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Perspectives on Wildland Fire

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On the Cover:

Firefighters size up a blaze on the Bridger–Teton National Forest, 23 miles (37 km) south of Jackson, WY. Photo: Jed Conklin, The Spokesman Review, *Spokane, WA, 2003.*

The FIRE 21 symbol (shown below and on the cover) stands for the safe and effective use of wildland fire, now and throughout the 21st century. Its shape represents the fire triangle (oxygen, heat, and fuel). The three outer red triangles represent the basic functions of wildland fire organizations (planning, operations, and aviation management), and the three critical aspects of wildland fire management (prevention, suppression, and prescription). The black interior represents land affected by fire; the emerging green points symbolize the growth, restoration, and sustainability associated with fire-adapted ecosystems. The flame represents fire itself as an ever-present force in nature. For more information on FIRE 21 and the science, research, and innovative thinking behind it, contact Mike Apicello, National Interagency Fire Center, 208-387-5460.

Firefighter and public safety is our first priority.

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America's Wildlands: A Future in Peril

Jerry Williams

A crisis is facing our public lands from the risk of uncharacteristically severe wildfire. From the plains of the Dakotas to the Sierra Nevada, the expectations for fire protection in the Western United States have never been higher. However, when social expectations exceed firefighting realities, we have a problem. Despite firefighters' best efforts—including $1.66 billion in fire season spending in 2002, the most ever—the costs, losses, and damages associated with wildfires have never been higher. Our experiences with these kinds of wildfires force us to look at the predisposing factor: the condition of the land.

Stalled in Crisis

I believe that we are witnessing a crisis in fire-adapted ecosystems in the United States; in fact, I believe that we are "stalled in crisis." In the United States, our most damaging, most costly, and most dangerous wildfires usually occur in the short-interval-fire-adapted forests and grasslands. In the West, it's in chaparral, dry-site Douglas-fir, western larch, and long-needle pine types such as ponderosa pine. These ecosystems occupy the lower elevation, warm/dry sites where people typically live, work, and play. This is where fuels have built up following decades of excluding low-intensity fire. Reducing this threat is rightly a USDA Forest Service priority.

Engine captain directs a hoselay on the Rowland Fire near Contansia, CA. Photo: Sue McCourt, Plumas National Forest, Quincy, CA.

> The rate of fuel accumulation remains far higher than the rate of fuel reduction.

We are taking steps to address this crisis; we are using prescribed fire more now than ever before. We sharpened our focus with the National Fire Plan in 2000, and now we have new tools for streamlining the planning process, such as the Healthy Forests Restoration Act. But the rate of fuel accumulation remains far higher than the rate of fuel reduction. And our objectives for the land, as a society, are often at cross-purposes with the ecological dynamics of the land. The prospects are for ever larger, more severe wildfires.

There is nearly always disagreement, distrust, and debate in the management of public lands. But our current inability to find consensus seems to go beyond mere differences of opinion. I believe that we are stalled in crisis because we lack context.

Our management of the land rarely considers ecological processes. Instead, more often than not, our management objectives simply derive from our wants from the land. Our objectives for secure wildlife habitat, clean air, visual quality, secluded homesites, and other social values often overlook the disturbance regimes that shape the land.

Jerry Williams, the former Director of Fire and Aviation Management for the USDA Forest Service's National Office in Washington, DC, now resides in Missoula, MT.

The article is based on a speech by the author at the annual meeting of the Outdoor Writers Association of America on June 22, 2004, in Spokane, WA.

Prescribed burn in the Black Hills of South Dakota, where ponderosa pine forests were historically shaped by fire. Photo: Randall Benson, South Dakota School of Mines, Rapid City, SD, 2003.

Nowhere is this more apparent than in the fire-prone forests of the American West. We find ourselves adopting resource objectives without regard for the ecological risks involved and bargaining to sustain those objectives by relying on the strength of our fire protection forces. In the past few years, these fire protection forces have found themselves running up against their limits of effectiveness.

Two Points of View

Let me use southern California to illustrate this situation. However, let me also make clear that the losses I'll describe are not unique to California; the same trends are observable throughout the Western United States. In October 2003, within a 5-day period, southern California experienced its worst wildfires on record. The fires killed 24 people, destroyed more than 3,600 homes, and spread across more than 750,000 acres.

> Our objectives for secure wildlife habitat, clean air, secluded homesites, and other social values often overlook the disturbance regimes that shape the land.

After the fact, the fires brought intense scrutiny. To oversimplify somewhat, two opposing points of view emerged. One side found fault with the fire services and argued that the fires became so large, destructive, and costly due to poor strategies, poor tactics, and a lack of cooperation, coordination, or communication. From this point of view, the answer is more aggressive attack, larger air tankers, bigger helicopters, and more engines. The other side acknowledged that we can always improve strategies and tactics and that newer, more modern equipment is often a plus. Fundamentally, however, until we focus on the causal factors—the fuels—that predispose large areas to severe wildfires, larger investments in fire suppression capacity will realize only marginal benefits and only hold temporarily. Until we reduce flammability potential, suppression costs, resource losses, and environmental damages promise to continue climbing as the condition of fire-adapted forests continues to deteriorate.

One of some 3,400 southern California homes destroyed by wind-driven fires in October 2003. Photo: Rick Barton, Gunnison, CO, 2003.

Our strategic imperative should be directed toward the restoration, maintenance, and sustainability of fire-adapted ecosystems.

Suppression Limits

There is indeed an important place for wildfire suppression—I've been in this business my whole career. But it should be a tactical necessity where values at risk are high, not a strategic imperative where continued fire exclusion will only exacerbate wildfire potential over time. Instead, the strategic imperative should be directed toward the restoration, maintenance, and sustainability of fire-adapted ecosystems.

Let me explain why I subscribe to this latter point of view.

The 2003 fire siege in southern California was remarkable in a State that, more than any other, is highly prepared to fight fire. This is a place that burns and can burn fiercely. In answer, the fire services at local, State, and Federal levels have put in place a fire suppression force that is remarkable, in terms of capability and capacity. On an interagency basis, the combined wildfire protection budget in California exceeds $2.9 billion per year. At Federal, State, and county levels, California fields more firefighters, more engines, and more assets than any place else in the United States—and perhaps the world.

Yet even with this suppression force in place, severe wildfires develop. About once per decade, the confluence of drought, Santa Ana winds, and desiccated fuels results in wildfires that overwhelm all early control efforts, such as:

- Bel Air (1961),
- Laguna (1970),
- Panorama (1980),
- Oakland Hills/Tunnel (1991),
- Malibu/Topanga (1993), and,
- Cedar (2003).

When wildfires like these occur, we begin to see limits to our suppression capacity. The California fire services boast an extraordinarily high initial-attack suppression success rate, nearly 99 percent. However, the 1 percent of wildfires that escape control account for a disproportionately high percentage of the total costs and losses. Nationally, only 1 percent of all wildfires account for about 85 percent of the total suppression-related expenditures and nearly 95 percent of the total acres burned. The interagency fire services in California are arguably the best we have and they are nearly always successful, but when the rare wildfire escapes under adverse weather and other conditions, our suppression capabilities are overwhelmed—usually with catastrophic results. As large and as good as the fire services are in California, they are not always large enough.

We may have pushed reliance on fire suppression about as far as we can push it when we see wildfires setting size records, as they have in five States since 2002 (Arizona, California, Colorado, New Mexico, and Oregon). At these scales and intensities, the wildfire problem in the United States can no longer be viewed as a fire operations issue, per se. The wildfire problem in America today is a resource management and land use issue. Today's land use demands fail to take the

Firefighters should not have to be heroes because we cannot agree on how to better manage the land, consistent with the dynamics of fire-prone ecosystems.

dynamics of fire-adapted ecosystems into account.

Building Fire Risks

Despite the fact that our western forests are among the most volatile fire regimes on earth, we are not managing them with an eye toward wildfire risk mitigation. We're often managing them for everything but wildfire risk. In fact, we are often inadvertently building fire risks by adopting resource strategies that increase biomass, close canopies, and connect fuel layers. Ironically, our objectives for the resource imperil the very values we're trying to sustain, especially in fire-prone ecosystems. When we protect endangered species, watersheds, recreation, visual quality, and other values by keeping out fire, Nature answers by burning it all. There is not a fire department big enough anywhere that can deny her.

We are, I believe, at a critical juncture in terms of wildland fire management in the United States. Two centuries ago, Lewis and Clark described many of the physical characteristics of our western forests; today, after centuries of research and experience, we are beginning to understand the processes that shape those characteristics. However, even though our fire policies have been modified to better align with the ecologies of fire-prone forests, our land and resource policies are at odds. They tend to reflect social expectations that are rarely consistent with the way fire-prone ecosystems work.

Paradigm Shift Needed

Until we change this paradigm, wildfire protection expectations will force the fire services into an untenable and dangerous position. Firefighters should not have to be heroes because we as a society cannot agree on how to better manage the land, consistent with the ecological processes that shape and sustain it. ■

Contributors Wanted

We need your fire-related articles and photographs for *Fire Management Today*! Feature articles should be up to about 2,000 words in length. We also need short items of up to 200 words. Subjects of articles published in Fire Management Today include:

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

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

A New Look at Wildland/Urban Interface Hazard Reduction

Jeremy A. Keller

Federal land management agencies have long tried to reduce fire hazards in the wildland/urban interface (WUI) as part of their mission. Their hazard reduction projects are now oriented toward ecosystem management, giving exceptional depth to their fuels reduction programs. Still, we must beware of wearing blinders when it comes to our role in protecting communities. Reducing fire hazards in the WUI is not just a land management activity.

This article proposes a new way of looking at reducing fire hazards in the WUI in the context of ongoing efforts to protect communities from all hazards. I propose a common set of definitions for terms relating to community hazard and risk reduction and a Four-E Model for WUI mitigation interventions, based on the familiar Three-E Model of prevention interventions.

A common set of definitions is needed for terms relating to hazard and risk reduction in the wildland/urban interface.

