Fire Management today

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Managing Wildland Fire

United States Department of Agriculture
Forest Service

Share Your Story…

This issue of Fire Management Today explores the new Interagency Guidance for Implementation of Federal Wildland Fire Management Policy. Striving to achieve sound natural resource management, apply the best available science, and collaborate among agencies, wildland fire management agencies changed their strategy in 2009 to allow fires to be managed concurrently for multiple objectives and to allow boundaries of fire management objectives to shift as fires move across the landscape. Along with this new implementation guidance come stories of success—acres burned, fires contained, and resource goals attained—and stories of frustration—communication errors, funding complications, and challenging management scenarios.

Share your stories from the 2009 and 2010 fire seasons and your lessons learned about managing wildfire for resource benefits with the FMT community. Send photos, excerpts, and articles to Monique LaPerriere, managing editor, at FireManagementToday@fs.fed.us.

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On the Cover:

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A lightning storm over the Beaverjack Fire, a wildland fire use fire (now termed a wildfire) in the Selway-Bitterroot Wilderness, viewed from Hells Half Acre Lookout in the Bitterroot National Forest, ID. Photograph by Mark S. Moak, professor at Rocky Mountain College in Billings, MT, and lookout at Hells Half Acre, 2005.

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

Anchor Point

by Tom Harbour
Director, Fire and Aviation Management
Forest Service, Washington, DC

Managing Wildfire for Resource Benefits

Change has come to wildland fire use (and its precursor, prescribed natural fire). The Federal Interagency Wildland Fire Community now has only two kinds of fire: wildfire (unplanned fire) and prescribed fire (planned fire). According to the 2009 "Guidance for Implementation of Federal Wildland Fire Management Policy," the Forest Service and U.S. Department of the Interior agencies can now manage wildland fires for multiple objectives concurrently, and the objectives can change as the fire moves across the landscape. This means that where fire is a major component of the ecosystem, naturally ignited fires can be managed to achieve resource benefits where the impacts to landscape are tolerable. What does that mean to us? Currently, in simple terms, wildland fire management is comprised of two types of fire. First, there are those fires we plan and ignite; we refer to them as prescribed fires. Then, there are unplanned fires, the ones we call wildfires, which can be started either naturally (by lightning strikes) or unnaturally (by humans). Although wildfires are, by definition, unplanned, we conduct a planning and analysis process, closely linked to land management plans, in which we decide ahead of time if we want to allow some naturally occurring fires to burn in order to either reap a positive resource benefit or to allow fire to burn within tolerable limits set by the agency administrator.

Naturally caused wildfires can enhance many natural resource values when we allow fire to play its natural role while we protect private property and social values. For centuries, these lightning-caused fires have resulted not only in the enhancement of land conditions, but in better places for wildlife to live and roam. Simply stated, in some cases, fire on the landscape is beneficial, and resource managers need to become more active in allowing it to be part of the natural landscape.

> All fires have risks, but we have developed sophisticated tools that will assist us in predicting what a fire will do.

That's not to say that managing wildfires for resource benefits comes without risks. All fires have risks, but we have developed sophisticated tools—and are developing more—that will assist us in predicting what a fire will do—where it will go and how it will act.

Managing wildfires as an ecosystem process is a relatively new fire management strategy for most of us throughout the Forest Service. However, there are some forests with long-standing histories of this practice, referred to in the past as wildland fire use, or prescribed natural fire. On national forests such as the Gila in the Southwest Region and the Bitterroot in the Northern Region, wildfires have been managed for resource benefits since 1972. Managers and the public are beginning to see the advantages of allowing fire to play a natural role in some defined areas, the same role it played more than 100 years ago.

Climate change continues to challenge the Nation and our national forests. Fire season comes earlier and stays longer each year. Fires burn with more intensity. They are more damaging and dangerous to our firefighters, the public, and people's properties. When appropriate, management of wildfires for resource benefits is one component of fire management that can help us improve the condition of the land where, ultimately, we will be better able to control those unwanted fires when they happen.

We have individuals who specialize in managing naturally ignited wildfires within the Forest Service, but all of us need to be aware of and support the new interagency strategy, in which fires can be managed for multiple objectives. We will continue to suppress human-caused fires at the lowest cost and with the fewest negative consequences possible. Naturally caused wildfires will not be used to benefit natural resources everywhere—not every location is appropriate. But, under the right conditions, wildfires can be a tremendous asset to effectively move us toward our motto, "*caring for the land and serving people.*" ■

Implementing Federal Wildland Fire Policy—Responding to Change

Richard Lasko

Federal wildland fire policy has significantly changed since the 1935 introduction of the "10 a.m. policy," whereby all wildland fires were to be contained by 10 a.m. on the day following ignition. Although revisions to policy and implementation guidance have often been the result of tragic loss-of-life events or notably destructive fire seasons, other factors have provided an impetus to examine relationships between wildland fire policy and Federal land managers' mandate to protect life and property while managing ecosystems. The exponential growth of the wildland-urban interface—a result of rapid development in and near wildland areas—coupled with the dramatic increase in wildland fire frequency (fig. 1), intensity, and size (fig. 2), and an increasing need to use fire to meet natural resource objectives provided the latest incentives to take a fresh look at the guidance for implementation of Federal wildland fire policy.

Continuing the quest to provide land managers with relevant Federal wildland fire policy, the interagency fire community field-tested potential modifications to the 2003 "Interagency Strategy for the Implementation of Federal Wildland Fire Management Policy." Based on information from the field test and discussions with the fire community, fire management agencies modified the Implementation Strategy and removed the categorical distinction between wildland fire use and wildfire. Field deployment of this change began in 2009.

A revision to the 2003 Interagency Strategy removes the distinction between wildland fire use and wildfire. This will enhance a fire manager's ability to implement Federal Wildland Fire Management Policy by allowing consideration of the full range of positive and negative attributes of a fire.

Implementing Federal Wildland Fire Policy—Changes Since 1988

The Yellowstone National Park fires of 1988 reinvigorated the debate over management of wildland fire and raised public awareness that fire is a necessary disturbance for the overall health and diversity of many ecosystems. The fires of the 2000 fire season stimulated further debate and fostered acceptance for the idea that fire exclusion had increased fire hazards in vegetation types historically characterized by frequent, low- to mixed-severity fire regimes. The 2000 fire season also nurtured the concept that fire exclusion is not operationally or

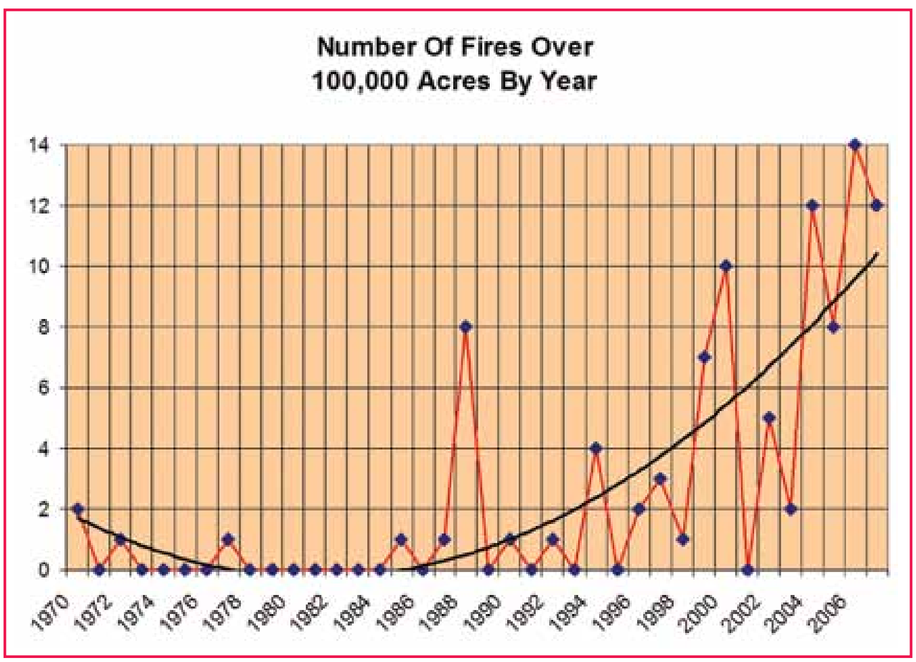

Figure 1—*The number of fires greater than 100,000 acres (40,500 ha) in size has increased dramatically over the years.*

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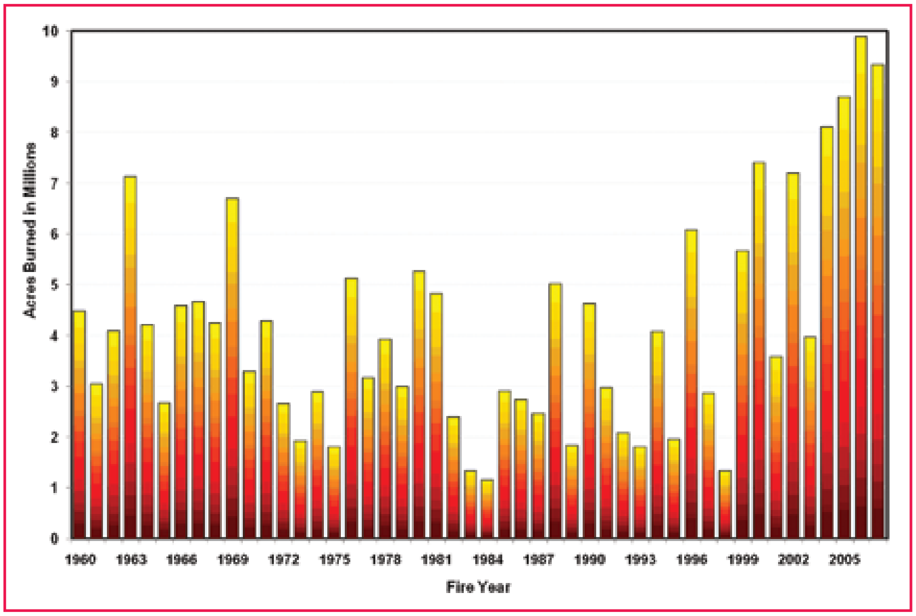

Figure 2—*Acres burned, in millions, 1960–2007.*

ecologically desirable in infrequent, stand-replacing fire regimes. This discussion led to the development of the "National Fire Plan," part of a national program linking fire research with land management practices to address the changing forest conditions.

In 1995, the "Federal Wildland Fire Management Policy" addressed the role of fire as a natural disturbance and moved fire planning toward integration with resource management. Natural ignitions could be managed to achieve natural resource benefits and maintain fire-dependent ecosystems. The 1995 policy also introduced the appropriate management response concept, which was further refined in the 2001 "Review of Federal Wildland Fire Management Policy."

The 2003 "Interagency Strategy for the Implementation of Federal Wildland Fire Management Policy" broadened the scope of fire management to balance fire suppression with management for ecosystem sustainability. It defined the alternative strategies available to manage unplanned natural ignitions: manage a fire to achieve resource benefits **or** (author's emphasis) manage a fire to reduce losses and minimize suppression costs. While all person-caused fires were to be managed as wildfires and treated as such, land and resource management plans or fire management plans could identify the appropriateness of using natural ignitions to achieve resource benefits through wildland fire use. Regardless of the chosen strategy, the 2003 Interagency Strategy required that Federal land managers respond to all wildland fire events with an appropriate management response, which allowed the use of any tactic (or combination of tactics), from monitoring to intensive management actions, to achieve a defined strategic objective.

Impetus for Change

The 2003 "Interagency Strategy for the Implementation of Federal Wildland Fire Management Policy," divides unplanned fire events into two categories: wildland fire use and wildfire. The distinction between the two categories is often obscured, especially when tactical actions implemented on a wildfire to minimize loss may be essentially the same as those implemented for a wildland fire use event to achieve resource management objectives.

The distinction imposed by the two categories presented difficulties in addressing the biophysical, temporal, and spatial complexities of wildland fire events. The fact is that the effectiveness and efficacy of a fire management strategy in protecting public values and achieving natural resource goals is highly situational. As fire moves across the landscape, scenery, structures, and valued resources are threatened at the same time that land management benefits are realized.

Success of a fire management strategy is dependent upon an intricate web of conditions. Fire managers encounter changing levels of risk as fires occur throughout the season. Actions that may be successful and sensible under one set of conditions may be unachievable or unrealistic under more extreme conditions of weather and terrain or with regard to the national and regional priorities that dictate availability of fire management resources. Costs of a management action may be inordinately high in relation to the resources protected or improved.

Engaging the Future

The 2008 field test of modifications to the 2003 "Interagency Strategy for the Implementation of Federal Wildland Fire Management Policy," and the subsequent dialogue and collaborative engagement with many of our partners and the public provided the opportunity to carefully reconsider the 2003 Implementation Strategy. The 2009 revision to the 2003 "Interagency Strategy for the Implementation of

Federal Wildland Fire Management Policy" removes the categorical distinction between wildland fire use and wildfire. The revision provides fire managers with the flexibility to respond successfully to changing conditions and address the complexities of the wildland fire environment encountered on a fire event. This will enhance a fire manager's ability to implement Federal Wildland Fire Management Policy by allowing consideration of the full range of positive and negative attributes of a fire while developing and implementing realistic, cost-effective actions to accommodate changing conditions as a fire moves across the landscape and through time. ■

Web Sites On Fire

Ecosystem Restoration Through Fire

A diverse group of volunteers is promoting the use of controlled fire to restore and maintain ecosystem health on the Mendocino National Forest and surrounding lands. This campaign, called "Restore the Mendo," has generated support from local governments, landowner associations, and individual citizens as well as State and national environmental groups.

The Web site at <http://www.restorethemendo.org> explains the benefits of low-intensity fires to homeowners, landowners, and others. The site provides information about fire management objectives, recent management actions, and positive results and responses. The Web site features video testimonials and a 30-second commercial used for local television spots in an ongoing effort to make prescribed fire an accepted part of maintaining the local landscape and its resources. Links to participating organizations, other fire information sites, and publications are provided.

Watching the Red. Mandi Unick keeps an eye on burnout operations on the Cub Creek Complex, Lassen National Forest, CA. The lightning-caused fire burned more than 19,000 acres in northern California. Photo: Aaron Black-Schmidt, Squad Leader, Columbia River Division Initial Attack Crew, Wenatchee-Okanogan National Forest, June 2008.

Organizational Learning Contributes to Guidance for Managing Wildland Fires for Multiple Objectives

Thomas Zimmerman and Tim Sexton

Since the inception of organized fire suppression in the early 1900s, wildland fire management has dramatically evolved in operational complexity; ecological significance; social, economic, and political magnitude; areas and timing of application; and recognition of potentially serious consequences. Throughout the past 100 years, fire management has matured from a single-dimensional program focused solely on control and immediate extinguishment to a multidimensional program. Throughout this period, fire managers have adapted their responses to changing conditions, emerging knowledge, and increasing experience. Now, they can utilize the full spectrum of responses to wildland fire to achieve both protection and ecological benefits based on objectives described in the applicable land and resource management plans and fire management plans.

Social pressures and organizational biases have created barriers to program development for wildland fire management.

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As organizational learning has affected the entire wildland fire management program, its influence on the management of wildland fires for resource benefits has accounted for significant advances, directly contributing to the program's evolution and growth, including:

- Expanded knowledge and understanding of fire ecology and the natural role of fire;
- Continual adjustments to the Federal wildland fire management policy;
- Focused planning, procedures, and precision;
- Advanced risk assessment of management knowledge and capabilities;
- Expanded and improved directions and magnitude of operational procedures;
- Increased management of fires as an ecological process, with implementation scales expanded beyond wilderness areas and into all fire regimes and vegetation types;
- Improved capability to manage fires for multiple objectives, and to redefine those objectives throughout the life of a fire;
- Improved capability to manage fires across a wider fire behavior range; and
- Implemented after-action reviews to observe, evaluate, and document accomplishments, successes, and failures.

