Fire Management today

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Using Fire on the Land

United States Department of Agriculture
Forest Service

Coming Next...

The next issue of Fire Management Today *(67[1] Winter 2006) will feature everything from an examination and comparison of agency vs. contract crew fire costs, to American Indian fire use in our eastern woodlands. A professor of English literature and rhetoric—a former wildland firefighter—also debates the order of the 10 Firefighting Orders. And we glean the latest about why "rapid response research" is vital on our wildland fires, as well as insights into the public's support for our wildland fire policies.*

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On the Cover:

Spot-pattern ignition under twilight on the West Hunter Prescribed Fire on the Wenatchee National Forest, Wenatchee, WA. This photo earned second place honors in the "prescribed fire" category in Fire Management Today's *2006 photo contest. It was taken by Eli Lehmann, squad leader on the Baker River Hotshot Crew, Mount Baker–Snoqualmie National Forest, Concrete, WA. (See article beginning on page 59 for all of the 2006 photo contest winners and their photos.)*

For a discussion of the complexities surrounding wildland fire use and prescribed burning, see the articles beginning on page 4.

The USDA Forest Service's Fire and Aviation Management Staff has adopted a logo reflecting three central principles of wildland fire management:

- *Innovation:* We will respect and value thinking minds, voices, and thoughts of those that challenge the status quo while focusing on the greater good.
- *Execution:* We will do what we say we will do. Achieving program objectives, improving diversity, and accomplishing targets are essential to our credibility.
- *Discipline:* What we do, we will do well. Fiscal, managerial, and operational discipline are at the core of our ability to fulfill our mission.

Firefighter and public safety is our first priority.

Contents

Short Features

Fire on the Land – Probing the Challenges and Opportunities

This issue of *Fire Management Today* provides a series of articles that describe and probe the challenges and opportunities associated with both elements of "fire use"—prescribed fire and wildland fire use (see sidebar).

We cover everything from the hurdles that confronted the USDA Forest Service's first wildland fire use program managed *outside* the wilderness on the Kaibab National Forest, to a description of the various—ground-truthed—common denominators for high-performance prescribed fire programs.

One of this issue's articles tells the story of how Klamath National Forest fire managers wanted to authorize a wildland fire use response on a new fire burning out in the remote reaches of the rugged Marble Mountain Wilderness. But they couldn't be certain it was lightning caused. Because of firefighter safety and long-term commitment of resources and expenditure concerns, they didn't want to initiate a suppression response. Unfortunately, it appeared to be their only option. In the end, however, they are able to manage this incident—the Wooley Fire—under the appropriate management response. It's an interesting tale of success.

This issue also explores everything from an enlightening examination of potential "weak signals" and "early warning signs" mined from an analysis of prescribed fire escape reviews, to the 2005 wildland fire use complex in Montana/Idaho that claimed a 4-million acre (1,618,749 ha) "mega" maximum management area. How did they do it? Keep reading.

Wildland fire use articles begin on page 5, followed by the prescribed fire coverage on page 38. ■

Fire Use

"Fire use," a major program element of wildland fire management, includes both wildland fire use and prescribed fire applications.

Wildland Fire Use

"Wildland fire use" is the application of the appropriate management response to naturally ignited (lightning) wildland fires to accomplish specific resource management objectives in predefined, designated areas outlined in Fire Management Plans.

Wildland fire use provides very low cost opportunities for achieving hazard reduction and other resource benefits while reducing large fire suppression costs.

Prescribed Fires

"Prescribed fires" are any fires ignited by management actions to meet specific objectives. A written, approved prescribed fire plan must exist, and National Environmental Policy Act (NEPA) requirements—where applicable—must be met, prior to ignition.

Prescribed fire has been the dominant treatment method for National Fire Plan implementation. It serves as a hazard reduction tool while restoring key ecosystem processes, including everything from nutrient cycling to insect and disease regulation.

Increasing the resistance to severe fire effects—another success story. The 1995 lightning-started Mill Creek Wildland Fire Use Fire (then known as a "prescribed natural fire")—shown here—on the Pacific Northwest Region's Deschutes National Forest, successfully reduced fuel loadings in the Mill Creek Wilderness. Six years later, the 2001 Hash Rock Fire's intensity and rate-of-spread was greatly reduced when this wildfire moved into the Mill Creek Wildland Fire Use Fire's previously burned areas. Photo: Tom Iraci, USDA Forest Service, Pacific Northwest Region, Regional Office, Portland, OR, 1995.

Forest Service Wildland Fire Use Program Is Expanding

Tim Sexton

Wildland fire use (WFU) is an expanding program that enables fire managers to achieve resource benefits from natural ignitions and reduce the cost of aggressive suppression actions which, otherwise, would have been taken.

Wildland fire use was first implemented in northern Idaho wilderness areas by the USDA Forest Service in 1972. (The USDI National Park Service had first implemented WFU in California in 1968.) The program—introduced in wilderness areas—developed cautiously and remained relatively small during the 1970s and 1980s. The 1988 Yellowstone Fire controversy caused the Forest Service to evaluate the risks and benefits of its WFU program.

This evaluation determined that while the program was sound, forest WFU plans needed to be improved to reduce risks and to enable better achievement of resource benefits.

During the 1990s, existing WFU plans were revised and many forests that had not previously allowed WFU developed plans that authorized this management tool. The average annual burned area increased from about 13,000 acres (5,261 ha) during the 1970s and

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The 1988 Yellowstone Fire controversy caused the USDA Forest Service to evaluate the risks and benefits of its wildland fire use program.

The 2005 Dragon Complex Wildland Fire Use Incident. Photo: Sharon Hood, USDA Forest Service, Rocky Mountain Research Station, 2005.

Wildland Fire Use Effects

Colin Hardy (pictured above), project leader of the Fire Behavior Research Work Unit, Missoula Fire Sciences Laboratory, Missoula, MT, presents the "Rapid Response Research" operations plan to the incident management team on the 2005 Dragon Complex Wildland Fire Use Incident on the North Rim of the Grand Canyon, AZ. (For more information on the benefits of wildland fire use in the Grand Canyon, see article beginning on page 21.)

Rapid Response Research is the process by which researchers collect data, either on active fires or immediately after fire occurrence. This important undertaking provides real-time information, useful data, and improved tools for managers.

Rapid Response Researach can encompass fire ecology, burn severity, fire behavior, firefighter safety, emissions, erosion, vegetation response, remote sensing, and a multitude of various fire-related topics. (An in-depth article on Rapid Response Research will be featured in the forthcoming winter issue of *Fire Management Today.)*

80s to more than 33,000 acres (13,355 ha) during the 1990s.

Starting in 2001, after the National Fire Plan was initiated, a significant increase in WFU accomplishment occurred. From 2001 through 2005, the average annual area burned was 111,985 acres (37,454 ha).

Wildland fire use outside of wilderness areas is relatively new. Prior to 2004, only a few forests (mostly in Arizona and Utah) had authorized WFU outside of wilderness areas.

After the National Fire Plan was initiated, a significant increase in wildland fire use accomplishment occurred.

Across the country, just a few small fires had actually been managed as WFU fires through 2004. In 2005, about 30 percent of the area burned under WFU strategies occurred outside of wilderness.

Fire management plans completed in December 2004 greatly increased the area available for WFU outside of wilderness areas. In 2005, about 25 percent of Forest Service lands had planning in place to allow WFU. As new fire management plans in progress are completed, this percentage should increase significantly during the next 2 years. ■

USDA Forest Service Wildland Fire Use History

Year	WFUs	Acres
1972-1989 totals	155	220,007
1972-1989 annual average	**9.1**	**12,942**
1990	35	1,965
1991	68	2,272
1992	71	2,620
1993	29	32,486
1994	47	2,194
1995	82	48,671
1996	105	132,379
1997	150	32,873
1998	169	53,190
1999	531	51,976
2000	60	5,159
1990-2000 annual average	122	33,253
2001	92	28,544
2002	82	36,208
2003	185	161,139
2004	156	38,655
2005	311	295,380
2001-2005 annual average	**165**	**111,985**

USDA Forest Service – Area Available for Wildland Fire Use

Region	Forests/Units	Total National Forest System Acres	National Forest System Acres Approved in FMP for WFU
1	13	25,441,151	5,723,000
2	11	22,082,077	6,798,000
3	11	20,705,347	10,547,000
4	13	32,171,000	17,330,000
5	17	20,151,340	4,368,000
6	18	24,732,174	1,784,000
8	15	13,123,629	0
9	17	11,907,106	1,000,000
10	2	21,973,662	0
Total	117	192,287,486	47,550,000
Percent of total area available for wildland fire use 25%			

In 2006, the Southern Region amended plans to allow WFU in more than 6.8 million acres (2,751,874 ha) of national forest lands. The region implemented its first WFU on the Ouachita National Forest in Arkansas in June and July of 2006. The Sulpher Mountain WFU burned almost 4,000 acres (1,619 ha).

The Changing Face of Wildland Fire Use

G. Thomas Zimmerman and Richard Lasko

For more than three decades, public and management support has increased for a fire management strategy that allows naturally ignited wildland fire to accomplish resource benefits.

Initially limited by funding, uncertain public support, and agency reluctance—and confined almost exclusively to wilderness and national parks—wildland fire use (WFU) is now emerging as a strongly supported and endorsed component of wildland fire management.

Expectations that all wildland fires can and should be immediately suppressed are changing. For the most part, this is most likely due to the realization that the following realities make fire exclusion a daunting and undesirable goal:

- Wildland fire workforce limitations,
- Safety concerns,
- Fiscal constraints, and
- Fire behavior characteristics.

Increased understanding of the ecological role of fire and the detrimental effects of universal fire exclusion require the inclusion of WFU as an integral element of a sound fire management program.

> *"The application of the appropriate management response to naturally ignited wildland fires to accomplish specific resource management objectives in predefined areas designated in Fire Management Plans."*
>
> –Wildland fire use as defined in the Federal Wildland Fire Management Policy

Greater Understanding

Strong advocacy from management, employees, the scientific community, policymakers, and the public for using wildland fire to achieve beneficial purposes is allowing for significant program evolution. Wildland fire use has moved beyond the confines of remote, inaccessible areas. It is expanding across an increasing variety of land use situations.

> Early prescribed natural fire efforts were tacitly supported, limited in extent, and carried out under close scrutiny.

In the 1990s, redefinition of national fire management policy changed the program name from "prescribed natural fire" to "wildland fire use"—with little change in objectives and management intent. But, within a few years of establishing WFU, a greater understanding of the strategy, an improved definition of management procedures, and an increase in application opportunities occurred.

During the last 8 years, more programmatic change has been associated with using wildland fire for resource benefits than in the previous three decades. The following is a summary of this WFU program emergence and expansion.

Prescribed National Fire – Program Emergence

Ever since the agency's program changed from "fire control" to "fire management," wildland fire has been used by land managers in varying degrees to accomplish ecological benefits through both prescribed natural fire and WFU.

Prescribed natural fire (PNF)—historically limited to wilderness applications—was utilized from 1970 to 1997. This strategy was a management application defined by policy as *"the use of naturally ignited wildland fires to accomplish beneficial objectives within a set of predetermined prescriptive criteria."* At the time PNF was initiated, compared to the longstanding historical emphasis on fire control, it was revolutionary. Early efforts were tacitly supported, limited in extent, and carried out under close scrutiny.

Tom Zimmerman is Director of Fire and Aviation Management for the USDA Forest Service, Southwestern Region, Albuquerque, NM; Richard Lasko is strategic fuels planner for the USDA Forest Service, Fire and Aviation Management, Washington, DC.

The initial PNF pioneers established a solid foundation for future innovations and use of wildland fire. Twenty-seven years of experience in managing fire in wilderness led to extensions of planning processes and implementation techniques and increased abilities to successfully manage risk. As a result, PNF became a proven technique to meet wilderness and ecological objectives that became widely accepted over time.

> Wildland fire use has moved beyond the confines of remote, inaccessible areas. It is expanding across an increasing variety of land use situations.

Wildland Fire Use – Program Evolution

Wildland fire use, defined through the 1995 Federal Wildland Fire Management Policy, has been utilized since 1998: *"The application of the appropriate management response to naturally ignited wildland fires to accomplish specific resource management objectives in predefined areas designated in Fire Management Plans* (USDA/USDI 2005)."

Wildland fire use realizes beneficial ecologic effects from wildland fire. Other appropriate management responses, however, are focused on countering or preventing adverse effects from *unwanted* wildland fire.

While few differences exist between PNF and WFU in their objectives, substantial variation between the two can be found in:

- Policy requirements,
- Programmatic planning requirements,
- Implementation procedures, and
- Fiscal authorizations (Zimmerman and Bunnell 2001).

While the WFU program developed from an initial focus on sustaining ecological and wilderness values, WFU applications today are moving beyond wilderness into managed lands. These treatments are transitioning from a wilderness-only practice to potential application across a variety of land use situations.

The evolution of the program to include implementation of WFU in nonwilderness is predicated on the acknowledgement of the inseparability—and equal importance—of ecologic, social, and economic needs and requirements.

Management Challenges

The emerging WFU management landscape still presents those fundamental challenges associated with managing an unfettered fire event from start to finish. Moreover, this management landscape now embraces even more concerns, including:

- Size constraints as defined by smaller maximum manageable areas,
- The presence of private lands,
- Socioeconomic considerations,
- Threatened and endangered species protection needs,
- Smoke management, and
- The presence of recreational and urban developments.

> During the last 8 years more programmatic change has been associated with using wildland fire for resource benefits than in the previous three decades.

Managing wildland fire in nonwilderness settings, while conducted on a small scale since the late 1990s, has yet to receive extensive public endorsement. With any new process, practice, or substantial change, real or perceived management failures can potentially limit WFU implementation.

As the focus expands beyond wilderness, mitigating emerging challenges will require continued evolution of policy and implementation procedures, as well as increased public involvement in planning and implementation. These challenges can be successfully addressed through the development and implementation of clear direction and procedures that are thoroughly understood by all who implement the program.

Significant Evolution

While a variety of constraints limited PNF application for more than two decades, WFU has undergone significant evolution in a very short

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Prescribed Natural Fire and Wildland Fire Use – A Comparison of Management Considerations and Practices

Management Consideration	What's Old	What's New
Objectives	Restoration of fire as a natural process in wilderness.	Restoration and maintenance of ecosystems, fuel reduction, and improved protection capability by lessening extent, spread, and behavior of future wildland fires.
Land Use Situation	Wilderness and national park-only.	All land use situations where feasible.
Scale	Size mattered. Fires were confined to large wildernesses and national parks so that fire growth and chances for spread toward values needing protection was low. Fires burned in all sizes—from very small to relatively large. Size and time were the primary mitigation measures used to ensure the fire remained within the desired area.	Size doesn't matter. Fires of all sizes are managed. wildland fire use (WFU) implementation in non-wilderness will—by necessity—frequently, but not always, be implemented on a smaller scale than in wilderness. Intensive planning, long-term risk assessment, identification of potential threats, and development and application of mitigation actions all ensure fires remain within desired parameters.
Fiscal Authorizations and Cost Containment	Finite allocated fund accounts were in place. The small size of these accounts led to frequent exhaustion of funds prior to the end of fire season and missed opportunities every year. Cost containment was a significant topic of concern by agency administrators regarding management of prescribed natural fire (PNF) due to limited availability of funds.	Authority to use emergency fire funds. Cost containment continues to be an important management concern. But it is no longer a case of limited fund availability for WFU accounts. Cost containment is a concern for all fire management program components. WFU is subject to agency cost containment goals, total fire management funding limits, and the propensity for rapidly escalating expenditures on fires. Alternatively, WFU application is viewed as a potential cost saving alternative to long-duration, large-fire suppression events.
Planning Procedures	A PNF plan that was agency-specific was used as the planning document. Implementation was neither guided nor documented by a specific document.	A Wildland Fire Implementation Plan is used to complete progressively developed stages of planning and to guide document implementation. This document is established as interagency policy. Instructions are provided in the *Wildland Fire Use: Implementation Procedures Reference Guide,* published in 1998 and revised and updated in 2005 and 2006 (USDA/USDI 2005).

Continued on next page

Management Consideration	What's Old	What's New
Planning Area Reference	A maximum allowable perimeter was initially used as the geographic limits for a PNF. For clarification in understanding and application, this was changed to a maximum manageable area (MMA) in the early 1990s. Early MMA perimeters relied primarily on size as a requirement and were considered a prescriptive element. If fires exceeded this perimeter line, they were considered out of prescription and were declared a wildfire—with an accompanying suppression response.	MMAs have no size limitations. MMAs are designed to be consistent with the set of circumstances surrounding each fire situation. Managing WFU in smaller landscapes creates numerous situations where the fire is immediately adjacent to a MMA. These situations will be more frequent in non-wilderness WFU applications—but are not inappropriate or undesirable. MMAs are used as a planning area reference for assessing threats from a fire, completing long-term risk assessments, and developing mitigation actions that can be implemented between the fire and the value threatened. MMAs now have much greater flexibility in their application. They are not a strict prescription element and can be changed in response to changing fire situations.
Planning and Implementation Qualifications	No qualifications—aside from standard Incident Command System positions identified by agencies for wildfire suppression—existed for PNF. At the time of the 1995 policy change from PNF to WFU, a PNF manager had been created for this purpose.	After the transition from PNF to WFU, WFU became a part of wildland fire and not prescribed fire. As a result, the PNF manager position was dropped and a fire use manager (FUMA) position was created for dedicated use on WFU events. In recent years, the FUMA has expanded into two types: a fire use manager type 1 (FUM1) and a fire use manager type 2 (FUM2).
Public Perceptions	The public was generally uncertain of purpose, actions, and outcome. Some people were sometimes contentious and viewed fires as "let-burn" management. Agencies did not always communicate proactive public education messages that could alleviate these perceptions. At times, these misperceptions were exacerbated by media representations of fire situations.	While the public exhibits higher levels of support and understanding, viewing WFU as an acceptable fire management practice, the objectives, associated risks, planning procedures, implementation practices, and potential tradeoffs of using wildland fire are *still* not clearly understood and are sometimes not well accepted. Correspondingly, some people are resistant to accept WFU as a legitimate fire management option.
Management Perceptions	Managers remained cautious, viewed all fires as high risk, were uncertain of the outcome, and struggled with acceptance. Implementation was constrained as higher levels of national preparedness were reached.	As understanding of risk assessment and risk mitigation processes increase, many Federal managers are generally supportive with increased tolerance for risk. Not all State and local governments accept WFU as an acceptable practice. WFU implementation occurs even at the highest levels of national preparedness.

Management Consideration	What's Old	What's New
Mitigation Actions	Less mitigation utilized. In addition to the amount of mitigation actions, the kind of actions also varied. Wilderness fire implementation had a high focus on monitoring, mapping, and closures with some on-the-ground holding or checking actions. "Hands on" actions were viewed as failures of policy or implementation.	Management of WFU does not have a strict requirement of no on-the-ground action. In fact, smaller area management actions must be commensurate with values to be protected. Nonwilderness fires are proving, in general, to present a slightly higher risk level. More management actions are often necessary in these areas. Nonwilderness fires frequently require more intense containment actions. These types of focused and more intense management actions—seemingly inconsistent with the original philosophy of restoring fire to wilderness—are not inconsistent with objectives of ecosystem restoration and maintenance in all land use situations.
Private Lands	Private lands were not included in PNF activities. In previous applications of the use of wildland fire, it was a standard practice to protect private lands and, in the process, prevent fire from burning outside of Federal lands.	In recent years, a growing interest has surfaced from private landowners wanting to be included in WFU applications. Where practicable, arrangements have been—or are being—made to include private lands. This is reducing overall complexity, lowering overall implementation costs, and building public and community support for WFU.
Social, Economic Concerns	Few social, economic concerns were associated with PNF implementation in large wildernesses. Impacts of closures or restrictions to outfitters, hunters, campers, hikers, or other outdoor recreationists resulted from fire activity. Personal safety issues were sometimes encountered with PNF in national parks.	The same issues that confronted PNF still exist for WFU with additional social and economic concerns. Wildland fires in nonwilderness increase the scope of economic impacts. Examples include impacts to livestock operators, damage to public and private fences, protection of threatened and endangered species, threats to community values, and damage to harvestable timber. Additional mitigation actions are necessary and can involve movement of livestock to alternative areas, delaying or checking and preventing the spread of fire through, or into, a specific area.
Smoke Management – Air Quality	Smoke management concerns have always existed and implementation activities accounted for and mitigated these to the greatest extent possible. Impacts were limited to a small number of geographic locales.	Smoke management impacts are receiving greater attention than ever before. The expansion of the program potentially increases the number of fires and cumulative smoke production. With geographic expansion, coordination among land management agencies, State air quality agencies, and local air quality boards has increased.

Continued on next page

Management Consideration	What's Old	What's New
Post-Fire Management – Invasive Species	Invasive species spread and intensification during PNF applications were viewed as a far less important problem than they are today. Few actions were taken to address this problem.	Invasive species have become a serious threat on recently disturbed sites. In many areas, managed fire can be beneficial in the long term. But on some sites, short-term protection against invasive species (until native plants are established) is needed and can be desirable. In addition, concerns about increasing fire hazard due to the domination of a site by invasive species are becoming more prevalent.

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time. It has literally spread like wildfire across administrative units, land use situations, and jurisdictions. It is receiving the highest level of support and advocacy within Federal wildland fire management.