Hazard Versus Risk

A hazard must exist before a disaster, emergency, or incident occurs. The U.S. Department of Homeland Security Federal Emergency Management Agency (FEMA) defines hazard as a source of danger and risk as a possibility of loss or injury (FEMA 2001).

A hazard is a potential threat to people, goods, or the environment (Smith 2001). The existence of a hazard is not enough to cause a disaster. For a hazard to become a disaster, it must pose a risk to something of human value. Risk is the probability that an event will occur that will threaten something of value, thus elevating a hazard into a disaster.

For those involved in wildland fire prevention, the concepts of hazard and risk are well known (NWCG 1997; Sampson and others 2000). A potential disaster is an undesired wildland fire threatening to harm something of value. The hazard is an accumulation of fuels necessary for a fire to occur. The values potentially threatened by the hazard could range from homes and human life, to a stand of commercial timber, to a sensitive watershed or critical habitat. Risk, for the wildland fire prevention community, is associated with ignition sources. Because lightning and other natural ignition sources are neither controllable nor reducible, risk reduction, in this context, refers exclusively to human ignition.

Clarifying Terms

The terms "prevention" and "mitigation" are often used interchangeably within the wildland fire community. Although related, these terms are quite different. Fire prevention refers to diminishing the number of wildfires by reducing the risk associated with human ignitions, whereas mitigation refers to hazardous fuels reduction.

This terminology is often confusing when using the Emergency Management Cycle for WUI hazard management (see the sidebar). In the Emergency Management Cycle, the mitigation phase includes more than what we traditionally think of as mitigation (hazardous fuels reduction). It also includes risk reduction activities, which are traditionally considered something else (fire prevention).

When addressing a fire hazard in the WUI, prevention and mitigation each play a role. Both risk and hazard must be addressed, because risk-reducing efforts can decrease but not eliminate the risk of a WUI fire incident. Hazard reduction activities must be carried out in tandem with risk reduction activities.

Vulnerability and Risk

Although the overall assessment process is referred to as a hazard assessment, vulnerability and risk are also assessed. A hazard assessment process can be conducted at three levels of increasing sophistication and expense (Deyle and others 1998):

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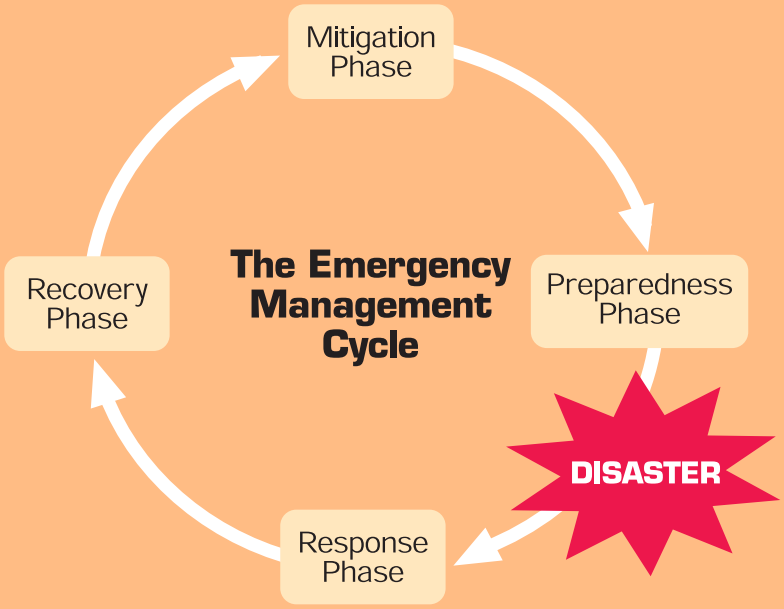
The Emergency Management Cycle



The Emergency Management Cycle (modeled above) deserves more attention in the fire management community (FEMA 2003; Godschalk 1991). The emergency management community sees the management of all types of disasters and emergencies in terms of a continuous cycle of four phases: mitigation, preparedness, response, and recovery. The model also applies to the process of managing wildfire incidents in the wildland/urban interface. Using the model in the fire community would improve our ability to collaborate with our colleagues in the Federal, State, and local emergency management agencies.

1. *Hazard identification:* Defining the magnitudes (intensities) and associated probabilities (likelihoods) of natural hazards potentially posing threats to human interests in specific geographic areas.
2. *Vulnerability assessment:* Characterizing exposed populations and property (values at risk) and the extent of injury and damage that might result from a natural hazard event of given intensity in a given area.
3. *Risk analysis:* Estimating the probability of various levels of injury and damage to ensure a complete description of the risk from the full range of possible hazard events in the area.

This hazard assessment process addresses all types of community hazards. Although an all-hazards approach should be conducted during mitigation planning, it must also be applied to each individual hazard.

Hazard identification is the level of hazard assessment most familiar to the wildland fire community (see the sidebar on page 10). At its most basic, it is simply a map of vegetative cover emphasizing potential hazardous cover types. Increased availability of geographic information system (GIS) technology has made the process relatively simple to initiate and maintain.
For local emergency planning purposes, the vulnerability assessment is the end product. The availability of funds and personnel skilled at statistical analysis are what propel hazard assessments to the vulnerability assessment level. Adding data gathered from structural fire safety assessments and defensible space surveys to the GIS product is the beginning of the vulnerability assessment for WUI hazard areas.

Ecosystem Management

The traditional Three-E Model focusing on education, engineering, and enforcement for fire prevention applies to both hazard reduction and risk reduction because the two are complementary. Both are more effective as part of a coordinated effort.

To reduce the potential for disaster from the accumulation of wildland fuels, the wildland ecosystem must be effectively managed. Although an aggressive fuels reduction campaign can produce impressive initial results, plants continue to grow and the fuels will eventually return. To cost-effectively manage fuel buildup, proven land management techniques are needed that are designed to maintain the ecosystem within an acceptable range of fuel conditions.

> When addressing a fire hazard in the WUI, prevention and mitigation must each play a role.

Therefore, a fourth "E"—"Ecosystem"—is needed for hazard reduction (table 1) interventions in the WUI. The Four-E Model for WUI hazard reduction includes the special expertise required during the

A Hazard Assessment in Progress

An example of a wildland/urban interface hazard assessment currently underway is the Southern Wildfire Risk Assessment (SWRA) project, led by the Southern Group of State Foresters and supported by State and Federal wildland fire agencies. In spite of its title, the SWRA is actually a hazard identification assessment, with elements of a vulnerability assessment. Based on satellite imagery, the SWRA project will provide a coarse description of fuel loading across 13 Southern States. Additional information is available at <http://corp.spaceimaging.com/swra>.

mitigation phase of the Emergency Management Cycle.

However, the Four-E Model is only effective if it is based on a foundation of collaboration. A mutual understanding of the roles and capabilities of those within the wildland fire, structural fire, and emergency management disciplines is mandatory. Hazard reduction will succeed by making the greatest use of the relative strengths of land management skills for wildland fire, community education and public relations for structural fire, and comprehensive mitigation planning skills for emergency management.

Collaboration Needed

Collaboration among the responsible disciplines, and by extension the agencies they represent, is the foundation for successfully navigating the mitigation phase of the Emergency Management Cycle. Collaboration within the mitigation phase will set the tone for the remaining phases of the cycle, which pertain to incident management.

Mitigation activities focusing on a single hazard must always be under the umbrella of a larger program addressing all hazards. Fire hazard reduction within the WUI should be part of a larger local or regional mitigation strategy addressing the full range of hazards facing the community. A Four-E Model can help set the stage for close collaboration among agencies responsible for wildland fire, structural fire, and emergency fire management.

Table 1—*A Four-E Model for wildland/urban interface hazard reduction interventions, with examples of each "E".*

Education	Engineering
• Firewise programs • Extension publications • Education of elected officials	• Defensible space • Fire-resistant building materials • Fireline construction and maintenance
Enforcement	**Ecosystems**
• Wildland/urban interface code[a] • Local building material codes • Local brush clearance ordinances	• Prescribed burning • Conversion of ecosystem types • Thinning, grazing, biomass harvest

a. International Fire Code Institute 2000.

To reduce the potential for disaster from the accumulation of wildland fuels, the wildland ecosystem must be effectively managed.

References

Deyle, R.E.; French, S.P.; Olshansky, R.B.; Paterson, R.G. 1998. Hazard assessment: The factual basis for planning and mitigation. In Burby, R.J., ed. Cooperating with nature: Confronting natural hazards with land-use planning for sustainable communities. Washington, DC: Joseph Henry Press: 119–166.

FEMA (Federal Emergency Management Agency). 2001. Understanding your risks: Identifying hazards and estimating losses. FEMA Pub. 386–2. Washington, DC: FEMA.

FEMA (Federal Emergency Management Agency). 2003. Principles of emergency management (course IS–230), student text. Emmitsburg, MD: FEMA Emergency Management Institute.

Godschalk, D.R. 1991. Disaster mitigation and hazard management. In Drabek, T.E.; Hoetmer, G.J., eds. Emergency management: Principles and practice for local government. Washington, DC: International City Management Association: 131–160.

IFCI (International Fire Code Institute). 2000. Urban–wildland interface code. Whittier, CA: IFCI.

NWCG (National Wildfire Coordinating Group). 1997. Wildland fire prevention planning (course P-301), instructor's guide. NWCG Wildland Fire Education Working Team. Boise, ID.

Sampson, R.N.; Atkinson, R.D.; Lewis, J.W. 2000. Indexing resource data for forest health decision-making. In Sampson, R.N.; Atkinson, R.D.; Lewis, J.W., eds. Mapping wildfire hazards and risks. Binghamton, NY: Food Products Press: 1–14.

Smith, K. 2001. Environmental hazards: Assessing risk and reducing disaster. London, UK: Routledge. ■

Ecological Restoration: Two Recent Studies

Hutch Brown

In Federal land management, ecological restoration has emerged in recent years as an alternative to the intensive management for commercial resource extraction widely practiced following World War II and the passive management—"letting Nature heal herself"—espoused by some environmental groups. Growing interest in ecological restoration is reflected in recent research, including two book-length studies.