The expanded knowledge of fire's natural role has markedly facilitated the increased use of wildland fire to accomplish beneficial ecological effects. Management of naturally caused wildland fire to protect, maintain, and enhance resources and, as nearly as possible, to function in its natural ecological role, is one of many management responses supported by the new "Guidance for Implementation of Federal Wildland Fire Management Policy" (USDA and USDI 2009).

What we know today about management of wildland fires to meet resource objectives evolved from decisions made nearly 40 years ago about the use of fire in wilderness areas, national parks, and other lands. This progressive thinking and the associated adaptive responses have extended fire man-

Table 1—*Critical tasks important to organizational learning.*

Task	Specific Activity	Outcome
Acquire new information.	• Collect information; • Consolidate program history and —current status; and • Develop shared vision.	• Information and existing information from personal sources documented; • Information accuracy validated; • Current policies, procedures, and processes reviewed; and • Program goals and purposes better defined.
Analyze the best procedures.	• Analyze program development; • Examine past performance; • Establish standards and baselines; and • Analyze interdependency of all program elements.	• Programmatic needs identified; • Past practices, both good and bad, both limiting and facilitating, evaluated; • Past experiences that need to be replicated or eliminated identified; and • Best practices that lead to superior performance and accomplishment identified.
Apply knowledge, processes, technology, and proven practices.	• Experiment with new knowledge applications; • Experiment with new technological applications; • Incorporate best knowledge and technology into business; • Address problem solving; and • Transfer knowledge.	• Continual flow of new ideas, knowledge, and technology into application established; • Distinction between factual information, perceptions, and personal viewpoints recognized; • Knowledge, principles, guidelines, procedures, practices, etc., transferred through all available methods to practitioners; and • Application through the use of a dynamic learning environment improved.
Archive overall processes and results.	• Document program development, practices, and organizational growth; and • Ensure the retention of critical information.	• Information transfer processes improved; • New practices, experiences, and knowledge, both positive and negative, documented; and • All information for future reference and application retained.

agers' knowledge and experience. We now think of management of naturally caused ignitions as an essential tool for achieving beneficial ecological effects.

Organizational Learning

Organizational learning has contributed to continuous and programmatic development of the guidance for management of wildland fires and has increased the ability of personnel to manage fires for multiple objectives by:

- Recognizing the importance of consolidating program examination;

- Acquiring new information;
- Analyzing the best procedures;
- Applying knowledge, processes, technology, and proven practices; and
- Archiving the overall processes and results and using the information to improve program effectiveness.

Fire managers recognize the importance of examining the results of management responses to wildland fire and applying the information to improve program effectiveness. However, organizations are sometimes controlled by social influences that hinder innovation and administrative mandates that limit response.

Barriers to Managing Wildland Fire as an Ecological Process

Social pressures and organizational biases have created barriers to program development for the management of wildland fires as a natural process. Such internal and external forces have led to divisiveness and a lack of clear and concise messages, direction, and goals. This situation has stifled overall organizational growth, restricted productivity, and has most certainly fueled negative public attention.

Public and governmental responses to specific fire situations have promoted agency reluctance to advance wildland fire management and resulted in procedural statements, operational guidance, and other circumstances intended to limit the magnitude and slow implementation of change in fire management. The conviction that all wildland fires can and should be suppressed is long standing, but mixed success in achieving this provides widespread support for defining multiple fire management objectives. This belief has limited fire managers from full utilization of "emerging knowledge" of fire's natural role, fire effects, and the ramifications of fire exclusion in the development of management responses.

The conviction that all wildland fires can and should be suppressed is long standing, but mixed success in achieving this provides widespread support for defining multiple fire management objectives.

Administrative barriers have existed throughout the history of wildland fire management. Use of wildland fires to support ecological processes has been viewed as an action that is distinctly separate from wildland fire management and with different operating standards. Internal policymaker resistance to changes that advocate expanded use of wildland fire have surfaced in every review and revision of wildland fire management policy.

Managing wildland fire to achieve land and resource management goals continues to be riddled with misperceptions and misinformation, which have limited both programmatic growth and overall effectiveness. As more credibility has been placed on identifying best practices for wildland fire management, efficiency and accomplishment have improved; yet despite this development, resistance still affects resource agencies to some degree today.

Changing Perspectives

Today, organizational learning promotes a broader understanding and awareness that is beginning to change outdated thinking and reduce barriers. Organizational learning is spurring policy revisions, directing funding, and relaxing fiscal constraints for managing wildland fires for multiple objectives. The 2009 "Guidance for Implementation of Federal Wildland Fire Management Policy" allows wildland fires to be managed concurrently for many objectives and allows personnel to redefine those objectives as conditions change. Additionally, public perceptions and support have improved, workforce limitations have been reduced, and safety concerns have been addressed.

Finally, fire's role in a healthy ecosystem is receiving positive recognition. Management of wildland fire for ecological benefits has grown from a wilderness-only application to one that spans all land-use situations with marked increases of land types considered suitable for application and expanded operational capabilities.

References

USDA and USDI. 2009. Guidance for Implementation of Federal Wildland Fire Management Policy. Washington, DC: U.S. Department of Agriculture and U.S. Department of the Interior: 20 p. ■

Table 2—*Specific examples of organizational learning benefits that support the management of wildland fire for resource benefits.*

Changes and Advancements	Learned Outcome	Fire Management
Expanded knowledge of fire and its natural role	• Better understanding of wildland fire as a natural process and of its role in restoring and maintaining healthy ecosystems; and • Understanding that many ecosystems contain plants that depend upon periodic fire presence for their continued existence and that many of the effects of fire are positive.	• Significant knowledge base of literature and reference materials established; The Fire Effects Information System Web site <http://www.fs.fed.us/database/feis> provides fire managers with an array of reference and support for land management and project planning; and the Wildland Fire Decision Support System <http://wfdss.usgs.gov/wfdss/WFDSS_Home.shtml> assists fire managers and analysts in making strategic and tactical decisions for fire incidents.
Continual adjustments of policy	• Understanding that wildland fire policy must provide flexible and responsive direction for wildland fire management—without unnecessary constraints, and readily adapting to emerging knowledge, technology, and science.	• Accountability for long-term unplanned fire events managed for resource benefits that consider preparedness levels and fire management plan completion; • Prescribed natural fire eliminated as a strategy; • Wildland fire use eliminated as a defined and separate entity from other wildfires; • Approval of naturally caused ignitions to be managed as an ecological process, and to be managed for multiple objectives. • Fiscal procedures established that are conducive to greater use of wildland fire for resource benefits; • Standardized qualification of all fire management activities; and • Specific policy elements in the areas of science, planning, fire management, and ecosystem sustainability.

Changes and Advancements	Learned Outcome	Fire Management
Improved planning processes	• Successful application of fire to ecosystems depends upon detailed planning at all levels from the land management plan to the fire management plan and into specific fire implementation action planning.	• Guidance to incorporate fire effects and the natural role of fire information into land management plans; • Land management processes that guide fire management planning and implementation; • Fire management plans that translate and support land management plans and on-the-ground action; • The Wildland Fire Decision Support System, providing the most detailed and comprehensive fire management planning and implementation information for fire use decision and tactical action to accomplish the strategic objectives of an unplanned ignition managed for resource benefits; and • A process developed with a focus on efficient long-term risk assessment, strategic planning, and tactical implementation instead of short-term, tactical operational implementation.
Risk assessment and decision support tools	• Acceptance of the importance of assessing risks associated with wildland fire management in terms of values, hazards, and probability in order to more adequately determine if the level of risk can be accepted and successfully mitigated or eliminated; and • Recognition of the importance of obtaining better information, reducing uncertainty, assessing potential fire outcomes, evaluating consequences of failure, determining probabilities of success, evaluating potential costs, and identifying values to be protected to better support decisionmaking.	• Significant advances in predicting fire behavior spread and intensity, analyzing climatological and meteorological data, and assessing rare weather occurrences; • Advances in predicting fire effects, smoke production, and smoke dispersal; estimating fire-spread areas; identifying values at risk; and evaluating probabilities of the fire spatial extent; • Enhanced experience and knowledge in utilizing this kind of information in support of fire management decisionmaking, planning, and implementation; and • Improved decisionmaking processes.

Changes and Advancements	Learned Outcome	Fire Management
Increased management of wildland fires for ecological benefits	• Balanced fire management program with multiple management objectives; • Recognition of the value and importance of managing wildland fire for resource benefits; and • Recognition of the role wildfire can play in long-term restoration programs.	• Improved understanding of wildfire and its primary and secondary benefits; and • Expanded fire management accomplishments, strengthened ecosystem maintenance and restoration, increased vegetation mosaics, decreased long-term wildfire potential, increased community protection, and advanced land management practices.
Development of operational procedures	• Better understanding that operational mitigation actions must include the full range of firefighting responses and tactics as appropriate to the specific situation; and • Understanding that successful wildland fire management requires detailed planning that defines threats, operational mitigation actions, constraints, number, and types of resources needed, and contingency actions.	• Increased capability to respond to wildland fire under a wider range of jurisdictional situations and individual management areas; • Ability to acquire and utilize all firefighting resources as needed to respond to wildland fires, regardless of objectives; and • Established dedicated resources for use in managing wildland fire for resource benefits.
Expansion beyond wilderness	• Acceptance of the use of wildland fire to protect, maintain, and enhance resources and, as nearly as possible, to function in its natural ecological role as an effective management practice in wilderness and nonwilderness; and • Realization that successful management across all landscapes is dependent upon continued and proactive collaboration among Federal and State agencies, private organizations, and private landowners.	• Increased vegetation mosaics, decreased long-term wildfire potential, and increased community protection capabilities resulting from the expansion of the use of wildland fire as an ecological process outside wilderness; and • Expanded fire management accomplishments, strengthened ecosystem maintenance and restoration, community protection strategies, and advanced land management practices achieved by managing naturally caused ignitions to accomplish resource benefits beyond wilderness to across all land-use situations, where applicable.

Changes and Advancements	Learned Outcome	Fire Management
Management across wider fire behavior ranges	• Understanding of the need to include wildland fire management across all fire regime classes and diverse situations, depending on land management direction and constraints; and • Understanding that the success of managing wildland fire for resource benefits is measured by fire effects and not solely by fire type and behavior.	• Growing experience with managing fire in all fire regime classes and all fire behavior scenarios; and • Successful examples of management of high-intensity stand replacement wildland fires.
Use of After Action Reviews	• Immediate illumination of both successes and failures; • Awareness of the importance of timely and frank assessments of actions and presentation of outcomes regardless of success or failure; and • Understanding the importance of documenting both successes and failures in fire management planning and implementation.	• Immediate feedback to program efficiency; • Facilitated progression toward a high-reliability organization; and • Established dynamic feedback mechanism supporting improved and advanced processes, procedures, and policy.
Documentation	• Understanding the importance of archiving both successes and failures in fire management planning and implementation; and • Understanding the value of saving examples and practical knowledge.	• Markedly improved and advanced training; and • A substantial record of accomplishments, examples, case studies, etc., accessible to fire management practitioners.

Wildland Fire Behavior Case Studies and the 1938 Honey Fire Controversy

Martin E. Alexander and Stephen W. Taylor

Over the past 90 years, fire research has contributed to our understanding of wildland fire behavior through laboratory and field experiments, physical and empirical modeling, numerical simulations, analyses of individual fire reports, and wildfire case studies. Although basic research on combustion is essential to a full understanding of fire behavior, such research would not be very useful without actual field experience gained and case study documentation (Brown 1959).

In general terms, what is a case study? Contributors on *Wikipedia* (<http://www.wikipedia.org/>) propose that case studies "provide a systematic way of looking at events, collecting data, analyzing information, and reporting the results." With the renewed interest in carrying out research on active wildfires (e.g., Lentile and others 2007a), it's worth reexamining the features of a good case study.

To this end, this article summarizes the findings from the case study of the controversial Honey Fire of 1938, originally published in *Fire Control Notes* by Olsen (1941)—one of the first comprehensive case studies of a wildland fire undertaken by fire behavior researchers. This account was reprinted in the Fall 2003 issue of *Fire Management Today*, the first of three special issues devoted to the subject of wildland fire behavior (Thomas and Alexander 2006).

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The story of the Honey Fire and the ensuing controversy is as much about human behavior as it is about fire behavior.

The Story of the Honey Fire

The story of the Honey Fire and the ensuing controversy is as much about human behavior as it is about fire behavior. In broad outlines, the situation was as follows. A fire behavior research crew happened upon a newly started wildfire, but rather than engaging in any suppression action, the crew began documenting its behavior. This course was taken partly because the crew had advance clearance to do so. The fire became one of the largest fires in the region that year and was finally contained by local fire suppression forces. The research crew's decision to not fight the Honey Fire raised some eyebrows. Later, a member of the research crew published a case study that not only analyzed the fire's behavior but also critiqued the actions of the suppression forces. That article, in turn, provoked a harsh outcry.

Synopsis of the Honey Fire Case Study

Chronology and Behavior

The major run of the Honey Fire took place on January 25, 1938, on the Catahoula Ranger District of the Kisatchie National Forest in north-central Louisiana (fig. 1). A total of 494 fires were to burn more than 12,800 acres (5,180 ha) on the Kisatchie National Forest in 1938 (Burns 1982), and the Honey Fire was one of the many human-caused fire occurrences that year. Interestingly enough, Burns (1982, 1994) did not mention the Honey Fire in her historical accounts of the Kisatchie National Forest.

The Honey Fire was the result of careless actions on the part of freight train employees disposing of burning waste along the east side of the Louisiana & Arkansas Railroad, approximately 1.5 miles (2.4 km) north of Bentley, LA, at around 9:50 a.m. The lookout at the Catahoula Tower, located 2 miles (3.2 km) to the east, detected the fire within 2 minutes, a very acceptable discovery time (Bickford and Bruce 1939b).

Carl Olsen, a forester with the Southern Forest Experiment

Timeline and Tactics

Initial Fire Behavior and Attack

The fire started at 9:50 a.m. on the east side of the Louisiana & Arkansas (L & A) Railroad (point A). Crew 1 (a pumper truck and 2 men) and Crew 2 (a fire boss and 12 men) were dispatched to the fire's presumed point of origin. When they arrived, the fire had a perimeter of 2,640 feet (805 m) and was spreading at about 360 feet per minute (110 meters per minute). Crew 2 began to work the north flank of the fire. The pumper truck could not be used because of wet ground and was redeployed to join Crews 3 and 4 (a total of 31 men), who had started backfiring along the west side of Tower Road. The fire boss then split Crew 2, taking five men (Crew 2A) overland to the west firebreak, and leaving seven men (Crew 2B) at the north flank. By 10:30 a.m., the fire reached the Civilian Conservation Corps (CCC) camp and Tower Road, where it was stopped at the line created by the backfires and the pumper truck. Crews 3 and 4 then joined Crew 2A on the west firebreak and began backfiring and attacking the north flank of the fire near the head. At 10:44 a.m., the wind shifted to the southwest, creating a new head (point B), which by 10:53 a.m. had spread to the west firebreak, where it was held by the backfiring operation; however, all of the constructed line on the north flank was lost.