> The initial prescribed natural fire pioneers established a solid foundation for future innovations and use of wildland fire.

Wildland fire use is quickly becoming a viable and well-accepted management strategy for directly achieving vital land management objectives of ecosystem restoration and maintenance—which indirectly supports community protection. A program proven to be an effective management practice in wilderness is now expanding into nonwilderness situations with highly successful results.

Even though success has been achieved, WFU may not be suitable in all nonwilderness situations. In some cases, prescribed fire or mechanical treatments may best meet resource objectives.

An expanding WFU program brings:

- Higher complexity,
- An increased need for on-the-ground mitigation actions,
- The development of a larger cadre of skilled managers, and
- Escalating public concern.

Whenever applied, the use of wildland fire must achieve land management objectives and remain anchored within specific bounds of operability.

> With any new process, practice, or substantial change, real or perceived management failures can potentially limit wildland fire use implementation.

In summary, successful WFU management must be predicated on skilled managers who implement actions that meet current program requirements—coupled with continued and proactive collaboration among Federal and State agencies, private organizations, and private landowners.

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Nonwilderness Wildland Fire Use Is Born on Kaibab National Forest

David P. Mills

While the very first outside-the-wilderness flames of the USDA Forest Service's wildland fire use (WFU) program burned on the Kaibab National Forest in the spring of 2003, the planning for that unprecedented undertaking began a full decade before.

During the early 1990s, many of us in wildland fire management were interested in the changing relationship between humans and wildfire. We listened carefully to Dr. Wally Covington and others at Northern Arizona University whose studies indicated an ecosystem out of balance due to fire exclusion.

We heard Steve Servis and Paul Boucher at the Gila National Forest explain their efforts to reestablish a low-intensity–high-frequency fire regime using appropriate management response. We read Stephen Pyne's account of *Fire in America* (Pyne 1982) and other papers that examined evidence of aboriginal fire use as a landscape management tool.

We noticed how our increasing effectiveness at suppressing small wildfires meant that unmanageable and highly destructive fires ultimately moved across the landscape. We saw how fire suppression efforts often did more damage than the fire itself—as we also questioned the high costs of aggressive fire suppression.

We saw how fire suppression efforts often did more damage than the fire itself—as we also questioned the high costs of aggressive fire suppression.

At the same time, we watched our neighbors at Grand Canyon National Park continue to develop their fire use program. During these years, many other fire managers, researchers, writers, and speakers provided inspiration and leadership for our evolving fire use perspective.

Skeptics Voice Concern

With encouragement from the Forest Service Southwestern Regional Office, the Kaibab National Forest began the process of composing a forest-wide WFU plan, seeking public involvement in 1996. Four years later, in 2000, it was finally signed by the forest supervisor and ready for implementation.

The 250-acre (100 ha) Antelope Wildland Fire Use Fire, in 2003, was one of the first five wildland fire use fires on nonwilderness USDA Forest Service lands—all occurring that year on the Kaibab National Forest. Photo: USDA Forest Service, 2003.

David Mills is the assistant fire management officer and fire use manager for the USDA Forest Service, Tusayan Ranger District, Kaibab National Forest, Grand Canyon, AZ.

During this process, many people wondered if such a program could actually work. Even some members of the wildland fire management community found it difficult to imagine allowing wildfires to burn outside of wilderness boundaries—especially on a national forest with:

- High recreational use,
- Ranching,
- Private inholdings,
- Scattered communities and subdivisions,
- Historic and prehistoric archaeological sites,
- Wildlife concerns, and
- Smoke-sensitive areas such as Grand Canyon National Park.

Gradually, concerns and issues were resolved. By 2003, the Kaibab National Forest's WFU plan was implemented.

Successful Treatments

Starting that spring, decisions were made to use a total of five lightning-started wildfires for resource benefits. The North Kaibab Ranger District gained the distinction of managing the first WFU on the Kaibab National Forest. That fire, named the South Rock WFU Fire, grew to 15 acres (6 ha).

After fire season peaked and potential forest fire conditions were less volatile, the Tusayan Ranger District continued this Forest Service's national christening of WFU implementation outside wilderness areas.

In early August, the Horse WFU Fire burned about 150 acres (60 ha). At that time, this seemed to be a major accomplishment. A few weeks later on the Tusayan District, the Antelope WFU Fire burned almost 250 acres (100 ha). We were

The lightning-triggered Horse Wildland Fire Use Fire—due to fairly high relative humidity and fuel moisture following the 2003 summer rains—burned with low intensity. Photo: USDA Forest Service, 2003.

Even some members of the wildland fire management community found it difficult to imagine allowing wildfires to burn outside of wilderness boundaries.

ecstatic to have successfully treated nearly 400 acres (162 ha)—watching fire function once again within northern Arizona's fire-adapted ponderosa pine ecosystem.

After the arrival of summer rains, the North Kaibab Ranger District together with the Tusayan Ranger District had successfully managed a total of five WFU fires.

Confidence Is High

The success of the 2003 season was followed by a more ambitious year in 2004. More than 4,000 acres (1,620 ha) were treated on the Tusayan Ranger District. A few hundred additional WFU acres were also accomplished on the Kaibab's Williams Ranger District.

Because the spring of 2005 ushered in some relief from the drier-than-normal conditions, the decision was made to begin considering WFU fires with that year's earliest lightning strikes. This resulted in the treatment of more than 8,000 acres (3,240 ha) on the Tusayan Ranger District—with no serious smoke impacts and very little high-severity burning.

Of course, Kaibab National Forest fire managers realize that an increase in WFU acres each year—such as occurred the past few seasons—is not sustainable. Nonetheless, much has been learned about this necessary application of fire on the landscape. Simultaneously, confidence in the WFU program from resource specialists—as well as among the local public—is high.

Even with the current return of drier conditions, we expect to continue the use of this new and exciting tool.

And while these more restrictive droughty conditions in 2006 might not provide us with as many opportunities to manage WFUs as we received last year, we are, nonetheless, still confident that the roots of a viable, long-term WFU program on this forest have successfully taken hold.

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Lessons Learned from First Nonwilderness Wildland Fire Use Fires

David P. Mills

As with any new approach, in planning and implementing some of this country's first wildland fire use (WFU)—nonwilderness—fires on the Kaibab National Forest, we have found some things that work well.

And some that don't.

Perhaps one of the most important lessons is that the WFU program requires participation and support from internal personnel as well as local residents and neighboring agencies.

Fire information has to be readily available, timely, and accurate. Concerns or complaints need to be heard and addressed quickly. In our experience, many local residents became interested in the program. We quickly realized that it is worth the effort and time to provide opportunities for the public to see, for themselves, the results of our burning activities.

Inside Tips

For WFU to be successful on the Kaibab National Forest, we have chosen lightning starts that occur in areas where containment is not difficult. Within our local topography—given the prevailing southwest winds—this usually means to the north and east of a fire start.

Inside ponderosa pine stands, we strive to establish backing fire as the primary movement. This decreases the possibility for undesirable effects or escapes outside of our planned perimeter. As more of our forest experiences this return of fire, events in which a head fire is acceptable are becoming more numerous.

> The WFU program requires participation and support from internal personnel as well as local residents and neighboring agencies.

On the other hand, we have also discovered that fire starts within areas dominated by piñyon and juniper are less likely to be productive—*unless* fire behavior occurs at a higher intensity. This, in turn, means that:

> Incentives for wildland fire use need to be built from a vision of restoring forest health.

- Containment can be more difficult,
- Fire effects can be more dramatic—and possibly undesirable, and
- The potential for damaging sensitive features (such as archeology, wildlife habitat, and airshed) is more likely.

So far, our WFU acres in piñyon and juniper woodlands have been minimal.

Five Topmost Observations

A list of our WFU program's lessons learned could fill several pages. I will therefore share what I feel are the most important observations that we've made on the Kaibab National Forest:

1. WFU fire results in a mosaic that can range from unburned and low-intensity patches to high-intensity areas—with size depending on the fire environment (fuels, topography, and weather).
2. Reasons for suppressing a fire (risks, costs, safety) are still more numerous than reasons for allowing it to grow. Incentives for WFU need to be built from a vision of restoring forest health.
3. One of the biggest challenges for fire practitioners is to step back and watch. We have a tendency to want to speed things up or slow them down.
4. In addition to support from line officers, specialists and researchers, a viable WFU program *must* have the support of the local public.
5. Some aspects of risk management require courage. True success comes from practice.

Perhaps the most beneficial aspect of implementing WFU on the Kaibab National Forest has been the opportunity for all of us to participate in a new and exciting program of wildland fire management that results in a healthier forest, improved skills, and a lot of pride in our work.

Wildland Fire Use Success Stories

David P. Mills

Several times during the 2005 fire season on the Kaibab National Forest's Tusayan Ranger District, Grand Canyon, AZ, wildfire burned through areas that had been previously treated by burning or mechanical thinning, or both. Each time, these prior treatments helped to reduce wildfire intensity and severity.

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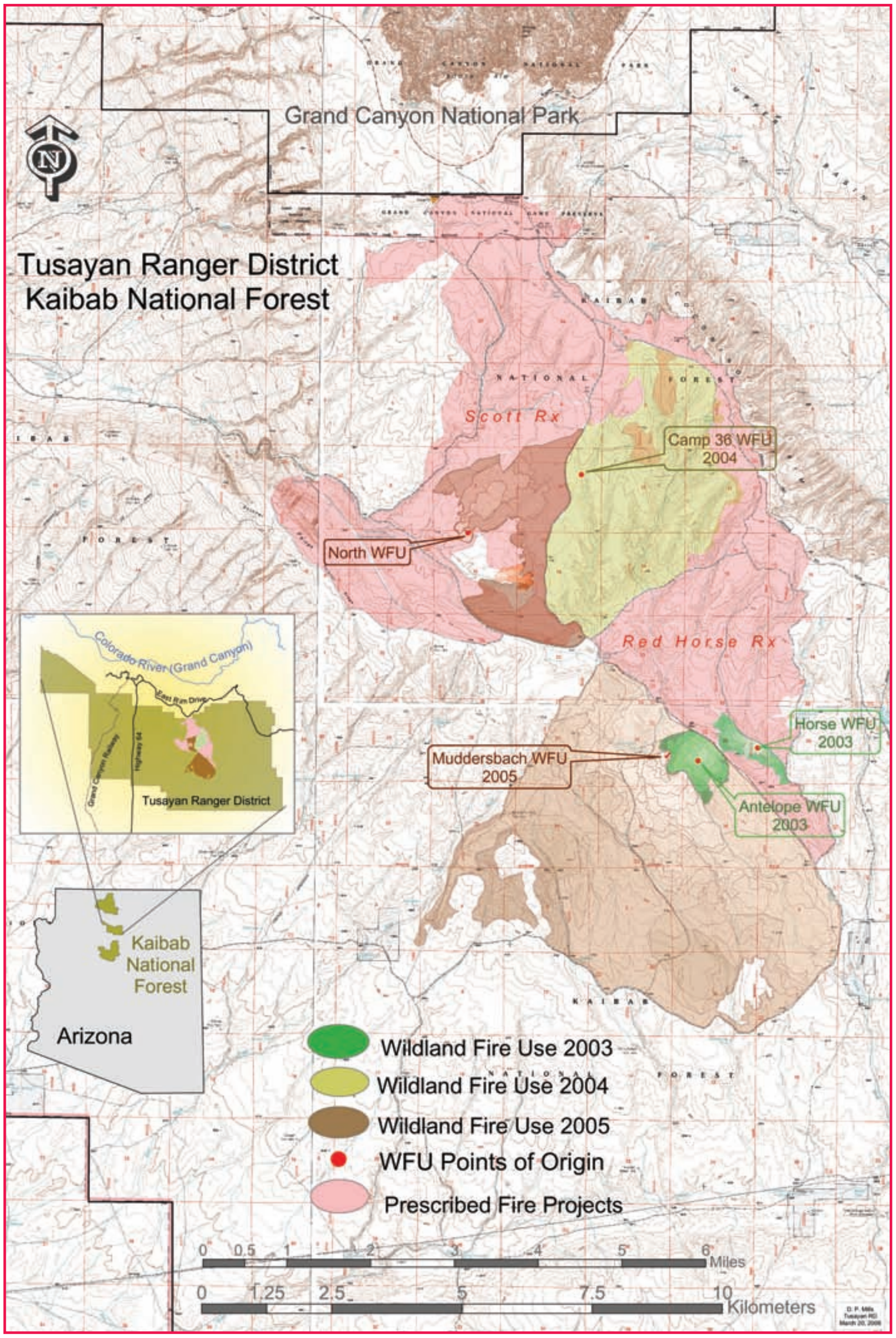
> Even though it was dry and hot, these spot fires were very easy to contain and extinguish with hand tools.

Ideally—as was demonstrated in 2005 on the Tusayan Ranger District—a mix of mechanical thinning and prescribed burning can provide stand characteristics that will allow wildfire to move through the forest—even in the middle of fire season—without causing excessive damage to ecosystem components.

Even where mechanical treatments have not been implemented, prescribed burning or wildland fire use (WFU) treatments that occur during the later and cooler part of

Fire managers correctly predicted that the Muddersbach Wildland Fire Use Fire on the Kaibab National Forest would burn with high intensity until it moved into the surrounding areas that had previously been treated with fire use. Photo: USDA Forest Service, 2005.



the fire season begins the process of reducing fuels and moving ecosystem conditions closer to those that provide resilience for in-season wildfire occurrence.

It could be argued that low-intensity burning may not sufficiently reduce tree density in grossly overstocked stands. However, with frequent return intervals (less than 7 years), fire intensity can increase *without* severe consequences—resulting in a gradual thinning of trees by natural means.

The following three events from these 2005 occurrences in Arizona demonstrate these beneficial effects that previous fuel treatments in ponderosa pine forests can have on current fires.

Once again, previous burning appeared to significantly reduce susceptibility to severe fire effects.

Mixed Treatments

In the mid-1990s, approximately 50,000 acres (20,250 ha) of the Tusayan Ranger District were mechanically treated by precommercial thinning and limited sales of saw timber. In 1997, this area was prescribe burned. Treatment prescriptions primarily involved thinning from below coupled with low-intensity burning.

These management actions left a somewhat overstocked stand of intermediate-aged ponderosa pine, scattered oak clumps, and very light grasses and forbs. Dead and down fuel loading had been reduced to less than 8 or 9 tons/acre (3 or 4 tons/ha).

In 2003, some of this area was burned again by the Horse WFU Fire. This fire was started by lightning and—due to fairly high relative humidity and fuel moisture following summer rains—burned with low intensity.

Post-fire tree mortality was therefore minimal, less than 15 percent in intermediate growth, and nearly 0 in mature and older yellow pine.

In 2005, the Muddersbach WFU Fire burned west of this area, separated by a well-traveled road. Because the Muddersbach WFU Fire burned with moderate to high intensity, numerous spot fires were ignited and burned within the area of the 2003 Horse WFU Fire.

Even though it was dry and hot—conditions that normally contribute to rapid burning with moderate resistance to control—these spot fires were very easy to contain and extinguish with hand tools.

The prior tree removal and reduction of dead and down fuels by the previous prescribed burning clearly resulted in a forest that was capable of accepting mid-season fire occurrence with few—if any—undesirable effects.

Reducing Severe Fire Effects

In 2003, in the same portion of the district—within an area that had *not* received significant mechanical treatments—the Antelope WFU Fire started burning just as the Horse WFU Fire was stalling out. While conditions were still relatively cool and humid, fire intensity was occasionally moderate due to:

> Required elements include frequent ignitions; competent fire managers; and the support of line officers, specialists, and the public.

- Dense clumps of pine reproduction—dog hair thickets with 500 to 2,000 trees per acre (1,250 to 5,000 trees per ha), measuring less than 6 inches (15 cm) in diameter;
- Overstocked intermediate growth—150 to 250 trees per acre (370 to 620 trees per ha) where research indicates presettlement conditions were 1/10 or less of this tree density range; and
- A considerably heavier fuel load of surface litter—11 to 16 tons/acre (5 to 7 tons/ha).

Within this area, while tree mortality in younger trees may have been closer to 20 percent, mortality in mature and older pines was still less than 5 percent.

The Camp 36 Wildland Fire Use (WFU) Fire proved to be a prime example of how these natural WFU fires can result in a broad mosaic of hot, cool, and unburned patches. This 3,052-acre (1,220-ha) fire burned sporadically—with a variety of effects—during the summer rains throughout August 2004. It burned with the desired low to moderate intensities through a variety of fuel types—including goshawk nesting areas. The fire accomplished several objectives, including providing a patchwork of tree clumps and openings necessary for healthy goshawk nesting and foraging. Photo: USDA Forest Service, 2004.

Two years later, the Muddersbach WFU Fire ignited just west of the Antelope WFU Fire and burned with even higher intensities. Tree stands just north of the Antelope WFU Fire that were burned by the Muddersbach WFU Fire suffered severe, stand-replacing fire intensities. All trees in one 35-acre (14-ha) area were killed.

When the Muddersbach WFU Fire started, fire managers recognized that the point of origin and prevailing winds would likely push the fire toward the previously burned Horse and Antelope WFU areas. They knew this would afford an opportunity to moderate the forward spread of the Muddersbach fire as it reburned into this area that had already been treated with fire.

For the first several days, this did prevent the Muddersbach fire from moving to the northeast. As conditions became hotter and drier, the fire moved rapidly with high intensity to the north and south around the Antelope WFU Fire area. This resulted in high intensity burning for a couple days—until the fire's forward spread was impeded by roads as well as the previously treated area of the Horse WFU Fire.

In the days that immediately followed, the fire moved through the Antelope fire site with much lower intensity and more acceptable fire effects. Once again, previous burning appeared to significantly reduce susceptibility to severe fire effects.

Moderate Fire Effects

A third area on the Tusayan Ranger District had received a combination of mechanical and prescribed burning treatments prior to the occurrence of the 1,035-acre (420-ha) North WFU Fire in 2005.

This fire burned into a portion of the previous prescribed fire project that had been burned with low intensity in various blocks from 2002 through 2003. In addition, approximately 150 acres (60 ha) had been thinned soon after the initial prescribed burning. In the spring of 2005, the area's lopped and scattered slash was reburned.

Then, in mid-June 2005, the North WFU Fire was ignited by lightning. It started in a location that allowed the fire to move with prevailing winds through these nearby previously treated stands.

As fire weather conditions moved toward the hotter end, the North WFU Fire exhibited increased fire behavior—including rapid surface runs, isolated and group torching in denser stands, and frequent spotting.

Depending on stand densities, fuel loads, and previous treatments, the North WFU Fire burned with varying intensities and effects.

Due to an almost total lack of available fine fuels, the North WFU Fire did not reburn the area of thinning slash that had been prescribed burned earlier that spring. In other parts of the burn, fire intensity was high enough to cause mortality in more than 20 percent of the intermediate-aged and younger trees. However, mortality in the older pines was rarely more than 5 percent. Most of the fire's effect—even when wind-driven—was moderate or low-intensity burning.

In summary, to achieve these beneficial fire results takes more than prior mechanical and prescribed fire treatments. Required elements include frequent ignitions; competent fire managers; and the support of line officers, specialists, and the public. ■

Wildland Fire Use Makes Headway With U.S. Fish and Wildlife Service

John Segar

While prescribed fire continues to be the U.S. Department of the Interior, Fish and Wildlife Service's preferred means for managing fuels and fire-adapted habitats—the agency started using this "tool" to manage wildlife habitat back in the 1930s—an increasing number of the service's refuges are now using wildland fire use (WFU) as a fire management strategy.

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At present, several refuges have land management and fire management plans that allow for utilizing WFU as an appropriate management response to natural wildland fires. Several other refuges are considering WFU and are updating plans to allow this fire use option as an appropriate management response.

Refuge size, flammability, and boundary defensibility are the most common reasons why more refuges have not made greater use of WFU. Refuges tend to be smaller than most other Federal land units and have a higher proportion of light, flashy fuels. This creates situations in which fires can often spread outside refuge boundaries within one burning period. In addition, many refuges are located adjacent to wildland/urban interface areas.

Refuge utilization of WFU will likely increase as fuel treatments increase the defensibility of values and boundaries, adjoining landowners become more receptive to accepting WFU fires, and agency staff become more proficient in managing fires under WFU strategies. ■

The Fire Use Working Team – A Coordinated, Interagency Effort

Tim Sexton

The field of wildland fire management, always in a state of constant change, requires the integration of interdisciplinary and interagency efforts to support today's resource management programs.

> A coordinated, interagency effort is required to ensure that fire use programs are implemented in a professional and competent manner.

The use of both wildland fire use and prescribed fire to achieve agency objectives is becoming a significant wildland fire management program element.

The underlying strength of agency fire management programs is the fundamental understanding of fire behavior and fire effects' roles in resource management decisions. Fire management is as much a philosophy and attitude toward the land as it is an action program.

The rationale for understanding fire as an ecosystem process must be transferred to all resource management activities. This transfer often occurs when we employ fire as a tool.

Emphasis and Concerns

The ignition of wildland fuels—by land managers or natural causes—to achieve specific management objectives is receiving continued emphasis from fire management specialists, land managers, politicians, and the general public. Yet, at the same time that fire use programs are increasing, concerns are being expressed regarding:

- Associated smoke management problems,
- Escape fires,
- Funding, and
- The health and safety of employees and the general public.