Mimicking Nature's Fire, by Stephen F. Arno and Carl E. Fiedler (Washington, Covelo, London: Island Press, 2005), explores "restoration forestry" in the Interior West. The authors define restoration forestry as a process of recreating "a range of conditions representative of historical ecosystems" in "tree communities that were in the past shaped by distinctive patterns of fire." By treating vegetation, restoration forestry facilitates ecological restoration—restoring fire-adapted ecosystems that have been degraded, damaged, or destroyed. The book covers restoration projects in various forest types of the Interior West, including pinyon–juniper, ponderosa pine–fir, giant sequoia-mixed conifer, western larch–fir, lodgepole pine, whitebark pine, and aspen–conifer. The projects described are on both private and public lands, including wilderness areas. For each project, the authors delineate historical site conditions; symptoms and causes of ecological degradation; and project design, implementation, and outcomes. By offering the information under a single cover, they hope to inspire restoration projects elsewhere and to help land managers plan and conduct them.

Ecological Restoration of Southwestern Ponderosa Pine Forests, edited by Peter Friederici (Washington, Covelo, London: Island Press, 2003), takes an in-depth look at southwestern ponderosa pine, one of the most extensive and best known nonlethal fire regimes in the Nation. Sponsored by the Ecological Restoration Institute at Northern Arizona University in Flagstaff, AZ, the work comprises articles by an impressive array of scholars on a wide range of subjects related to the history, sociology, politics, and ecology of southwestern ponderosa pine. Topics range from the (minimal) ecological impact of American Indians, to the history of natural resource governance in relation to science and politics, to ecological processes and functions such as fuels and fire behavior, to smoke and wildland/urban interface issues, to project monitoring and adaptive management. Lists of threatened, endangered, and sensitive species supplement an extensive section on restoring and protecting biological diversity. Though useful to anyone interested in ecological restoration, the book is especially valuable for land managers in the Southwest. ■

Prescribed fire roars through a dead and dying storm-damaged forest in Quetico Provincial Park, Ontario, Canada. The burn followed a regional blowdown in July 1999 that also hit the adjacent Boundary Waters Canoe Area across the border in Minnesota. An example of restoration forestry in the stand replacement fire regime, the burn was designed to promote natural forest regeneration while reducing the fire hazard for park users. Photo: Ministry of Natural Resources, Fire Management Centre, Dryden, ON, 2000.

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Public Perspectives on The "Wildfire Problem"

Antony S. Cheng and Dennis R. Becker

Just as wildland fire managers must have a working knowledge of fire behavior, they must also understand the social dimensions of wildland fire in order to effectively engage the public. Social scientists are therefore gathering information about public attitudes toward wildland fire and wildfire mitigation. How do people see the "wildfire problem"? What social values are threatened? What role do community dynamics play? How can citizens be engaged in mitigating the threat? And what is the institutional context of wildland fire management?

Wildland fire managers must have a basic understanding of the social dimensions of wildland fire to effectively work with the public.

A Question of Perception

The way individuals perceive wildland fire influences their proposals for action. Some people see wildfire as a problem because a fire-prone forest has too many trees, whereas others see the problem as too many people living in or near the forest. Those who see too many trees as the problem will promote forest thinning, whereas those who believe that too many people and houses are the problem will focus on land use and access restrictions. Each course of action includes additional questions about the size and scope of the prescriptions or regulations to follow.

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Public attitudes toward wildland fire are also influenced by the reputation of those who propose a given course of action. The public frequently judges individuals based on their organizational affiliations, professional reputations, and social standing—factors that wildland fire managers should consider when working with citizens and communities to build a successful wildland fire management program.

Social Values at Stake

The fundamental social value threatened by wildfire is human life. After human life, several values rate about equally in surveys and interviews:

- *Sense of place.* Just as "home" is more than a physical structure with rooms, "place" is more than a piece of land. People often associate landscapes with rich, multilayered experiences, memories, symbols, and meanings. Wildland fire can transform a landscape to the point where it is not the same place, with social results that range from anger to deep emotional trauma. Even wildfire mitigation strategies can affect people's sense of place. Aggressive thinning around people's houses can undermine the very reason that many people choose to live in a particular place — a sense of seclusion from living in the woods.
- *Sense of belonging.* People are part of a complex web of social relationships, networks, and cooperative efforts that offer a sense of identity, security, and well-being. When wildfire affects a community, whether urban or rural, it can dramatically transform these social ties. Responses might be positive ("the fire brought neighbors together"), negative ("this community will never be the same"), or neutral ("people are just going on with their lives as if nothing happened").
- *Property.* People spend a lot of effort and money to have property in the woods—often in forest ecosystems prone to wildland fire. Losing property to a wildfire can be a devastating financial and emotional loss. On a community level, when property is destroyed, property taxes decline—taxes that are needed to fund schools, roads, and other public services.
- *Public environmental resources.* In ecosystems that are functioning within their historical fire regimes, the fires that can adversely affect water, wildlife, and recreation resources in the short term are necessary to sustain the same values in the longer term. It would be a mistake to interpret public support for minimizing wildland fire as

support for any and all means of risk reduction. The public might lack a clear, in-depth understanding of what mitigation efforts involve. The same people who approve the idea of doing something to reduce the fire threat might oppose the necessary scale of logging or prescribed burning.

Prioritizing these values is difficult, if not impossible. The social values threatened by wildfire are interconnected, giving value to each other. Although wildfire mitigation programs attempt to encompass several values, there are often tradeoffs. Engaging citizens and communities in active, ongoing dialogue is essential when it comes to tradeoffs, because managers and the public then know each other's position and can work towards sustainable improvements and outcomes.

The Encebado Fire approaches Taos Pueblo in New Mexico as tribal members watch. Particularly where communities are threatened by wildland fire, the social dimensions of fire management are critical. Photo: Ignacio Peralta, Carson National Forest, Taos, NM, 2003.

Understanding Communities

Wildfire mitigation is most successful at the community level because mitigation must be sustained across ownership boundaries. If wildland fire management is about addressing a wildfire before, during, and after the event, then managers must understand several things about communities:

- *Communities are dynamic.* A community is a long-running story, and a fire is just one event in that story. Understanding the story will help wildland fire managers understand how communities function, how they respond to fire events, and what mitigation measures might best succeed.
- *Communities are diverse.* It is important to understand the cultural connections people have with the land. For example, experiences with fire and land management stretch back countless generations in American Indian communities and in Hispanic communities in the Southwestern United States. Listening to community histories and then honoring and respecting longstanding ways of knowing are essential to building effective partnerships with any community.
- *Communities have different capacities for self-governance and action.* Some communities have enough skilled people, organizations, finances, and physical infrastructure to organize around, prepare for, and respond to a wildfire. Others do not. Communities vary in the type and amount of assistance needed to cope with fire. One size does not fit all.
- *Communities have various mechanisms for innovation and for adopting and diffusing solutions.* Wildfire mitigation is more successful in communities with innovative, risk-taking leaders who are willing to try something new, adapt it to their particular circumstances, and spread the message to others. Utilizing these leaders and their networks is important for wildland fire managers. For communities without them, more intensive and innovative outreach, training, and demonstration projects might be necessary.
- *Communities have unique social and political dynamics.* Communities have formal leaders—those elected to serve in public office—as well as informal leaders, such as ministers, newspaper editors, long-time residents, prominent business people, educators, and public-interest activists. Some informal lead-

Engaging citizens and communities in active, ongoing dialogue is essential to successful wildfire mitigation.

ers have more influence on a community's politics than the formal elected leaders. Moreover, rumors, perceptions, and information circulate through various networks—mass media, organizational meetings and newsletters, Internet chat groups, coffeeshop discussions, and neighbor-to-neighbor conversations. Finally, although several organizations can operate within a community, some have stronger ties and are more respected than others.

Wildland fire managers must adapt their messages and practices to the community; they should not expect the community to adapt to them. It is not the community that gets involved in wildland fire management, but rather the wildland fire manager who gets involved with the community.

Engaging Citizens

Fire management projects can falter if there is public opposition. How do wildland fire managers sustain public understanding, support, and participation? Several points are key:

- *People's attitudes do not always predict their behavior.* People favorably disposed to wildfire mitigation might not initiate mitigation activities, perhaps for lack of technical knowledge or financial means. Public education and financial assistance might help, but research shows that most people will not participate in mitigation efforts, even with sufficient funding and education.
- *People perceive wildfire risk in a broader context.* People tend to worry more about their kids getting into a car accident or contracting an illness than about wildfire. When it comes to allocating personal investments of time, energy, and money, most people have many priorities ahead of wildfire.
- *Public information campaigns benefit from interpersonal communication.* Public information campaigns through mass media, mailings, or other approaches are an important first step in raising public awareness. However, the messenger is as important as the message, if not more so. Public persuasion campaigns are only effective if people trust the source. To build trust, managers must initiate one-on-one communication and public involvement programs.
- *People learn from their peers.* Research shows that communities adopt and diffuse technological information better through a neighbor-to-neighbor or peer-to-peer training approach. Cooperative extension has successfully used this approach for years by connecting people with people like them, not with outside experts. Peer relationships are also powerful motivators—when people see others doing certain things, it builds confidence.
- *Collaborative learning helps sustain productive relationships.* In a collaborative process, managers and citizens learn from each other, working together to reach solutions that are otherwise unattainable. Collaborative learning is active and experiential, emphasizing hands-on analysis, fieldwork, and face-to-face communication to minimize misunderstanding, establish accountability, and build trust. In a collaborative process, managers are facilitators, technical advisors, and information providers rather than authority figures.

Engaging citizens and communities requires more than mere public information campaigns. To sustain wildfire mitigation efforts, managers must motivate people to take long-term actions. Raising awareness and facilitating mutual learning are necessary for sustaining motivation and action.