Later Fire Behavior and Tactics

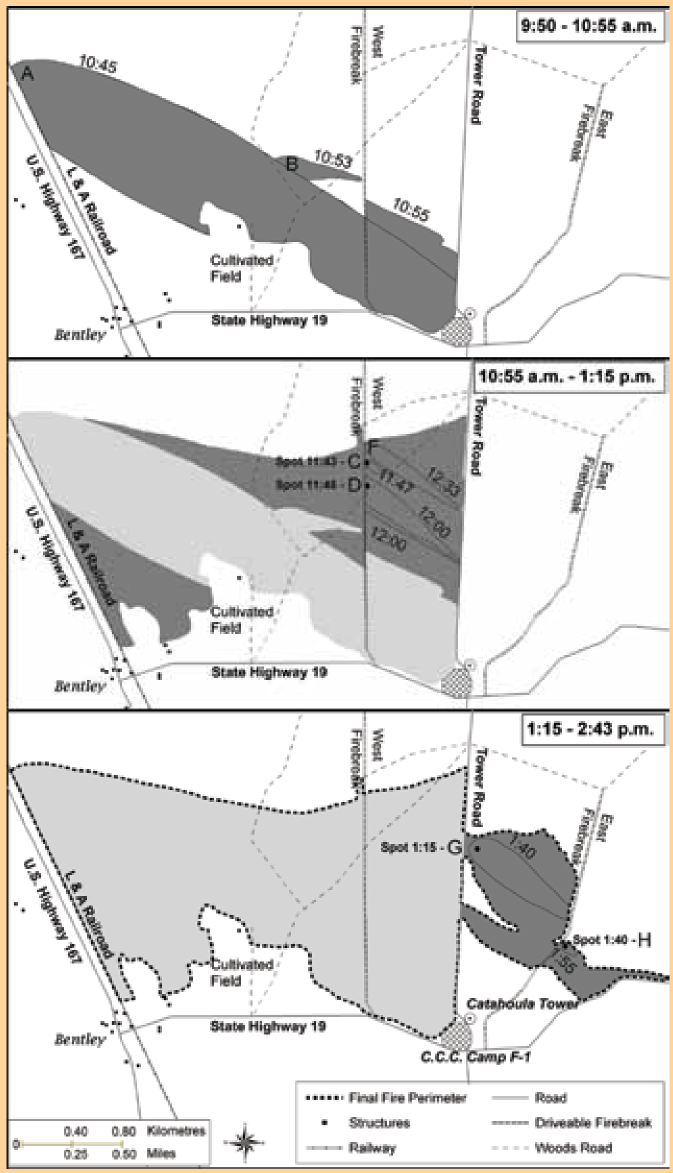
After the wind shift, the north flank, from the tail to the west firebreak (now effectively the head), was left to burn freely, which resulted in fire spread to and spotting across the west firebreak with new heads developing between the west firebreak and Tower Road (points C, D, and F). Crews continued patrolling and backfiring along the east and west firebreaks, Tower Road, and Highway 19. The south flank of the fire was stopped by patrols (22 men), a cultivated field, backfiring against Highway 19, and a wind shift to the southwest.

Final Attack

During the final attack on the fire, crews reinforced the backfires on the Tower Road and east firebreak (although spot fires at points G and H occurred across the Tower Road and east firebreak) and worked the north flank from the rear or tail of the fire to the head, mopping up as they went, aided by the pumper truck and additional crews. The fire was contained at 2:43 p.m. by a force of 19 supervisors and 129 men. The fire was mopped-up and declared out some 4 hours later.

Suggested Strategy and Tactics

Olsen made many positive comments on preparedness, dispatch time, equipment, and crew morale under trying conditions. However, he felt that, given the extreme fire behavior during the fire's initial run, indirect attack by backfiring was the only feasible control measure and valuable time had been lost in direct attack at the point of origin. He suggested that if the pumper truck and crews 2, 3, and 4 had begun aggressive backfiring earlier along the west firebreak, the fire might have been held there. He also suggested that the fire boss and crew leaders should not have worked directly on the line alongside their crews, but should have been more engaged in directing and managing the firefighting operation.



Maps of fire progress and summary of fire suppression activities and general fire behavior associated with the major run of the 1938 Honey Fire (adapted from Olsen 1941).

Station of the Forest Service, and three others (A.H. Antonie, R. Brooks, and C.A. Bickford) were members of a research crew assigned to study the behavior of free-burning wildfires in the region (Harper 1937, Olsen 1938). Normally, the crew was dispatched with initial attack forces. However, in the case of the Honey Fire, the crew happened to arrive on scene (at 9:53 a.m.) within 3 minutes of the fire's origin; they had been traveling about a mile (1.6 km) behind the train south along U.S. Highway 167, which ran parallel to and west of the railroad tracks (see description on previous page).

Within 2 minutes of happening upon the initiating fire, the four-person crew began mapping the fire perimeter (fig. 1) in order to determine rates of fire spread and fire size, collecting fuel and soil samples for analysis of moisture content, recording fire weather data, and making notes on various fire behavior characteristics (e.g., flame size and spotting distances). Unfortunately, to our knowledge, the crew took no photographs during or immediately after the fire. The technology of the time would not likely have permitted the research crew to have radio communication with the local fire suppression organization (Gray 1982).

At one point, the Honey Fire advanced almost 2 miles (3.2 km) during a 30-minute interval following ignition, and the fire eventually burned a total area of 1,092 acres (442 ha) before containment at 2:43 p.m. on the day of origin. The Honey Fire's documented rate of advance ranged from 330 to 463 feet per minute (101 to 141 meters per minute). Spot fires over 200 feet (61 m) in advance of the main head were observed. Computed fireline intensities, determined after the fact and based on these observed spread rates and estimated fuel consumption, ranged from 6,660 to 9,295 British thermal units per second per foot (23,050 to 32,170 kw/m) with corresponding flame lengths averaging 26 to 30 feet (8 to 9 m) (Byram 1959). However, flames at the head of the fire "frequently reached out in long tongues extending 100 feet [30 meters] or more" (Olsen 1941), no doubt in response to momentary gusts of wind (table 1).

When should the observer drop the camera and notebook and pick up a shovel or pulaski?

Environmental Conditions

The fire started in an area that was "typical of open cut-over longleaf pine land in the Upper Coastal Plain" (Olsen 1941), the predominant fuel being a heavy stand of cured broomsedge grass (*Andropogon* sp.) resulting from more than 3 years' accumulation. Available fuel loads would have been in the order of 3.4 tons per acre (7.6 tonnes per hectare), based on the sampling carried out by Bruce (1951).

Although air temperatures were considered "crisp" at 45 to 50 degrees Fahrenheit (7.2 to 10 degrees Celsius), moderately low relative humidities prevailed (26 to 33 percent). The moisture content of the fine, dead, fire-carrying fuels was determined to be about 12 percent. Winds were moderately strong and gusty (table 1), and shifted about 90 degrees, from northwest to southwest, during the initial major run.

Fire Suppression

The Civilian Conservation Corps and Work Projects Administration provided 129 firefighters and 19 supervisory personnel for suppression duty on the Honey Fire. They used a single 350-gallon (1,325-L) pumper truck along with the standard fire tools of the day—swatters or flaps (Sykes 1940), backpack pumps, fire rakes, fusees, and axes. Some photographs illustrat-

Table 1—*Onsite wind speeds measured during the major run of the 1938 Honey Fire (adapted from Olsen 1941)*

Duration and exposure	mph	km/h
Average at 3.5 feet (1.1 m) above ground	9.7	15.6
Average at 20-foot (6.1-m) open standard	15	24
Average at 33-foot (10-m) open standard	17	27
Maximum 1-minute average at 3.5 feet (1.1 m) above ground	16.6	26.7
Maximum 1-minute at 20-foot (6.1-m) open standard	25	40
Maximum 1-minute at 33-foot (10-m) open standard	29	47

Note: The 20-foot (6.1-m) and 33-foot (10-m) open wind speeds used for fire danger rating and fire behavior prediction in the United States and Canada, respectively, were estimated from the observation at 3.5 feet (1.1 m), as per Lawson and Armitage (2008).

A Suggestion To Help Improve Fire Suppression Tactics*

The morale and determination of all men were excellent, and in many cases remarkable. Virtually all of them used their flaps and backpack pumps effectively, showing that the training they had received was very much worthwhile. During the hot flank attacks, however, the flapmen [i.e., firefighters using swatters that are commonly used in containment of grass fires] relied heavily upon the pumpermen spraying water to knock down the flames. The men should be trained to rely less upon water in fighting the flanks by having the crew leaders temporarily stop suppression and rest the crews when the wind shifts on a flank, resulting in a very hot fire to fight. More line on the flanks will be extinguished and held by resting a crew while the fire is burning intensely and then efficiently directing them when the heat and flames have diminished.

Two firefighters attack a spot fire in 4-year-old rough using swatters or flaps, South Carolina. Photo: George K. Stephenson, Forest Service, 1944.

Firefighters use backpack pumps and a swatter or flap on a small grass fire, Georgia. Photo: Clint Davis, Forest Service, 1942.

Civilian Conservation Corps crew undertaking suppression action on a wildfire with backpack pumps and handtools, Ozark National Forest, Arkansas. Photo: Bluford W. Muir, Forest Service, 1938.

*Excerpt from Olsen (1941).

ing firefighting scenes of the era and general geographical location associated with the Honey Fire are presented here.

Communication on the fireline would have been difficult under the circumstances. There would have been no radio communication capability between the local district office and the fire boss or among the fire suppression crews (Gray 1982).

In addition to observing and recording the fire's development and chronology, Olsen's crew documented the fire suppression activities and the fire's resistance to control (e.g., arrival time, suppression tactics, amount of constructed and held line, and general difficulties experienced by the firefighters). No firefighters were killed or injured during the Honey Fire, but Olsen (1941) acknowledged that, after the wind shifted, "the danger of a crew getting trapped by the high, oncoming flames was great" along the left flank of the fire.

The Controversy That Followed

Roy Headley, who served as head of fire control for the Forest Service from 1919 to 1942, was interested in analyzing the accounts of large fires for the lessons that they might provide. For the year 1938, the Honey Fire was the third largest of the 13 Class E fires (fires greater than 300 acres [121 ha] in size) in the Southern Region of the Forest Service and 1 of 5 large fires on the Kisatchie National Forest. A little more than a third of the area burned by the Honey Fire had been planted with slash pine seedlings about a year earlier. Wildfires had been and continued to be a chronic problem for the reforestation pro-

Lessons Learned in Large Fire Management*

Such an infinite variety of problems are involved in the management of large fire jobs that thoughtful men seldom fail to learn from each one something which should be guarded against in the future, something which should be done differently, some cherished belief which must be modified or abandoned. For 35 years I have been working on or observing suppression jobs, but I still learn something from every fire I reach.

Roy Headley, circa 1942. In "Re-thinking Forest Fire Control," Headley (1943) summarized the lessons he had learned from a long and distinguished career in fire control administration with the Forest Service. Photo: courtesy of Stephen J. Pyne, Arizona State University.

Sometimes, alas, we "learn the same lesson over and over"—or do we? For example, I have learned throughout many years that there is some flaw in our management of larger fires which keeps us from getting a reasonable output of held line from a crew of a given size. Plenty of other people have learned the same thing. But, untrained as we are in the science and art of management, we have not found ways to act satisfactorily on what we have learned. Our learning has too often failed to lead to productive action.

The first essential in such matters is to grasp the need for change, the nature and importance of a problem, the chance to introduce something better. With that fact in mind, the outline for 1938 reports on larger fires requested a record of lessons learned by the man or men who had most to do with each fire. Some of the most suggestive answers received are quoted in this article. … All fire-control men may benefit by the lessons learned on these fires. Perhaps these notes will help reduce the number of times lessons have to be "relearned" by different men—or by the same men.

*Excerpt from Headley (1939a), which was published when Roy Headley headed the Division of Fire Control, Forest Service, Washington, DC.

gram that began in 1930 when the Kisatchie National Forest was first established (Burns 1982, 1994).

In his analysis of the Honey Fire, Headley (1939b) felt that the fire boss had failed to recognize the severity of the burning conditions that prevailed at the time and thus failed to select an appropriate strategy and tactics for containing the fire, namely backfiring from existing roads and firebreaks (Cooper 1969; Riebold 1956). Yet as Cheney and Sullivan (2008) have rightly pointed out, there are inherent dangers with backfiring that limit the chances of success. At the time, the fire boss was required to rely solely on his general knowledge and experience; no guide to judging fire potential relevant to the fuel type was available at the time. Less than 2 years later, Bickford and Bruce (1939a) produced what evolved into the Coastal Plain Forest Fire Danger Meter for the Southern and Southeastern United States (Jemison and others 1949).

Olsen and his fellow crew members were criticized for not immediately attempting to suppress the fire. However, the forest supervisor had previously agreed that this research crew was free of any obligation to undertake any fire suppression action so that the best possible fire behavior data could be obtained. It's unlikely that they could have done much anyway: "With two fences and a railroad between them and the fire, there is no doubt that their truck was unusable on this fire" (Olsen 1941). Furthermore, when the research crew arrived on the scene, the fire had already advanced more than 100 feet (30 meters) from its point of origin and "was very definitely too big for them to hold with hand tools alone" (Olsen 1941).

Olsen's (1941) account of the Honey Fire included considerable commentary on the actions taken by fire suppression personnel in addition to his description of fire behavior and the associated fire environment. This commentary was presumably in part the result, according to the editor of *Fire Control Notes* at the time, of a board review held by the regional forester that provided additional information to the Southern Forest Experiment Station for use in its study of the Honey Fire (Olsen 1941).

Olsen (1941) indicated that one of his objectives in publishing his case study was "to offer constructive criticism and suggestions as a guide in planning suppression action for future fires burning under similar conditions." He also offered many positive observations.

Despite his good intentions, Olsen was criticized in an article published in 1942 in *Fire Control Notes*. Barry (1942) chastised the fire behavior research crew for not attempting to control the fire; he also deemed it inappropriate for fire research personnel to analyze or critique the efforts of the fire suppression personnel involved after the fact. Further, Barry asserted that such actions could have serious repercussions on the image and morale of the organization and that only those fires that had escaped initial attack should be the subject of fire behavior studies.

Reflections

Wildfire case studies are invaluable in providing fire behavior data for developing and evaluating fire behavior models (e.g., Pearce 2002, Townsend and Anderson 2006) and as a source of training material (Alexander 2002). The recent report on the 2006 Billo Road Fire in New South Wales, Australia, by Cruz and Plucinski (2007) is a good example of this traditional role of wildfire case studies. Documentation of the effects of fuel treatments on fire behavior in relation to fire suppression effectiveness (e.g., Murphy and others 2007), highlighting firefighter safety incidents (e.g., Pearce 2007), and fostering institutional memory of local, historically significant fires (e.g., Ward 2005) represent other valuable contributions. Case studies of prescribed fires (e.g., Alexander 2006) are just as valuable as their wildfire counterparts. A combination of case study knowledge, experienced judgment, and simulation modeling of fire behavior is seen as the most effective approach to appraising fire potential and predicting wildland fire behavior (Alexander 2007, Alexander and Thomas 2004).

Lessons-Learned Analyses of the Honey Fire*

In this case the fault lies with the fire boss in his failure to recognize extreme fire conditions that existed on January 25, and to modify his attack to fit these extreme conditions. If he had recognized the danger, or had means other than his general knowledge and experience to guide him in selecting the correct method of attack, the fire would have been controlled much easier, and with a somewhat smaller acreage. Instead of attempting a direct attack, had he backfired all existing roads and firebreaks facing the oncoming fire, the fire would have been controlled at about 700 acres [280 ha] and the slash-pine plantation inside of the fence would have been saved. The amount of held line per man-hour would have been at least tripled. One answer is a well-constructed, fire-danger meter which will leave as little as possible to the judgment of the fire boss on the fire line.

The only method of controlling this fire at a smaller acreage after it had started would have been an immediate attack by the indirect method by backfiring. Under such conditions, tank trucks and specialized equipment are of very little value. A strip of burned ground at least 400 feet [120 m] wide is necessary to stop the heads of such a fire.

The fire was started by the L. & A. Railroad train which was temporarily stalled at the point of origin. The Louisiana State law requires that the railroad free their right-of-way from combustible material. The forest [Forest Service] has never been able to force the L. & A. to do this. The railroad officials have been warned, both in person and by letter, many times. Also, they have paid suppression cost and damages for other fires caused by their railroad. Railroad business is rather poor, and the officials took the attitude that they could not afford to keep rights-of-way clear as required by law. Reimbursement of damages and suppression costs amounting to $2,160.62 has been asked for.