> Fire management is as much a philosophy and attitude toward the land as it is an action program.

A coordinated, interagency effort is therefore required to ensure that fire use programs are implemented in a professional and competent manner. The Fire Use Working Team is 1 of 10 chartered working teams of the National Wildfire Coordinating Group. The mission of this working team is to:

- Coordinate and advocate the use of wildland fire to achieve land management objectives,
- Promote a greater understanding of the role of wildland fire and its effects, and
- Recommend and maintain a fire use qualification system. ■

Fire Use Working Team

Dick Bahr, U.S. Department of the Interior, National Park Service
Dave Mueller, U.S. Department of the Interior, Bureau of Land Management
Jeff Stephens, California Department of Forestry and Fire Protection
John Segar, U.S. Department of the Interior, U.S. Fish and Wildlife Service
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Tim Sexton, USDA Forest Service (Fire Operations)
Kirk Rowdabaugh, National Wildfire Coordinating Group Liaison

Fire Use Working Team Advisors

Cyndie Hogg, National Advanced Fire and Resource Institute
Woody Kessler, National Fire and Aviation Training Support

Tim Sexton, coordinator for this special "fire use" issue of Fire Management Today, *is the fire use program manager for the USDA Forest Service, Fire and Aviation Management, Washington Office, National Interagency Fire Center, Boise, ID.*

Meeting Forest Ecosystem Objectives with Wildland Fire Use

Daniel C. Laughlin and Peter Z. Fulé

The U.S. Department of the Interior (USDI), National Park Service has been a leading agency in the application of both prescribed fire and wildland fire use (WFU) for resource benefits (van Wagtendonk 1991; Stephens and Ruth 2005).

In 2003, Grand Canyon National Park fire use modules managed the largest and most complex group of WFU fires in the park's history, totaling more than 19,000 acres (7,690 ha) of North Rim old-growth forests that span from 7,300 to 8,800 feet (2,225 to 2,682 m) in elevation.

Since 1997, 202 permanent plots have been established in Grand Canyon National Park to study the relationships between:

- Fire history,
- Forest structure,
- Fuel load, and
- Understory plant communities.

The 2003 North Rim fires burned 83 plots across the entire elevation range, providing an excellent opportunity to evaluate low- to mixed-severity fire effects.

The North Rim of Grand Canyon National Park contains thousands of acres of unharvested old-growth forests that range from open ponderosa pine groves to dense spruce–fir–aspen stands. These stands provide researchers a unique setting to study the role of fire in forested ecosystems.

> Old-growth forests provide researchers a unique setting to study the role of fire in forested ecosystems.

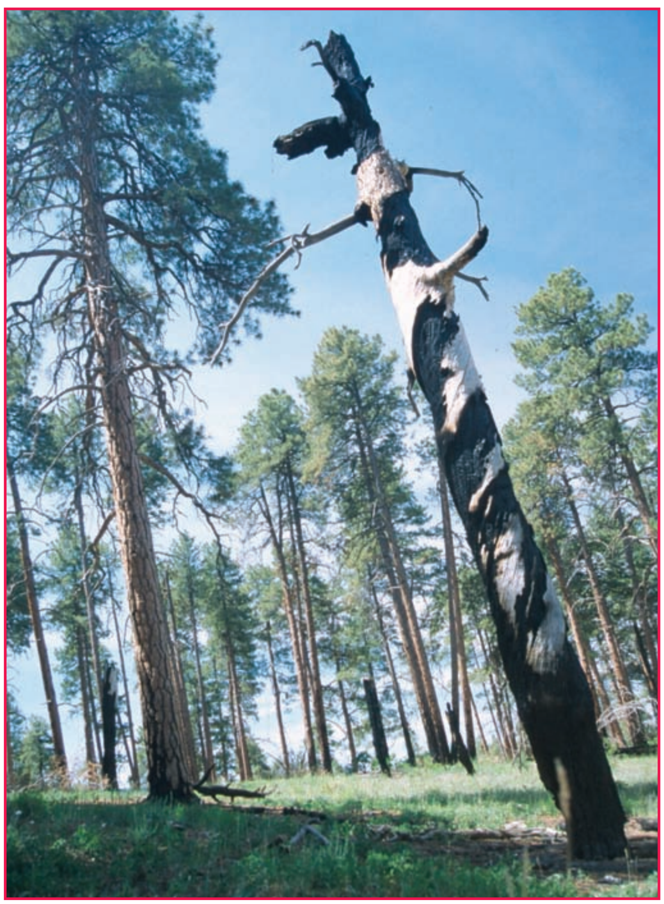
Daniel Laughlin is a plant ecologist at the Ecological Restoration Institute and graduate student in the School of Forestry, and Peter Fulé is an associate professor in the School of Forestry and associate director of the Ecological Restoration Institute, Northern Arizona University, Flagstaff, AZ.

Three WFU Fires

In 2003, three lightning-initiated fires were managed by the USDI National Park Service as WFU fires to meet resource objectives:

1. **The Powell Fire.** This low-intensity surface fire occurred in lower montane ponderosa pine-Gambel oak forest (see photo), which has burned naturally several times in the past century (Fulé and others 2002, 2003a).

2. **The Rose/Big Fire Complex.** This was an intense surface fire



Old-growth ponderosa pine trees and standing snag on the recently burned Powell Plateau, Grand Canyon National Park. Photo: D. Laughlin, 2004.

with high scorching in upper montane mixed-conifer forest, which has been invaded by fire-intolerant white firs (Fulé and others 2004).

3. **The Poplar Fire.** This was a mixed-severity fire in spruce–fir–aspen forests that have not burned in more than a century, which is not out of the historic range of fire return intervals for subalpine forests (Turner and Romme 1994; Fulé and others 2003b).

> These wildland fire use fires have important management implications for Federal land management agencies.

To evaluate fire effects—with funding from the six-agency partnership Joint Fire Science Program and the USDA Forest Service—we measured all of the permanent plots that burned in these three fires and nearby unburned reference plots. In each plot we:

- Recorded the species and diameter of trees,
- Measured fuel loads using planar transects, and
- Measured plant cover and species composition of the understory plant community.

Management Implications

These fires have important management implications for Federal

Evaluating Wildland Fire Use Fire Effects

Daniel C. Laughlin and Peter Z. Fulé

Three 2003 Grand Canyon National Park fires burned 83 plots across the park's North Rim old-growth forests that range from open ponderosa pine groves to dense spruce–fir–aspen stands at 7,300 to 8,800 feet (2,225 to 2,682 m) elevation.

Ignited by lightning, these fires were managed by the U.S. Department of the Interior (USDI) National Park Service as wildland fire use (WFU) to meet resource objectives. As outlined below, they provided an excellent opportunity to evaluate low- to mixed-severity fire effects.

Forest Structure

The low-intensity fire in the ponderosa pine forest reduced total tree densities but did not significantly reduce total basal area because small trees (less than 5 cm) were disproportionately killed. The mixed-severity fire in the spruce–fir–aspen forests reduced both density and basal area of the forest and trees across all diameter classes.

Three of the 18 plots at high elevation incurred more than 90-percent tree mortality. Our permanent plots might underrepresent the actual proportion of high-severity fire in the Poplar Fire. Across all elevations, larger trees had a higher probability of survival than small trees. Pine and Douglas-fir had a higher probability of surviving the fire than aspen, white fir, Engelmann spruce, or subalpine fir.

Fuel Load

Forest floor depth (litter + duff) declined by an average of 43 percent in the ponderosa pine forest and 64 percent in the spruce–fir–aspen forests. Fine woody debris, material less than 3 inches (7.6 cm) in diameter, was also reduced by 35 percent and 40 percent, respectively. Coarse woody debris went down by an average of 40 percent in the ponderosa pine forest and 60 percent in the spruce–fir–aspen forests.

After burning, coarse woody debris averaged 4 tons/acre (9t/ha) in the ponderosa forest and 10 tons/acre (22t/ha) in the spruce–fir–aspen forests. In contrast, unburned control sites increased in coarse woody debris loading over the same time period, reaching levels of 10 tons/acre (22t/ha) in the ponderosa forest and 21 tons/acre (47t/ha) in the spruce–fir–aspen forests.

Understory Vegetation

In ponderosa pine forests, understory plant species richness and cover increased slightly 2 years after the fire, but was not much different than unburned forest. This suggests that old-growth ponderosa pine forest plant communities are resilient to changes in plant abundance following surface fire.

land management agencies. They were successful, both in terms of logistical operations and ecological outcomes. Unless they can meet resource objectives, WFU fires are not allowed to burn.

Our study's results suggest that many key objectives were met:

- Forest densities were reduced and large old-growth trees—especially from fire-resistant species—survived the fire much better than small, younger trees;
- Forest floor depth was reduced by 43 to 64 percent and coarse woody fuels were reduced by 40 to 60 percent; and
- Native plant cover and richness were not harmed, though community composition was altered toward greater occurrence of native annual plants.

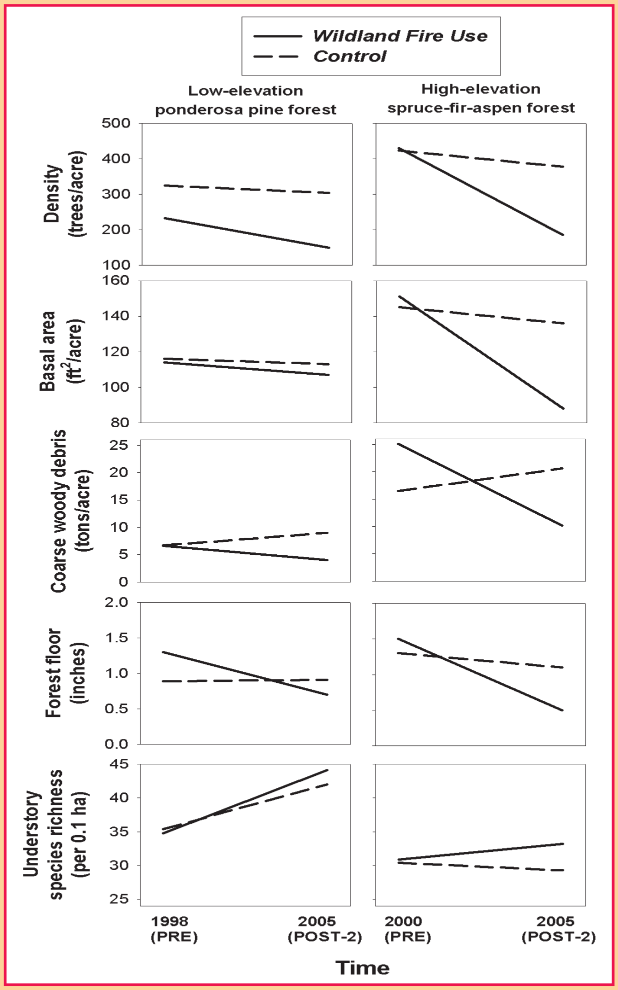
Fire effects were consistent with our general understanding of fire ecology in these systems. The low-intensity fire at low elevation killed primarily small-diameter pines and oaks, whereas the mixed-intensity fires at high elevation burned with greater severity, killing trees across all diameter classes.

Land managers often face conflicting objectives when managing for native ecosystem dynamics in a time of widespread exotic plant invasions.

The fire induced a shift in community composition toward greater occurrence of native annual forbs. The non-native annual cheatgrass (*Bromus tectorum*), which was present on Powell Plateau well before the fire, increased in frequency across the plateau after the fire.

In spruce–fir–aspen forests, understory plant richness increased slightly in the burned forests whereas richness declined in the control. Community composition shifted dramatically toward greater occurrence of native annual forbs.

Plant species loss increased with fire severity, though most losses were short-lived. This suggests that plant richness and abundance recovered rapidly after the mixed-severity fire in spruce–fir–aspen forests, but the composition of the community is still different than pre-fire conditions.



Changes in forest structure, fuel load, and plant diversity in burned and unburned ponderosa pine and spruce–fir–aspen forests before and after wildland fire use.

Some negative effects, however, also occurred. After the fire, the frequency of cheatgrass increased across the remote Powell Plateau. Cheatgrass has been noted at this site since as early as 1941 (McDougall 1941). We detected a post-fire increase in the burned plots.

Native Ecosystem Dynamics

Land managers often face conflicting objectives when managing for native ecosystem dynamics in a time of widespread exotic plant invasions (Keeley 2006). It is uncertain whether cheatgrass could significantly affect the natural fire regime in ponderosa pine forests, but it can possibly reduce native plant cover and diversity over time.

Now that fuels and forest densities have been reduced by these fires, future ignitions can be managed more easily within these burns due to reduced fire intensities and more manageable fire behavior. Fires on the North Rim have consistently met resource objectives (Fulé and others 2004; Laughlin and others 2004; Huisinga and others 2005), though non-native species invasions and the loss of some old-growth trees in mixed-severity fires are causes for continued monitoring in the park.

Future ignitions can now be managed more easily within these burns due to reduced fire intensities and more manageable fire behavior.

The Grand Canyon's never-harvested forests are an important resource for understanding relatively undisturbed forest dynamics. Based on the results of the 2003 fires, we recommend the continued use and monitoring of wildland fire in these old-growth forests where natural processes can still operate at landscape scales.

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Reexamining the Role of Lightning in the Landscape

Dana Cohen and Bob Dellinger

Lightning-ignited fire is often underestimated as a significant force on the landscape in the southern Appalachians. Some researchers assert that the dominant forest type is not conducive to large, widespread fires of natural origin, and that “cultural” (anthropogenic or human-caused) fires maintained these fire-dependent communities (Buckner, 1999).

Recent fire history data supports this assessment. In *Fire History of Great Smoky Mountains National Park, 1940-1979* (Harmon, 1981), the author notes “A total of 618 fires started in or near the Great Smoky Mountains between 1940 and 1979. The majority of these fires, both in terms of number (86.6 percent) and area burned (97.2 percent), were started by man.”

Yet in this same work, Harmon makes another note that is often overlooked: “The first lightning fire that was not extinguished by management in the Great Smoky Mountains burned 44.5 hectares (110 ac) [Polecat Ridge, 1976]. This indicated a (wildland fire use) policy will increase the mean lightning-caused fire size, but to an unknown degree.”

The 1999 Blacksmith Wildland Fire Use Fire burned 523 acres (212 ha) on the far west portion of Great Smoky Mountains National Park. Photo: Bob Dellinger, Great Smoky Mountains National Park.

> The success of wildland fire use fires raises an important question. Have we been underestimating the type of fire that shaped the landscape we are now trying to manage?

As Great Smoky Mountains National Park concludes its first decade of implementing wildland fire use (WFU) policy, it is becoming clear that the Polecat Ridge Fire was not an experimental fluke or an aberration from an extreme fire season. The success of WFU fires raises an important question. Have we been underestimating the type of fire that shaped the landscape we are now trying to manage?

Wildland Fire Use in the Smokies

Until the adoption of WFU in its 1996 fire management plan, Great Smoky Mountains National Park had a policy—since its inception in 1934—of suppressing *all* fires.

Today’s WFU policy enables National Park fire staff to manage lightning-caused fires to accomplish resource objectives, providing that the fires meet certain predefined conditions. The National Park Service is the first Federal land management agency in the southern Appalachians to address natural ignitions without suppressing them.

Since the first WFU fire was implemented in 1998, fire statistics have been revealing an impressive lesson about the nature of lightning ignitions in Great Smoky Mountains National Park. Fire control records compiled from 1942 through 1997—55 years worth—indicate that 1,261 park acres (510 ha) burned due to suppressed lightning-ignited fires. Today, in just 9 years of selectively suppressing natural ignitions, unsuppressed lightning fires have burned a total of 1,143 acres (463 ha). This includes the experimental Polecat Ridge Fire of 1976 and fires managed for resource benefit from 1998 to 2005.

From 1942 to 1997, the average suppressed lightning-ignited fire grew to only 11 acres (4.5 ha),

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while the average unsuppressed lightning-ignited fire is now 186 acres (75 ha). At press time, the Chilly Springs Fire is being managed for resource benefit, currently at approximately 900 acres (360 ha).

It is important to note that these statistics and studies focus solely on fires that began and remained within the park. This region's broader fire history studies reflect a higher yearly average number of lightning-ignited fires on the Cherokee National Forest, located at the park's southwestern boundary (Barden 1973). This suggests that lightning-ignited fires might have played an even more substantial role in unfragmented landscapes.

It is also important to note that the WFU fires observed in the Smokies have had no management actions that would have increased the fire acreages. In other words, there have been no burn-out operations. Fires here generally persist until they reach flowing creek beds, less flammable vegetation, or are rained out.

Characteristics of Natural Ignitions

Fires in this region have exhibited interesting behavior. The first WFU fire, Forney Ridge, began on April 6, 1998. The fire burned in mesic, old-growth, oak-dominated communities and stopped when it reached tulip poplar/red maple-dominated communities. It burned predominantly through the litter layer and persisted through heavy downed fuels, snags, and stump holes.

The Forney Ridge Fire area received:

- Light rain on April 9,
- A total of 0.5 inches of snow on April 10, and
- Several inches of rain from April 18 to 20.

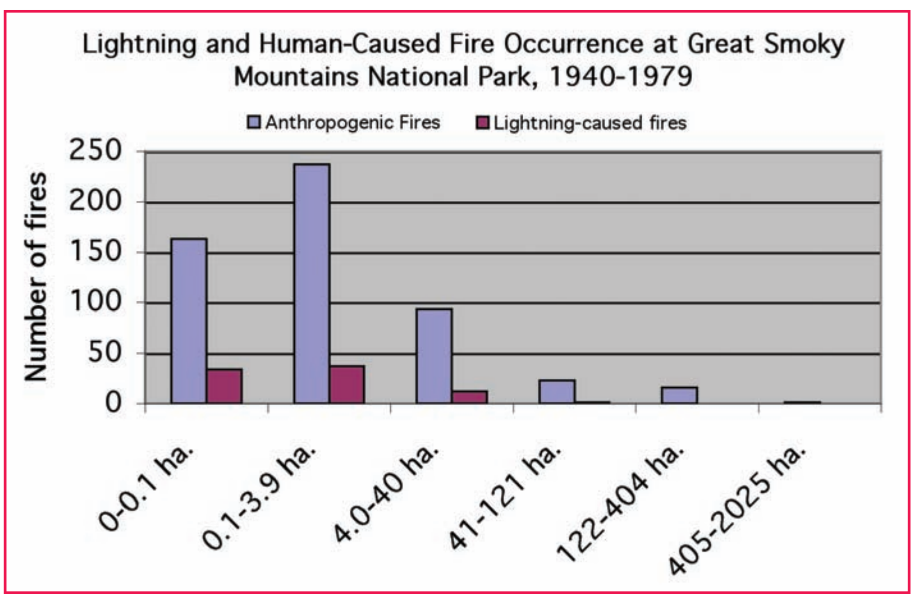
Since the first wildland fire use fire was implemented in 1998, fire statistics have been revealing an impressive lesson about the nature of lightning ignitions in Great Smoky Mountains National Park.

The Forney Ridge Fire was declared out on April 27, with a total fire size of 370 acres (148 ha) over 22 days. The majority of fire growth occurred in the first 3 days of the fire. By April 13, the fire's eighth day, there was no growth in fire size, although smoldering continued within the burn.

The April 1999 Collins 2 WFU Fire was notable for burning during the height of the spring wildflower season, backing through moist drainages and topkilling an unexpected amount of rhododendron (*Rhododendron maximum*) and mountain laurel (*Kalmia latifolia*).

The largest WFU prior to the Chilly Springs WFU Fire was the 523-acre (212 ha) 1999 Blacksmith WFU Fire that occurred on the far western portion of the park. The fire began on August 19, but 429 (174 ha) of 523 acres (212 ha) burned between August 29 and September 6 after a series of dry cold fronts. Relative humidities were variable throughout the fire, with sporadic drops into the high teens. During the majority of the fire growth, relative humidity remained in the 40s. The fire was declared out on September 22.

As WFU fires are managed, studied, and observed within Great Smoky Mountains National Park, new lessons are continually emerging about the role of fire in the landscape. These fires certainly raise questions about the paradigm of a fire-adapted ecosystem maintained predominantly by cultural—human-initiated—burning practices.



Lightning and human-caused fire occurrence at Great Smoky Mountains National Park, 1940 to 1979.

The Problem with Suppression-Era Lightning Statistics

Comparing the park's recent experiences with WFU to the decades of suppressed "natural" ignitions raises another important question. Have we underestimated the role of nonanthropogenic, "natural" ignitions because of an improper reliance on suppression-era lightning statistics?

It's intuitive to most fire managers that lightning fires often burn slowly and with low intensity at their outset, making them easy to suppress while still small (Barden 1973, Show 1923). During most of the intensive fire suppression era, staffed fire lookout towers existed inside and around the park. This capability enhanced the ability to pinpoint the lightning strike and its subsequent fire while the area was still damp from the passing thunderstorm.

Suppression-era data reflects this history, with lightning-caused fires accounting for a low percentage of total fire acreage. Unfortunately, such information has often led land managers and researchers to dismiss the role of lightning, and therefore, of slow-burning, low-intensity fire within the landscape.

This data is being interpreted and applied incorrectly when it is used to infer that a fire-adapted ecosystem must be a result of human-caused burning practices.