Institutional Issues

Many institutional issues affect how wildland fire managers engage the public. Being aware of the issues helps managers identify potential barriers and focus on progress. Institutional issues include:

- *Organizational culture.* Wildland fire management programs often have a hierarchical organizational structure composed of technical experts. Although these programs effectively address the technical side of fire management, they are not always user-friendly from the public's perspective. It is important for technically trained professionals in these programs to encourage public involvement and accountability, regardless of perceived delays.
- *Organizational capacity.* Attention to community assistance and collaborative planning in wildland fire management is a recent phenomenon. Although land management agencies such

It is not the community that gets involved in wildland fire management; it is the wildland fire manager who gets involved in the community.

as the USDA Forest Service have a long history of seeking public input, the responsibility to do so is assigned to only a few—typically, public affairs officers, district rangers, and interdisciplinary planning teams. Many technical staffs in public resource agencies lack the training and experience necessary to address public concerns.

- *Agency specialization.* Federal, State, and local agencies vary in their roles and responsibilities in wildfire mitigation. During a wildland fire, citizens eager for information are often frustrated because they do not know who to go to for updates. When a new group of specialists arrive for postfire recovery, the level of frustration and confusion can increase. Local fire officials might also experience a degree of frustration with their assigned responsibilities.
- *Interagency and intergovernmental relations.* These relationships are affected by agency culture, budgets, and legal authorities. A memorandum of understanding formalizes relationships but does not always lead to cooperation and coordinated actions. Although the National Fire Plan improved such relationships, an analysis by the National Association of Public Administration suggests that more work is needed (Fairbanks and others 2002).
- *Laws, policies, and administrative rules.* Myriad mandates and procedures can slow down implementation of wildfire mitigation strategies on Federal lands. Studies by the General Accounting Office and researchers at Northern Arizona University suggest that administrative appeals and litigation might not have as large an overall effect on fuels treatments as sometimes claimed (GAO 2003; Cortner and others 2003), but appeals and litigation have in some cases resulted in smaller projects than planned, with adverse consequences (see, for example, Keller 2004). The ongoing debates about multiple mandates contribute to the politicization of wildland fire.

Asking critical questions about the institutional dimensions of wildland fire management can challenge conventional wisdom and the historical way of doing things. The ultimate purpose of institutional analysis is to improve how institutions are able to address a problem as complex, controversial, and dynamic as wildland fire. It is important for wildland fire managers to engage in dialogue about institutional issues to ensure sustainable outcomes.

Social Dimensions Are Critical

The growing publicity surrounding wildfire mitigation has better engaged citizens and communities in planning and implementing fuels treatments. Budgets, interagency coordination, and public awareness have all increased. However, the complexity and controversy associated with wildfire mitigation still put many wildland fire managers in challenging social situations.

It is just as crucial for wildland fire managers to understand the social dimensions of wildland fire as to understand fire regimes and fire behavior. How a wildland fire manager addresses the social side of wildland fire will determine the sustainability of future wildfire mitigation programs.

References

Cortner, H.J.; Teich, G.M.R.; Vaughn, J. 2003. Analyzing USDA Forest Service appeals: Phase 1, the database. Website <http://www.eri.nau.edu/forms/files/FS-appeals-database-web.pdf>. Flagstaff, AZ: Ecological Restoration Institute.

Fairbanks, F.; Hill, E.; Kelly, P.; Laverty, L.; Mulrooney, K.F.; Philpot, C.; Wise, C. 2002. Wildfire suppression: Strategies for containing costs. A report by a panel of the National Academy of Public Administration for the U.S. Congress and the U.S. Departments of Agriculture and the Interior. Washington, DC: National Academy of Public Administration.

GAO (General Accounting Office). 2003. Information on appeals and litigation involving fuel reduction activities. GAO–04–52. Website <http://www.gao.gov/new.items/d0452.pdf>. Washington, DC: GAO.

Keller, P. 2004. What comes from doing nothing? Fire Management Today. 64(4): 9. ■

Building a Landscape-Level Prescribed Fire Program

Joseph P. Ferguson

As we enter year 4 of the National Fire Plan, treatment of hazardous fuels remains a top priority for natural resource management agencies. Although mechanical fuels treatments have made many communities safer, we will never be able to afford enough mechanical treatments to make a significant difference nationally. Prescribed fire can be a good alternative, provided we change our approach and focus on landscape-level programs rather than developing individual projects.

Regardless of geographic location or agency affiliation, the Nation's largest, most successful fire use programs have found five keys to success.

Five Keys to Success

Regardless of geographic location or agency affiliation, the Nation's largest, most successful fire use programs have found five keys to success.

Breaking the Suppression Attitude. Many topnotch fire management officers have difficulty transitioning from a suppression mentality to a prescribed fire approach. For instance, it is common to see holding forces arrayed along every control line, an excess of contingency resources, and lack of basic fire behavior knowledge.

Most fire managers evaluate fuel conditions, calculate weather, and estimate what will occur when a prescribed fire is ignited. But too often these same managers default to the suppression mode of thinking rather than relying on their skills and knowledge. The result is often a dramatic increase in execution costs and a prevalence of no-go decisions.

More than in any other program area, prescribed fire success depends on individuals with the vision, drive, and desire to conduct the program. No matter where they are located or what local challenges they face, prescribed fire champions have broken the suppression attitude. Notable examples include the late Paul Gleason of the USDA Forest Service and U.S. Department of the Interior National Park Service and the recently retired Jim Paxon of the Forest Service.

Better training programs will improve understanding of fire behavior. Additionally, developing, using, and expanding existing training programs will help instill confidence in prescribed fire planners and practitioners and produce intelligent managers to place in key roles and positions.

Seeing the Big Picture. When building a landscape-level program, key managers and specialists with big-picture perspectives should be used. Considering the whole ecosystem is critical when making decisions, measuring success, and evaluating impacts on plants and animals. Prescribed fire proposals often are not implemented because key individuals focus only on short-term impacts rather than long-term benefits. The fate of many endangered species depends on fire to maintain and improve habitat. Any burn might harm a given individual, but that is not necessarily a valid reason for no or limited action if, in the long term, the entire species suffers.

To develop a broad vision, trainers and mentors with big-picture understanding are needed. Recommendations should be based on long-term prescribed fire effects, and regulators should be apprised of the long-term benefits of prescribed fire. Although short-term effects might sometimes take precedence, the broader perspective must be evaluated.

Expanding the Burning Window. Across the country, fuel buildups often keep managers from using underburns within the historical range of low-intensity fires. Nevertheless, using such burns should be a goal when building a landscape-level program. Mother Nature rarely burns large acreages with a cool backing fire alone; after fuels are reduced, neither should a prescribed burn. A true landscape-level program will mimic the his-

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Figure 1—*Prescribed fire ignition around the base of a red-cockaded woodpecker cavity tree on the Apalachicola Ranger District, Florida National Forests. Photo: Susan Fitzgerald, Florida National Forests, Apalachicola Ranger District, Bristol, FL, 2004.*

To develop a broad vision, trainers and mentors with big-picture understanding are needed.

torical or natural variability with little effort.

Managers of fire-adapted ecosystems will likely never have enough perfect burning days to accomplish their goals. If 30 days are needed, it is likely that only 10 days will be ideal. But managers shouldn't simply discontinue burning. Instead, they should continue burning on another 10 days—5 that are a little too cool and 5 that are a little too hot. Then 10 more days of burning are needed—5 with very cool burns and 5 with very hot ones. The cumulative result is a program that comes closer to the natural range of variability than a program where the decision to burn is delayed until a perfect day arrives.

Most fire use programs have prescribed fire seasons that rarely match the natural fire seasons. Although nature's variability cannot be replicated, it is important to conduct some burns during the season when wildland fires naturally occur in order to maintain important ecosystem components and to burn sufficient numbers of acres.

Making Every Day a Burn Day. Developing an atmosphere in which all employees support the burn program and see every day as a potential burn day is important for fire use success. Other projects might be just as important, but few have the narrow window of opportunity typical of a fire use project. In units with a successful landscape-level burn program, employees come to work expecting to burn every day.

Line officers should clearly explain that prescribed fire is the top priority and should set an example by expecting to burn on every feasible day. That means wearing Nomex to the office even on marginal days and starting the preburn processes even when it's not certain that a burn will actually take place. Other project work should be planned with flexibility in mind so it won't interfere with an opportunity to proceed with a burn.

Including the Entire Workforce. Local fire organizations might burn a lot of acres, but they will never build a landscape-level fire use program without involving the entire workforce. Fire managers should recruit and maintain employees who are capable of passing the physical fitness standards. Biologists, archeologists, recreation technicians, timber markers, planners, and line officers should all be incorporated into the program. All employees working on burns must sustain current prescribed fire qualifications, and fire season assignments should be planned to keep the prescribed fire program going, even when some employees are away.

The four largest prescribed fire programs in the country are conducted on the Apalachicola National Forest, Desoto National Forest, Fort Stewart Army Base, and Eglin Air Force Base. Collectively, these four units typically burn 500,000 acres (170,000 ha) per year. Their fire management officers and line officers understand the importance of breaking the suppression attitude, seeing the big picture, expanding the burning window, making every day a burn day, and including the entire workforce. They make it happen and so can you.

Taking the Next Step

The most important thing is to get started. You can start moving your program forward in a number of ways. Ten steps in particular are worth considering:

In units with a successful landscape-level burn program, employees come to work expecting to burn every day.

1. Discuss the importance of landscape-level programs with line officers.
2. Solicit the support of employees at all organizational levels.
3. Contact the planners and contribute to your unit's forest plan, refuge management plan, comprehensive plan, or other agency guiding document.
4. Discuss the possibility of enlarging the prescribed fire program at the next leadership team meeting.
5. Contact a biologist, maybe in a social setting, to exchange views and foster better understanding.
6. Send employees to the Prescribed Fire Training Center in Tallahassee, FL, or Fire Use Training Academy in Albuquerque, NM, and ask them to share their experience with others.
7. Contact someone you met on a wildfire and arrange to exchange personnel to help each other burn.