Since this fire occurred, however, the railroad officials have decided it is cheaper to clear the right-of-way than to pay damage and suppression costs. Both the L. & A. Railroad and Missouri-Pacific Railroad Cos. have cleared their rights-of-way of combustible material within the forest boundary. For the first time in the history of the Kisatchie Forest, we will enter the 1938-39 fire season without the constant hazard of railroad fires.

Fusees used for backfiring in some of the tool boxes had absorbed enough moisture from the air to be worthless. The wet or damp fusees could not be detected by casual examination. Some delay in backfiring was caused by these dud fusees. Fusees cost only about 9 cents a piece, and this failure could have been eliminated by simply replacing old fusees with new ones every 30 days.

*Excerpt from Headley (1939b), which was published when Roy Headley headed the Division of Fire Control, Forest Service, Washington, DC.

Criticism of the Actions of the Wildfire Behavior Documentation Crew on the Honey Fire*

A reading of the article by C.F. Olsen, entitled "An Analysis of the Honey Fire," in the October 1941 issue of *Fire Control Notes*, brings to attention a situation hard to imagine. Of course, it is practically impossible for us at this remote location to visualize all the factors; nevertheless, after making generous allowances, I still experience an unpleasant jolt when I think of what happened.

There were two branches of the same department involved in the suppression of a fire, one interested in determining how the fire would behave on a bad burning day, the other charged specifically with the responsibility for stopping its spread.

The branch interested in behavior arrived at the Honey Fire first, 3 minutes after its origin according to the article. A four-man fire-behavior crew had been traveling on a paralleling highway about a mile [1.6 km] behind a train that stopped to service a hot box. The train crew carelessly threw some burning waste into dry grass and the behavior crew happened along 3 minutes later. They found it "definitely too big for them to hold." The decision of the fire-behavior crew—equipped with a car having various fire-fighting tools—to refrain from an attempt to check or retard the spread of this fire when it was approximately 100 feet long is hard to understand. We would expect more from four untrained men off the street as a quality of citizenship. Forest Service guard-training instructions have emphasized for years that there is always something that even a single guard can do to retard the spread of a fire, although it may be obvious that a frontal attack is impossible. The failure to make some attempt in that direction on the part of this fire-behavior crew indicates that they did not believe in such a theory. Won't the morale and fighting spirit of our temporary guards be lessened by such an example? The public, too, may find such action, or lack thereof, confusing.

If the fire-behavior crew admitted that they were unskilled in fire fighting and limited their report to factors of weather and rate of spread, their disregard for attempting control action could be overlooked to some extent.

The fact that suppression foremen, who apparently did their best to stop this fire, were subjected to criticism by such men indicates an oversight in personnel management that cannot help but decrease spirit and morale in a marked degree. Moreover, the fire-behavior crew has been permitted to make capital of their questionable action by printing the results of their study.

There is no quarrel with the policy of conducting fire-behavior studies, and the men assigned to that duty should not be expected to take part in the suppression work on fires that have escaped first control efforts. However, there should be no tolerance of a policy permitting an organized crew of men to travel about the country looking for fires to study unless they are willing to lend a hand in an effort to check the spread of small fires pending the arrival of regular suppression crews.

It is hoped that in the future this fact will be made clear to all, so that even though a fire cannot be entirely stopped, it may be retarded, thereby permitting arriving suppression crews to handle it more easily. That kind of action will make far better reading than the one referred to above, and the results after the fire is out will go far toward strengthening the spirit and morale of the whole organization.

*Excerpt from Barry (1942), which was published when E.F. Barry was a staff assistant on the Flathead National Forest, Northern Region (Region 1), Forest Service.

The value of the fire behavior documentation of the Honey Fire that Olsen (1941) provided is unquestionable. As Van Wagner (1971) has pointed out, "some valuable reference data can be collected by being at the right place at the right time" through wildfire monitoring and documentation. This is especially true during periods of extreme burning conditions, which are often impractical or impossible to simulate with outdoor experimental fires, in the laboratory, or by computer simulation. At the time, Olsen's article was the most comprehensive published wildfire case study of its kind. Over time, many others have used his data and information in their own fire research studies and for other purposes,

On Wildfire Case Studies and Firefighter Safety

I confess that I like case studies. They are the kind of thing historians are used to dealing with. We don't expect to find general laws: we accept the particularity of experience. Moreover, the case study is a story. That's why I think it's especially useful for safety. Nobody remembers guidelines the way they remember a story, which is the next best thing to actually experiencing the events.

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Global Wildland Fire Historian

including the present article. For example, the Honey Fire was one of five wildfires that Anderson (1983) used to evaluate his two elliptical fire shape models.

Olsen's (1941) documentation of the fire suppression decisions and actions on the Honey Fire are also valuable, though controversial. His case study analysis of the Honey Fire provides lessons for fire managers and researchers alike and raises issues that are still pertinent today, including some of the following ethical questions:

- Should case studies document fire control activities as well as fire behavior and compare model predictions and accepted knowledge against observations?
- When should the observer drop the camera and notebook and pick up a shovel or pulaski?
- When is it appropriate for a researcher to critique the decisions and actions of firefighters and fire managers or analyze how a fire should have been suppressed?
- Is it incumbent upon researchers to raise questions and point out deviations from standard operating procedures and discuss potential reasons for doing so?

A clear understanding of what happened during a fire is often "hard to acquire because it is obstructed by the natural human desire to save face, fear of disciplinary action, fear of being made a goat, and lack of confidence in the competence and impartiality of men who may judge the record," as pointed out by Headley (1943). However, a case study is not intended for "taking people to task for errors in judgment, but solely to ensure that the lessons that have been learned contribute to the success of future fire suppression operations" (Luke and McArthur 1978).

Implications

The general value of wildland fire behavior case studies has been discussed at length (Alexander and Thomas 2003a, 2003b, 2006). However, case studies are commonly seen as the "poor cousins" of fire science, occasionally tolerated but seldom encouraged in the scientific and technical peer-reviewed literature, although exceptions do exist (e.g., McRae 1986, Noble 1991). This situation contrasts with that of other professions, such as engineering, medicine, business, and law, where case studies are well accepted (Henderson and others 1983). For example, the *New England Journal of Medicine* has published an ongoing series of case studies since 1923 (Falagas and others 2005) and the Harvard Business School is renowned for the use of the case study method in the classroom (McNair 1954).

On Criticism and Wildland Fire Suppression

The one contemporary issue that interests me most in this article is sensitivity to the concept of criticism—constructive or otherwise.

We still have not, I'm afraid, learned to use criticism to its full benefit. Many fire managers and leaders in today's firefighting ranks are especially fearful of criticism from official sources—especially as it relates to firefighter safety. After-action reviews, risk refusal, lessons learned, accident prevention analysis and other tools are being successfully used to counteract resistance to constructive criticism, but much more work is needed. It will always be so as long as firefighters remain a proud, self-assured bunch, and they want to control fires in risky environments.

The source and purpose of criticism is key here. The threat of "witch-hunts," real or imagined, will keep criticism a sensitive subject. Direct criticism from research is no exception, even with good intentions.

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We can only speculate whether the gain was worth the adversity that Olsen and his crew faced afterward.

Case studies can bring to light unusual or perplexing problems that might otherwise be neglected and, by telling a story, can ground what would otherwise be dry theory into a meaningful context (Hallenbeck 2005). However, case studies can be among the worst of the literature, offering few conclusions. Additionally, extrapolating conclusions from a single case is usually unwise, and attempting to solve a difficult case after the fact can become an exercise in self-aggrandizement (Hallenbeck 2005).

The role of the fire researcher as an independent observer established by Olsen (1941) and others more than 70 years ago continues to be used today. For example, current work by rapid-response researchers focuses on gathering data related to fire behavior and fire effects (Lentile and others 2007a, 2007b).

Similar activities have been undertaken in the past, especially in documenting free-burning fire behavior (e.g., Hardy 1983, USDA Forest Service 1993, Wilson and Davis 1988). In fact, Forest Service pioneer fire researcher Harry T. Gisborne is believed to have published the very first attempt at a comprehensive wildfire case study in his description of the Quartz Creek Fire (Gisborne 1927), which occurred on the Kaniksu National Forest adjacent to the Priest River Experimental Forest in northern Idaho during the summer of 1926; Kay (1927) published a less detailed documentation of several fires that occurred the following summer in Western Canada. This was followed by several other pioneering case studies in North America in the early 1930s (e.g. Jemison 1932, Dauge 1934, Shaw 1936).

Documenting or analyzing fire suppression strategies and tactics has not been undertaken as part of rapid response research to date, despite the fact that fire behavior may be influenced by fire suppression and that fire suppression actions are arguably an important part of the record. Although further analysis of human factors and activities on a fire opens the door to controversy, it may nonetheless provide valuable information and learning tools for fire managers. Taking a page from the *New England Journal of Medicine* and developing a mechanism to analyze and publish a regular series of peer-reviewed case studies of fire behavior and fire suppression activities would be a valuable addition to both the fire management and fire research professions. This would serve to complement the suggestion of creating operational wildland fire behavior research units (Alexander 2002).

Perhaps the idea of fire researchers critiquing human decisionmaking and actions would be viewed by fire managers as taboo, although there doesn't seem to have been any past reluctance to publish positive assessments (e.g., Countryman 1969, Kurth 1968, Scowcroft and others 1967). Nevertheless, we suspect a certain sensitivity still exists in having fire researchers second-guess fire operations personnel. This might be overcome in part by involving practitioners in the analysis.

Parting Thoughts

As fire behavior research professionals, we admire the determination that Olsen and others showed in their approach to systematically documenting the Honey Fire. It must have been extremely difficult for Olsen to complete his case study article in the face of the criticism that followed the control of the Honey Fire.

We can only speculate whether the gain was worth the adversity that Olsen and his crew faced afterward. Despite their express freedom to study fire behavior, the question of whether or not to engage in initial attack must have constituted a major moral dilemma. Obviously, the crew sincerely believed in the value of their research, and such dedication to the task is commendable. Would you have done the same?

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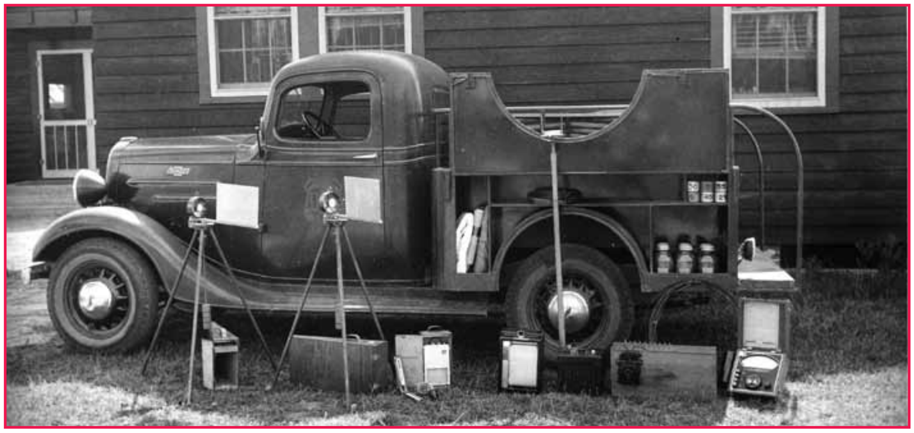

Vehicle and equipment used in fire behavior studies by fire research staff of the Southern Forest Experiment Station during the mid to late 1930s on the Harrison Experimental Forest, De Soto National Forest, MI. From left to right, the instruments are Foxboro pyrometer, thermocouple wire, thermocouple switch dial, storage battery, compass and Jacob staff, 8-pen thermograph recorder, portable recording hygro-thermograph, hand aspirated psychrometer, anemometer, and wood carrying case. In the truck compartments there are glass jars for fuel samples, cans for soil samples, a chain, and cloth of varying colors for plot markings. Photo: T.T. Kohara, Forest Service, 1937.

Remembering (or Discovering) the 1988 Yellowstone Fires

Any member of the wildland fire community younger than 21 years old was not even born when the Yellowstone fires of 1988 took place. And many of those who were involved have since gone on to retire from active service or are about to. Thus, a report recently published by the Wildland Fire Lessons Learned Center (WFLLC) will no doubt be of value to both generations in remembering, or in fact discovering, the past. The WFLLC report is entitled “The 1988 Fires of Yellowstone and Beyond as a Wildland Fire Behavior Case Study” and was written by Dr. Marty Alexander. This report is based in part on the opening remarks made by the author at the fire behavior fuels and weather session of The ’88 Fires: Yellowstone and Beyond conference held 22–27 September 2008 in Jackson Hole, WY. Dr. Alexander served as the co-organizer and co-moderator of the session. A copy of the WFLLC report is available for download at: <http://www.wildfirelessons.net/documents/alexander_Yellowstone88_FB.pdf>.

A crowning forest fire begins to descend upon the Old Faithful complex in Yellowstone National Park on September 7, 1988. Photo: Jeff Henry, National Park Service, courtesy of the Yellowstone Digital Slide File.

The Effects of Climatic Change and Wildland Fires on Air Quality in National Parks and Wilderness Areas

Don McKenzie

How will climatic change and wildfire management policies affect public land management decisions concerning air quality through the 21st century? As global temperatures and populations increase and demands on natural resources intensify, managers must evaluate the trade-offs between air quality and ongoing ecosystem restoration. In protected areas, where wilderness values are paramount, public land agencies have adopted the policy of using wildfires to benefit natural resources, allowing naturally ignited fires to burn unless they present additional threats, such as fire risk to structures or degraded air quality.

Effects on Air Quality

Fire effects on air quality can be both local and regional. Smoke exposure at fires and immediately downwind from fires can cause respiratory problems even in healthy people, but exposure is especially problematic for those with asthma or other chronic respiratory problems. Particularly hazardous are the particulate emissions smaller than 2.5 microns (2.5 x 10-6 m) in diameter ($PM_{2.5}$), which can be breathed more deeply and cross protective membranes in the lungs. These same particulates and other elements of the smoke plume can impair visibility hundreds of miles downwind from emissions sources (Malm 1999). In the Western United States, regional haze from fires and other sources reduces visibility in most of the protected areas at some time during a typical year. The worst days, in terms of visibility, are usually associated with smoke from wildfires.

To maintain air quality, we need to understand not only present-day emissions from fires but also how conditions may change over time in response to future climatic changes, land use, and management strategies. Fire regimes will likely evolve in response to temperature increases and associated vegetation changes (McKenzie and others 2004). The annual area burned by wildland fire is expected to increase across the Western United States

In the Western United States, regional haze from fires and other sources reduces visibility in most of the protected areas at some time during a typical year.

Yosemite (left) and Glacier (right) National Parks experiencing near-pristine (top) and severely degraded (bottom) visibility. Photos courtesy of the IMPROVE Web site. [Web site <http://vista.cira.colostate.edu/IMPROVE/>.]

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and Canada (Flannigan and others 1998, McKenzie and others 2004, Gedalof and others 2005).

Fires in many ecosystems are already becoming larger and more severe than under historical conditions because of increasingly severe fire weather, unnatural fuel buildup from fire suppression, or both (Agee 1997, Allen and others 2002). Increases in area burned and fire severity increase biomass consumption, smoke emissions, and atmospheric dispersion of particulates and aerosols that produce regional haze.

