www.firescience.gov

John Cissel, Program Manager
208-387-5349
National Interagency Fire Center
3833 S. Development Ave.
Boise, ID 83705-5354

National Interagency Fire Center
3833 S. Development Ave.
Boise, ID 83705-5354

OFFICIAL BUSINESS
Penalty for Private Use, $300

BULK MAIL
POSTAGE & FEES PAID
BUREAU OF LAND MANAGMENT
PERMIT NO. G-27