A survey of historical fire reports provide myriad examples of lightning-caused fires, which appeared to have gone out after the initial smoke report. Yet, several days later, these fires began to smolder again, or even made small runs. The following are two examples of these occurrences:

1. **Tunis Ridge Fire, June 1943.** Fire began on June 8, was first reported on June 9, and "Warden Ogle hunted for it on that day and again on June 10, but light rains had damped it down, as no smoke was visible, he did not find the fire. Fire was corralled at 2 a.m. on June 12, but kept breaking over [escaping control line] on mop-up crew on that day."

2. **Turkeypen Ridge Fire, April 1971.** "During the night of April 19, a violent thunderstorm passed over Cades Cove. On Turkeypen Ridge, a bolt of lightning struck a large hickory tree and set it to smoldering. April 27, in the afternoon, the top of the hickory fell, scattering fire into the dry leaves around it."

Furthermore, in 2004, the Shot Beech WFU Fire persisted in a single hemlock for 35 days, taking on a total of 6.5 inches (17 cm) of rain before it was finally extinguished.

Lightning-ignited fires must be recognized as significant in shaping the landscape, not because they are key to restoring the park to historic or desired conditions—they alone will not (Miller 2004). The lessons learned from the seasonality, severity, and effects of these fires are a key component on the road toward comprehensive landscape management.

Implementing a WFU program in the Smokies has taken persistence and exceptional vision (Barden). Other Federal land management agencies in the region are currently attempting to implement WFU policies and meeting many of the same struggles—and no doubt many different ones. Sharing the park's experience and understanding the historical role of lightning-ignited fires will better enable land managers to define target conditions and provide the toolbox that will help attain them.

Acknowledgments

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True Story: A 4-Million Acre "Mega" Maximum Manageable Area

Jacquie M. Parks

Just the thought and sound of the words "mega" maximum manageable area (MMA) can put fear into the hearts of line officers, decisionmakers, and fire management personnel everywhere.

But—before describing this "mega" component—first, a quick review. What is a MMA?

The wildland fire community knows that the MMA delineates the geographic limits of the fire area as defined by the capability of management actions to meet resource objectives and mitigate risk. Once established as part of an approved fire use plan, this general impact area is fixed and is usually not subject to change.

The 2005 fire use season, although considered average by some, was in full swing on the Bitterroot National Forest. By August 1, the forest already had 13 wildland fire use (WFU) fires. As operational tempo began to increase, for 9 days beginning August 1, a total of 25 fires were designated as WFU. For the first time in the forest's extensive fire use history, all four of its districts were simultaneously managing WFU—in addition to suppression events.

After assessing its Selway–Salmon WFU Complex situation, the forest decided it had exceeded the limits of its management capability (see table). Help was called in. First, with Byron Bonney's fire use management team, followed by Wayne Cook's fire use management team. With adjacent forest resources also busy with fire use, a WFU working group was also called into action.

Jacquie Parks is the assistant fire management officer for the USDA Forest Service, West Fork Ranger District, Bitterroot National Forest, Darby, MT.

Dictionary Definition of "Mega"
Mega: (From the Greek: "great.") Surpassing others of its kind. Extraordinary. Extended. Powerful.

The intent of this collaboration was to use a shared fire management approach and philosophy along the common boundaries of the various forests.

Shared Management Approach

The WFU working group called a meeting that gathered line officers and fire managers from both the Northern and Intermountain Regions, representing six neighboring national forests:

- The Bitterroot National Forest,
- The Salmon-Challis National Forest,
- The Payette National Forest,
- The Clearwater National Forest,
- Nez Perce National Forest, and
- The Boise National Forest.

To facilitate effective communication and coordination of the fire events occurring within the wilderness areas of central Idaho and Montana, this group developed a working draft *Central Idaho Wildland Fire Use Management Complex Operating Guide.* The intent of this collaboration was to use a shared fire management approach and philosophy along the common boundaries of the various forests. This working draft addressed portions of the Frank Church River of No Return Wilderness, the Selway-Bitterroot Wilderness, and contiguous portions of each forest that allowed WFU—both inside as well as outside wilderness areas.

"Mega" Decision Is Made

The outcome: A MMA that consisted of roughly 4 million acres

Continued on page 31

"This MMA made sense because fire doesn't know the difference between regional and forest boundaries. Why should a fire be converted from WFU status to a wildfire if it crosses an administrative boundary? People need to understand that just because you draw an MMA on the map—does *not* mean that you are going to allow the fire to burn to it."

–Byron Bonney, Fire Use Manager,
Selway–Salmon Wildland Fire Use Complex, 2005

Selway/Salmon Wildland Fire Use Complex – Wildland Fire Use Fires 9/10/05 0700

Fire #	Fire Name	Start Date	Area	Lat	Long	Legal	Size	Growth	Stage Completed	Potential Threats	Anticipated Resource Needs
5039	Wapiti	7/28/2005	SBW	45°53.2	-114°42.19	30N 14E 27 NWSW	1131.08	+0.00	Stage 3 approved	White Cap Trail Cooper Flat G.S.	Air Patrol Fire Use Module
5037	Cedar-Barefoot	7/28/2005	SBW	45°53.54	-114°39.29	30N 14E 36 NWNE	1777.54	+7.97	Stage 3 approved	White Cap Trail Cooper Flat G.S.	Air Patrol Fire Use Module
5204	Mt. George	8/22/2005	SBW	45'55.77	114'38.16	30N 15E 19 NWNW	858.87	+3.54	Stage 2 approved	Trail 50	Air Patrol
5147	(3) Haystack	8/9/2005	SBW	45°42.51	-114°44.52	27N 14E 4 NW cent	0.00	+0.00	Stage 3 approved	N/A	Air Patrol
5060	Beaverjack	8/1/2005	SBW	45°44.86	-114°42.6	28N 14E 35 NWSE	7244.42	+11.94	Stage 3 approved	Magruder/ Elk City Road Kim Creek Trail #26 Selway River Trail #4	Air Patrol Fire Use Module Imp/Struc Prot Road Patrol
5107	Pole Mtn	8/6/2005	FCRONR	45°41.07	-114°38.38	27N 15E 18 SENE	9.48	+0.00	Stage 3 approved	Hell's Half Acre LO	Air Patrol
5108	Pole Two	8/6/2005	FCRONR	45°41.28	-114°38.96	27N 15E 7	0.10	+0.00	Stage 3 approved	Hell's Half Acre LO	Air Patrol
5063	Upper Burn	8/1/2005	FCRONR	45°37.73	-114°39.13	27N 15E 31 SESW	0.50	+0.00	Stage 3 approved	Hell's Half Acre LO	Air Patrol
5064	Lower Burn	8/1/2005	FCRONR	45°37.19	-114°39.92	26N 14E 1	1086.22	+25.72	Stage 3 approved	Hell's Half Acre LO Trail 65	Air Patrol Fire Use Module Lookout Protection
5065	Trail #65	8/1/2005	FCRONR	45°38.7	-114°39.02	27N 15E 30	0.10	+0.00	Stage 3 approved	Hell's Half Acre LO	Air Patrol
5110	Trail #62	8/6/2005	FCRONR	45°41.51	-114°41.3	27N 14E 11 Center	0.10	+0.00	Stage 3 approved	N/A	Air Patrol
5106	Hells Half Acre Cr	8/5/2005	FCRONR	45°40.14	-114°39.26	27N 14E 13 SESE	797.45	+14.99	Stage 3 approved	Hell's Half Acre LO Trail #12	Air Patrol
5112	Pasture Ridge	8/16/2005	FCRONR	45°41.83	-114°42.04	27N 14E 11 NW	0.10	+0.00	Stage 3 approved	Trail #62	Air Patrol
5149	(2) Gabe Creek	8/9/2005	SBW	45°43.25	-114°40.27	28N 14E 36 SWNW	0.00	+0.00		Magruder/ Elk City Road	Air Patrol
5080	Elk Lake	8/1/2005	SBW	46°2.288	-114°26.586	3N 23W 3 NENW	701.64	+0.00	Stage 3 approved	N/A	Air Patrol
5075	El Capitan	8/1/2005	SBW	45°59.887	-114°26.531	3N 23W 15 SESW	1405.01	+0.00	Stage 3 approved	N/A	Air Patrol
5132	Spot Mountain	8/8/2005	SBW	45°47.14	-114°51.37	28N 13E 15 NWNE	355.76	+0.00	Stage 2 approved	Trail #3, Spot Mtn Lookout	Air Patrol
5156	Pyramid Peak	8/9/2005	SBW	45°46.85	-114°50.11	28N 13E 10 NENW	319.60	+0.00	Stage 2 approved	Trail #3, Spot Mtn Lookout	Air Patrol
5175	Green Spot	8/6/2005	SBW	45°48.23	-114°51.06	29N 13E 33 NESE	356.64	+0.00	Stage 2 approved	Trail #3, Trail #40	Air Patrol
S-C fire	Reynolds	8/6/2005	FCRONR	45°32.32	-114°36.15	26N 16E 28 SW	3847.65	+50.98	Stage 2 approved	Reynolds Lk CG Trails #18, #68, #31 Gattin Ranch	Air Patrol
5123	(1) Wilk Head	8/7/2005	FCRONR	45°33.052	-114°34.213	26N 15E 35 NWNW	0.00	+0.00	Stage 2 approved	N/A	Air Patrol
5111	(5)Mist Creek	8/6/2005	FCRONR	45°31.98	-114°36.44	25N 15E 4 NW	0.00	+0.00	Stage 2 approved	N/A	Air Patrol
5113	Stripe Creek	8/1/2005	FCRONR	45°30.074	-114°44.803	25N 14E 16 SENE	4278.77	+27.61	Stage 2 approved	Trails #19, #4, #80	Air Patrol
5076	Stripe Mountain	8/2/2005	FCRONR	45°30.75	-114°47.6	25N 14E 18 SWNW	0.10	+0.00	Stage 2 approved	N/A	Air Patrol
5139	Thirteen Creek	8/9/2005	FCRONR	45°32.5	-114°44.41	26N 14E 33 SW	0.10	+0.00	Stage 2 approved	N/A	Air Patrol
5109	(4)Hidden Creek	8/6/2005	FCRONR	45°29.63	-114°43.17	25N 14E 14 SE	0.00	+0.00	Stage 2 approved	N/A	Air Patrol

Continued on next page

Fire #	Fire Name	Start Date	Area	Lat	Long	Legal	Size	Growth	Stage Completed	Potential Threats	Anticipated Resource Needs
5085	*Thirsty Ridge	7/30/2005	FCRONR	45°30.18	-114°52.51	25N 13E 22	166.36	+0.00	Stage 2 approved	Swet Lake Cabin, Trail #9	Air Patrol
5090	Dennis Lake	8/1/2005	FCRONR	45°32.19	-114°52.2	25N 13E 4 NWNW	10.00	+0.00	Stage 2 approved	Swet Lake Cabin, Trail #29	Air Patrol
5062	Arrow Creek	8/1/2005	FCRONR	45°34.76	-114°51.48	26N 13E 27 NW	59.96	+0.00	Stage 2 approved	N/A	Air Patrol
5025	Sentimental	7/22/2005	SBW	45°47.49	-114°24.81	1N 23W 35 NWNE	1.00	+0.00	Stage 2 approved	Wilderness/ WFU boundary	Air Patrol
5047	(7) Lodgepole Hump	7/30/2005	SBW	45°41.81	-114°54.09	27N 13E 7 Center	0.00	0.00	Stage 2 approved	Trail #61	Air Patrol
5124	Sabe Mountain	8/7/2005	SBW	45°39.56	-114°56.27	27N 12E 23 NWSE	0.10	+0.00	Stage 1 approved	Trail #61	Air Patrol
5161	Dry Saddle	8/12/2005	SBW	45°40.74	-114°58.44	27N 12E 16 SENW	0.10	+0.00	Stage 1 approved	N/A	Air Patrol
N-P fire	Burnt	8/10/2005	SWB	45'42.009	115'0.61	27NR12E6	8580.10	+0.00	Stage 3 approved	Horse Heaven (historic cabin) Burnt Knob Lookout Magruder Rd. Trail #26	Air Patrol / Structure Protection T2 Crew / FUM / Road Patrol
5192	Halfway Creek	8/23/2005	SBW	45'42.84	114'35.78	27N 16E 3 NW	165.08	+0.81	Stage 2 approved	Pete Creek/ Magruder Rd. Kit Carson	Air Patrol
5181	Nez Perce Peak	8/22/2005	SBW	45°43.91	-114°30.71	28N 15E 22 Center	262.66	+19.26	Stage 2 approved	Trail #13	Air Patrol
5099	(6) Cayuse Creek	8/6/2005	SBW	45°44.09	-114°36.35	28N 15E 28 NE	0.00	+0.00	Stage 1 approved	N/A	Air Patrol
5134	Burnt Strip Mtn	8/9/2005	SBW	45°50.55	-114°39.77	29N 14E 24 NENE	905.38	+20.11	Stage 1 approved	Trails #10, #5	Air Patrol
5202	Snake	8/22/2005	SBW	45'50.6	114'40.5	29N R14E 24NWNW	0.10	+0.00	Stage 1 approved	Trails #10, #5	Air Patrol
5092	Scofield Ridge	8/1/2005	SBW	45°49.32	-114°38.11	29N 15E 29 NWSW	3.00	+0.00	Stage 1 approved	N/A	Air Patrol
5074	Fire Mountain	8/1/2005	SBW	45°48.934	-114°47.393	29N 13E 25 NWSE	60.90	+0.00	Stage 1 approved	N/A	Air Patrol
5086	Goat Mountain	7/30/2005	FCRONR	45°36.56	-114°49.15	26N 13E 11 NW	0.10	+0.00	Stage 1 approved	N/A	Air Patrol
5089	Falls Creek	8/5/2005	SBW	45°54.94	-114°30.94	30N 16E 30 NWNW	0.10	+0.00	Stage 1 approved	Trail #46	Air Patrol
5153	(8) Watchtower	8/10/2005	SBW	45°50.04	-114°32.98	29N 15E 19 SW	0.00	0.00	Stage 1	Trail #23	Air Patrol
5155	Little Pyramid	8/10/2005	SBW	45°46.4	-114°48.58	28N 13E 11 SENE	0.10	+0.00	Stage 1 approved	N/A	Air Patrol
5157	White Cap Lake	8/10/2005	SBW	45°53.34	-114°26.08	30N 16E 34 SWNE	160.28	+0.86	Stage 1 approved	Trail #2	Air Patrol
5164	Upper Canyon Creek	8/10/2005	SBW	45°51.59	-114°28.076	29N 16E 9 NWNW	251.82	+13.11	Stage 1 approved	Trail #2	Air Patrol
5165	Upper White Cap	8/10/2005	SBW	45°56.81	-114°29.25	30N 16E 8 SESW	163.50	+5.91	Stage 1 approved	Trail #2	Air Patrol
5167	Granite Creek	8/10/2005	SBW	45°56.16	-114°30.71	30N 16E 18 NWSE	19.59	+0.56	Stage 1 approved	N/A	Air Patrol
5191	Watch It	8/22/2005	SBW	45°49.90	114'32.33	29N 15E 24 NENE	738.21	+2.07	Stage 1 approved	Trail 23	Air Patrol
5208	Sweeney Lake	8/22/2005	SBW	45'36.70	-114°16.84	10N 21W 19NENE	65.00	+0.00	Stage 2 approved		Air Patrol

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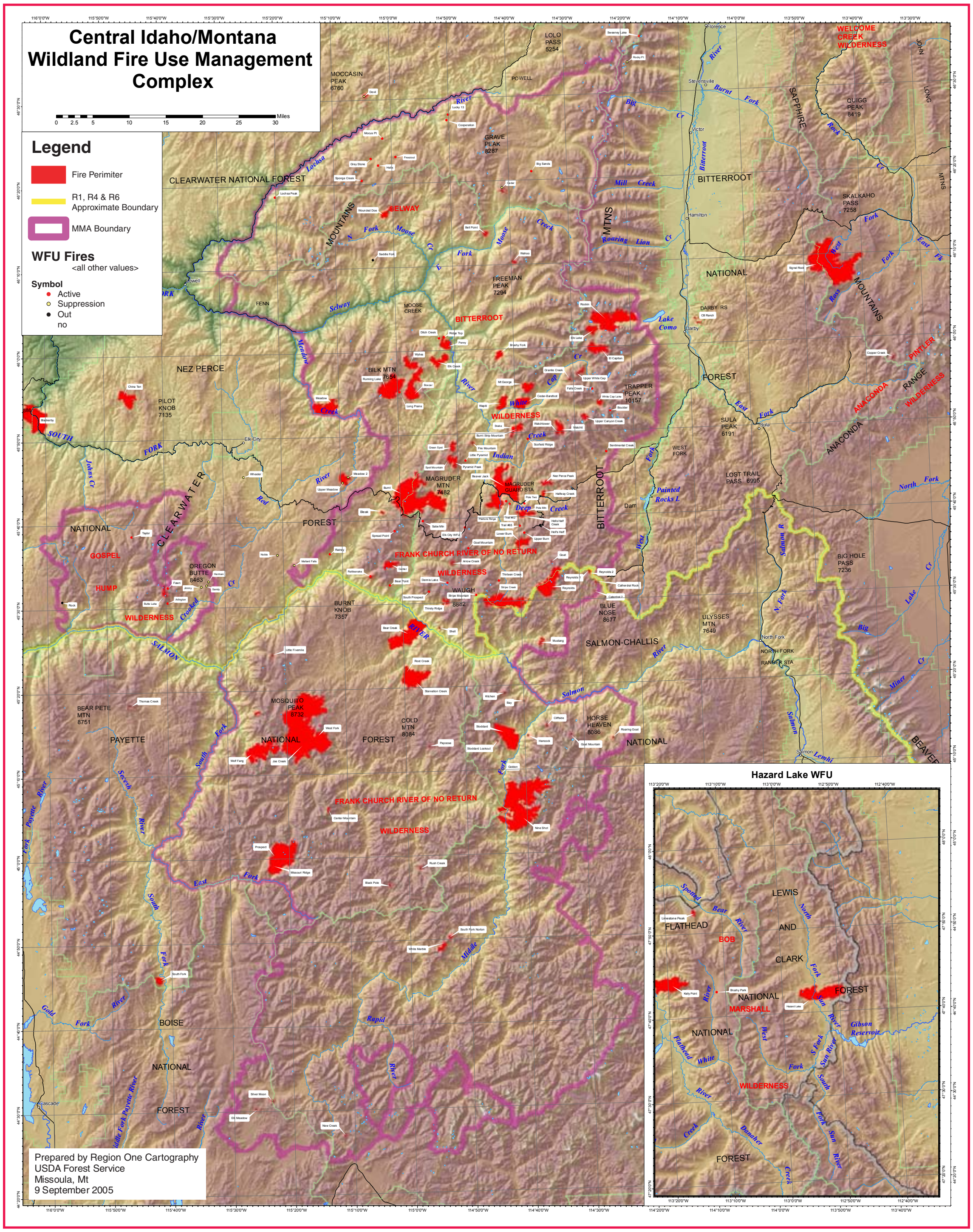
(1,618,749 ha) of allowable WFU (see map). Because this MMA was considered to be so large in scale, someone dubbed it a "mega MMA." The term stuck.

Did this mean that we were going to actually allow 4 million acres (1,618,749 ha) of fire use? No. But it *did* provide the opportunity to glimpse the possibility of what wildland fire use could be. Even so, not everyone was thrilled with this mega MMA concept.

Concerns arose such as how an individual was to understand

Because this 4-million acre maximum manageable area was considered to be so large in scale, someone dubbed it a "mega MMA."



The 4-million acre "mega" MMA.

Not everyone was thrilled with this mega maximum manageable area concept.

the big (mega) picture and know when to say "enough is enough." Suppression events that were happening within the MMA added additional risk. Increasing situational complexity—compounded by the sheer size of this MMA—could mean a potential threat to any successful fire use program if not handled with "C.A.R.E." (see sidebar).

Byron Bonney, the fire use manager involved with managing a portion of the mega MMA, explained: "It made sense because fire doesn't know the difference between regional and forest boundaries. Why should a fire be converted from WFU status to a wildfire if it crosses an administrative boundary? People need to understand that just because you draw an MMA on the map—does not mean that you are going to allow the fire to burn to it."

Multi-state and regional coordination—buttressed by constant and effective communication—made this WFU opportunity work. The size of this Northern Rockies mega MMA may not be applicable everywhere. But the concepts that made it successful can be applied to all MMAs—regardless of their size. ■

Helpful Hints for Determining Your Next MMA

The "C.A.R.E." concept—Communicate, Act, Recognize, Evaluate—is based on a project that evolved from the USDA Forest Service Northern Region's "Exploring Leadership Workshop" held in Missoula, MT, in November 2005 and January and February 2006. (For more information, contact Harvey Hergett at 406-329-3172.)

Communicate

- Develop good operating plan guidance for wildland fire use (WFU).
- Know your neighbors. Good cooperation and communication is essential. Identify common fire use boundaries.
- Communicate clearly and often. Identify the meaning of large—"mega"—for your fire use program.

Act

- Ask for help early in the process.
- Follow your gut instinct. Just because a map says you can—doesn't mean that you should.

Recognize

- Recognize the capability and limitations of your WFU program.
- Recognize that not everyone will agree with the concept. To make a better decision in maximum manageable area (MMA) development, listen effectively and address concerns.