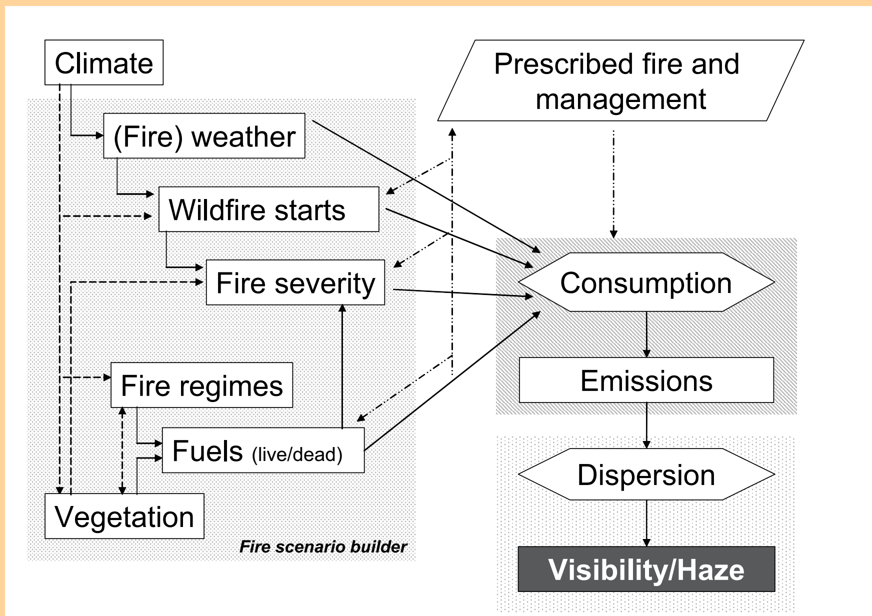
Air Quality Trade-Offs

There are many obstacles to returning the Nation's wildlands to their natural fire regimes, as noted by other authors in this issue. In many regions, such as the Pacific Northwest, air quality restrictions are one of the major impediments even to well controlled prescribed fires. These restrictions are based on the hazard of smoke exposure to local communities. Local effects, and the prospect of generating unacceptable visibility impairment in protected areas many miles away, make the management of wildfires for resource benefits less available as a fire management tool.

In one study, colleagues and I simulated smoke dispersion and regional haze from the wildland fires of 2003 in the Pacific Northwest with an integrated model of fire starts, combustion, emissions, and dispersion. We found that wildland fires in Oregon and Washington produced significant regional haze downwind at Glacier National Park in Montana and the Bob Marshall and Selway-Bitterroot Wilderness Areas in Montana and Idaho (fig. 1).

Fire Scenario Builder: A Tool for Predicting Regional Haze From Wildland Fire

Haze-producing emissions are sensitive to weather patterns and the nature of fire occurrence, which can be offset by management efforts. The fire-scenario builder uses real-time regional meteorology to simulate regional haze under current conditions and allows for the projection of wildfire events. A fuel-mapping module links vegetation data to a fuel classification system. A framework of emission, consumption, dispersion, and trajectory models reads the fire event data and the fuel mapping and calculates smoke emissions, plume rise, and regional-scale dispersion. Associated research is reported in McKenzie and others (2006).



Thinking Locally, Reacting Globally

Fire managers in national parks and wilderness areas are faced with background levels of reduced air quality, which exacerbate the conflict between air quality and other wilderness management goals. The contribution of wildfires to haze, in particular those wildfires allowed to burn as a natural ecological process, may be overestimated in some areas, leading to management choices hostile to the expansion of the use of wildfires for resource benefits. In some cases, wildfires may be the sole source of smoke, whereas in others it may be a minor contributor alongside agricultural and industrial pollution and haze from distant wildland fires.

Climate Change and the Use of Wildfires as an Ecological Process

How will wildland fire affect visibility in the future? With a warming climate, statistical models and simulation models suggest that wildland fire areas will increase in

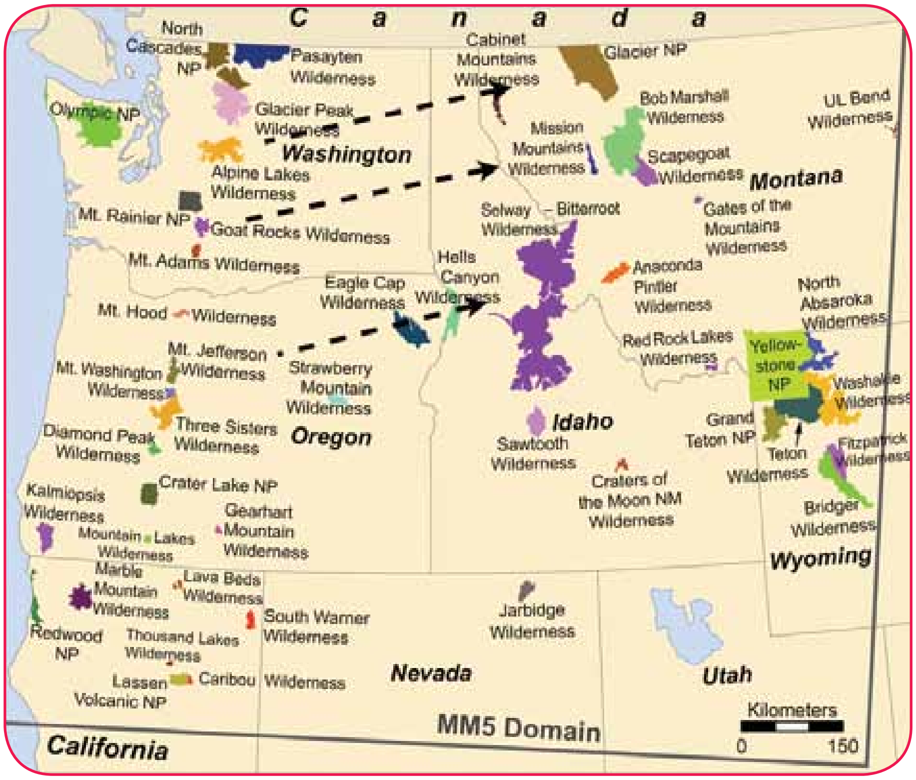


Figure 1—*Class I wilderness areas in the Pacific Northwest. Arrows indicate approximate flow patterns of smoke emissions from wildland fires in Washington and Oregon. From McKenzie and others 2006.*

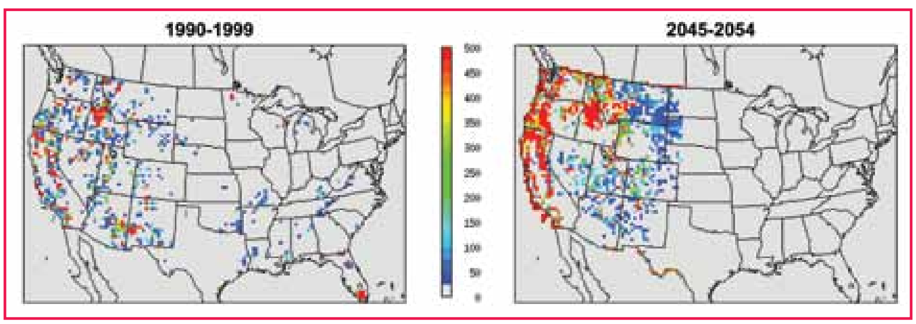


Figure 2—*Total emissions of $PM_{2.5}$ (tons) from wildland fires simulated over a future decade (2045–2054) compared to estimates from fire records (1990–1999). Simulations were restricted to the West; the observational data covered the conterminous United States.*

the Western United States (fig. 2). We can, therefore, also expect the contribution of fire to regional haze and reduced visibility to increase.

Emissions are projected to increase, especially in the westernmost States. Given current patterns of smoke dispersion, in which haze from fires in Washington, Oregon, and California significantly degrades visibility in national parks and wilderness areas to the east, Idaho and Montana will continue to be affected by regional haze, thereby compromising the role of naturally ignited wildfires as an ecological process.

Given the expected complexity of future management and policy decisions, multidisciplinary approaches are needed to guide management alternatives in the face of dynamic ecosystems and a warming climate. Examining prescribed fire scenarios or other means of fuel reduction allows us to estimate the potential value of fuel treatments on multiple-use lands for enabling ongoing application or expansion of managing wildfires for resource benefits in protected areas. Understanding trade-offs between air quality and ongoing ecosystem restoration, and precise quantitative estimates of the effects of fuel treatments, will help land managers across the West make informed choices.

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The 10 Standard Firefighting Orders and 18 Watch Out Situations: We Don't Bend Them, We Don't Break Them...We Don't Know Them

Bryan Scholz

Most of us don't know the 10 standard firefighting orders and 18 watch out situations, the "10 & 18," by heart. Judging by our fatality reports and close calls, it shows.

> Knowing the "10 & 18" is the best tool we have to protect ourselves from bad decisions. It is the best tool we can give to our rookies to protect them from our bad decisions.

In 1956, Forest Service Chief Richard McArdle convened a task force to study 16 fires that occurred from 1937 to 1956. These fires had 79 fatalities due to burnover. The resulting 1957 report to the Chief (Moore and others 1957) identified 10 factors that were common to many of these fires:

1. Unexpected fire behavior—basic elements not understood; indicators of change in usual fire behavior not recognized; local fire weather forecasts not obtained, inaccurate, or not understood.
2. Instructions—not followed, not clear, or not given.
3. Foremanship—lost control of personnel at critical time.
4. Line supervision—overhead busy on minor jobs, not available when major decisions had to be made.
5. Communication—not available, not used, or broken down.
6. Firefighting strategy and tactics—control effort made in wrong location or without adequate margin for safety; detailed line location incorrect.
7. Scouting—not done, not thorough, too dependent on air scouting.
8. Escape plan—not formulated, not explained, not executed.
9. Lookout posting—routine practice not followed.
10. Organization—humans and machines committed to action without adequate supervision, or without adequate tie to the rest of the organization.

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To address these critical factors, the report presented a list of 10 "standard firefighting orders" and recommended:

> "These orders are to be committed to memory by all personnel with fire control responsibilities.
>
> "Military organizations have had long experience in training men to remember certain fundamental instructions and to react even in emergencies in accordance with those instructions. One device by which such discipline is achieved is that of 'general orders,' which all men of the unit are required to memorize. On some of the fires we reviewed, men who knew better just did not pay adequate attention to good firefighting practices that seem like small details, but could become the critical item in an emergency. The use of a form of standard orders starting immediately would be a long step in the direction of assuring attention to the fundamentals" (Moore and others 1957).

Shortly after the standard firefighting orders were incorporated into firefighter training, the 18 watch out situations were developed to complement them (USDA Forest Service 2008a).

Fifty years later, fire has found no new way to hurt us. We continue to make the same mistakes. From Mann Gulch to South Canyon to Cramer, we put ourselves into places where there is unburned fuel between us and the fire, or where we can't see the main fire and we're not in contact with someone who can. We make decisions that are not based on current and expected fire behavior.

In "A Trend Analysis of Fireline 'Watch Out' Situations in Seven Fire Suppression Fatality Accidents" (Morse 2004), 84 separate hazardous conditions or events were identified in the fatality reports. Morse states, "In each of seven fatality events, a single overlooked 'watch out' appeared to be the major contributing factor."

In a September 2004 report to the Chief, the Office of Inspector General (OIG) analyzed the fatality reports for the Cramer, Thirtymile, and South Canyon Fires. The OIG found that "fire suppression personnel violated all of the [standard firefighting] orders and failed to mitigate most of the watch out situations. Each fire had rapid growth unexpected by management; fire suppression personnel employed questionable or improper tactics and did not adjust their tactics as necessary" (USDA Office of Inspector General 2004).

This is not just a problem during wildfire suppression. In 2006, 10 people assigned to the Little Venus Fire on the Shoshone National Forest in Wyoming as part of a fire use module were entrapped by the fire and deployed fire shelters. Members of this fire use module did a great service to their profession by contributing openly and honestly to the after-action review, especially by reminding us that a fire managed in part for ecosystem benefits (those previously called wildland fire use events) is still a wildfire, and the same rules apply. From the review:

> "This incident...differs from past deployments in that the involved personnel were not actively engaged in the performance of an operational fireline assignment when the deployment occurred. They were enroute to a camp location to debrief with a crew they were replacing and would not have been given a fireline assignment until the next operational period."

> "Many individuals did not have a thorough understanding of the purpose and objectives of their fireline assignments; many did not have a good awareness of the weather, its influence on fire behavior, and resource disposition; an understanding of planned contingencies; working knowledge of personnel assigned to the fire and the chain of command; and assumptions were made that led to failure to realize deficiencies in the organization and implementation. As a result, this lack of situational awareness created instances of confusion, incomplete information sharing, and contributed to complacency."

> "There were numerous instances where personnel indicated their perceptions that wildland fire use and wildfire suppression were two separate events, even on a single wildland fire such as the Little Venus Fire."

"The 10 standard firefighting orders must be firm rules of engagement. They cannot be simple guides, nor can they be 'bargained.' They are the result of hard-learned lessons. Compromise among one or more of them is always the common denominator of tragedy. On Dude, South Canyon, and Thirtymile, these orders were ignored, overlooked, or somehow compromised. The orders mean little once we are in trouble, and because of that we must routinely observe them and rely on them before trouble confronts us."

—Jerry Williams, former director, Fire and Aviation Management (2002)

The reasons for not recognizing the 18 watch out situations and not following the 10 standard firefighting orders are complex, and have much to do with human factors. But whatever the reasons, judging by our fatality reports and close calls, we continue to act like we don't know the "10 & 18," and the reason is, a lot of us don't. This doesn't make sense. We should be required to prove, every year, that we know the "10 & 18" by heart in order to get an incident qualifications card ("red card"). Knowing the "10 & 18" is the best tool we have to protect ourselves from bad decisions. It is the best tool we can give to our rookies to protect them from our bad decisions.

Some people think that the new foundational doctrine for fire suppression (USDA Forest Service 2005) replaces the "10 & 18." While this is not its intent, there is language in the doctrine that confuses the issue. The doctrine describes the "10 & 18" as "universal principles of suppression operations… principles [that] guide our fundamental fire suppression practices, behaviors and customs, and are understood at every level of command." However, the doctrine then states that they "…are not absolute rules. They provide guidance in the form of concepts and values." This is an unfortunate contradiction. Either the "10 & 18" are universal and fundamental, or they are not. Either we base all of our actions on current and expected fire behavior or we don't. And if we're not going to base all our actions on current and expected fire behavior, then what are we going to base them on?

Some people think that "lookouts, communications, escape routes, and safety zones" (LCES) replace the "10 & 18." I had the privilege of hearing one of the first lectures that Paul Gleason gave about his concept of LCES, and it was not his intent that LCES replace the "10 & 18." The establishment of LCES on the fireline is dependent on recognizing the watch out situations and following the standard firefighting orders. The use of LCES is a dynamic system; it exists and moves in space and in time, as the fire moves and as the firefighter moves. LCES "must be continuously evaluated as fire conditions change" (USDA Forest Service 2008b). But the system will not work unless it is based on current and expected fire behavior, and a firefighter who doesn't know that standard order can't follow it.

There is a perception among some firefighters that following the "10 & 18" reduces our tactical options, but there is no fire suppression tactic that is prohibited by "10 & 18." For example, downhill line, 1 of the 18 watch out situations, is a potentially hazardous situation whose risk is mitigated by following the standard firefighting orders. Downhill line is not prohibited; in some situations, it is safer.

"Safety first" is a simple, clear expression of the fundamental value of our profession.

There is concern that the orders are not measurable and quantifiable. So what? They are clear and concise: "keep calm," "give clear instructions," and "know what your fire is doing." While most mission statements, vision statements, and value statements are ambiguous or grammatically challenged, "safety first" is a simple, clear expression of the fundamental value of our profession.

Fifty years ago, some smart, experienced firefighters identified the common hazards of the fireline and came up with a set of rules to mitigate those hazards that is elegant in its simplicity. It is one of the best things that the Forest Service has ever done. We should honor the memory of those firefighters by seeing that "the orders are committed to memory by all personnel with fire control responsibilities."

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From Another Perspective—The 10s, 18s, and Fire Doctrine

Larry Sutton

The following comments are offered as response to the article, "The 10 Standard Firefighting Orders and 18 Watch Out Situations: We Don't Bend Them, We Don't Break Them...We Don't Know Them;" they are meant to continue the discussion on this important topic. My impression of some of the points the article makes might be summarized as follows:

1. If all firefighters memorized the "10 & 18," we would have fewer fireline fatalities;
2. Historic investigation reports have reached the correct conclusion that firefighter mistakes cause firefighter fatalities, and the same reports accurately point out what those mistakes were;
3. The standard orders need not be measurable and quantifiable; and
4. Foundational doctrine for fire suppression somehow contradicts or confuses the intent or purpose of the "10 & 18."