Figure 2—*Results of a prescribed fire on the Apalachicola Ranger District, Florida National Forests, include a dense wiregrass understory. Some areas on the district are approaching the appearance that early Spanish explorers found in Florida. Photo: Susan Fitzgerald, Florida National Forests, Apalachicola Ranger District, Bristol, FL, 2004.*

8. Arrange for a prescribed fire workshop in your area.
9. Attend the prescribed fire courses at the National Advanced Fire and Resource Institute in Tucson, AZ.
10. Partner with your local State forestry officials, volunteer fire departments, or anyone who might be interested in prescribed fire.

For more information on building a prescribed fire program, contact Joe Ferguson, National Forests in Florida, 325 John Knox Rd., Suite F-100, Tallahassee, FL 32303, 850-523-8562 (voice), jferguson@fs.fed (e-mail). ■

Contrast Modeling and Predicting Fire Behavior

James K. Barnett

Contrast modeling is a tool that ordinary firefighters can use to identify the subtle clues that help predict fire behavior.

Fire behavior is so complex that it often requires the expertise of fire behavior analysts and fire weather meteorologists to fully understand. Experts know that successful fire modeling is based on determining the degrees of variation from homogeneous conditions—the more consistent the conditions, the more accurate the model. Conversely, when there is a great variation in conditions on a fire, it becomes more difficult for a model to make an accurate prediction.

Contrast modeling provides intelligence using a single analytical premise—the observation of contrast in nine key factors associated with the fire environment. The model is another tool for firefighters to use in identifying the subtle clues that help predict fire behavior. Through contrast modeling, firefighters can calculate the appropriate level of caution to use in approaching a fire.

Modeling: A Fire Suppression Tool

There are many checklists, warnings, models, and other tools for wildland fire suppression. Tools vary from the Ten Standard Fire Orders to elaborate fire modeling techniques. In experienced hands, all the tools can provide indicators that assist in analyzing and developing suppression plans. When properly used, fire suppression tools are extremely effective; when ignored, the likelihood of tragedy increases.

As a tool, a fire behavior model is similar to a charged fire hose aimed at the flames. Both the model and the hose need constant oversight and adjustment to ensure success. Fire behavior analysts use their extensive training, experience, and skill to supervise and modify fire behavior models. Both they and fire weather meteorologists measure countless factors to successfully predict when, where, and how a fire will burn.

When the factors measured on a fire are constant or homogeneous, a fire behavior model can be highly accurate. During the 1996 Buffalo Creek Fire in the municipal watershed for Denver, CO, afternoon winds blew the fire 12 miles (19 km) in one direction, but the fire's width rarely approached a mile (1.6 km). In this case, the wind was the controlling, homogeneous factor that allowed firefighters to predict the fire's likely path. This is an example of modeling in its most elementary form.

Unfortunately, fire behavior modeling and fire weather forecasting are readily available only on larger, more complex fires. Fire behavior analysts and fire weather forecasters have limited opportunities to provide information until after transition from one command structure to another, when the fire is most dangerous and unpredictable. Due to the limited availability of fire behavior analysts and the complexity of their models, incident commanders and firefighters often rely on their own elementary to intermediate training for basic predictive tools.

Primary Elements of the Fire Environment

There is an unlimited number of potential fire environments, each with an infinite number of influencing factors that could potentially produce dangerous firefighting situations. Contrast modeling helps firefighters focus on the primary elements of the fire environment and the most important factors that influence fire behavior.

The first step is to identify the three primary elements of the fire environment, together with their key subfactors. The primary elements are:

1. *Atmosphere:* interlacing air masses and contrasting weather, which are most apparent at the air mass boundaries.
2. *Fuels:* anything of tangible substance capable of burning.
3. *Landforms:* conduits for heating, funneling, and mixing air masses.

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Contrast modeling is based on observing key subfactors of the primary elements influencing fire behavior.

Two commonly measured factors that do not often directly affect fire behavior are heat and humidity. Although heat and humidity can indicate where fuels will burn more rapidly, they are relatively constant and rarely change rapidly enough to become a primary influencing element (fig. 1).

Identifying the Subfactors

The contrast model is designed to provide subtle clues that increase the firefighter's awareness of variables that could contribute to changing fire behavior. It is based on observing key subfactors of the primary elements influencing fire behavior. Key subfactors must be relatively dynamic, contributing to subtle change for a short distance or period of time; and observable without using measuring equipment. They must also show obvious contrast, with variable boundaries, colors, shapes, or sizes.

More on Heat

The sun's heat is the primary influence on the Earth's weather as it pushes and pulls air through the atmosphere. For example:

- Frontal boundaries, where warm and cool air masses collide, often cause moderate to extremely destructive winds.
- Variable heating and cooling generate onshore, offshore, upcanyon, and downcanyon winds.
- Differential heating sucks cooler air laterally into the main fire front.
- Smoke from a campfire is drawn toward the one person generating the most external body heat, which demonstrates how the atmosphere is influenced by heating bodies or air masses.

Heating and cooling occur slowly and are neither dynamic nor easily observed without instruments. The primary elements of the fire environment (atmosphere, fuels, and landforms—fig. 1) indirectly include the effect of heat on fire behavior. For example:

- *Fuels:* A uniform group of trees or vegetation can absorb or reflect heat at a relatively constant rate, which can vary greatly from the rate of heat absorption and reflection of the surrounding fuels or landforms.
- *Landforms:* An ocean, sea, or lake can absorb the sun's heat at a rate that differs measurably from surrounding landmasses.
- *Landforms (subfactor slope):* When altitude increases, temperature declines. An air mass high up a slope heats fuels and landforms differently than air masses downslope.

Each primary element has three key subfactors:

- *Atmosphere:* windspeed, wind direction, and cloud cover.
- *Fuels:* size, amount, and type.
- *Landforms:* slope, aspect, and type.

Eliminating Subfactors

The second step in contrast fire modeling is to lower the number of influencing subfactors by evaluating their potential impact on fire behavior. The process begins by observing the fuels and landforms within a 1,000-foot (300-m) radius from the burned or burning perimeter. Of course, the nine subfactors might not always be visible from a single location—some could be miles away. Maps, local knowledge, and information from aerial observers can help identify unobservable influences as well as determine distances from canyons or large bodies of water, which can generate effects from miles away.

Examples of subfactor influences are shown in tables 1 and 2. Based on the observations made, some of the subfactors might be eliminated due to their absence, uniformity, or

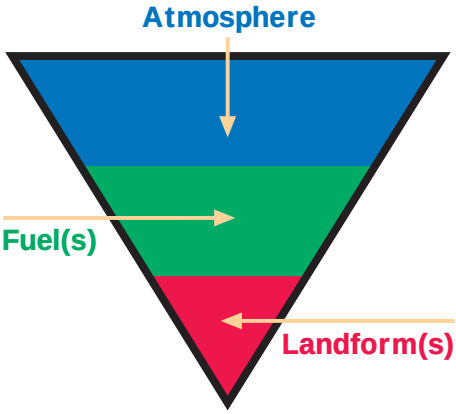

Figure 1—*Contrast model influences. The three primary elements of any fire environment provide a reference for envisioning and segregating the primary elements and subfactors.*

Table 1—*Contrasting influences observable within a 1,000-feet (300-m) radius from the burned or burning fire perimeter.*

Subfactors	Homogeneous	Contrasting
Atmosphere		
Windspeed	None or steady	Variable
Wind direction	None or steady	Variable
Cloud cover	Fog, clear, or overcast	Scattered or broken
Fuels (ground and aerial)		
Size	Uniform	Variable
Amount	Consistent	Variable
Type	Similar	Variable
Landforms		
Slope	Flat or even grade	Variable
Aspect	None or single direction	Variable
Type	No influencing type in the general vicinity	Type within reasonable distance

Table 2—*Dynamic observable contrasting influences.*

Subfactors	Potential Influences
Atmosphere	
Windspeed	Growth variability
Wind direction	Indication of multiple influencing factors and growth variability
Cloud cover	Localized instability due to heating/cooling variations
Fuels	
Size	Variable drying, flammability, and intensity rates
Amount	Variable burning speeds and intensities
Type	Variable heating/cooling, flammability, and intensity rates
Landforms	
Slope	Variable heating/cooling generating variable airflow
Aspect	Variable heating/cooling generating variable burning intensity
Type	The closer and larger a significant landform, the greater the potential for localized influences

The process begins by observing the fuels and landforms within a thousand-foot radius from the burned or burning perimeter.

consistency. After analyzing and eliminating them, the next step is to evaluate the remaining subfactors.

Rating the Unpredictability

All nine subfactors can contribute to fire movement in unexpected directions. Several factors together, combined with a fire during transition—which typically takes place when the fire is around 25 acres (10 ha) in size—can create chaos. Tables 3 and 4 can be used to calculate escalating levels of caution. Assessing the level of caution pro-

vides information about the unpredictability of a fire's behavior.

The experience and knowledge of fire behavior analysts and fire weather meteorologists cannot be replicated. However, when fire behavior analysis and fire weather modeling are unavailable, the contrast model—another firefighting tool—can help firefighters focus on subtle environmental clues and variables that can have unpredictable and disastrous consequences. ■

Table 3—*Table for calculating warning points based on key subfactors of the primary elements influencing fire behavior.*

Subfactors	Contrast? Yes / No
Windspeed	1/0
Wind direction	1/0
Cloud cover	1/0
Fuel size	1/0
Fuel amount	1/0
Fuel type	1/0
Slope	1/0
Aspect	1/0
Landform type	1/0
Total warning points	[add above scores]

Table 4—*Table for assessing level of caution based on number of warning points from observing key subfactors of the primary elements influencing fire behavior.*

Warning points	Caution level
0–1	Low—fire should burn consistently
2 (different primary element areas)	Concern—fire shows some potential for variation
2–3 (same primary element area)	Vigilance—constant subfactor observation needed
3 (two or three primary element areas)	Caution—initial indicators of complex behavior
4–5	Watch out—fire has high potential of unpredictability
6–9	Strong warning—fire is unpredictable

Websites on Fire*

Wildland Fires in Yellowstone

Just the facts! That's what you'll get when you visit Yellowstone National Park's Wildland Fire Website. The homepage is a concise summary of the current year's fire activity, with access to a database that provides several types of fire maps—access, aerial, cover and fuel type, and topographic—as well as links to press releases and photos for many fires. Fire reports archived back to 1999 are also accessible from the homepage.