Evaluate

- Evaluate your MMA options: Is it definable, defendable, and can it be effectively managed?
- Evaluate each fire event by itself. Not every fire is a good WFU candidate.
- Realize situational complexity will increase. Wildland fire use is not for the "faint of heart." It's tiring; it requires C.A.R.E. in thinking and planning and in knowing the full consequences of the decisions being made.
- Decide what "mega" means. It may mean 4 million acres (1,618,749 ha) for some, or much, much less for others.

Did this mean that we were going to actually allow 4-million acres of fire use? No. But it did provide the opportunity to glimpse the possibility of what wildland fire use could be.

Management Action on the Wooley Fire Is the Appropriate One

Guy E. Lewis

It is the evening of September 20, 2005. An aerial observer calls the Yreka Interagency Communication Center in northern California to report a fire in the Klamath National Forest's Marble Mountain Wilderness.

The 2-acre (0.9-ha) fire is burning actively on a heavily timbered midslope above Wooley Creek, a major tributary of the Salmon River. A combination of darkness and the fire's remote location delays further action until the following day.

Early the next morning, the Wooley Fire is now 30 acres (12 ha). And, it is still spreading.

The Klamath National Forest is in its second year of implementing wildland fire use (WFU) as called for in its land and resource management plan. As the morning progresses, fire managers work on completing the Wooley Fire's "strategic fire sizeup" so that the Scott/Salmon Ranger District's district ranger can complete the necessary decision criteria checklist in stage one of the wildland fire implementation plan (WFIP).

But, unfortunately, there's a catch.

Natural Ignition – To Be or Not to Be?

For several weeks, no thunderstorms have been observed anywhere on the forest. What's more, a review of records from the automated lightning detection system shows no lightning strikes in the vicinity of the Wooley Fire for the last 2 months.

The Wooley Fire, burning in a rugged, remote corner of the Klamath National Forest, presents land managers with a perplexing challenge of how it should be categorized and managed. Photo: Ray Haupt, USDA Forest Service, District Ranger, Scott/Salmon Ranger District, Klamath National Forest, Yreka, CA.

Once fires are established on the western portion of the Klamath National Forest, the pattern becomes a long-term commitment of resources, overhead teams, and expenditures.

For the fire to be considered a WFU candidate—before the line officer can authorize a WFU response—the sizeup must determine that a fire is a natural ignition. Considering the available information, a suppression response appears to be the district ranger's only option.

Local managers are well aware of the Klamath Mountains' past fire suppression history. Once fires are established on the western portion of the Klamath National Forest, the pattern becomes a long-term commitment of resources, overhead teams, and expenditures. Around the country today, many firefighters—as well as former firefighters—have vivid memories of fighting fire in northern California and being exposed to its inherent

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hazards of fire, unforgiving terrain, poison oak, insects, and poisonous snakes.

But perhaps the greatest threat that surrounds fire suppression in this region is the adverse effect of living and working under its omnipresent smoke inversions. This well-known condition hampers air as well as tactical and logistical operations. It makes life difficult for residents and firefighters alike.

Issues Confronting Land Managers

When it comes to what to do with the Wooley Fire, there is no shortage of issues and concerns that confront local land managers, including:

- Ensuring firefighter safety and well-being is the first priority,
- Reducing potential threats to cultural resources important to local Indian tribes,
- Alleviating smoke effects on local communities,
- Mitigating negative impacts to threatened and endangered species such as the northern spotted owl and spring Chinook salmon habitat,
- Adhering to and protecting wilderness values and principles, and
- Implementing a cost-effective management response.

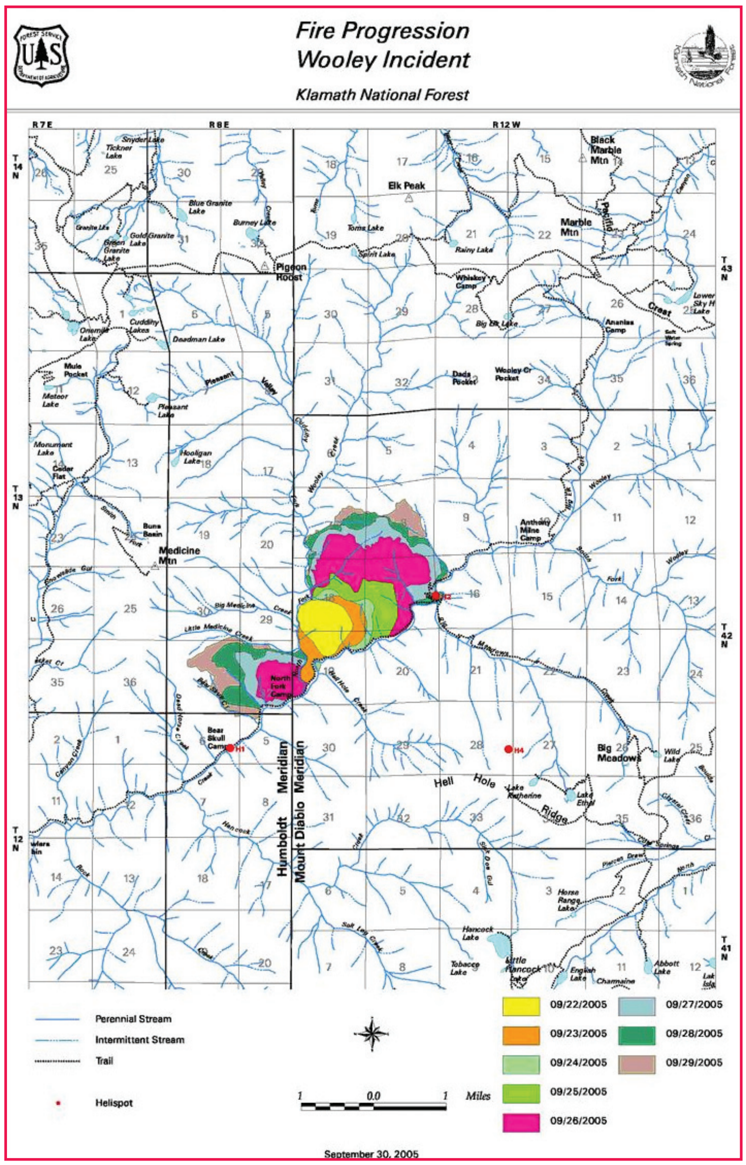
In the past, the response to such a fire would be to order a type 2—or even type 1—incident management team along with numerous resources to lay siege to the fire. Today, however, local managers are disappointed that—due to the unknown origin of the fire—WFU is not an option.

When it comes to what to do with the Wooley Fire, there is no shortage of issues and concerns that confront local land managers.

Appropriate Management Response

Fortunately, it is soon determined that another management opportunity exists for addressing the Wooley Fire. Current fire policy allows another option to meet objectives for this fire. Under the umbrella of "appropriate management response," the complete spectrum of options—from monitoring to full suppression—is available when supported by the wildland fire situation analysis (WFSA).

Thus, it is decided to order Gary Cones' Great Basin Fire Use Management Team to manage this fire.



Fire progression of the 3,131-acre (1,268 ha) Wooley Fire.

Fire Use Management Team Flexibility

Fire use management teams were developed specifically to manage wildland fire use (WFU). However, when not assigned to a WFU, they have been available for and have been assigned to "suppression-strategy" wildfires.

Conversely, at least one type 2 incident management team has been assigned to manage a WFU.

The first priority for fire use management teams remains WFU. They were established to be utilized up until that time when *all* incident management teams are skilled, configured, and available to manage *all* types of incidents, including WFU.

Fire use teams come with a fully qualified type 2 incident commander and general staff, with other positions being filled as necessary. These teams are experienced in low-impact, minimum-resource use, as well as low-cost expenditure operations in remote settings.

In addition, the fire use team's fire behavior unit is expected to provide long-term fire behavior modeling through an assigned fire behavior analyst, long-term fire analyst, and FARSITE and RERAP (information system) technical specialists.

Two Processes Melded

The Klamath National Forest decided to manage the Wooley Fire in the appropriate management response matrix's "lower impact zone." While it is also determined that the WFIP process is more appropriate for this incident, policy dictates that the WFSA process must nonetheless be used.

> In the past, the response to such a fire would be to order a type 2—or even type 1—incident management team along with numerous resources to lay siege to the fire.

The fire use team is therefore tasked with melding the WFIP process into the WFSA process so that the agency administrator validates only one process each day. The Wooley Fire managers also utilize the concept of a "maximum confinement boundary" rather than maximum management area (MMA), which would have been used on a true WFU event.

The Wooley Fire burns a total of 3,131 acres (1,268 ha) and costs $396,666 to manage—averaging $126.69 per acre ($313 p ha).

Positive Experience

In the end, the land could not tell what policy was used. The fire did what it was going to do. Ground operations were limited to primarily monitoring fire behavior and effects, with very minimal suppression actions taken.

While this wasn't a WFU fire, the forest benefited from the flexibility of the appropriate management response policy and was successful in working through the policies of the WFSA/WFIP process.

In the final analysis, the Wooley Fire proved to be a positive experience for both firefighters and resource managers. The local public also benefited. Its members were very understanding and supportive of the Klamath National Forest doing what is right for the land—with their tax dollars in mind. ■

Prescribed Fire Is Main Fire Use Occurring in Southeastern States

John Dickinson

This country's Southeastern States do not allow wildland fire use on State or private lands. South Carolina, for instance, requires that all wildland fire—both naturally and human-caused—be controlled. It is only allowed in this State when the landowner accepts direct responsibility for the fire and takes the appropriate steps to ensure that it doesn't cross property lines.

A wide range of prescribed fire on State and private lands is the only accepted use of wildland fire within these States. The range of prescribed fire spans from minimal to hundreds of thousands of acres burned each year under a prescription.

The range of prescribed fire spans from minimal to hundreds of thousands of acres burned each year under a prescription.

Of the eight (Alabama, Arkansas, Florida, Georgia, North Carolina, South Carolina, Tennessee, and Virginia) out of 13 reporting Southeast States in a 2005 data survey, the average number of prescribed fires for that year was 32,257 per state, with an average of 591,175 acres (239,241 ha) burned per state. Florida had the most acreage with 166,056 burns, representing 2,050,874 acres (829,963 ha). Virginia had the lowest with 128 prescribed burns for 3,998 acres (1,618 ha).

Last year in South Carolina, 532,129 acres (215,345 ha) of forestry, wildlife, and agriculture burns were completed.

Prescribed fire is the only viable method of fire use in these States where landownership is mostly private, the size of these private ownerships averages less than 100 acres (40 ha) per landowner, and wildland/urban interface areas are intermixed among these ownerships. ■

John Dickinson is the Pee Dee Regional Forester with the South Carolina Forestry Commission, Columbia, SC. He is a member of the National Wildfire Coordinating Group's Fire Use Working Team.

Wildland Fire Use Expected To Increase Across Bureau of Land Management Lands

David Mueller

"Fire use" within the Department of the Interior, Bureau of Land Management (BLM) includes both prescribed fire and wildland fire use (WFU). Using fire to meet land management objectives has always been a part of BLM activities.

With the inception of the 2001 National Fire Plan, the BLM formally created its hazardous fuels program through the allocation of funds directly to fuels management activities. The BLM has since used prescribed fire to treat 508,800 acres (205,905 ha) in the wildland/urban interface and 603,900 acres (244,390 ha) for ecosystem restoration.

Planning and implementing WFU on BLM lands is relatively new. Under BLM policy, WFU is used to implement land management objectives identified in the agency's land use plans and supported by its approved fire management plans.

The agency's land use plans currently permit WFU on 78 million acres (31,565,600 ha), or 30 percent of its land base. From this total acreage, Alaska has approximately 57 million acres (23,067,174 ha) available for WFU.

In the lower 48 States, approximately 21 million acres (8,498,433 ha) are available, with 2.8 million acres (1,133,125 ha) designated for WFU treatment, annually. Since 2001, 944,300 acres (944,300 ha) have been treated with WFU in Alaska, and 45,600 acres (18,454 ha) in the lower 48 States.

> Wildland fire use is used to implement land management objectives identified in the agency's land use plans and supported by its approved fire management plans.

Wildland fire use is expected to increase across BLM lands as its managers become more familiar with utilizing fire to meet land management objectives under the bureau's policies, planning, and implementation requirements.

During fiscal year 2003, the BLM's "Unaweep Fire Use Module"—the agency's first and only fire use module at this time—was created to fill a critical void in the Bureau's budding fire use program. After the 2003 fire season, the module received national certification. During the past 3 years, it has been assigned to numerous fire use events in New Mexico, Arizona, Idaho, Montana, and Colorado. ■

Smoke column from the 2004 wildland/urban interface Greasewood Wildland Fire Use Fire in Meeker, CO. Photo: U.S. Department of the Interior, Bureau of Land Management, 2004.

David Mueller is a fuels management specialist for the U.S. Department of the Interior, Bureau of Land Management, National Interagency Fire Center, Boise, ID.

Almost the Same Age: Prescribed Fire Program and Forest Service

Tim Sexton

The USDA Forest Service has implemented prescribed fire for a variety of reasons for almost as long as the agency has existed. Throughout most of the twentieth century, prescribed fire was used to reduce hazard fuel that had been created through management actions such as timber sales.

Late in the twentieth century, prescribed fire began to be applied to accumulations of natural fuels. With the implementation of the 2001 National Fire Plan, this management activity has increased substantially.

All Forest Service regions now have strategies designed to reduce wildfire hazard primarily through the application of prescribed fire. Several regions have also developed aggressive wildland fire use programs which have contributed substantially to the overall Forest Service goals of reducing risk of wildfire and restoring fire-adapted ecosystems (see table).

All Forest Service regions now have strategies designed to reduce wildfire hazard primarily through the application of prescribed fire.

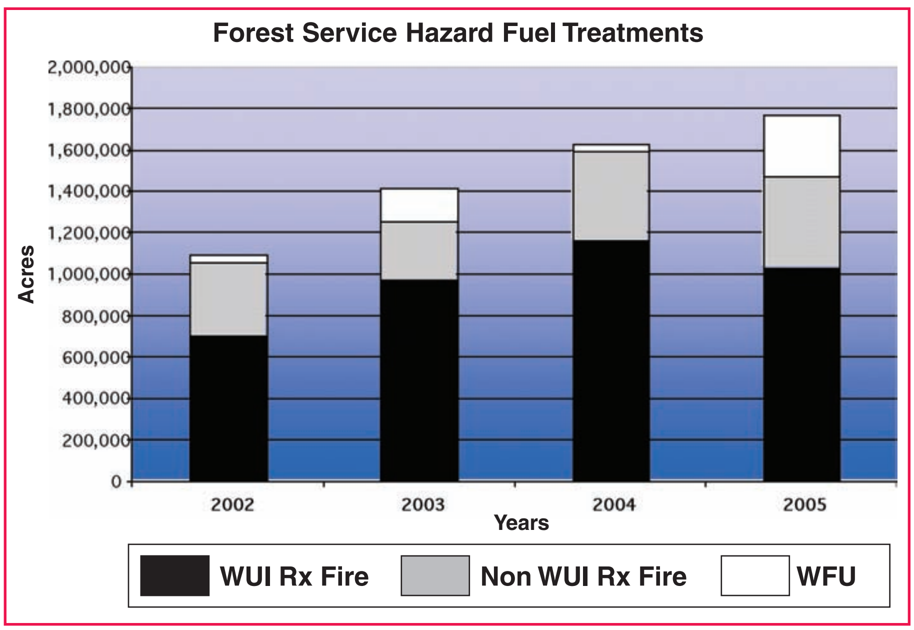
Hazard Fuel Reduction Accomplishments

The Forest Service intends to continue increasing hazard fuel reduction accomplishments. While we do not expect large increases in funding, we believe we can increase accomplishment through escalating both the average size of prescribed burn units and the amount of wildland fire use.

We believe we can increase accomplishment through escalating both the average size of prescribed burn units and the amount of wildland fire use.

From 2003 to 2005, the average prescribed fire unit within the Forest Service was about 450 acres (183 ha). During this time period, the Forest Service's Southeast Region had the greatest prescribed fire accomplishment. That region's average burn unit size was more than 800 acres (324 ha). While some regions burned almost as many units, they only accrued about 10 percent of the Southern Region's total burn acres.

Excluding its Southern Region's totals, the average burn unit size for the Forest Service during the last 3 years was less than 250 acres (102 ha). Increasing these unit sizes and using roads, natural bar-



Fire use activity in the USDA Forest Service for fiscal years 2002-2005.

Tim Sexton, coordinator for this special "fire use" issue of Fire Management Today, *is the fire use program manager for the USDA Forest Service, Fire and Aviation Management, Washington Office, National Interagency Fire Center, Boise, ID.*

Wildland/Urban Interface—The Finley Butte Prescribed Fire is implemented on the Methow Valley Ranger District, Okanogan–Wenatchee National Forest to reduce excess fuels and help protect nearby communities from the threat of wildfire. Photo: Tom Iraci, USDA Forest Service, Pacific Northwest Region, Regional Office, Portland, OR, 2002.

riers, and fuel type changes as unit boundaries will result in:

- Lower unit costs,
- Reduced risk of fire escape, and
- Greater overall program accomplishment.

Many forests have developed strategies that utilize a sequence of treatments to reduce risk and to better position their future program goals.

Many forests have developed strategies that utilize a sequence of treatments to reduce risk and to better position their future program goals. By first applying mechanical treatments in the wildland/urban interface, then utilizing prescribed fire adjacent to those treatments, can significantly reduce costs and increase the opportunities for successful prescribed fire and wildland fire use.

The Forest Service is committed to reducing wildfire risk to communities and restoring fire-adapted ecosystems. Fire use has been—and will continue to be—the most effective tool for accomplishing these goals. ■

Common Denominators in High-Performance Prescribed Fire Programs

Tim Sexton

This January, USDA Forest Service regional fuels managers were asked to identify the top-performing forest- or district-level prescribed fire programs within their regions. In March, line officer and fire manager representatives for these high-performance programs participated in a week-long workshop targeted to identify the common traits of these programs. The overall intent was to determine how these units achieve their high levels of success.

Workshop participants identified five significant factors that they agreed were most common for contributing high performance to their prescribed fire programs:

- Active line officer involvement and leadership,
- Prioritization of efforts toward improving and maintaining partnerships and collaboration,
- Excellent internal and external communication,
- Well-informed risk management, and
- Support for innovative implementation.

Many other factors that contributed to specific program success were also discussed and reviewed. This article focuses on the most universal of these factors. In doing so, it provides examples and explanations of how these factors enable high performance in prescribed fire programs.

Tim Sexton, coordinator for this special "fire use" issue of Fire Management Today, *is the fire use program manager for the USDA Forest Service, Fire and Aviation Management, Washington Office, National Interagency Fire Center, Boise, ID.*

A prescribed fire on the Deschutes National Forest reduces hazard fuels in fire-prone terrain near the 3,800 homes and condominiums in Sunriver, OR. Photo: Tom Iraci, USDA Forest Service, Pacific Northwest Region, Regional Office, Portland, OR, 2004.

> Line officer support and active involvement was identified as the most important common denominator of the high-performance prescribed fire programs.

Active Line Officer Involvement and Leadership

Forest supervisors and district rangers exert great influence over on-the-ground implementation of most Forest Service program areas. Line officer support and active involvement was identified as the most important common denominator of the high-performance prescribed fire programs.

From priority setting to ensuring interdisciplinary involvement, line officers—more than any other factor—have the opportunity to directly affect program achievements.

Forest supervisors and district rangers can elevate the prescribed fire program from specific fire management objectives to overall forest or district objectives. This can be accomplished through specific direction to all staff and adding prescribed fire accomplishment to staff performance elements.

Interdisciplinary support has been generated through encouragement, performance ratings, prioritization of discretionary funding, and commitment of staff time to accomplish prescribed fire objectives. When all resource disciplines are involved in planning, implementation, and monitoring at the program and project level, greater accomplishment occurs.

Holding Forest Supervisors Accountable

Sharing responsibility for target attainment among functional staff within a unit, and among line officers between units, increases the availability of personnel and funding to accomplish prescribed fire projects.

For example, regional foresters in the Forest Service Northern Rockies and Southwest Regions have held all forest supervisors accountable for the regional hazard fuel target. This has made it much easier for local units to obtain outside help on prescribed fire projects.

To effectively accomplish program goals, line officers must ensure that the correct skill levels are available. Developing the appropriate skills among forest personnel has been accomplished through ensuring training is available and by allowing employees to serve as trainees and maintain currency (in many cases, utilizing off-unit assignments).

Sharing Employees

Successful prescribed fire programs have also developed formal and informal agreements between units that have different prescribed fire windows to share employees when seasonal need is greatest.

Southeast forests obtain personnel from Rocky Mountain and Pacific Northwest national forests during January and February and, in turn, provide personnel to the Rocky Mountain Region during April and May.

> This personnel interchange between units not only helps accomplish agency targets, but it enhances the skills of these people who participate in this prescribed fire sharing.

Within regions, as the burn season progresses, sharing also transpires between forests. Forests within prescription obtain resources from other forests that are too wet or too dry to burn. They then reciprocate when those forests *can* burn.