We all want firefighters to come home safely after every shift, on every fire. Yet we recognize that the environment in which we operate contains many hazards, some of which can be difficult to detect or predict until it's too late. The problem with relying too much on memorization of rules to keep us safe is that we are presupposing that a firefighter's mind will retrieve the appropriate piece of memorized information for any situation, even under stress, and make it available just when needed. Unfortunately, human minds under duress just don't work that way. Even if they did, a firefighter would still have to consider multiple possible courses of action, decide, and then act under conditions involving time pressure, fatigue, and incomplete information. These "human factors" are extremely important to any complex human endeavor like wildland firefighting, which is why the approach of simple memorization of rules will ultimately be ineffective. It is easy to memorize words without understanding their implications.

The problem with relying too much on memorization of rules to keep us safe is that we are presupposing that a firefighter's mind will retrieve the appropriate piece of memorized information for any situation, even under stress, and make it available just when needed.

Furthermore, we have to look at what is being memorized. Standard order #3 is frequently mentioned: "Base all actions on current and expected behavior of the fire." The problem with this order is that you can follow it and still be killed! All that is required is for the fire to do something unexpected. In fact, that is the true common denominator of fire behavior on tragedy fires: what the fire actually did wasn't what firefighters thought it was going to do. An investigation report that says that specific fire behavior could have been or should have been predicted is itself an interpretation: investigators have the advantage of hindsight. What actually happened was that the fire moved faster, or went in a different direction, or burned with more intensity than firefighters thought it would. Is this a shortcoming on the part of the firefighters? Not necessarily. Unpredictability is not predictable: even the most sophisticated fire behavior prediction tools currently available cannot always replicate observed fire behavior.

Unfortunately, accident investigation reports have historically done a poor job of reconstructing the "whys" of an accident. Why did the firefighters' decisions make sense to them at the time? Simplistic causal factors have been cited, such as the "violation" of a standard order requiring firefighters to have an escape route. Often, firefighters did have one or more escape routes, but they were inadequate when needed. We need to know why firefighters thought an escape route would be adequate when in fact

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it proved not to be. Most reports haven't told us that, even when firefighters survived a burnover.

The standard firefighting orders and watch out situations focus on preventing burnovers, but they are no guarantee of safety from fire behavior-related hazards, and they do not address the other four-fifths of accidents that kill firefighters. Accident data show that burnovers account for approximately 21 percent of all wildland firefighter fatalities. The other 79 percent are from causes unrelated to fire behavior, including aviation (23 percent), driving (23 percent), heart attacks (22 percent), and hazard trees/rocks (4 percent) (see "Wildland Firefighter Fatalities in the United States, 1990–2006," available at <http://www.nwcg.gov/pms/pubs/pms841/pms841_all-72dpi.pdf>).

> The foundational doctrine for firefighting is based on the premise that the best tools we have are firefighters' brains using all our best practices for safe firefighting, not a set of hard and fast rules to cover all situations.

It's very important for firefighters to clearly understand what the standard firefighting orders represent. First, we need to be clear about whether or not they are, in fact, "orders": standards that must be followed at all times. Second, if we consider them to be mandatory orders and use them as a yardstick to judge firefighter behavior when things go wrong, then they must be "measurable and quantifiable." But, is it even possible for the standard orders to be measurable and quantifiable? It seems clear that while the standard orders and the 18 situations are extremely useful as principles or best practices, they are, in fact, subjective and circumstance-dependent enough that they cannot function as true standards by which firefighters should be judged in a post-accident investigation. In the past, occupational safety and health investigators have agreed to have standard order "violations" removed from the record. There is also now case law (*Backfire 2000 vs. United States of America*, 2006, available at <http://wildfirelessons.net/documents/CJ_Molloy_ruling_memo.pdf>) describing the standard orders as "vague principles" and calling the language used in them "…the language of discretion, not of specific mandatory actions or protocols."

For example: should you automatically disengage if you can't maintain prompt communications with your supervisor? How are "prompt communications" defined? Is it really possible to know what your fire is doing at all times, when you are on one division of an 80,000 acre (30,000 ha) fire? It's important to know what's happening on your division and adjoining divisions for the safety of your crew, but it's often a practical impossibility to know what's happening with the whole fire unless you're an operations section chief. Even then, you'd only have a general idea—you wouldn't know about every spot fire on every division. The standard orders cannot be absolute rules. We must recognize them as best practices for safe firefighting and teach them that way.

The foundational doctrine for firefighting is based on the premise that the best tools we have are firefighters' brains using all our best practices for safe firefighting, not a set of hard-and-fast rules to cover all situations. Simply put, the standard orders and watch outs alone *aren't enough* to keep firefighters from harm. There is no silver bullet in managing the risks confronting wildland firefighters; there is just a large toolbox of principles and best practices for safe and effective firefighting, coupled with firefighters' discretion.

Doctrine was never meant to replace the standard orders; lookouts, communications, escape routes, safety zones (LCES); or other published guidance. Doctrine is the leaders' intent: a common set of values that can guide our actions in a variety of situations. It's noteworthy that, while the idea for standard orders came from military organizations, so did the idea for operational and strategic doctrine, something that exists today in all branches of the U.S. military. Furthermore, the general orders in the military, upon which the standard orders were modeled, are just that: general orders, not specific ones. The general orders have to do mainly with soldiers' conduct while on guard duty—they are not a set of prescriptive rules to be followed in any given tactical situation. The military places a high value on individual soldiers' initiative and creativity in those situations, just as we do for our firefighters.

As for LCES, that too is dynamic guidance. Brad Mayhew, a former hotshot, developed a variation on LCES that he calls “F LCES Δ.” The “F” stands for fire behavior, which urges you to consider the potential “worst case scenario.” LCES is looked at to determine if it’s adequate for that worst case. And the “Δ” (delta) represents change—it is there to remind you to consider “what’s changing now” as well as “what might change later.” (For a more thorough discussion, see http://www.firerescuemagazine.com/pdfs/WUI_04.pdf.)

These topics will be discussed and debated by firefighters forever. It’s important for firefighters to learn and understand—not just memorize—the standard firefighting orders and watch out situations, LCES, and all the other tools of our trade. Well-educated firefighters and capable leaders who are able to maintain situation awareness and continuously make sense of their environment are safe firefighters. But we’re kidding ourselves if we think that any single rule set will serve to keep everyone safe on every fire. There is no such thing as a “safety guarantee” in the dynamic wildland fire environment. ■

Introducing the Virtual Incident Procurement (VIPR) System

Beginning with the 2009 fire season, the Forest Service is using the Virtual Incident Procurement (VIPR) system to acquire certain types of contracted equipment for incident management. The VIPR system is a Web-based Forest Service application that awards and administers preseason Incident Blanket Purchase Agreements or I–BPAs (formerly called Emergency Equipment Rental Agreements or EERAs; EERAs are used for at-incident sign ups and are not part of VIPR).

Solicitations for wildland fire equipment are posted on the FedBizOpps Web site: <https://www.fbo.gov/>. Vendors may easily sort and find solicitations issued through VIPR, e.g., “VIPR I–BPA for Mobile Laundry in the Intermountain Region.” Computer-based forms submitted to VIPR are used to respond to solicitations. Vendors who wish to participate will need appropriate computer access and an eAuthentication account.

For more information about VIPR, including how to set up an eAuthentication account and what equipment categories are being solicited, visit <http://www.fs.fed.us/business/incident/vipr.php>.

The Potential for Restoring Fire-Adapted Ecosystems: Exploring Opportunities To Expand the Use of Wildfire as a Natural Change Agent

Gregory H. Aplet and Bo Wilmer

Fire has shaped America's forest ecosystems for millennia. From ponderosa pine woodlands that burn every few years to subalpine forests that erupt into flame every few centuries, most forests have evolved with fire and depend on periodic blazes for health and regeneration. Fire is such an important force that vegetation ecology and fire cannot be described independently.

Just as vegetation ecology and fire are intimately connected, land management and fire management are inextricably linked. Policymakers and forestry experts recognize that, after a century of fire suppression, there is a crisis in forest health: fire-dependent ecosystems starved of regular fire cycles now have unhealthy fuel loads and experience unnaturally large wildfires (Laverty and Williams 2000, Aplet and Wilmer 2005).

In response, forest managers seek to restore fire to fire-dependent ecosystems using both management-ignited and natural fires. The management of natural fires as a natural change agent in designated, remote sections of the landscape is widely accepted by scientists, managers, and policymakers. It is a tool for restoring forest health and mitigating the escalating costs of fire suppression (USDA Forest Service and others 2001). But despite its broad acceptance, in practice, wildfires are rarely used to benefit natural resources. Many people consider allowing wildfires to burn for resource benefit to be appropriate only in national parks and wilderness; even some fire managers view this management option as too risky (Parsons 2000, Black and others 2008). If the benefits of wildfire are to be realized, use of wildfires as a natural change agent must be applied over large areas wherever safe. The fire management approach we suggest would greatly expand the use of wildfires for resource benefit across significantly larger areas of the Western landscape.

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Just as vegetation ecology and fire are intimately connected, land management and fire management are inextricably linked.

A Three-Zone Approach

Three situations exist on any landscape with regard to communities and fire:

1. Where fire has the potential to cause great damage to people and homes, and fire should always be excluded;
2. Where people are uncomfortable with the close proximity of natural fire but fire could be used as a tool to reduce fuels and restore ecosystems under tightly prescribed conditions; and
3. Where fire is distant enough from communities that it poses little risk to people and resources and natural fires can be used to help achieve land management objectives.

These three situations are compatible with a three-zone, landscape approach to wildland fire management (DellaSala and others 2004, The Wilderness Society 2006). Under this approach, a *community fire planning zone* (zone 1) consists of the area immediately adjacent to communities and is managed for community protection. A *wildfire resilience zone* (zone 2) exists beyond zone 1 for a few miles and is managed not only to minimize unplanned fire through direct attack or containment but also to restore conditions that are ecologically resilient to fire. Beyond zone 2, the full range of management responses to fire (from direct attack to monitoring) is possible, but emphasis is placed on the use of fire for resource benefit. In this *fire use emphasis zone* (zone 3), management of fire as a natural process is a priority when conditions allow. Public land managers may use these three planning zones to focus resources where they are most needed and to restore natural processes to the landscape where practical.

Because the highest priority is the protection of people and their homes, the first step in designing a plan to promote the management of fire as an ecological process is identifying the *community fire planning zone* (Wilmer and Aplet 2005). Although sometimes called the wildland-urban interface, the term community fire planning zone better conveys the overriding objective of community protection for the area. Areas designated as zone 1 should be examined for opportunities to improve public safety through public education, infrastructure improvement, and fuels treatment (Cohen 2000, Nowicki 2002). Delineation of community areas at risk from wildland fire can help focus community protection efforts.

The *wildfire resilience zone* would extend from the *community fire planning zone* to a distance considered safe for possible fire use. Within zone 2, suppression would be the response to unplanned ignitions, but fire could be introduced intentionally to achieve management objectives. The primary management objectives in zone 2 would be (1) protection of critical resource values such as recreation sites, experimental forests, and research natural areas, and (2) maintenance of ecological resiliency through modification of forest composition and structure. Generally, this means fuels would be modified to protect specific resources and restore ecosystems (Landres and others 1999, Brown and Aplet 2000).

Opportunities for expanded management of wildland fires for resource benefit exist in the *fire use emphasis zone*. The full suite of management responses (including suppression and containment) is available under any given condition, but the preference would be to maximize opportunities for managing wildfire for resource benefit wherever possible. Delineation of zone 3 would require rigorous analysis to determine if an area is far enough away from communities such that fire would not be expected to threaten structures or other highly valued resources. Zone 3 delineation should increase managers' confidence to select this management option in the event of a natural ignition.

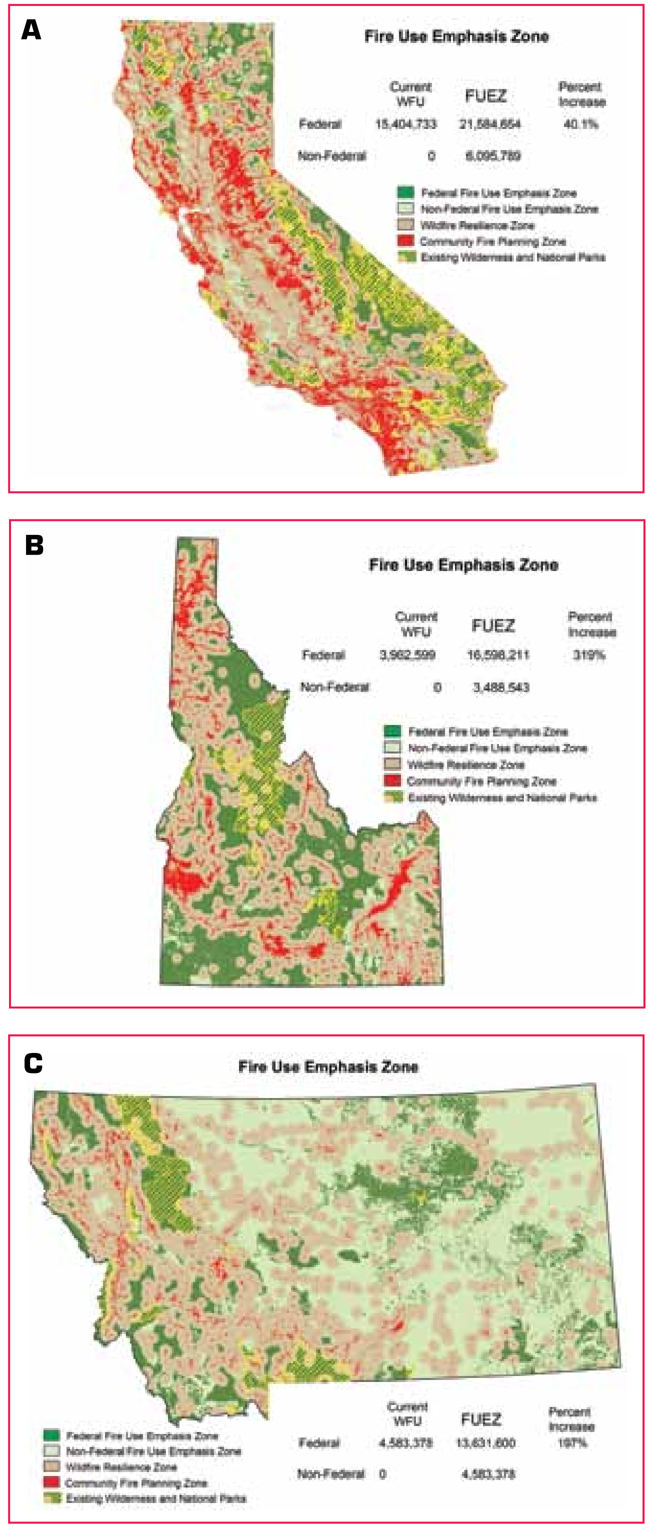

Figure 1—Comparison of current opportunities for using wildfires for resource benefits with an expanded fire use emphasis zone (FUEZ) in California (A), Idaho (B), and Montana (C). Current opportunities to use wildfire as a natural change agent based on existing national parks and wilderness are represented by yellow cross-hatching. Fire use emphasis zones (zone 3) are represented in dark green (Federal lands) and light green (non-Federal lands). The wildfire resilience zones (zone 2) are shown in pink. Community fire planning zones (zone 1) are shown in red.

Mapping the Zones

To represent the three-zone approach and identify opportunities for expanded use of wildland fire as a natural change agent, we mapped areas meeting the definition of a wildland-urban interface community.* Using housing data from Census 2000 and ownership data for California, Idaho, and Montana (three States representative of conditions in the Western United States), we identified locations meeting the housing density threshold for definition as a community. We removed public land (where houses generally do not occur) from census blocks and calculated where housing density within a census block exceeded one house per 40 acres (16 ha) on private land. We assigned those communities a ½-mile buffer to complete delineation of zone 1. A ½-mile buffer is codified in law (Healthy Forests Restoration Act of 2003) and provides a practical zone in which to look for opportunities to reduce home ignitability through fuels reduction, emphasis on use of fire-resistant building materials, and education efforts (Wilmer and Aplet 2005).