The objective of the Wildland Fire Program at Yellowstone is to suppress wildfires that are human-caused or that threaten people, property, or resource values and to ensure that naturally ignited wildland fires burn as part of an ecological process. The site offers information about the park's fire ecology, fire management, and other fire-related features and activities in Yellowstone, plus many links.

Found at <http://www.nps.gov/yell/technical/fire>

* Occasionally, *Fire Management Today* briefly describes Websites brought to our attention by the wildland fire community. Readers should not construe the description of these sites as in any way exhaustive or as an official endorsement by the USDA Forest Service. To have a Website described, contact the managing editor, Hutch Brown, at USDA Forest Service, Office of the Chief, Yates Building, 4th Floor Northwest, 201 14th Street, SW, Washington, DC 20024, 202-205-0878 (tel.), 202-205-1765 (fax), hutchbrown@fs.fed.us (e-mail).

Rapid-Response Fire Behavior Research and Real-Time Monitoring

Carol J. Henson

Fire managers planning projects often evaluate the effect of fuel treatments and other land use activities on potential wildfire behavior. To make these assessments, managers typically rely on fuel and fire behavior modeling before a fire or fire research afterward. In 2002, the Adaptive Management Services Enterprise Team launched a unique research project: The team collected fire behavior data during actual wildfires.

The real-time project, funded by the Joint Fire Sciences Program and the Fire and Aviation Management Staff in the USDA Forest Service's Pacific Southwest Region, focused on providing fire managers with quantitative information. Researchers, successful in meeting many objectives, are expanding operations and seeking additional funding and support.

Getting Started

From 1999 to 2004, JoAnn Fites-Kaufman, team leader and the project's principal investigator, worked extensively with incident management teams on wildfires. Fites-Kaufman became familiar with fire operations and developed operational research procedures.

In 2002, with the support of the Forest Service's Missoula Fire Lab and Missoula Technology and Development Center, Fites-Kaufman and Tiffany Norman, the team's technology specialist, developed equipment to use in studies on safety zones and crown fires. The Development Center made special fire-resistant boxes for video cameras and a heat trigger device to safely videotape fire behavior during a wildland fire. The equipment was tested in California on a prescribed fire in Yosemite National Park in 2002 and on prescribed burns on the Tahoe and Plumas National Forests in 2003 (fig. 1).

Figure 1—*Testing a buried heat flux sensor during project development on a prescribed burn in California. Photo: Adaptive Management Services Enterprise Team, USDA Forest Service Tahoe National Forest, Nevada City, CA, 2002.*

In May 2003, the Rapid Response and Research Team (RRT) was formed. The team was trained in operational and scientific procedures, including fireline safety. Team members included Fites-Kaufman, firefighters, a fire behavior analyst, and field technicians with firefighting experience. Objectives for the 2003 fire season were to:

- Prototype fire behavior research on wildfires;
- Design equipment and test sensor operation and layout on selected sites;
- Establish operational procedures and methods for collecting data;
- Work successfully with incident management teams on active fires;
- Observe and measure fire behavior in fuel treatment areas; and
- Measure prefire fuel conditions to identify the metrics applicable to wildland fire behavior and to refine fuels inventories, maps, and monitoring data.

A research team collected data during actual wildfires, a unique study on fire behavior.

Evaluating a Fire Season

The RRT evaluated nine wildfires on six national forests during the summer of 2003 (table 1). Equip-ment was installed and fuel plots were determined to capture fire behavior as it passed through the research sites (fig. 2). The layout design was based on successful research by Professor Phil Omi of Colorado State University, Fort Collins, CO, in reconstructing changes in fire behavior after fires (Pollet and Omi 2002). Detailed fuel plots were taken using the Brown's Planar Intersect method and measurements of crown fuels with laser devices.

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Table 1—*Summary of the 2003 Rapid Response and Research Team's investigations of wildfire behavior.*

Fire	Location	Targeted sample site	Results
Salt	Eldorado National Forest, CA	Thinned, burned fuelbreak	Fire did not reach research site
Hidden Lake	Bearverhead–Deerlodge National Forest, MT	None suitable	Fire deemed unsuitable for project
Black Frog Complex	Bearverhead–Deerlodge National Forest, MT	Selective harvest	Rain made fire unlikely to reach site
Wedge	Flathead National Forest and Glacier National Park, MT	Fuelbreak around community and harvest area on private property	Fuelbreak research site had already burned; second site on private land was not suitable
Robert	Flathead National Forest and Glacier National Park, MT	2000 Moose Fire	Sensors pulled from first site after 1 week due to rain; data collected at second site as part of burnout operation below Apgar Lookout (sensor placement test)
Crazy Horse	Lolo National Forest, MT	Shelterwood and clearcut on Plum Creek Timber Company lands	Sensors pulled after more than 1 week; fire did not reach research sites due to rain
Black Mountain 2	Lolo National Forest, MT	Contrasting open and closed forests	Sensors moved from first site after suppression forces contained fire; second site experienced extreme fire behavior with an active crown fire
Codfish Complex	Tahoe National Forest, CA	Selective harvest	Sensors pulled after 1 week; suppression forces contained fire
Old	San Bernardino National Forest, CA	Wildland/urban interface	Sensors pulled after several days; it rained, and the fire did not reach the research sites

The team found sites that had experienced fuel treatments, timber harvest, and old fires and were suitable for the project objectives. After daily assessments of expected fire behavior, changes in weather, and fire suppression operations, the team installed sensors at the sites thought most susceptible to fire. In all instances, when equipment was placed in treated areas, fire suppression operations or weather changes prevented the fire from reaching the research sites.

On the Robert Fire on the Flathead National Forest and Glacier National Park in Montana, sensors were removed from a site in the Deep Creek drainage after it rained. The team had reached the end of a 14-day tour, and it appeared that the fire was contained on that edge. But 2 days after the sensors were removed, weather conditions changed, and the fire raged through the abandoned research site. Based on this experience, the team decided that better weather information and logistics that allowed for longer assignments and equipment data collection were needed.

Reaching a Goal

After limited success gathering fire behavior data on four of the five

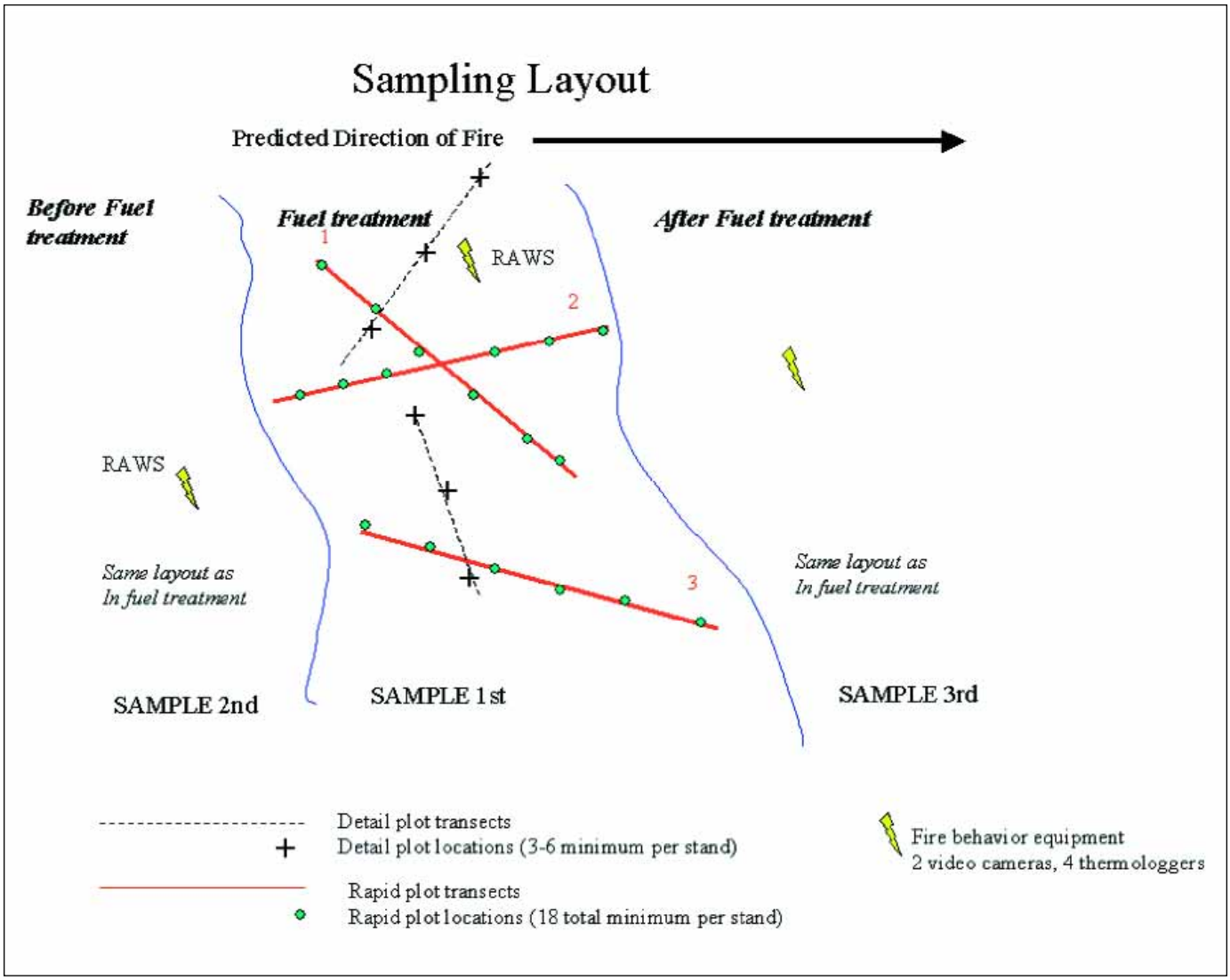

Figure 2—*Schematic showing sample layout of fire behavior equipment and fuels plots used for rapid-response, real-time monitoring and fire behavior research.*

Team members gathered data by measuring fuel conditions and fire behavior as fire passed through landscapes with different treatment histories and fuel configurations.

fires in Montana (table 1), the RRT adjusted its strategy. The Black Mountain 2 Fire on the Lolo National Forest was started by lightning in August 2003. Vegetation in the fire area was subalpine fir and lodgepole pine, with some lodgepole pine having a grass understory. Ten days after the fire started, the RRT arrived at the blaze, and the incident commander allowed it to install the necessary equipment.