For example, the Northern Region facilitates sharing among forests. The Bridger–Teton National Forest shares among local agencies to take advantage of prescription windows. Such interchanges not only help accomplish targets, but also enhance the personnel skills of those who participate in this prescribed fire sharing.

Line officer effectiveness is evident when forest and district staffs have clear direction and parameters for implementing both regional and national hazard fuel strategies. For instance, the Wallowa–Whitman National Forest developed clear forest-specific guidance for implementing the Healthy Forest Initiative. This resulted in more efficient and consistent planning and implementation through common understanding of the guidance by all staff areas.

Partnerships

Leveraging Funding

There are often multiple benefits from prescribed fire. Fostering partnerships with specific interests can bring outside funding for prescribed fire projects that have identified these benefits in the planning phase.

These outside interest groups include:

- The Rocky Mountain Elk Foundation and the Foundation for North American Wild Sheep in the Pacific Northwest,
- The Wild Turkey Federation in the Southern and Eastern Regions,
- Firesafe Councils in California,
- Firewise Programs in the Forest Service Eastern Region; and
- State Habitat Partnership Programs in Wyoming and Colorado.

Because the scale of our work is often much greater than our available program funding, bringing partners' funds into the mix allows for more acres to be treated. When multiple interests and disciplines can claim the accomplishment, there is also a greater incentive to treat even more acres.

Broad-Based Support

Developing partnerships with cooperators and these diverse interests broadens the base of support to the prescribed fire program. A clearer understanding of the reasons for burning builds overall support and tends to minimize vocal opposition within communities and interest groups.

For example, working closely with State air regulators when planning and implementing prescribed fire and wildland fire use (WFU) projects improves the accurate assessment of smoke impacts—and, thus, allows more opportunities to use fire.

Turning this relationship from adversarial to cooperative has proven to be beneficial—through fewer citations and more burning windows—in every Forest Service region:

- Clearwater and Nez Perce National Forests' telephone conference calls with partners and air quality regulators;
- Sequoia National Forest remote smoke monitoring cameras are facilitating better understanding with the San Joaquin Air Quality Board;
- Arizona fire zones have implemented a collaborative fuels group that prioritizes and coordinates all prescribed burning across units within the zones;
- The Front Range Fuels Treatment Partnership in Colorado brings a diverse group of stakeholders together to facilitate prioritization and planning of prescribed fire treatments, resulting in broad-based support for that program;
- The Clearwater Elk Initiative sponsored by U.S. Senator Mike Crapo provides significant support for prescribed burning in northern and central Idaho; and
- The Northeast Oregon Smoke Management Memorandum of Understanding allowed the Wallowa–Whitman National Forest to increase prescribed burning for forest health while meeting State air quality requirements.

Workshop Participants and Accomplishments

The National Fuels Management Workshop was conducted by Tim Sexton, fire use program manager; and Sarah Robertson, fire management specialist, for the USDA Forest Service, Fire and Aviation Management, Washington Office, National Interagency Fire Center, Boise, ID.

Workshop participants included:

Northern Region

Joe Hudson, district ranger, Moose Creek Ranger District, Nez Perce National Forest
Bob Lippincott, assisant fire staff, Clearwater–Nez Perce National Forests

The Nez Perce and Clearwater National Forests are implementing the full range of fire management during fire season. Last August, 12,000 acres (4,013 ha) were burned under prescribed fire while 24,000 acres (8,027 ha) of wildland fire use (WFU) were being managed—in addition to several project fires and multiple type 3 wildfires.

Rocky Mountain Region

Pat Medina, assistant fire management officer, Gunnison Ranger District, Gunnison National Forest

The Gunnison Ranger District has been very consistent over the last several years at accomplishing its burn targets. In recent years, it has hosted many trainees from the National Interagency Prescribed Fire Training Center and other units. The district has also undertaken some of the most complex, high-risk stand-replacement prescribed fire treatments—*without* mishap.

Southwest Region

Bruce Greco, fire staff officer, Coconino National Forest
Jeff Thumm, fuels specialist, Mogollon Rim Ranger District, Coconino National Forest

The Coconino National Forest has focused its prescribed fire program on the wildland/urban interface, emphasizing collaboration to overcome historic barriers and allowing prescribed fire in urban interface settings. Flexibility and innovation have broadened windows of opportunity on this forest, resulting in higher levels of attainment in the non-wildland/urban interface.

Intermountain Region

Rod Dykehouse, fire staff officer, Bridger–Teton National Forest

The Bridger–Teton National Forest and Grand Teton National Park provide a great example of interagency partnering to achieve common objectives in fire use and safe, effective wildfire management. Their long-established, mutual prescribed fire program affords a solid foundation for meeting multiple objectives, including hazard fuel and wildlife habitat program goals.

Long-Term Support

Partners recognize that managing fuels at the landscape scale is a long-term effort that will require the careful attention and commitment of resources for decades. This ongoing support—as more supporters see how individual projects fit into the big picture—should reduce barriers to future project planning.

The support of Wilderness Watch for the Minam Backbone and Minam II Management Ignited Fire project in Oregon's Eagle Cap Wilderness is an example of this phenomenon. Since 1995, successful implementation of these projects continues to pave the way for future use of management ignitions in the Eagle Cap and other wilderness areas.

> When multiple interests and disciplines can claim the accomplishment, there is a greater incentive to treat more acres.

Likewise, on the Bridger–Teton National Forest, the Jackson Interagency Habitat Initiative has gathered wildlife biologists from a variety of Federal, State, and local agencies to provide scientific support for using fire to enhance winter range big game habitat. This, in turn, is promoting program efficiencies through the sharing and funding of resources that can achieve various program goals.

In addition, the Grand Teton National Park and the Bridger–Teton National Forest are working together to achieve prescribed fire objectives by prioritizing treatments and utilizing interagency crews for fuels treatments, fire

Pacific Southwest Region

Art Gaffrey, forest supervisor, Sequoia National Forest
Brent Skaggs, fire staff officer, Sequoia National Forest

Pacific Northwest Region

Ken Rockwell, fuels and air quality manager, Wallowa–Whitman National Forest
Nick Lunde, Wallowa zone fire management officer

Successful implementation of the Wallowa–Whitman National Forest's hazard fuel reduction program consistently averages more than 125 percent of target. This forest has strategically applied prescribed fire to enhance WFU opportunities, using these opportunities to implement even more fire onto the landscape.

In 2005, the Granite WFU Fire accomplished resource benefits through unplanned ignitions on more than 35,000 acres (11,706 ha). This was a record-setting year for both the forest and the region. The Wallowa–Whitman National Forest maintains a strong integration of funding and mission for timber, silviculture, and fuels. It has great contingency planning to accomplish hazard fuel targets under dynamic conditions.

Southern Region

James Hart, fire staff officer, National Forests of Florida

The National Forests of Florida has been very successful in developing and maintaining a wide diversity of partnerships with other agencies, environmental groups, and various interest groups. It has been a consistently high performer in achieving targets in a cost-effective manner. This forest has also been a proven leader in ensuring that all disciplines actively participate in planning and implementation of the prescribed fire program. Line and staff are actively involved—to the extent that even district rangers are often part of the burn crew.

Northeast Region

Derrick Wilkerson, assistant fire management officer, Wayne National Forest

The Wayne National Forest fire/fuels program is a recent addition to the forest. Yet, despite its recent development, the Wayne Fuels Program has aggressively applied fire to the wildland/urban interface—where approximately 90 percent of its burning occurs.

The Wayne Fire and Fuels Program has also led the development of the Firewise Program in Ohio, helping develop partnerships with State and local agencies, as well as nongovernmental organizations and universities.

effects monitoring, and prescribed fire and suppression resources.

This approach is providing increased acres treated for each agency. Additionally, these partnership programs are more effective when the interagency managers use a unified approach to foster better understanding of issues, resulting in increased support and shared accountability.

Communication and Collaboration with Publics, Internal Customers, and Regulatory Agencies

Effective communications is an essential component of all prescribed fire programs. When involving the public in the forest's goals and objectives, we need to actively encourage participation—where allowed—in collaborative planning and information sharing that provides a shared understanding of the issues and how we manage and mitigate risk in the prescribed fire programs.

This includes forming integrated partnership groups (such as the Greater Flagstaff Forest Partnership) to actively provide input and ideas into the management of the prescribed fire program:

- The Greater Okefenokee Association of Landowners and the Teton Area Wildfire Protection Coalition both provide public service messages that advocate for prescribed fire and educate the public about wildfire;
- County mitigation plan committees in northern Idaho are facilitating agreement on issues and distributing information to stakeholders and the public;
- The Northern Arizona Ponderosa Fire Advisory Council conducts education outreach to inform the public and targeted stakeholders on the benefits and need for prescribed fire (the council has also put together fuels crews for use by all agencies in northern Arizona when conducting prescribed burns); and
- Prescribed Fire Councils in Florida are promoting the acceptance of prescribed burning with legislators, stakeholders, and the public.

> Regulatory agency partnerships allow line officers to feel more comfortable with addressing and accepting risk.

Education Efforts

To provide our external and internal publics with an understanding and knowledge of prescribed fire program issues and results, it is also advantageous to create a prescribed fire education–information program that is integrated with fire suppression and other resource programs.

As fire program strategies are implemented, it is also important to communicate successful burning program results (such as through news releases and news briefings) to internal and external interests and to reward the success by program managers. Such efforts support the communication–collaboration process with both the public and regulatory agencies.

Regulatory Agencies

It is also essential to create relationships with the regulatory agencies. Involving these agencies in the planning and project design helps to foster an understanding of prescribed fire issues and how to proactively solve them. This collaboration also leads to increased opportunities to apply prescribed fire to the landscape.

Fostering regulatory agency relationships requires a strong commitment from fire managers, line officers, and other resource specialists. The resultant benefits greatly increase prescribed fire program support and involvement. Furthermore, these regulatory agency partnerships allow line officers to feel more comfortable with addressing and accepting risk. Such efforts are currently occurring on many units. They have accomplished many successes.

An example is the Clearwater and Nez Perce National Forests gaining public and partnership support in implementing a 12,000-acre (4,013-ha) prescribed fire while simultaneously managing WFU *and* wildfire suppression incidents during the same time period.

Our efforts to establish productive communication and collaboration with the public, regulatory agencies, and other land and fire management agencies will result in:

- Beneficial partnerships,
- Better shared support in accepting risk, and
- Increased prescribed fire program opportunities and capabilities.

Risk Management

How Does Good Risk Management Get the Job Done?

1. **Experience and skills.** A workforce that has experience enables the decisionmaker to achieve a higher risk threshold. **How?** Maintain and diversify current workforce experience and skill level through intensive performance-based training. Plan projects that challenge employees and require training opportunities in a variety of prescribed fire positions as well as vegetation types. Train prescribed burn bosses to allow multiple ignitions during limited burn windows. The National Interagency Prescribed Fire Training Center exchanges personnel nationally to better take advantage of prescribed fire windows.
2. **Support from stakeholders, politicians, and collaborators.** This support allows the decisionmaker to achieve a higher risk threshold through shared ownership, active participation, funding, and involvement in implementation. **How?** Describe what is in it for "them." Convey your mission and leader's intent, defining their role in the process. (Example: Local stakeholder California Department of Forestry's chief officers meeting with Forest Service prior to implementation of wildland/urban interface hazard fuels reduction projects.)
3. **Publicize Success, Education and Communication.** A successful program that incorporates these attributes allows the decisionmaker to achieve a higher risk threshold by reducing resistance and encouraging the solicitation of by-in. **How?** Deliver the right message, using multimedia coupled with opportunities to educate and communicate the agency's internal and external messages.

The broader our prescribed fire program support base, the greater our support will be when that rare bad outcome event occurs.

Increasing Risk Tolerance

The greater the support and understanding from diverse groups, the greater the understanding of risks and consequences. When a negative prescribed fire program outcome occurs, this support can help lessen the political consequences and unwanted impacts on the entire program.

An example of this support is a group of outfitters in Idaho who understand the wildlife benefits of prescribed fire and fire use. Such support has permitted prescribed burning for more days within the burn season and reduced the barriers to decisionmakers for making the "Go" fire use event decisions.

Accountability will always go hand-in-hand with this support. Using fire to manage landscapes is not a perfect science. Even a seemingly flawless burn plan will always encompass an element of risk. Therefore, the broader our prescribed fire program support base, the greater our support will be when the rare bad outcome event occurs.

Contingency plans also need to be fully designed and developed. They must consider likely alternate scenarios and utilize all the tools available for safely and effectively achieving treatment objectives. This enables the work—despite changing conditions—to be accomplished efficiently and successfully.

If risk at all levels of program implementation is not managed appropriately, program success will be marginal. Managing risks (such as program acceptance, smoke management, potential of escape, burn effects, and resource impacts and benefits) without active line officer leadership will provide marginal results. We must always ensure that risk acceptance is based on sound decision support.

Implementation Characteristics

What are the project implementation characteristics at the top-performing fuel reduction programs?

- Program managers take advantage of all burning opportunities that are presented throughout the year—including night burning. For example, they have more acres available to burn than simply their target acres. Then, as burning opportunities arise, they can pursue multiple directions (various elevations and aspects).
- Flexibility is built into the prescribed fire program. Plans are based on the expectation that not all program elements will occur as anticipated. For example, while a forest might not receive an appropriate spring burn window, it nonetheless has plans in place to accomplish the fuels target through contract obligation (identified on the advanced acquisition plan) or by switching to mechanical treatment. Thus, units suitable for contract implementation are identified in

advance. Liability associated with the contract is managed.

- Project implementation is integrated among everyone involved in project analysis and development. For example, the Apalachicola National Forest has wildlife biologists, silviculturists, and archeologists serving on its burning crews. This provides for more project ownership as well as for better understanding of treatment effectiveness and mitigation measures. In addition, the integration of implementation funding sources allows for a more focused approach to meet agency goals and to accomplish multiple objectives.
- Prescribed burning is applied to larger units designed with sufficient pre-burn treatment/preparation and with variable outcomes that are anticipated consistent with the variability of landscape conditions. This improves cost/treatment effectiveness and implementation efficiency. In many situations, it is no more expensive to hold the perimeter of a 2,000-acre (669 ha) burn unit than a 200-acre (67 ha) unit.
- Maintenance burning is an increasingly important part of the overall fuels reduction program in the West. It is the norm in the East. Maintenance burning improves previous treatments, such as in wildland/urban interface areas, and protects investments. Maintenance treatments in strategically placed units—located within high-priority areas—take precedence over entering new areas during times of flat or decreasing budgets.
- Distribution of funding between the time of analysis and implementation is balanced to maximize accomplishment on the ground. Therefore, no more funding than necessary is directed to analysis to maintain an adequate implementation pipeline or, alternatively, a minimum-sized analysis workforce. ■

Websites on Fire*

National Staff Ride Library Website

You are the superintendent of a southern California hotshot crew. It is 0900 hours on November 1. It has been a long fire season. It began early—in late May—with the 10,000-acre (4,047 ha) Wellman Fire on the Los Padres Nation Forest. Your crew has been fighting fire nonstop ever since.

Fuel conditions are exceptionally dry. The past four days, a Santa Ana wind has been blowing from the northeast. This is the sixth Santa Ana wind event this fall. You have just received a dispatch for a fire in the Angeles National Forest's front country near Pacoima Canyon.

What information and instructions do you convey to your crew?

That is the actual scenario for the tactical decision game for stand two in the 1966 fatality Loop Fire Staff Ride. This staff ride format, and several others, are available on the National Staff Ride Library Website.

Provided by the National Wildfire Coordinating Group's Wildland Fire Leadership Development Program, this helpful Website provides a myriad of information on staff rides, from background material and information sources for building staff rides and these tactical decision games, to actual staff ride templates.

The intent of this resource is to provide a library of information on significant wildland fire events to assist people who want to conduct staff rides to those sites. This Website also serves as a reference source for those who want to develop new staff rides for incidents of local interest.

Found at <**http://www.fireleadership.gov/toolbox/staffride**>.

* Occasionally, *Fire Management Today* briefly describes Websites brought to our attention by the wildland fire community. Readers should not construe the description of these sites as in any way exhaustive or as an official endorsement by the USDA Forest Service. To have a Website described, contact the managing editor, Paul Keller, at 503-622-4861, pkeller@fs.fed.us (e-mail).

Wildland Fire Use as a Prescribed Fire Primer

Dana Cohen

There are several goals for prescribed fire programs, from intensive fuel reduction inside the wildland/urban interface for reducing the risk of severe fire near homes, to restoring the natural role of fire to the landscape out where a century of fire suppression has left an unintentional—yet indelible—impact.

With such a variety of goals, however, we tend to apply fire at the same times of year with the same tools, and often with the sole objective of reducing wildland fuels to very low levels. For units where the goal is not a "natural" setting but rather a defensible space, this type of fire is often exactly what's needed. But where the goal is restoration of process and ecosystem health, we need to ask: Are these prescribed fires *truly* replicating "natural" fire?

As wildland fire use (WFU) becomes more common outside of wilderness areas and moves onto a greater variety of Federal, State, and private lands, we have the opportunity to observe more fire use events. Thus, we have the ability—if we're paying attention—to better calibrate our prescribed fire prescriptions for restoration purposes and add an important set of tools to our arsenal.

Dana Cohen is a fire prevention officer for the USDA Forest Service, North Kaibab Ranger District, Kaibab National Forest, Fredonia, AZ. When she wrote this article in April 2006, she was a fuels specialist for the USDA Forest Service's Dixie National Forest, Cedar City, UT.

Where the goal is restoration of process and ecosystem health, we need to ask: Are these prescribed fires *truly* replicating "natural" fire?

The Nature of Fire

When we talk about the role of fire in ecosystems, the term "mosaic" is often used. As managers move toward larger treatment units, more of a mosaic is inevitable—regardless of ignition source, timing, or length of the burn.

The mosaic achieved in a WFU fire, however, is rarely replicated in a prescribed burn. There are many reasons for this, all of which can be gleaned from observing "natural" fires.

After nearly a decade of observing lightning-caused, unsuppressed fires in Yellowstone National Park, Don Despain, research ecologist at the Department of the Interior, U.S. Geological Survey, Northern Rocky Mountain Science Center, made the following key observations (Despain 1985):

- Large fires do not result from every ignition;
- Fires can persist for long periods of time; and
- Fires are not active through most of their duration—large acreage increases are only sporadic.

Perhaps the greatest missing link in our attempts to "restore" natural fire to the landscape is our typical human impatience—grounded in political realities. Would the public tolerate the smoke of a long-term planned ignition event? Will we have resources to manage this fire in another week? In another month?

Applying Fire in a Restorative Mode

And yet the reality is that fires allowed to move with little or no management intervention create a much greater mosaic as they progress. Fires *are* patient—they smolder, creep, or merely persist through heavy fuels as fuel conditions, weather, and topography allow for a period of fire growth.

If we, as managers, could be so patient in our application of fire, we would be taking great strides toward truly applying fire in a restorative mode.

Research ecologist Despain further noted that less than 20 percent of the lightning starts in old-growth stands in Yellowstone National Park grew to greater than 5 acres (2 ha). It is also a fact that in landscapes so far from their "natural" compositions, minimally managed fires alone will not restore ecosystems (Miller 2004). There is no one answer, no one magic bullet.

There is always the opportunity for us to learn and to grow, the opportunity to add more tools to our arsenal. The three adjacent case studies are excellent examples of this (see sidebar). As we continue to shift from a suppression paradigm to one of integrated landscape management, WFU fires offer an undeniable opportunity to add to our management toolbox.

Does it really matter who starts the fire?

Ultimately it doesn't. But the timing and type of fire do matter. Taking the lessons learned from WFUs and integrating them into our prescribed fire management practices are the next step in the evolution of fire management.

Acknowledgments

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The Next Step in Our Evolution of Fire Management: Three Case Studies

Right Fork Wildland Fire Use Fire/Texas Mountain Prescribed Fire

Northwest Colorado Fire Management Unit, Department of the Interior, Bureau of Land Management, White River Field Office

On August 21, 2003, a lightning strike started a wildland fire use (WFU) fire in the Texas Mountain prescribed burn unit near Rangely, CO. The Texas Mountain prescribed burn had been planned 10 years earlier. The burn had been attempted several times prior to this lightning ignition. That coming October, a prescribed burn was slated for yet another try.

The goals of this planned prescribed burn were to:

- Reduce heavy fuel remnants from "chainings," a method for felling large numbers of piñyon and juniper trees using a large anchor chain pulled between two tractors, in the 1960s and 1970s;
- Reduce the piñyon pine and juniper encroachment into the area; and
- Create a better mosaic of age classes and species diversity within the shrub/forb community.

When the fire was first reported, the Zone Fire Management Officer and others recognized the location and proceeded to manage the fire for resource benefit. After several days of observing the fire's behavior, it was clear that the conditions were optimal for conducting the prescribed burn. Resources were gathered; fire restrictions were reexamined. On September 1, the prescribed burn was successfully initiated while the WFU continued within its boundaries until it was completely absorbed into the prescribed fire burn.

Six Mile Wildland Fire Use Fire

Manti-LaSal National Forest

In the late 1990s, a project was developed on the Manti-LaSal National Forest in eastern Utah to promote aspen regeneration through the reintroduction of fire. In 2000, fire was applied to a portion of the target unit. Plans were in place to treat additional acreage following the 2004 fire season. Managers had been constrained in their prescribed burn attempts for several reasons, including inability to meet prescription and staff turnover.