A buffer extending 5 miles around zone 1 represents the wildfire resilience zone (zone 2). In practice, the extent of zone 2 would have to be negotiated through participatory public planning; a 5-mile buffer was chosen as a starting point for this analysis because it seems a reasonable approximation of the discomfort zone within which it is unrealistic to expect people to accept natural fire. From ½ to 5 miles outside of communities also provides a reasonable area for fuels treatments that should be the focus of restoration work in the dry forests of the Western United States. In some cases, restoration would be desirable beyond this distance, but most opportunities to reduce fuels in dry forests at low elevations for restoration purposes exist within a few miles of communities. By limiting zone 2 to a 5-mile wide buffer, restoration planning can be focused on the "frontcountry," where the need is clear and there is less controversy over the use of thinning.

> Managing the landscape under a three-zone, landscape-scale fire management strategy could dramatically increase the area on which natural fire could be managed for resource benefit, without fear of property loss.

We classified the remainder of the landscape beyond zone 2 as the *fire use emphasis zone*. We assessed opportunities for expanded management of wildfire by comparing the extent of zone 3 with an approximation of the current opportunities for managing wildfires for resource benefit, defined by the boundaries of existing national parks and wilderness areas in California, Idaho, and Montana.

Fire Use Emphasis Zone

Currently, 15,404,733 acres (6,234,074 ha) of national parks and wilderness areas in California are available for using wildfires as part of land management (fig. 1A). Under the three-zone approach suggested above, the estimated fire use emphasis zone would encompass 21,584,654 acres (8,935,000 ha) of Federal land (a 40-percent increase over the current situation) and 6,095,789 acres (2,466,878 ha) of private land, most of it in the mountains to the west of the Central Valley. Together, lands in this zone would amount to 27.5 percent, about one-quarter, of the area of California.

In Idaho, national parks and wilderness cover less than 4 million acres (1.6 million ha) (fig. 1B). Our estimated fire use emphasis zone would increase the amount of Federal land available for using wildfires as part of land management by 319 percent to 16,598,211 acres (6,717,057 ha), and identify 3,488,543 acres (1,411,763 ha) of non-Federal land, mostly in southeast Idaho, where natural fire could be considered as a management option. Zone 3 in Idaho would represent 37.6 percent, over one-third, of the State's area.

In Montana, the situation is even more dramatic. Montana currently has 4,583,378 acres (1,854,827 ha) of national parks and wilderness (fig. 1C). The delineated zone 3 would almost triple the amount of Federal land suitable for using wildfires as part of land management to 13,631,600 acres (5,516,512 ha), but an even larger change would be the inclusion of almost 29 million acres (11.7 million ha) of private land in the eastern two-thirds of the State. All told, zone 3 would represent 45.6 percent, almost one-half of the area of Montana.

*"Urban wildland interface communities within the vicinity of Federal lands that are at high risk from wildfire" (Federal Register 66(3): 751–777, January 4, 2001).

Land Management and the Management of Wildland Fire For Resource Benefit

Our calculation shows that managing the landscape under a three-zone, landscape-scale fire management strategy could dramatically increase the area on which natural fire could be managed for resource benefit without fear of property loss. The fire use emphasis zone would start at a distance of 5½ miles from delineated communities. In practice, this distance could be modified by individual community and scientific input, but these numbers do suggest ample opportunity for expanded use of wildfire in the West.

In order to implement the use of wildfire as a management strategy, Federal policy requires the existence of a management plan that recognizes a beneficial role for fire; currently, all human-caused ignitions must be suppressed. Even with an approved fire management plan that authorizes the use of naturally caused wildfire for resource benefit in a given area, weather conditions, personnel availability, and other variables would have to be considered before a manager could make a definitive decision to use wildland fire to improve ecosystem condition. Once the initial decision was made, fire managers would have to constantly monitor and re-assess conditions and order suppression where appropriate.

Identifying the specific conditions under which management of wildfire as a natural change agent might be appropriate requires detailed scientific and spatial analyses. Even in remote areas, forest conditions, weather, and wind factors may preclude the safe use of fire. The use of wildfires is appropriate only where the results of fire would benefit resources. For example, benefits are unlikely where invasive weeds now carry frequent, intense fire into plant communities in which fire was historically rare. Generally, ensuring resource benefits requires a determination that fire behavior will be natural or historically typical for the location. To provide a sufficient basis for fire management, a land management plan would not need to include these detailed analyses but must provide sufficient latitude to allow fire planners to identify the appropriate conditions for management of wildfires for natural resources in the subsequent fire management plan. Such latitude could be provided by delineating zone 3 as widely as possible.

> Wilderness, roadless areas, and remote roaded land provide excellent opportunities to plan for management of wildfire as a natural ecological process.

Management prescriptions appropriate for zone 3 range from addressing wilderness concerns and protection of roadless character in a roadless landscape to active restoration and protection of recreation sites in roaded areas. Prescribed fire could be used throughout zone 3 to achieve a composition and structure that can accommodate natural fire. This is especially true for roaded areas, where existing roads could be used (possibly after thinning of adjacent fuels) to systematically reintroduce fire to the landscape.

In the roadless landscape, including wilderness, managers must prove that proposed actions will not degrade roadless or wilderness character prior to manipulation, including the use of prescribed fire. The Wilderness Act requires a “minimum requirements analysis,” a deliberate review to determine the least disruptive method necessary to accomplish the objective. The special values of roadless areas also demand that special care be taken. The Wilderness Act does not specifically prevent suppression action or fuel management in wilderness, but actions proposed for any part of the roadless landscape must be carefully planned using best available science and an inclusive public process. Because remote areas tend to be in higher elevation montane and subalpine forests, open deserts, and arid shrublands, little of zone 3 is likely to be in the low-severity fire forest types that may require thinning or prescribed fire before natural fire will yield resource benefits. The majority of zone 3 areas would include forests typified by less frequent fire regimes that would likely benefit from natural fire as long as fire regimes have not been altered by invasive species, human ignitions, or other causes.

Fire management in zone 3 should seek to maintain the natural character of the area, even in any roaded portion, and minimize impacts to aquatic, terrestrial, or watershed resources. Accordingly, minimum-impact suppression tactics should be used throughout zone 3 when suppression is the appropriate response.

Management of wildfires for resource benefit has historically been confined largely to wilderness areas and national parks, but there is no reason why fire cannot be used outside wilderness, wherever safe. Thus, the *fire use emphasis zone* may be mapped as everywhere beyond zone 2. Zone 3 in our examples includes any location further than 5 miles from the wildland-urban interface. The extent of zone 3 would vary regionally, depending on the degree of regional development. Opportunities for use of wildfires may be virtually nonexistent in some places, and in other areas, those opportunities may dominate. Wilderness, roadless areas, and remote roaded land provide excellent opportunities to plan for management of wildfire as a natural ecological process.

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Working Toward a Fire-Permeable Landscape—Managing Wildfire for Resource Benefits in Remote, Rural, and Urban Areas of Alaska

Mary Kwart and Morgan Warthin

Wildland fire is a recurring, significant, natural process in the boreal forest and tundra ecosystems of Alaska. These ecosystems surround Alaskan cities, towns, native villages, remote homes, and historic properties, rendering them susceptible to wildland fire. In 2004 and 2005, two of Alaska's three most severe wildland fire seasons on record, fires burned more than 11 million acres (4,444,000 ha), an area greater than that of Massachusetts and Connecticut combined. Now, fire managers must think of values at risk in terms of their permeability to wildland fire and begin to promote a fire-permeable landscape: one in which fire and values at risk coexist. Managing wildfires as an ecological process and natural change agent is the first of many steps toward achieving that landscape.

> Fire managers must think of values at risk in terms of their permeability to wildland fire and begin to promote a fire-permeable landscape in which fire and values at risk coexist.

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A Tool for Alaska's Fire Managers

The Alaska Interagency Wildland Fire Management Plan sets priorities for the assignment of firefighting resources statewide and provides a range of initial responses to wildland fire through the use of fire protection categories called "management options" (Alaska Wildland Fire Coordinating Group 1998). The four management options—*critical, full, limited*, and *modified*—are tied to the proximity of the fire to values at risk; they determine priorities for fire suppression needs and indicate where using naturally caused wildfires to benefit natural resources is appropriate.

Lands managed under the *critical* management option—where human lives, inhabited property, housing developments, or National Historic Landmarks are at risk—are the first priority for the assignment of suppression forces. Lands under the *full* management option—where uninhabited property or cultural, historical, or high-value natural resources are at risk—have second priority. Fires on *limited* management option lands are generally managed for resource benefits unless they threaten values on adjacent lands.

The *modified* management option is more flexible and provides a level of management between the *full* and *limited* options. A predetermined conversion date is used as part of the *modified* management option to determine whether initial attack on wildland fire is appropriate. Fires that start before the conversion date normally receive initial attack. On the conversion date, the Alaska Wildland Fire Coordinating Group assesses the current fire danger indices and fire activity to determine whether it is appropriate to convert to a noninitial attack response strategy. Fires starting after the conversion date might not be selected to receive initial attack and can be managed to accomplish resource management goals and reduce long-term suppression costs.

Most of Alaska's park units and wildlife refuges managed by the U.S. Department of the Interior, National Park Service (NPS) and U.S. Fish and Wildlife Service (FWS) have fire management plans that approve management of some wildfires for resource benefits on lands in the *limited* management option and on lands in the *modified* management option following the conversion date. If suppression actions have not been initiated and the criteria for an alternative response have been met, the agencies can also use naturally caused wildfires on lands in the *modified* management option before the conversion date, and those on lands in the *full* management option, for resource benefits.

> Managing wildfires as an ecological process and natural change agent is the first of many steps toward achieving a fire-permeable landscape.

Fires used to protect, enhance, or maintain resources are managed with the expectation that they will be of long duration. Fire managers use long-term assessment methods and tools to help determine where the fire might burn, to identify long-term management actions, and to identify trigger points that will initiate actions for preventing the fire from burning into areas of higher protection priority or for protecting specific features. Fire managers face unique challenges: the incidence of wildland fire may be increasing on the landscape and Alaskan values at risk are varied, widely dispersed, and often difficult to access. Highlights of these challenges and their solutions follow.

Using Wildfire as an Ecological Process in Rural and Urban Alaska*

During the 2005 fire season, the Kenai National Wildlife Refuge in south-central Alaska managed two wilderness fires: the Irish Channel Fire and the Fox Creek Fire. Both were within sight of a major recreational road system and several Kenai Peninsula communities.

The Irish Channel Fire, ignited by lightning on July 6, burned on the south shore of 25,000-acre (10,100-ha) Skilak Lake within plain view of touring motorists. The fire burned in deep duff under white spruce and hemlock. Smoke was visible from the Sterling Highway, a main route into the Kenai Peninsula. The Irish Channel Fire was managed under a stage 1 wildland fire implementation plan (WFIP) analysis level for 12 days. When continuing dry weather indicated that active fire behavior and perimeter growth would continue, the WFIP analysis level progressed to a stage 2. Although not directly on a road network, the fire was directly west of a floatplane- and boat-accessible lodge on the shores of Skilak Lake. Final fire size was 925 acres (374 ha).

The Irish Channel Fire burned within view of a heavily used recreation road system. Photo: Paul Slenkamp, FWS, 2005.

The Fox Creek Fire, discovered the evening of July 11 by detection aircraft, was 392 acres (159 ha) at size-up and actively burning parallel to 73,000-acre Tustumena Lake. The weather on the Kenai Peninsula had been hot and dry, and the fire was burning by passive crowning in stands of black spruce and beetle-killed white spruce. Although the fire was within designated wilderness, the smoke column was in plain view of the town of Soldotna, which has a year-round population of about 4,000 and twice that during busy summer weekends, when recreationists arrive from Anchorage.

The Fox Creek Fire smoke column was consistently visible from central Soldotna. Photo: Jim Hall, FWS, 2005.

Smoke from the Fox Creek Fire was also visible within the communities of Kasilof, Clam Gulch, and Ninilchik. *Suppression action was taken only to protect specific values at risk, such as the Caribou Hills Recreation Area directly west of the fire, which contained over 200 structures with no road access*.

Because of the fire's potential to grow and threaten structures in the Caribou Hills, the Kenai National Wildlife Refuge and Kenai-Kodiak Area Forestry decided to order a "short" Alaska type 2 incident

*The wildland fires described in this article were managed under the 2003 "Interagency Strategy for the Implementation of Federal Wildland Fire Management Policy." The 2009 "Guidance for Implementation of Federal Wildland Fire Management Policy" replaces that strategy and no longer uses the terms "wildland fire use," "fire use incident," or "fire use manager" to describe naturally ignited fires managed for resource benefits. Terminology from 2003 policy was retained in this article to provide an accurate description of how these specific fires were managed.

Lessons Learned From The Fox Creek and Irish Channel Fires:

1. The fire use manager for the two fires worked as a liaison between the suppression service provider (Alaska Department of Natural Resources–Division of Forestry, Kenai-Kodiak area) and the land manager (Kenai National Wildlife Refuge) to revalidate the WFIP daily. This allowed both the suppression service provider and the refuge manager to be involved in the WFIP process, alleviating understandable anxiety about an unfamiliar process.

2. The incident commander for the Fox Creek Fire, the suppression fire management officer, and the refuge manager gathered around a fire area map showing vegetation, land management boundaries, and the latest fire perimeter. They collaboratively drew a maximum manageable area, which proved to be a good choice and remained intact for the duration of the fire.

3. The type 2 team provided successful management of the fire under a wildland fire use strategy, and, when they transitioned to a type 3 organization, the team ensured that the refuge manager and the type 3 incident commander agreed on a plan of action and organization.

4. Managing the impact of smoke on nearby communities was a constant challenge. Besides being visible to local Kenai Peninsula communities, a wind shift blew smoke into Anchorage (population of about 270,000). Managers and incident commanders on the Fox Creek and Irish Channel fires documented their work and followed the guidelines in the "Smoke Effects Mitigation and Public Health Protection Proposal" (see Alaska Wildland Fire Coordinating Group 2007), which the Alaska Wildland Fire Coordinating Group prepared in response to public concerns about smoke impacts from the record-breaking 2004 fire season.

5. It was important to have wildland fire use messages prepared and ready for use by incident information officers and staff who were not familiar with management of fires for resource benefits. A temporary staff answered a bank of phones so that information could be clearly and consistently communicated to the public.

6. Aerial resources were critical to success. The two Canadair CL-215 air tankers proved invaluable during the successful burnout operations. With the fire in such close proximity to a large lake, these "scooper" planes could make quick turnarounds, providing wetline and spot fire support as the burnout progressed. Maintaining scarce aerial resources while multiple suppression fires were active throughout the State was a constant challenge.

management team to help manage the wildfire. A fire use manager was already on site. The Fox Creek Fire spread extremely quickly through one of the largest contiguous fuel beds on the Kenai Peninsula—about 125,000 acres (50,600 ha) of beetle-killed white spruce and live, highly flammable black spruce.

While the Kenai National Wildlife Refuge and Kenai-Kodiak Area Forestry were transitioning with the type 2 team, the fire progressed quickly to a stage 3 WFIP analysis level. Within a few days, the fire grew to 25,189 acres (10,194 ha) with about 150 people performing suppression, support, and monitoring. The final fire size was 26,300 acres (10,640 ha), the largest wildfire on the Kenai Peninsula since 1969.

Using Wildfire To Manage Resources in Remote Alaska

Although many NPS fire management units in Alaska comprise extensive and remote tracts of fire-dependent ecosystems, values at risk dot the landscape. For instance, there are about 325 known cultural resources in Denali National Park and Preserve, but cultural resource inventories are incomplete, and this number represents only a small fraction of the total sites. In 2005, Denali National Park and Preserve sustained five naturally ignited wildfires that were used to benefit natural resources, totaling 118,034 acres (47,767 ha). To varying degrees, each of those wildfires threatened a value at risk.