RRT leaders met with the district fire management officer (DFMO) for the Missoula Ranger District. The Lolo National Forest had accomplished extensive fuel treatments along the wildland/urban interface where the fire had made major runs toward northwestern Missoula. The DFMO provided the team with information about the fire's spread and with maps showing the fuel treatments and other land use activities conducted.

Choosing an area with burn potential based on forecasted weather and limited suppression resources, the RRT went to Blue Mountain Road. After advising the division supervisor that they would be working in the area, the team conducted a safety session and briefing on expected weather and potential fire behavior. Lookouts were posted

Figure 3—*A site resembling a shaded fuelbreak was chosen for collecting fire behavior data during the 2003 Black Mountain 2 Fire on the Lolo National Forest in Montana. Photo: Adaptive Management Services Enterprise Team, Lolo National Forest, MT, 2003.*

for safety as the team began installing equipment and measuring fuels. Suppression forces succeeded in holding the fire above a road away from the research site.

That evening, RRT leaders decided to move the equipment to a new area to capture active fire behavior. Before the next morning's briefing, team leaders met with the type 1 team branch director, who recommended a location susceptible to active fire. After assessing the weather and fire behavior forecast for that day, team leaders decided that, although there were no fuel treatment sites in the area, they would attempt to capture data on sites with contrasting vegetation conditions.

The RRT moved to a new site to determine whether it could put direct handline along the fire's edge. The team leaders selected a site below a midslope road. Part of the area resembled a shaded fuelbreak (fig. 3), and another part was similar to an untreated area.

The fire was very active below the selected research site—lookouts were posted for the RRT's safety. Helicopters dropping water were being used to hold the fire in support of the hotshot crews. The RRT quickly installed the equipment, measured the fuels, and left the area. Later that morning, two hotshot crews in the area disengaged from their assignment due to unsafe conditions.

The next day, the RRT found that the area around the equipment had burned with a high intensity (fig. 4). Although the equipment was slightly damaged, the team successfully collected video and other data, including heat flux, rate of spread, and flame length. The results of this unique study on fire behavior are expected soon.

Figure 4—*Research site on the 2003 Black Mountain 2 Fire after fire burned through the area. The camera was damaged due to the fire's severity. Photo: Adaptive Management Services Enterprise Team, Lolo National Forest, MT, 2003.*

> Communication with key players who shared valuable information helped ensure project success.

Future Plans

Having met many initial objectives, the RRT is expanding its operation and seeking additional funding and collaborators to:

- Raise the number of teams;
- Increase the number of sensors and modify the equipment to withstand higher temperatures;
- Continue to focus on areas with fuel treatments or other land use activities;
- Provide data for a safety zone study; and
- Install sensors and equipment in wildland/urban interface areas.

For additional information, contact JoAnn Fites-Kaufman at 530-478-6151 (voice) or jfites@fs.fed.us (email).

Reference

Pollet, J.; Omi, P.N. 2002. Effect of thinning and prescribed burning on wildfire fire severity in ponderosa pine forests. International Journal of Wildland Fire. 11(1): 1–10. ■

The ABCs of Correctly Mapping a Fire

Ed Delaney

Wildland firefighters know the importance of accurately pinpointing a fire location. Retardant drops must hit the correct target. Climate and terrain can dramatically affect a fire management plan. Now a new budget system, Fire Program Analysis (FPA), has boosted the significance of fire location data beyond successful firefighting (see the sidebar on page 28). Under the new plan, fire report accuracy, and especially the fire locations on those reports, will influence where the system indicates that equipment and positions are needed.

Everyone involved in the record-keeping chain—from initial alarm to dispatch, from data entry to budget analysis—needs to know the subtleties of coordinate systems to obtain the correct data and to keep the FPA budgeting system working smoothly. This article is designed to help.

Dealing With Datums

The two prominent location referencing systems used for fire locations on fire reports are latitude/longitude (lat/long) and Universal Transverse Mercator (UTM). Lat/long comes in a number of variants, and UTM is a system that is based on narrow, north/south strips of the earth, with a separate grid for each strip.

Because both lat/long and UTM have their axis at an abstract location in space, both are relative to the shape of the Earth, which is represented in a datum. The word datum is the singular of data, and in mapping it represents the point or line of reference that is used as a starting location for measurement. As our understanding of the shape of the Earth has changed, the frame of reference (i.e., datum) for mapping has changed, and the "starting point" from which we measure has changed as well.

The concept of a map datum is easy to understand if you think about the average of tides on an ocean beach. Over a long period of time—perhaps 20 years—an accurate average of low or high tides can be developed. If average low tide is an indicator of where ocean ends and land begins, it gives a horizontal frame of reference. It is actually used on hydrographic charts. The datum provides a frame of reference for where to put the "0,0" coordinate in grid space.

In the United States, wildland firefighters are most likely to encounter three horizontal reference map datums:

- The North American Datum of 1927 (NAD27);
- The North American Datum of 1983 (NAD83); and
- The World Geodetic System of 1984 (WGS84).

NAD27 was the most widely used datum in the 20th century. It had its reference point in northern Kansas and was based on actual U.S. surveys. For mapping in the era before global positioning systems (GPSs) and geographic information systems (GISs), NAD27 provided sufficient accuracy and minimal confusion because it was the standard on USDI U.S. Geological Survey (USGS) topographic maps.

As satellite and electronic survey equipment increased the accuracy of surveys, the USDI National Geodetic Survey introduced NAD83 to serve as the new standard for mapping in the United States. The lower left corner of USGS 1:24,000-scale topographic quadrangle maps produced after the mid-1980s often offers a set of coordinate ticks that show the difference between NAD27 and NAD83 positions.

Unfortunately, the difference in locations from one datum to another is not constant. In the lower 48 States, this shift is usually within the range of 10 to 100 meters (11 to 109 yards). In Alaska, the difference can be as much as 200 meters (219 yards) and in Hawaii up to 400 meters (437 yards).

With a shift from NAD27, based on optical surveys, to NAD83, based on a mathematical model of the Earth's shape, the coordinates recorded for a specific point on the landscape can take on multiple meanings. A difference of 100 meters (109 yards), about the length of a football field, might seem insignificant but can easily move the location of a fire from Federal lands to private, or from land into water.

Many datum settings are available on GPS units, each with its own

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New Importance of Fire Location

We know where fires are when they occur, yet fire occurrence databases have later misplaced many fires for various reasons, including errors in writing the reports, errors in data entry, and confusion of latitude with longitude. A report in 2002 by the Desert Research Institute found that about 10 percent of the USDA Forest Service fire records were unusable for reasons that included incorrect location and that nearly 30 percent of agency records in the U.S. Department of the Interior were similarly unusable (Brown and others 2002).

Where's the Fire?

Often, locations are strangely misplaced. For instance, when maps were made from fire occurrence databases, numerous fires were reported in the South Atlantic Ocean off the west coast of Africa. A point on the equator near the Galapagos Islands appears to be a tinderbox, and Greenland and the Black Sea have erupted in flames, according to fire occurrence databases.

Fires show up all over the map partly because of recordkeeping systems. If a person leaves a numeric field blank, the systems automatically enter zero coordinates. If a system is using latitude/longitude coordinates, zero longitude falls on the Greenwich Meridian, running through England. Zero latitude falls on the equator. In combination, the coordinates put the location off of the west coast of Africa (zero latitude, zero longitude). If zero/zero Universal Transverse Mercator coordinates are picked up for a fire on the Upper Peninsula of Michigan, the recorded coordinates fall in the Pacific Ocean near the Galapagos Islands (UTM zone 16, zero Easting and zero Northing).

Jobs Depend on It

Avoiding these errors is crucial under Fire Program Analysis (FPA), the new Federal fire budgeting system slated to take effect in fiscal year 2005. Under FPA, the accuracy of fire records will affect Federal allocation of equipment and jobs. Instead of agencies allocating funds according to their traditional practices, the interagency system will use the location of historical fires in the fire occurrence databases to model hypothetical fires.

In the past, the location data on fire reports (such as those completed using the U.S. Department of the Interior's DI–1202 form) were not formally used in decisionmaking in some agencies. When errors were found, they sometimes were corrected at the local level, though not at the national level.

With the new program, the recorded location of historical fires will be part of the system that determines where funding will go in the future. Under FPA, location will also be used to tie together fuel characteristics, topography, and a weather station for fire weather data. Incorrect location information can sabotage these critical associations and influence the allocation of fire management resources. For more information on FPA and its development progress, check the FPA website <http://fpa.nifc.gov>.

Incorrectly mapped fire locations could distort the allocation of money and jobs.

specific point in space for "0,0". The standard datum for the GPS system is WGS84. The primary difference between NAD83 and WGS84 is that experts now know that the center of the Earth's mass is about 2.2 yards (2 m) away from where it was thought to be when NAD83 was developed. WGS84 has changed to accommodate this new knowledge, but NAD83 has not. For all but the most sensitive survey equipment, including a "recreational-grade" GPS unit, NAD83 and WGS84 are functional equivalents.