The Six Mile WFU Fire started in July 2004 near this original prescribed fire unit. The fire was called out in November. Ultimately, this WFU accounted for 5,027 acres (2,034 ha) burned, with the majority of fire growth occurring in September. Portions of the 2000 prescribed fire treatment were reburned.

Managers and the forest fire ecologist were impressed with the WFU's fire behavior, even during the monsoonal weather patterns of midsummer and occasional rainfall that the unit received. The fire burned in a mosaic, consuming heavy fuels and creating numerous gaps in the fir that had encroached into aspen habitat.

Because it was previously thought that fire during this time of year wouldn't achieve management objectives, burning at this time was not originally considered. However, as the fire effects—during both the fire's slow growth as well as its runs—continued to be monitored,

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Varied Consumption—The Six Mile Wildland Fire Use Fire on the Manti-LaSal National Forest burned through the monsoonal weather patterns of midsummer in a mosaic pattern, successfully consuming heavy fuels and creating numerous gaps in the fir that had encroached into aspen habitat. Photo: Dana Cohen, USDA Forest Service, North Kaibab Ranger District, Kaibab National Forest, Fredonia, AZ, 2004.

managers gained valuable information for future aspen restoration projects.

Great Smoky Mountains National Park Fire Use Program

The prevailing paradigm for fire-dependent communities in the southern Appalachians is that they are largely a result of anthropogenic, or human, influences (Buckner 1998). Fire histories, such as Mark Harmon's studies in the park would seem to confirm this (Harmon 1981). They attribute the majority of known fire starts and burned acreages to anthropogenic causes rather than to lightning.

Since the implementation of a WFU policy with the park's 1996 fire management plan, however, managers have been exposed to a number of lightning-caused fires that are beginning to tell a vastly different story.

From 1942 to 1997, of the 115 recorded suppressed lightning fires, the largest acreage burned in the park from a single fire was the 1988 163-acre (66-ha) Redman Fire. Only 21 fires (18 percent) during this time period grew to more than 10 acres (4 ha). In fact, the Redman Fire was the only suppressed fire that grew to more than 100 acres (40 ha) within the park.

Since 1998, 14 lightning started fires have been recorded in the park. The majority of these were not suppressed. Four grew to more than 100 acres (40 ha). Of these, the Chilly Springs Fire is the largest, currently at 900 acres (360 hectares). None of these large WFU fires experienced any management intervention, such as burnout operations, which might skew the data.

Recent experience suggests that lightning has played a greater role in the landscape than previously understood. It has also helped park fire staff approach their prescribed burns differently. Main ignition often occurs along ridgelines, and fire is allowed to back down toward blackened control lines or moist drainages.

Learning From Escaped Prescribed Fires – Lessons for High Reliability

Deirdre Dether and Anne Black

Meeting national goals for hazardous fuels reduction and ecosystem restoration would be difficult—if not impossible—without utilizing prescribed fire. Suspension of prescribed fire programs, as often happens following an escape, limits Federal capacity to meet programmatic, social, and ecological goals.

Thus, meeting these goals requires that fire programs—both prescribed fire and wildland fire use (WFU)—operate with "high reliability." In other words, they go about their work with less than their fair share of accidents (Weick and Sutcliffe 2001).

Deirdre Dether is the forest fuels planner for the USDA Forest Service, Boise National Forest, Boise, ID; Anne Black is an ecologist with the Aldo Leopold Wilderness Research Institute, USDA Forest Service, Rocky Mountain Research Station, Missoula, MT.

Our intent is to identify potential "weak signals" or "early warning signs" that fire use practitioners might want to heed as they prepare for future fire use and suppression events.

In this article, to understand how to improve future performance, we summarize a recent review (Dether 2005) of escaped prescribed fires from the perspective of high reliability (see "The Five Key High Reliability Organization Activities" sidebar). Our intent is to identify potential "weak signals" or "early warning signs" that fire use practitioners might want to heed as they prepare for future fire use as well as suppression events.

Getting a Leg Up On Reliability

Unexpected events surprise us. Managing for the unexpected implies a consciously nurtured and honed ability to attend to small surprises—to recognize, *early*, that events are not proceeding according to plan. And then respond decisively.

Yet, as authors Karl Weick and Kathleen Sutcliffe explain, the human tendency is to "search for confirming evidence which postpones the realization that some-

The Five Key High Reliability Organization Activities

Through their research into the successful operations of organizations involved in high risk operations—including nuclear aircraft carriers, air traffic control, emergency rooms, and fire operations—Weick and Sutcliffe (2001) have identified five activities in which all successful high reliability organizations engage to manage unexpected events:

1. Preoccupation with Failure,
2. Reluctance to Simplify,
3. Sensitivity to Operations,
4. Commitment to Resiliency, and
5. Deference to Expertise.

These five activities can be grouped into two functional categories, "mindful anticipation," and "mindful containment."

Mindful anticipation includes actions that focus on:

- Identifying and responding quickly to conditions that can lead to failure (Preoccupation with Failure),
- Seeking and maintaining a diversity and complexity of perspectives (Reluctance to Simplify), and
- A constant vigilance to operations and updating our understanding of events based on our observations (Sensitivity to Operations).

Mindful containment includes:

- Decisive response and adaptation to unexpected developments (Commitment to Resiliency), and
- A deference to those with greatest expertise and firsthand knowledge of the developing events (Deference to Expertise).

Constantly Looking for Ways To Improve Program

Tim Sexton

During the past few years, the USDA Forest Service's prescribed fire program has demonstrated a record of success and improvement. Analyses completed in 2002 and 2006 demonstrated a high rate of success and an improving trend (see table).

Most of the 38 escapes during this 3-year study were not significant in that they did not burn private lands, did not significantly damage natural resources, nor cause large, costly suppression actions.

While the agency's prescribed fire program has a high rate of success, we are constantly looking for ways to improve. Deirdre Dether and Anne Black's article "Learning From Escaped Prescribed Fires – Lessons for High Reliability" in this issue of *Fire Management Today* suggests that we can increase our prescribed fire program success rate through instilling high reliability organization (HRO) concepts more fully.

The authors have reviewed many escapes (USDA Forest Service as well as U.S. Department of the Interior) and identified areas where application of HRO concepts might have resulted in a more favorable outcome.

It is important to remember that the examples of prescribed fire escapes cited in the article represent a very small fraction of the number of prescribed burns implemented by these agencies.

Tim Sexton, coordinator for this special "fire use" issue of Fire Management Today, *is the fire use program manager for the USDA Forest Service, Fire and Aviation Management, Washington Office, National Interagency Fire Center, Boise, ID.*

While the agency's prescribed fire program has a high rate of success, we are constantly looking for ways to improve.

USDA Forest Service prescribed fire escapes and success rates.

	1996-2001	2003 -2005
Prescribed Fires	24,133	10,920
Annual Average	4,022	3,640
Acres Burned	6,406,217	4,928,766
Annual Average	1,067,703	1,642,922
Escapes	235	38
Annual Average	39.2	12.7
Average Success Rate	99.0%	99.7%

thing unexpected is developing. If you are slow to realize that things are not the way you expected them to be, the problem worsens and becomes harder to solve. When it finally becomes clear that your expectation is wrong, there might be few options left to resolve the problem" (Weick and Sutcliffe 2001:39).

If we can train ourselves to notice and respond to surprises early—while they are still small—we will have a leg up on reliability.

If we can train ourselves to notice and respond to surprises early—while they are still small—we will have a leg up on reliability.

Using the Concept of Surprise

Weick and Sutcliffe use the concept of surprise to help develop an understanding of unexpected events. Surprises come in a number of varieties (Kylen 1985):

1. An event for which you had no expectation, no prior model of the event, no hint that it was coming;
2. A recognized issue, but one that moves in the wrong direction;
3. An event you know will happen, when it will happen, and in what

order, but you discover that the timing is off;
4. An event for which the expected duration of the event proves to be wrong; and
5. An expected event, but of the wrong amplitude (Weick and Sutcliffe 2001:36-39).

In our study, we examine previous escaped prescribed fires through two lenses:

1. First, by considering the types of surprises noted in escape review reports,
2. Second, by fitting these identified surprises into the five activities common to high reliable organizations (HROs) (see sidebar).

Surprises can indicate where we have faulty assumptions and expectations. By looking at multiple events across agencies and conditions, we can identify the lessons that we might be learning in our individual units through direct experience, yet not incorporating into our broader, collective toolbox of organizational knowledge.

It is our hope and intent that this summary helps increase our individual and organizational capacity to mindfully anticipate and respond to these inevitable and unexpected occurrences.

It is our hope and intent that this summary helps increase our individual and organizational capacity to mindfully anticipate and respond to the inevitable unexpected occurrences.

The Prescribed Fire Escape Review

The review, "Prescribed Fire Lessons Learned: Escaped Prescribed Fire Reviews and Near Miss Incidents–Initial Impressions Report" (Dether 2005), represents the first known attempt to use an HRO framework to evaluate and synthesize causes and commonalities in reviews of escaped prescribed fires and near misses.

The 30 prescribed fire escape reviews and near misses studied in this review were:

- Obtained from the Wildland Fire Lessons Learned Center, Tucson, AZ,
- Collected from agency websites by agency personnel, or
- Located in personal collections.

Although all accessible documents were analyzed, this was by no means a comprehensive sweep of escape reviews. Because some agencies do not systematically report escapes or near misses and there is no central repository for this documentation, this report represents a "grab" sample. Even so, this effort represents a significant step in helping to identify common threads in lapses of mindfulness.

Documents reviewed ran the gamut from slide show presentations to final reports. They occurred from 1996 to 2004 under significantly different policy, as well as varied burning conditions—from February to October. Reviews from all four Federal land management agencies (USDA Forest Service, USDI Bureau of Land Management, USDI Fish and Wildlife Service, and USDI National Park Service) were evaluated—covering landscapes from Alaska to Florida.

Reviewed prescribed fire vegetation–fuel complexes included:

- Ponderosa pine,
- Mixed conifer,
- Subalpine fir,
- Pinyon–juniper,
- Chaparral,
- Sagebrush–aspen,
- Oak brush,
- Grass, and
- Activity fuels (slash).

The number of acres planned for ignition ranged from less than 5 acres (2 ha) to more than a 1,000 acres (405 ha) for individual burn blocks, with several of the more recent escapes involving multiple burn blocks.

Common Surprises During Implementation

The most common form of unforeseen and unanticipated events and outcomes noted in the reviews were surprises due to unexpected amplitude of events (see "Varieties of Surprise" sidebar), including greater than expected fire behavior due to winds, fuel moistures, fuel complexes, and unexpected complexity.

One burn boss described unexpected fire behavior in standing dead piñyon–juniper. The bug-killed trees had no needles left in their crowns, yet fire was able to move into the crowns and sustain fire spread through the aerial fuels much like a typical crown fire. In this case, an adequate control line stopped the spread of fire, preventing the prescribed fire to escape.

In another prescribed fire treatment, unexpected heat and spotting came from a small pocket of fuels adjacent to the burn area boundary. This was not the dominant fuel

Varieties of Surprise

1. **First Form.** Something appears for which you had *no expectation, no prior model* of the event—no hint that it was coming.
2. **Second Form.** The issue is recognized, but the *direction* of the expectation is wrong.
3. **Third Form.** Occurs when you know what will happen, when it will happen, and in what order—but you discover that the *timing is off.*
4. **Fourth Form.** Occurs when the expected *duration* of the event proves to be wrong.
5. **Fifth Form.** Occurs when the problem is expected, but the *amplitude* is not.

– Weick and Sutcliffe (2001) Chapter 2, pages 36-39

type within the burn area. It had not been noted in the burn plan.

People on escapes were frequently surprised by fire behavior unexpectedly more intense than anticipated in the burn plan. Placing test fires in unrepresentative locations and fuel types—such as in cooler or moister locations than characteristic across the unit, or in fuels with a less extreme fire behavior potential than the main burn area—also led to misconceptions of expected fire behavior.

Weakness in Burn Plans

Reviewers noted common weaknesses in burn plans surrounding:

- Complexity and risk assessments,
- Thoroughness of the ignition, and
- Holding and contingency plans.

Although analysis of burn complexity changed considerably from 1996 to 2004, correct assessment is still a critical step to success. Underrating complexity led to ineffective or underdesigned ignition, holding, and contingency plans. Planners and implementers commonly underrated both individual and overall prescribed fire complexity.

In several cases, this was due to the burn plan preparer not following agency direction. This underrating also occurred when burns that were implemented simultaneously were rated separately.

Review teams often noted that the depth and detail of analysis for complex burns was insufficient. Large-scale burns will likely have multiple aspects, variable vegetation–fuel complexes, and resource objectives and constraints that—to implement successfully—require more complex planning and burn organization.

Burn Boss Qualifications

Almost invariably, these escape reviews also noted surprises due to events or conditions outside the experience of the people involved in the burn. While people's burn qualifications was an issue in only two of the reviews studied, several reviews noted that burn bosses—while technically qualified—were still inexperienced with the fuel type.

The lack of appropriate "mental models"—expectations and assumptions—included weather, test firing, control points, and expectations for implementing a previously written burn plan. In several cases, lack of understanding of what constituted a logical or realistic control point led to indefensible burn block boundaries.

In some cases, even though burn personnel knew model predictions would not be accurate, the actual rate of spread, flame lengths, and resultant spotting were still beyond their experience—and, often times, even their imaginations.

How Weather Contributed

Weather was cited as the immediate causal factor of nearly 50 percent (14) of the escapes. This included increased or shifting winds and drops in relative humidity that lead to spotting beyond burn perimeters. Weather conditions were often cited as not being "normal" or being "more than normal" (such as periods of drought and untypical warmer and drier circumstances) prior to ignition. On some burns, it was noted that these weather-related conditions became progressively warmer and drier prior to escape.

Unexpected winds—in both strength and duration—were commonly cited as contributing factors to escapes. Some burn personnel reported being surprised by the effect of strong, erratic winds on

This review represents the first known attempt to use a high reliability organizing framework to evaluate and synthesize causes and commonalities in reviews of escaped prescribed fires and near misses.

their fire that resulted from nearby thunderstorm development. In one case, the storm was forecast. The crew could see the thunder cells developing. But because the storm was approximately 30 miles (48 km) away, they decided that it posed no threat and proceeded with ignition.

Mop-up and Patrolling

In most cases, burns were patrolled on a daily basis. In burns of longer duration, the patrols noted activity—visible smoke or open flaming of fuels—increasing inside the burn unit. On some escapes, while the patrols noted these "smokes," they—wrongly—thought they would not threaten the burn's boundaries. On other burns, personnel knew other prescribed burns had recently escaped within their geographical area. Despite these signals, they did not alter mop-up protocols or utilize heat-detecting equipment.

Another form of surprise occurred when fuels, change of vegetation type, or nighttime humidity recovery—despite the burn plan's predicted fire behavior descriptions—failed to check the spread of fire. On one burn, aspen stands that were intended to check the fire's spread failed because the burn was not implemented during the planned season when aspen could reasonably be expected to function as a natural barrier.

In another case, a wetland adjacent to the burn area was identified as a natural barrier. Yet when the burn was implemented, this preplanned natural barrier was dry. On several of these prescribed burns, nighttime humidity recovery was expected to stop or check the spread of fire, but failed. In these cases, burn personnel did not gather onsite information to confirm planned or expected conditions.

Unforeseen Events

In several cases, unexpected fuels or conditions, and thus fire behavior, resulted from the unexpected timing of events. When burn personnel did not recognize these changes or update their expectations, they often received dire surprises.

Several escapes noted that fine fuel loadings at the time of implementation differed from burn plan expectations and fuel condition assumptions. In some cases, this was due to seasonal variation, such as a wetter-than-normal growing season preceding implementation. In another prescribed fire escape, the "resting" of a pasture for 2 years prior to the burn implementation increased fine fuel loads. Unfortunately, this change of condition was not captured or discussed in the burn plan or was otherwise noted prior to ignition.

> Planners and implementers commonly underrated both individual and overall prescribed fire complexity.

Timing surprises often occurred at the margins of prescription parameters when either the conditions occurred sooner than expected, or delays in implementation resulted in ignitions already being in progress when conditions exceeded prescription parameters.

Surprise, Mindfulness, and High Reliability

By considering these prescribed fire escapes through the lens of high reliability, we see undue confidence placed in burn plans as well as a lack of testing, confirming, and updating of knowledge based on real-time, on-the-ground information—also known as situational awareness.

These are failures of "mindful anticipation" (see "The Five Key High Reliability Organization Activities" sidebar). They tend to group into lapses of "Preoccupation with Failure" and "Sensitivity to Operations." Lapses in "Preoccupation with Failure" occurred in the planning stages (such as improper fuel models used), as well as in implementation (such as test firing in nonrepresentative fuel types).

We also see signs of a lack of "Sensitivity to Operations" through a reliance on information in the burn plan without confirming that conditions at the time of ignition conform to those addressed in the burn plan. These lapses in "Sensitivity to Operations" also include failing to note small signals that indicate prior experience or planning might no longer match actual conditions (such as changes in fuel loads), and failures to capture changes in significant fire behavior parameters (such as fuel moisture recovery).

Next Steps to High Reliability Organizing

In retrospect, while many of the surprises can be viewed as failure to follow policy, we feel confident that no one intentionally set out to violate policy. Good policy is essential and must be followed. While improvements to policy give practitioners better "whats," we also need better "hows" and a deeper understanding of the "whys." Following policy is critical. But it does not necessarily increase our ability to identify and respond to the numerous "weak signals" encountered during fire operations.

Building this capacity is key to improving our performance as individuals and as a HRO. This is achieved through both individual and organizational actions. Individual and organizational capacity includes the individual knowledge and experience necessary to successfully implement policy, as well as the organizational structures that support ongoing learning at both individual and organizational levels.

Activities include tangibles such as internal HRO "audits," local and national training and mentoring programs, and mechanisms for transferring and institutionalizing lessons learned—as well as the broader intangibles such as becoming a "learning culture." Approaches such as the Forest Service's new fire suppression doctrine* appear to address this less tangible aspect of capacity.

Because the process of understanding our weaknesses and strengths is a key first step to improving reliability, the rigorous evaluations of existing practices and local efforts to improve mindfulness can also help build capacity for improving our performance.

Important Disclaimer

It is also important to remember that the original prescribed fire escape reviews that we examined in this study were not conducted for the purpose of ascertaining strengths and weaknesses in high reliability. Thus, we can only draw inferences from what is noted in these reviews.

> This effort represents a significant step in helping to identify common threads in lapses of mindfulness.

Further, because this sample might not be representative, we must treat the generalizability of our insights cautiously. For instance, simply because 50 percent of this sample noted weather as a factor, does not mean that, overall, 50 percent of escapes involve unexpected weather events.

> Unexpected events will continue to occur. How do we organize ourselves to successfully recognize and respond to them?

At the same time, we do know that weather can be problematic. We would be remiss if we didn't conclude that we can improve our mindfulness in this area.

In summary, in planning and implementing prescribed fire events, we offer the following observations and insights for consideration:

- Ensure that expectations of fire behavior are built on conditions existing at the time of ignition and for the duration of the burn, not simply at the time the burn plan was written.
- To help build more complete mental models, ensure that multiple perspectives (from the prescribed fire planner, burn boss, holding and ignition specialists) are secured during burn plan development—then follow up by seeking multiple perspectives at implementation.
- Rather than considering—until proven otherwise—that everything is acceptable, we need to train ourselves to the opposite: that our prior experiences are invaluable, not infallible.
- We need to treat our experiences and expectations as testable hypotheses and look for disconfirming evidence—then be prepared to quickly respond to the new information that these questions reveal.

Conclusions

Unexpected events will continue to occur. How do we organize ourselves to successfully recognize and respond to them?

Are we anticipating correctly but not responding sufficiently? Or, are we missing important signals? Are these lapses idiosyncratic by individual—or systemic across the entire organization?

Applying frameworks such as high reliability systematically can help us better understand our strengths and weaknesses—both across the organization and individually.

The weaknesses noted in our study are not new. While the vast majority of fire events (wildland fire use, prescribed fire, fire sup-

* For more information on fire suppression doctrine, see the Spring 2006 *Fire Management Today* issue on "Safety" (66(2).

pression) conclude successfully, there are common threads in those prescribed fire events that do not. Although these are "initial impressions," we can still begin to take action.

We need to learn from the experiences—both positive and negative—of those who have been the focus of these reviews. Their experiences are an invaluable asset to the organization as a whole.

Individually, we can view plans and expectations with skepticism and seek *disconfirming* rather than confirming evidence. We can also begin to use the frameworks of surprise and high reliability to assess our individual and local actions.

Organizationally, we might want to expand upon this effort to look comprehensively at escapes and near misses and discuss additional ways to build mindful anticipation and resiliency into our organizational structures and behavior. Consistent development and central collection and storage of escape and near miss reviews would surely assist such an effort.