Thunderstorms ignited three wildfire sites on June 16 in the remote northwestern portion of Denali National Park and Preserve.

The NPS Western Area Fire Management officer (a fire use manager type 2) managed the fires with support from a staff of six.

Denali National Park and Preserve wildland fire use and Denali Mountain. Photo: NPS Western Area Fire Management Staff, 2005.

Over several days, the McKinley River wildland fire use fire grew to 112 acres (45 ha). While completing "Wildland Fire Relative Risk Assessment, Step 1: Determining Values" from the McKinley River wildland fire use WFIP, the fire management officer determined that the McKinley River to the west and the Kantishna River to the north were sufficient natural barriers to prevent the fire from entering the full management option area (native allotments) around Lake Chilchukabena. However, the historic town site of Roosevelt, a cultural resource with several structures that needed protection, was located roughly 10 miles northeast of the fire. The park had proposed restorative stabilization plans for the structures and did not want to lose them.

To lessen the wildland fire threat to the historic site, Western Area Fire Management staff flew by helicopter to Roosevelt, brushed out thick alders, willows, and spruce, and created defensible space around the numerous structures. Sprinklers and hoses were used to wet down the area. The McKinley River wildfire was declared out on July 12 and never advanced towards Roosevelt.

Western Area Fire Management not only managed wildfires for natural resources in Denali National Park and Preserve but also in Noatak National Preserve. Four wildland fire use fires, totaling 17,945 acres (7,262 ha), occurred in the national preserve. The largest, the Goiter Fire, totaled about 8,000 acres (3,200 ha). Because of the remote nature of the fire and the fact that no values were threatened, the fire remained at a stage 1 WFIP analysis level and was monitored through aerial surveillance by the Bureau of Land Management Alaska Fire Service every few days.

Aerial view of Roosevelt following defensible space treatment. Photo: NPS Western Area Fire Management staff, 2005.

The Noatak National Preserve, located north of the Brooks Range, is characterized by immense sweeps of tundra strewn with ponds and marshes. The northernmost reaches of spruce forest that exist in the far west region of the preserve constitute less than 1 percent of the total vegetative cover of the preserve. Major portions of Noatak National Preserve are within the northernmost lightning belt of interior Alaska, where fire plays a critical role in ecosystem sustainability.

Periodic tundra and boreal forest fires act as a mechanism to select plants and animals that are adapted to fire-caused change. Without fire, organic matter accumulates, the permafrost table rises, and ecosystem productivity declines; vegetation communities become less diverse, and their value as wildlife habitat decreases. Fire rejuvenates these subarctic and arctic systems: it removes some of the insulating matter and elicits a warming of the soil; vegetative regrowth quickly occurs, and the cycle begins again. Wildland fire is a key environmental factor on the Noatak National Preserve, an appropriate area for using wildfires as a natural ecological process.

Conclusion

Managing naturally ignited wildfires specifically for natural resource benefits allows land managers to maintain the important role of fire across the Alaskan landscape even as they protect values at risk—whether homes at the wildland-urban interface adjacent to wilderness areas, a remote residence, or a historically significant cultural site within a national park and preserve. Using wildfires as an ecological process will promote fire permeability and will help maintain the character of the landscape while accommodating values and resource use.

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Fire Effects Information System: New Engine, Remodeled Interior, Added Options

Jane Kapler Smith

Some of today's firefighters weren't even born when the Fire Effects Information System (FEIS) (Web site <http://www.fs.fed.us/database/feis>) "hit the streets" in 1986. Managers might remember using a dial-up connection in the early 1990s to access information on biology, ecology, and fire offered by FEIS.

For more than 20 years, FEIS has synthesized scientific information on fire ecology and fire effects for managers. The resulting "species reviews" describe patterns in research results, point out conflicting results and possible reasons for disagreement, identify knowledge gaps, and provide thorough documentation and a complete bibliography. Species reviews cover the available knowledge on fire-related questions such as:

- Will changes in abundance after fire be short lived or long term?
- Will increased productivity provide food essential for wildlife?
- Will increases in one species interfere with regeneration of others?
- Is rejuvenation by fire the only way to ensure long-term species presence?

> FEIS reviews also offer extensive information on biology and ecology that can help readers make inferences about responses to fire.

FEIS reviews also offer extensive biological and ecological information that can help readers make inferences about responses to fire. For example, the review of rush skeletonweed, an invasive forb, reports successful sprouting from deep rhizomes after injury, so the review infers that it may be able to recover after a fire, possibly even a severe one, by sprouting (Zouhar 2003).

The usefulness of FEIS is not limited to fire. Because reviews give thorough descriptions of species

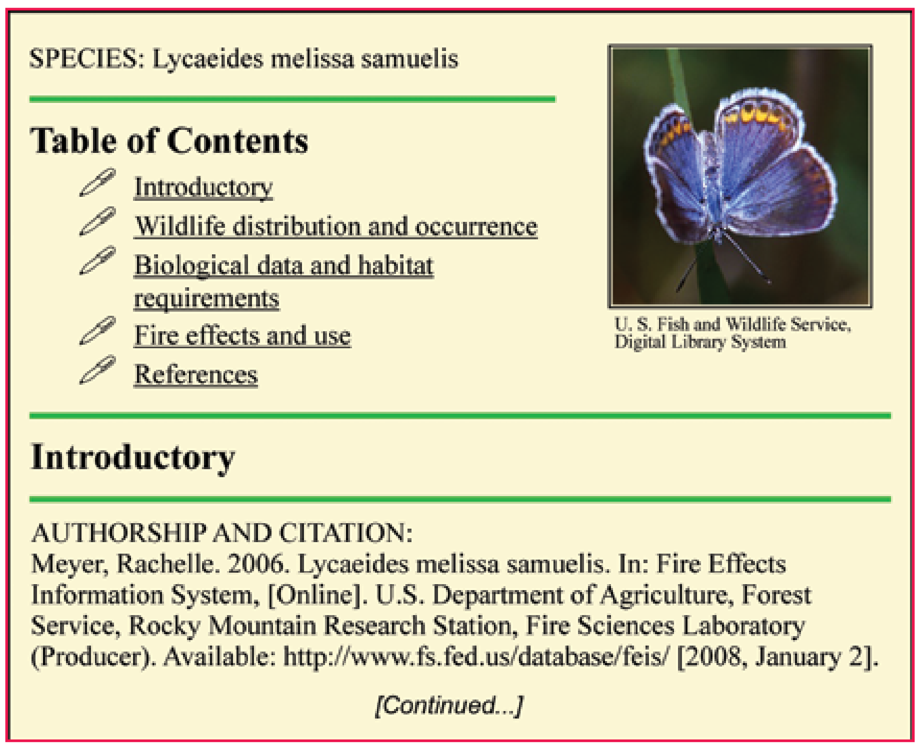
SPECIES: Lycaeides melissa samuelis

Table of Contents

- Introductory
- Wildlife distribution and occurrence
- Biological data and habitat requirements
- Fire effects and use
- References

U. S. Fish and Wildlife Service, Digital Library System

Introductory

AUTHORSHIP AND CITATION:
Meyer, Rachelle. 2006. Lycaeides melissa samuelis. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: http://www.fs.fed.us/database/feis/ [2008, January 2].

[Continued...]

Figure 1—*Opening page of species review in Fire Effects Information System showing table of contents (top) and citation (bottom). This review (Meyer 2006) contains nearly 20 pages of information and 76 citations.*

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biology and ecology, including regeneration and succession, they can be used for land use planning, restoration and rehabilitation planning, wildlife and range projects, and related environmental assessments. A person who is unfamiliar with a particular geographic region can use FEIS to get a quick orientation to the ecology of dominant species.

> Fires that are used to protect, enhance, or maintain resources are managed with the expectation that they will be of long duration.

While the fundamental purpose of FEIS is unchanged, the content and technology have advanced since its establishment. FEIS moved from the now-retired Data General* computer to the Internet in 1996. Additions, corrections, and revisions have been continuous, guided by input from a 20-member advisory committee and supported by the Forest Service Office of Fire and Aviation Management, the Joint Fire Science Program, the National Wildfire Coordinating Group, and the U.S. Department of the Interior. Other contributors include the National Forest System and individual agencies in the U.S. Department of the Interior, including the Bureau of Land Management, the National Park Service, and the U.S. Fish and Wildlife Service.

FEIS now contains reviews of more than 1,100 plant and animal species and subspecies, native and nonnative. The system is nationwide in scope, covering hundreds of species in every region of the United States. Nearly one-half of all fire-related environmental impact statements prepared by Federal wildland managers now cite FEIS. Recent changes that can help managers and fire specialists are discussed below.

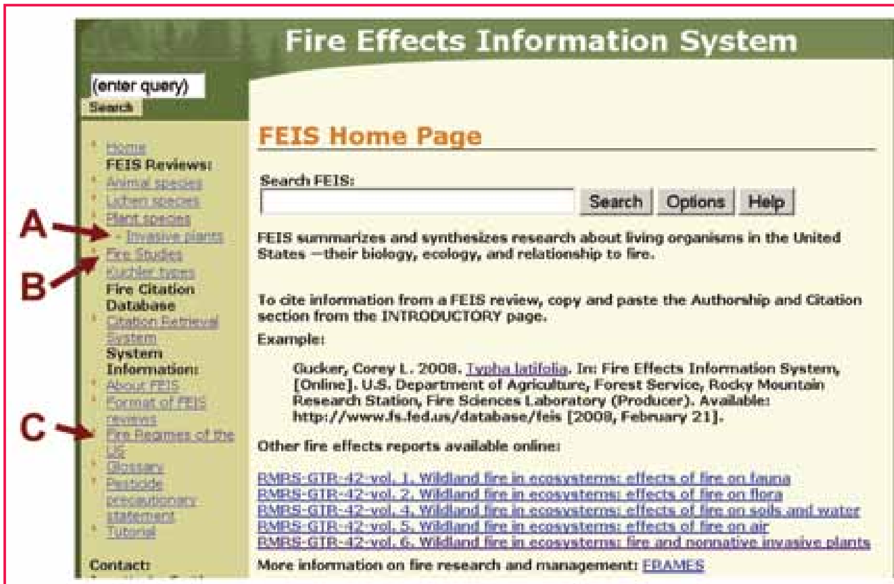

Figure 2—*Homepage of Fire Effects Information System shows (A) link to information on invasive species; (B) list of fire studies in FEIS, including research project summaries, fire case studies (located within species reviews), and downloadable research papers; and (C) link to list of fire regimes for the United States.*

FEIS Tips

If you locate a species review through the FEIS search window, your first screen shows mainly the citation and taxonomic information. You'll want the complete review, so *click on any link in the table of contents* before downloading.

Don't limit your use of FEIS to the *Fire Ecology* and *Fire Effects* sections of a review. Many facts reported in *Botanical and Ecological Characteristics* pertain directly to management issues. Examples include vegetative regeneration, response to nonfire disturbance, seedbed and establishment requirements, and successional patterns.

Go online to get the best that FEIS has to offer. Recycle those ancient printouts in your file cabinet. Since 2000, more than 100 new reviews have been added to the system, more than 150 old ones have been rewritten, and small changes have been made in at least 250 reviews. This means nearly 50 percent of the database has been improved in the past 7 years—and more improvements are coming.

If you use FEIS for environmental planning documents, cite individual species reviews rather than the entire database. Each review has its own date and author; so, when you cite reviews individually, you tell readers exactly what information you used and how current it is.

*Excerpt from Research Project Summary (Gucker 2005) describing effects of prescribed fire on graminoids in a rough fescue prairie.** *(The RPS includes a separate table describing fire effects on 19 forb and 3 shrub species.)*

Percent cover of graminoids species at the end of the second growing season after prescribed fire (Archibold and others 2003)				
Common Name	Unburned	Spring	Summer	Fall
Grasses				
thickspike wheatgrass	0.1	0	0.1	0.1
slender wheatgrass	1.3	0.5	0.1	0.3
rough fescue	11.3	13.2	7	8.8
spikeoat	0	0	0	0.1
porcupine grass	5.6	4.9	3	2.2
prairie Junegrass	0	0.2	0	0.1
green needlegrass	0.5	0.2	0.7	1.5
western wheatgrass	0	0	0.1	0.2
Kentucky bluegrass	6.8	0.2	1.3	5.4
Sedges				
needleleaf sedge	0.4	0.1	0.3	0.7
sun sedge	1.4	2.6	3.2	3.7
obtuse sedge	1	1	0	0

*Yellow identifies species that are cross-linked with FEIS reviews. Blue identifies species *not* reviewed in FEIS; a search on these species in FEIS retrieves the research project summary.

New Engine

FEIS users sometimes stalled out in the database's file structure before finding needed information on ecology and fire. Now, the system is rebuilt so that every review starts with a table of contents and links to all sections in order (fig. 1). This organization allows readers to quickly access topics of interest.

Remodeled Interior

Reviews covering 60 nonnative invasive plant species and subspecies were revised or added to FEIS between 2001 and 2006. A list of all invasives covered in FEIS (more than 100 species) is available through the homepage (fig. 2A).

The FEIS team recently completed a project that began in 2004 to update 100 FEIS species reviews and add reviews covering 100 additional species. Updates include:

- Rewritten reviews on the spotted owl, Table Mountain and pitch pines, several western oaks, and Jeffrey pine, all originally written in the late 1980s and early 1990s;
- New reviews on bear huckleberry, bog birch, and several cacti, lichens, and mosses;
- New reviews on the great gray owl, Indiana bat, eastern box turtle, red-headed woodpecker, fisher, and black-tailed prairie dog; and
- A review of the first insect species in FEIS, the Karner blue butterfly (fig. 1) and its obligatory forage species, the wild lupine.

FEIS reviews describe the fire regimes thought to have influenced the species in past centuries. When FEIS was established, reviews addressed fire regimes only for dominant species. At the request of managers, FEIS began in 2000 to report historic fire intervals for the habitat of each species reviewed. These reports were initially organized by plant community but not linked to a comprehensive national classification. Reviews completed since mid-2007 include new, more complete fire regime descriptions for a comprehensive list of vegetation types (fig. 2C). These descriptions were developed from data collected for the LANDFIRE Rapid Assessment (2007) and will be updated when the National LANDFIRE Mapping Project is complete.

Added Options

In 2006, FEIS began to provide a new kind of review, the research project summary (RPS). An RPS summarizes research on preburn vegetation, fire weather, fire behavior, and fire effects. It summarizes fire effects on *all* species covered by the study and is linked to—and from—every relevant species review in FEIS. For example, an RPS that describes fire effects on plants in a rough fescue prairie (Gucker 2005, summarizing information from Archibold and others 2003) provides information on nine species reviewed in FEIS and an additional three "non-FEIS" species (see table). An RPS describing restoration treatments in ponderosa pine-Douglas-fir forests (Metlen and others 2006) describes fire effects on 76 FEIS species and 121 non-FEIS species.

How can readers find an RPS? In several ways:

1. From within species reviews. The "fire effects" section links to every relevant RPS.
2. Through the FEIS search engine. When FEIS is searched by species name, it produces a list containing the species review (if there is one) and all relevant RPSs. The search engine also locates RPSs for species not reviewed in FEIS. For instance, Virginia strawberry is not reviewed in FEIS, but a search on this species retrieves five RPSs, each containing a little information on the species' response to fire.
3. From the FEIS list of fire studies, available through the homepage (fig. 2B). This list can be searched for a location, species, or plant community of interest. The list includes not only RPSs but also fire case studies (embedded within FEIS reviews) and downloadable research papers linked from FEIS reviews.

FEIS has served wildland fire managers for more than 20 years and continues to adapt and respond to managers' needs and requests. Please send your comments, suggestions, and corrections to <fmi@fs.fed.us>.

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