Acknowledgements

We would like to thank the Forest Service Intermountain Region fire and aviation management program, particularly Dave Thomas, regional fuels specialist (now retired), for promoting a learning organization and supporting and funding a detail program analyst (Dether) to the Wildland Fire Lessons Learned Center to develop the Initial Impressions Report; and to Brett Fay, regional wildland fire use specialist, for facilitating development of this article. The Boise National Forest graciously allowed Dether time to work on these issues. National Fire Plan funds support Black's work on high reliability and organizational effectiveness. Both authors have gained substantially from their interactions with both Doctors Karl Weick and Kathleen Sutcliffe. Tim Sexton, national fire use specialist for the Forest Service; and Al Carrier, national fuels management specialist–operations for the USDI Bureau of Land Management, dug into their files and supplied additional escape prescribed fire reviews not electronically available. We would be remiss if we did not also publicly extend our appreciation to and for those individuals whose actions have been the focus of review. Their experiences—both positive and negative—are an invaluable asset to the organization as a whole.

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What Was Your Biggest Surprise on a Prescribed Fire?

What was your biggest surprise on a prescribed fire or wildland fire use fire? What was your most stressful situation on a prescribed fire or wildland fire use fire? What was the most significant lesson you learned on a prescribed fire or wildland fire use fire?

These questions, and others, are posed to a panel of veteran burn bosses in the video/digital video disc (DVD) production "Burn Boss Stories: Learning From Veteran Prescribed Fire and Wildland Fire Use Practitioners." Their answers prove informative and insightful.

The production, available in 40- and 20-minute versions, can be acquired through the Wildland Fire Lessons Learned Center, Tucson AZ. For more information, and to peruse the other available wildland fire learning organization-themed video/DVD productions, access the Wildland Fire Lessons Learned Center Website at <myfirecommunity.net>. ■

Measuring Success in Your Fuels Program

Paula Nasiatka and David Christenson

Wildland fuels programs around the country are faced with periodic review and evaluations. Unfortunately, they often follow a "report card" format rather than a true learning practice method.

Unit-level fuels program members who take the time to practice the six critical tasks of a learning organization (see sidebar) and periodically take the companion learning survey should find they are better prepared for program reviews.

The program reviewers who incorporate these six critical tasks into their reviews and then follow-up by sharing unit lessons and effective practices, are helping to improve the entire wildland fire organizational learning environment.

Paula Nasiatka is the center manager, and Dave Christenson is the assistant center manager, of the Wildland Fire Lessons Center, Tucson, AZ.

Organizational Learning Survey

The Lessons Learned Center cooperated with Harvard Business School as it developed the first of its kind organizational learning survey to help individuals and units measure their strengths and weaknesses.

During the summer of 2005, approximately 200 interagency wildland fire people took the draft survey online. These members of the wildland fire community completed the survey as:

- An individual working unit,
- A wildland firefighting crew, or
- As an incident management team member.

The survey tool has three sections:

1. **Learning culture and environment.** This includes the inter-

A Six-Step Tool To Improve How Your Unit Is Learning

How can your unit *learn* from both its everyday fuels program activities and from its program reviews? How can your unit move from living in the "report card" culture to discovering more effective ways to improve what it knows and how it learns?

According to David A. Garvin of Harvard Business School, six specific tasks are critical to organizational learning. By engaging in these tasks (below), a unit can significantly improve both its programs *and* its learning.

By examining your learning environment, your learning processes, and your leadership, you can better measure your unit's level of learning—as well as its improvements over time. These six critical tasks can be directly applied to all wildland fire fuels programs:

1. ***Continually collect intelligence about the fuels environment.*** Make certain to collect critical information. Regularly incorporate it into your planning and implementation. Search, inquiry, and observation are the three methods for collecting this intelligence. When *searching*, use comparisons. Remember to crosscheck to validate the accuracy of the information. When using the *inquiry* method, be exploratory by asking open-ended questions. *Observation* is particularly important when a lot of the tacit knowledge at a unit resides inside individuals' heads. If "we know more than we can tell," the observation method is particularly effective in program reviews. Although program reviews generally take place in the off-season, everyone can learn more effectively if a review is done *during* a prescribed fire or wildland fire use event—when lessons and effective practices can be more clearly illustrated.

2. ***Learn from the best practices of other organizations.*** Look at the successful processes that other fuels or fire management programs are using to see how they might be applied to your unit. One way to do this is through the Wildland Fire Lessons Learned Center's Website <http://myfirecommunity.net>, the online community center for this country's interagency wildland fire community. Its member directory identifies current projects that individuals are working on, particularly in fuels. These "neighborhoods"

Continued on page 58

personal climate, how differences are valued, and the openness to new ideas.

2. **Learning Processes.** The six processes assessed are experimentation, information collection, analysis, education, training, and information transfer.
3. **Leadership.** There are eight different aspects of how managers who communicate and relate to employees are evaluated.

This survey tool is available online through the Wildland Fire Lessons Learned Center at <http://www.wildfirelessons.net>. Individuals can take the survey and have their scores measured against others in the wildland fire community. From these survey scores, individuals and units can then see in which areas they are strong—or, on the other hand, the areas in which they need work. To continue their pursuit to improve their fuels programs, units can continue to take the survey periodically.

Acknowledgments

David A. Garvin, Francesca Gino, and Amy Edmonson of Harvard Business School for developing the first of its kind organizational learning survey.

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A Six-Step Tool To Improve How Your Unit Is Learning (continued)

Continued from page 57

are specifically designed for communities of practice—networks of people—to share knowledge about their fire management programs. In addition, Lessons Learned Center Information Collection Team (ICT) reports are another way to learn about the effective practices of other fuels organizations. Two recent ICT reports have focused on wildland fire use programs—from a unit that had its first wildland fire use fire to a unit with a 35-year history of wildland fire use. Both of these reports are available at: <http://www.wildfirelessons.net/ICT.aspx.>.

3. ***Learn from your own experiences and past history.*** You can achieve this by ensuring that you continually examine your unit's past performance. You can best achieve this by using the After Action Review (AAR) process* to learn from all your projects, whether they be mechanical fuels treatments, prescribed burns, or wildland fire use events. [The four questions in an AAR: 1) What was the plan? 2) What actually happened? 3) Why did it happen? And, 4) What are we going to do (sustain or improve) next time?] To properly use the AAR process, it is imperative to take its answers to the process's fourth question and incorporate what will be sustained and improved into your short- and long-term planning. Units that successfully do this, actually assign individuals to be responsible for incorporating the AARs' recommendations into their fuels program planning process.

4. ***Experiment with new approaches.*** These could be the approaches that you are learning from other fuels programs, or that evolve from your unit's own AAR process. Or, you might want to try a different approach, especially if what you've been doing hasn't been meeting your needs. Remember: It is extremely important to listen to your unit's members who have a different perspective—to constantly be open to adopting a new ideas.

5. ***Encourage systematic problem solving among all members of your unit.*** Follow a systematic path while trying to solve a problem by looking at what was planned, what happened, and *why* it happened. Regrettably, it is all too common that we try to correct a problem without truly analyzing what happened and *why.*

6. ***Transfer knowledge throughout the organization.*** This is the true learning organization status test. You need to ensure that you set aside time during planning and information meetings to share new knowledge with your fuels and fire management staff—as well as with other units. The Lessons Learned Center is a convenient resource center for sharing what you have learned *beyond* the scope of your individual unit. The AAR "rollup" serves as a beneficial format for units to record and share their lessons and effective practices. The rollup captures the AAR's successes, challenges, training curriculum, and unresolved issue recommendations. Individual units and program reviewers should submit these to the Lessons Learned Center. The AAR rollup form is available at <http://www.wildfirelessons.net/AAR.aspx>.

* For more information on the AAR learning tool concept, see the article on the Wildland Fire Lessons Learned Center in the *Fire Management Today* issue on Safety (66(2).

2006 Photo Contest Winners Announced

Carol LoSapio

Surpassing our expectations, *Fire Management Today* received 424 images from 73 people for our 2006 photo contest. Thanks to everyone who contributed their best fire-related images to this year's competition. (The winning images are displayed beginning on page 60.)

We asked people to submit images in six categories:

- Wildland fire,
- Prescribed fire,
- Wildland/urban interface,
- Aerial resources,
- Ground resources, and
- Miscellaneous (fire effects, fire weather, fire-dependent communities or species, etc.).

Carol LoSapio is a technical publication editor for the USDA Forest Service, Fort Collins, CO.

After the contest deadline in March, we evaluated the submissions and eliminated all technically flawed images, such as those with soft focus or low resolution. Despite these technical problems, many of these images were otherwise outstanding.

Next, two wildland fire safety experts reviewed the images to ensure that they did not show unsafe firefighting practices (unless that was their purpose). If an unsafe practice was evident, we disqualified the image from competition.

New Contest Procedures

New timelines and guidelines are being developed for the next *Fire Management Today* photo contest. These will be announced in a future issue of FMT.

The three judges then reviewed, scored, and ranked the remaining images based on traditional photography criteria. They asked questions such as:

- Is the composition skillful and dynamic?
- Are the colors and patterns effective?
- Does the image tell a story or convey a mood? ■

Thanks To Our Fire Photo Experts

We assembled an excellent panel of judges, people with years of photography experience. We also ensured that fire safety experts evaluated the photos. We appreciate the time and skill that these panel members gave to this effort:

Safety Experts

- **Tammy Denney** is a webmaster for the USDA Forest Service, Fire and Aviation Management, Washington, DC. She has been with the agency for more than 19 years. As webmaster, Tammy develops and designs specialized fire-related communication materials for a broad audience. Her diversified experience includes national contracting, budget and fiscal management, public affairs, wildland fire safety, and fuels program analysis.
- **Shelby Gales**, Fire Operations Safety Manager for the USDA Forest Service Pacific Northwest Region, is currently acting as the Forest Service Fire Operations Safety Manager. Shelby has worked for the Forest Service in an interagency position with the Bureau of Land Management for nine years.

Judges

- **Dave Steinke** is an assistant director for public affairs for the USDA Forest Service, Rocky Mountain Region. He runs the Creative Services shop, producing videotapes, still photography, presentations, and exhibits; preparing and implementing Web content; and conducting training and meeting facilitation. Dave has been involved with fire his entire Forest Service career. He is currently qualified as a National Guard liaison, fire photographer, type 1 incident information officer, and instructs students in beginning and advanced information officer training. Dave co-produced the two-hour documentary film, *The Greatest Good*, the Forest Service centennial film on the history of the agency.
- **Roy Mita** is an application developer and analyst for the USDA Forest Service, Natural Resource Inventory System, Fort Collins, CO. Roy spent the first half of his Forest Service career on ranger districts in the Northern and Eastern Regions and maintains an active interest and involvement in both wildland and prescribed fire.
- **Mary Bollinger** is a visitor information specialist with the USDA Forest Service Arapaho and Roosevelt National Forests and Pawnee National Grassland. She has worked in this position since 1996, developing booklets, brochures, displays, flyers, handouts, and various publications designed to communicate forest and grassland management messages to the general public. Mary has served as a fire information officer on both prescribed and wildland fires. Prior to joining the Forest Service, Mary worked for 15 years as a program coordinator for community health information and education in Maine.

First Place, Wildland Fire. *Canopy fire explodes in a stand of dead spruce during the Tracy Avenue Fire, Homer, AK. Photo: Wade Wahrenbrock, Alaska Department of Natural Resources, Soldotna, AK, 2005.*

Second Place, Wildland Fire. *Smoke column from a helitorch burnout operation on the Bighorn Fire, Crow Indian Reservation, MT. Photo: Suzy Walton, USDA Forest Service, Tonasket, Ranger District, Tonasket, WA, 2005.*

Third Place, Wildland Fire. *Sheep evacuated on the Hinman Fire, Steamboat Springs, CO. Photo: Kari Greer, National Interagency Fire Center, Boise, ID, 2002.*

Honorable Mention, Wildland Fire. *Rumsey Fire Lookout destroyed by fire near Lake Berryessa, CA. Photo: Mike Forster, member, International Association of Fire Photographers, San Francisco, CA, 2004.*

First Place, Prescribed Fire. *A strip-head fire at dusk on the Butte Prescribed Fire at Lassen Volcanic National Park, CA. Photo: Eric Siemer, USDA Forest Service, Klamath National Forest, Yreka, CA, 2004.*

Second Place, Prescribed Fire. *Spot-pattern ignition under twilight on the West Hunter Prescribed Fire on the Wenatchee National Forest, Wenatchee, WA. Photo: Eli Lehmann, USDA Forest Service, Mount Baker–Snoqualmie National Forest, Concrete, WA, 2004.*

Third Place, Prescribed Fire. *All-terrain vehicle power torch is used on a prescribed burn in the Cimarron National Grasslands, Elkhart, KS. Photo: Brandyn Harvey, USDA Forest Service, Pike Interagency Hotshot Crew, Palmer Lake, CO, 2005.*

Wildland/Urban Interface

First Place, Wildland/Urban Interface. *Firefighter Seth Tuuri, Black Hills National Forest, Bearlodge Ranger District, battles a structure fire on a ranch near Aladdin, WY. In an effort to conserve engine water, Tuuri used a residential hose with a spray nozzle. Photo: Gary C. Chancey, USDA Forest Service, Black Hills National Forest, Custer, SD, 2005.*

Second Place, Wildland/Urban Interface. *Helitanker drops retardant around an observatory during the Florida Fire on the Coronado National Forest, Flagstaff, AZ. Photo: Jayson Coil, Sedona Fire District, Sedona, AZ; and division supervisor on Oltrogee's Southwest Area Type 1 Incident Management Team, Flagstaff, AZ, 2005.*

Third Place, Wildland/Urban Interface. *Smoke management at its finest! The Legion Curve Prescribed Fire on the J.N. "Ding" Darling National Wildlife Refuge, FL, was burned on a day with perfect winds that prevented its smoke from impacting any roadways or populated areas. The control line at the road boundary held the fire as planned. Photo: Paul Ryan, J.N. "Ding" Darling National Wildlife Refuge, Sanibel, FL, 2004.*

First Place, Aerial Resources. *Helicopter drops retardant on the Florida Fire, Coronado National Forest, Tucson, AZ Photo: Jayson Coil, Sedona Fire District, Sedona, AZ; and division supervisor on Oltrogee's Southwest Area Type 1 Incident Management Team, Flagstaff, AZ, 2005.*

Second Place, Aerial Resources. *Helitack rappellers practice dropping into terrain during a training exercise in Monument, CO. Photo: Kari Greer, National Interagency Fire Center, Boise, ID, 2005.*

Third Place, Aerial Resources. *Firing off during a prescribed fire on the Tulelake National Wildlife Preserve, CA. Photo: Eric Siemer, USDA Forest Service, Klamath National Forest, Yreka, CA, 2005.*

First Place, Ground Resources. *Firefighter retrieves additional firing tools during night burnout operation on the Blossom Complex, Siskiyou National Forest, Medford, OR. Photo: Eli Lehmann, USDA Forest Service, Mount Baker–Snoqualmie National Forest, Concrete, WA, 2005.*

Second Place, Ground Resources. *Firefighter silhouetted under madrone tree during night burnout operation on the Blossom Complex, Siskiyou National Forest, Medford, OR. Photo: Eli Lehmann, USDA Forest Service, Mount Baker–Snoqualmie National Forest, Concrete, WA, 2005.*

Third Place, Ground Resources. *Firefighter falls a hazard snag during mop-up on the Pot Peak Fire, Wenatchee National Forest, Wenatchee, WA. In falling this snag, wearing a pack would reduce the firefighter's ability to quickly retreat to safety. Photo: Eli Lehmann, USDA Forest Service, Mount Baker–Snoqualmie National Forest, Concrete, WA, 2004.*

▲ ***First Place, Miscellaneous.*** *Lightning strikes over the Beaverjack Fire—as seen from Hells Half Lookout on the Bitterroot National Forest, Hamilton, MT. Photo: Mark S. Moak, Rocky Mountain College, Billings, MT; and lookout at Hells Half Lookout, Bitterroot National Forest, 2005.*

▲ ***Second Place, Miscellaneous.*** *Smoke from the Deep Harbor Fire levels off at sunset on the Wenatchee National Forest, Wenatchee, WA. Photo: Eli Lehmann, USDA Forest Service, Mount Baker–Snoqualmie National Forest, Concrete, WA, 2004.*

▲ ***Third Place, Miscellaneous.*** *Single lightning bolt strikes the Deschutes National Forest, OR. Photo: Chris Jensen, USDA Forest Service, Deschutes National Forest, Bend, OR, 1994.*

Into the Fire: Video Tribute to Wildland Firefighters

Hutch Brown

Patrick Michael Karnahan is one talented individual. As a professional artist and performer, he not only paints some great scenes—including dramatic depictions of firefighting (see *Fire Management Today* 59[4]: 4–7)—but also writes some great songs performed by his California-based Black Irish Band.

A former firefighter with the USDA Forest Service, Karnahan likes to write songs about natural resource issues, particularly firefighting. In 2005, the Black Irish Band released an entire album of conservation-related songs—some traditional, some original—called *Into the Forest.* The band was chosen to perform along with many other talented singers, songwriters, and performers (mostly Forest Service employees) at the Smithsonian Folklife Festival on the National Mall in Washington, DC, commemorating the Forest Service's centennial in June/July 2005.

A former firefighter with the USDA Forest Service, Karnahan likes to write songs about natural resource issues, particularly firefighting.

The band turned one of Karnahan's original songs, called "Into the Fire," into a stirring video tribute to wildland firefighters. Featuring a full array of firefighting scenes, the video—like the song—captures the toil and sacrifice of firefighters in a way that is both skillful and inspiring. Both the song and the video quickly became favorites in my household, especially with my 6-year-old son, reflecting their potential to instill future generations with respect for the land—and for the firefighters who serve us so well. ■

Hutch Brown is a writer/editor for the USDA Forest Service, Chief's Office, Washington, DC.

Into the Fire—Members of the California-based Black Irish Band perform their tribute to wildland firefighters "Into the Fire" on the Groveland Ranger District, Stanislaus National Forest, at the site of the 2004 Tuolumne Fire that took the life of California Department of Forestry firefighter Eva Schicke. Members of the Groveland Interagency Hotshots hike past in background. Photo: Jerry Snyder, USDA Forest Service, Stanislaus National Forest, Sonora, CA.

Guidelines for Contributors

Editorial Policy
Fire Management Today (*FMT*) is an international quarterly magazine for the wildland fire community. *FMT* welcomes unsolicited manuscripts from readers on any subject related to fire management. Because space is a consideration, long manuscripts might be abridged by the editor, subject to approval by the author; *FMT* does print short pieces of interest to readers.

Submission Guidelines
Your manuscript may be hand-written, typed, or word-processed, and you may submit it either by e-mail or by mail to one of the following addresses:

General manager:
USDA Forest Service
Attn: Melissa Frey, F&AM Staff
Mail Stop 1107, 1400 Independence Avenue, SW
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Author Information. Include the complete name(s), title(s), affiliation(s), and address(es) of the author(s), as well as telephone and fax numbers and e-mail information. If the same or a similar manuscript is being submitted elsewhere, include that information also.

Release Authorizations. Non-Federal Government authors and coauthors must sign a release to allow their work to be in the public domain and on the World Wide Web. In addition, all photos that are not the property of the Federal Government require a written release by the photographer. The author and photo release forms are available from General Manager Melissa Frey.

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Do not embed illustrations (such as photos, maps, charts, and graphs) in the electronic file for the manuscript. We will accept digital images if the image was shot at the highest resolution using a camera with at least 2.5 megapixels or if the image was scanned at 300 lines per inch or equivalent with a minimum output size of 5 × 7 inches. Submit each illustration in a standard interchange format such as EPS, TIFF, or JPEG, accompanied by a high-resolution (preferably laser) printout. For charts and graphs, include the raw data needed to reconstruct them.

Style. Authors are responsible for using wildland fire terminology that conforms to the latest standards set by the National Wildfire Coordinating Group under the National Interagency Incident Management System. *FMT* uses the spelling, capitalization, hyphenation, and other styles recommended in the *United States Government Printing Office Style Manual*, as required by the U.S. Department of Agriculture. Authors should use the U.S. system of weight and measure, with equivalent values in the metric system.

Try to keep titles concise and descriptive; subheadings and bulleted material are useful and help readability. As a general rule of clear writing, use the active voice (e.g., write, "Fire managers know…" and not, "It is known…"). Provide spellouts for all abbreviations. Consult recent issues (at <http://www.fs.fed.us/fire/fmt/index.html>) for placement of the author's name, title, agency affiliation, and location, as well as for style of paragraph headings and references.

Tables. Tables should be logical and understandable without reading the text. Include tables at the end of the manuscript.

Photos and Illustrations. Clearly label all photos and illustrations (figure 1, 2, 3, etc.; photograph A, B, C, etc.). At the end of the manuscript, include clear, thorough figure and photo captions labeled in the same way as the corresponding material (figure 1, 2, 3; photograph A, B, C; etc.). Captions should make photos and illustrations understandable without reading the text. For photos, indicate the name and affiliation of the photographer and the year the photo was taken.

Contributors Wanted

We need your fire-related articles and photographs for Fire Management Today! Feature articles should be up to about 2,000 words in length but may be longer. We also take very short items. Subjects of articles published in Fire Management Today include:

Aviation	Firefighting experiences
Communication	Incident management
Cooperation	Information management (including systems)
Ecosystem management	Personnel
Equipment/technology	Planning (including budgeting)
Fire behavior	Preparedness
Fire ecology	Prevention/Education
Fire effects	Safety
Fire history	Suppression
Fire science	Training
Fire use (including prescribed fire)	Weather
Fuels management	Wildland/urban interface

To help prepare your submission, see "Guidelines for Contributors" in this issue.

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