GPS users should know their units' datum settings. If a GPS unit is set to a datum intended for use in Nepal or New Zealand, but the user is trying to map the perimeter of a fire in California, it might be hard for the fire GIS specialist on the incident to figure out what's wrong. The best practice is to standardize equipment with the GIS specialist. When an incident team is involved and there is no GIS or GPS specialist, the plans section should confirm the datum being used. Either way, complete records should be kept and transferred with the data, including user's name; position; date and time; type of GPS unit; mode of travel (foot, vehicle, helicopter, etc.); and the datum setting

in the GPS unit. It's a good practice to take a GPS point at a known location, like a benchmark, just to provide a good reference point for the GIS specialist.

Books that cover coordinate systems, map datums, and mapping in general include Muehrcke and Muehrcke (1992) and Campbell (2000).

Map Coordinate Systems

Only in the last 120 years has there been international agreement on where the zero line of longitude (the prime meridian) is. Prior to 1884, the zero meridian in the United States went through Washington, DC. The UTM zone system is based on latitude and longitude, so that locations can be identified based on distance from a reference point.

Latitude/Longitude. Lat/long is a spherical coordinate system, so the length of a degree of latitude is fairly constant from the Equator to the Earth's poles, but the length of a degree of longitude changes with latitude. At the Equator, a degree of latitude and a degree of longitude are both just under 70 miles (113 km). At the poles, a degree of latitude is still nearly 70 miles (113 km), but a degree of longitude converges to zero length at the North and South Poles. Although lat/long is a coordinate system, it is not a rectangular grid with even spacing in the X and Y dimensions.

Lat/long can be noted in several formats. The most common is degrees, minutes, and seconds (DMS). The location of the Space Needle in Seattle in DMS is 47° 37' 21" North latitude, 122° 20' 57" West longitude (NAD83). This is 47 degrees, 37 minutes, and 21 seconds north of the Equator and 122 degrees, 20 minutes, and 57 seconds west of the Greenwich Meridian, using NAD83. If the datum is shifted to NAD27, the same coordinates for the Space Needle move the location about 690 feet (210 m) to the southeast.

The two prominent location referencing systems used for fire locations on fire reports are latitude / longitude and Universal Transverse Mercator.

The lat/long notation used in GIS is decimal degrees (DD). For each coordinate, you take the whole degrees (e.g., 47°) and add minutes divided by 60, plus seconds divided by 3,600. For the Space Needle, latitude would be: 47 + (37/60) + (21/3,600), or 47.62249. Longitude would be 122 + (20/60) + (57/3,600), or 122.3349. This is a Cartesian coordinate system, with the Equator serving as the zero axis for latitude, and the Greenwich Meridian serving as the zero axis for longitude. For a location in North America, the latitude coordinate is positive whereas the longitude is negative, because the location is in the upper left quadrant of Cartesian space. Thus, the Space Needle in DD would be 47.6225, –122.3349. When working with decimal degrees, firefighters should provide a minimum of four significant digits to the right of the decimal place.

The Cartesian "X" coordinate in lat/long is longitude and the "Y" is latitude. The highest value latitude can have is 90° (North or South Pole), whereas the highest value longitude can register is 180° (middle of the Pacific Ocean). Reversing coordinates is a common error on fire report forms, especially east of the 90th Meridian. To avoid such errors, I prefer thinking "long/lat" instead of the more common "lat/long." It helps me remember X, Y coordinates, consistent with the UTM "Easting, then Northing."

Universal Transverse Mercator. UTM is a worldwide system that uses meters as its unit of measure. When two nearby locations are identified by UTM coordinates, computing the distance in meters between them is simple.

When using the UTM system, east is recorded first ("Easting"), then north ("Northing"). The coordinate pair is the distance in meters east from a zero point, or coordinate axis, and the distance in meters north from the Equator in the Northern Hemisphere. There are 60 zones, so the zone being measured in must be recorded. In North America, it is safe to assume that the coordinates are referring to the northern half of the UTM zone.

Coordinates for the Easting (Cartesian X-coordinate) have six digits to the left of the decimal place. A coordinate without any digits to the right of the decimal place has the accuracy of one meter, or about one yard. A Northing (Cartesian Y-coordinate) for locations in the United States, measured north from the Equator, will have seven digits to the left of the decimal place. USGS topographic quadrangles (1:24,000- or 1:25,000-scale maps) will have one full UTM coordinate along each axis, with six digits for the Easting along the top and bottom margins, and seven digits for the Northing

Everyone involved in the recordkeeping chain must know the subtleties of map coordinate systems.

along the left and right margins. Other UTM gridlines are shown with the trailing three zeros deleted. Thus, the Space Needle is located at about 548,900 E, 5,274,100 N, Zone 10 North (fig. 1).

In the UTM system, there are 60 zones that create north/south strips from about 80° North latitude to about 80° South latitude, bisected by the Equator. Each zone is 6° of longitude wide, and the zones are numbered from 1 to 60, starting in the Pacific Ocean (the west edge of the first zone is at 180° Longitude) and counting up toward the east. Thus, zone 1 is in the Pacific Ocean, Seattle is in Zone 10, New York is in zone 18, and Greenwich, UK is in zone 30.

Each zone, split at the Equator, has a northern portion and a southern portion. Each zone is also bisected by a meridian, or line of longitude. Zone 1, starting the system at about 180°, straddles the 177° West Longitude meridian. Zone 10 straddles 123° of West Longitude. For the northern portion of each zone, there is a coordinate axis (known as a "false origin") that is placed on the equator and to the west of the actual west boundary of the zone. This is so any measurement within the zone will be a positive number (east is measured only on the X-axis and north on the Y-axis).

The actual location of the "0,0" point for each zone is 500,000 meters west of the central, or bisecting, meridian for the zone, on the Equator. For those who still play "Trivial Pursuit," the X, Y origin for the southern portion of each zone is a little different. The X-axis zero point is still 500,000 meters west of the central meridian for the zone. The Y-axis zero point is 1 million meters south of the Equator. In polar regions, there is a different system. Therefore, even in the Southern Hemisphere, all UTM coordinates are still positive numbers, measuring Easting first, Northing second, and then specifying zone and hemisphere (southern).

Because the system ultimately is based in lat/long, a spherical coordinate system, coordinates must be measured in the correct order (Easting first, then Northing). The length of a degree of longitude gets shorter when moving from the Equator toward either of the poles. If north from the equator were measured first, and then east from a point 500,000 meters west of the central meridian in the zone, coordinates would be consistently to the west of where they should be on a map.

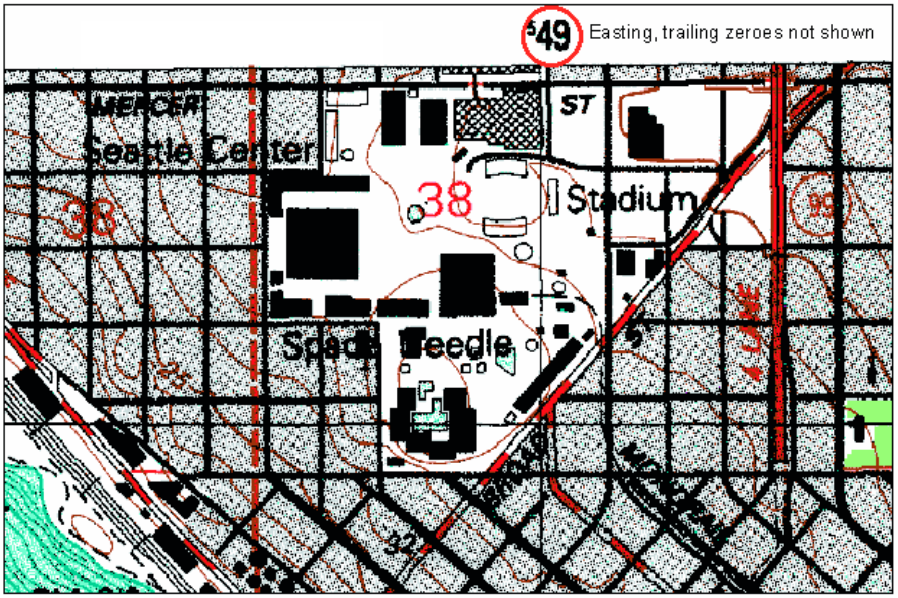

Figure 1—*Map location of Seattle's Space Needle using the Universal Transverse Mercator. The X coordinate (longitude) closest to the Space Needle is 549. The superscript indicates that the trailing zeros are not shown. The number of the gridline, 549,000, is larger than the coordinate for the Space Needle longitude because measurement is from west to east. The Y coordinate (latitude), without trailing zeros, is 5274 for 5,274,000 meters north.*

Accuracy Is Critical!

Maps seem pretty simple, but the coordinate systems can be confusing. Although map reading is now a standard part of wildland firefighter training, using map coordinates and map datums can still be a challenge. It is critical in the field to identify the correct location on the map to call in resources, to find the most efficient access, and to identify safety zones.

Now, a new budgetary system makes correct fire location data even more critical. Inaccurate reports might mean money is sent to the wrong places. It is imperative that firefighters continually review map coordinate essentials and improve their skills.

References

Campbell, J. 2000. Map use and analysis. New York: McGraw Hill.

Muehrcke, P.C.; Muehrcke, J.O. 1992. Map use. Madison, WI: J.P. Publications. ■

Indian Fire Use: Deflating The Legend

Stephen W. Barrett, Thomas W. Swetnam, William L. Baker

For many years, the importance of fire use by American Indians in altering North American ecosystems was underappreciated or ignored. Now, there seems to be an opposite trend, as exemplified in the pages of *Fire Management Today* (Summer 2004, volume 64[3]).* It is common now to read or hear statements to the effect that American Indians fired landscapes everywhere and all the time, so there is no such thing as a "natural" ecosystem. A myth of human manipulation everywhere in pre-Columbus America is replacing the equally erroneous myth of a totally pristine wilderness.

We believe that it is time to deflate the rapidly spreading myth that American Indians altered all landscapes by means of fire. In short, we believe that the case for landscape-level fire use by American Indians has been dramatically overstated and overextrapolated.

Scant Historical Record

Early-day accounts by Euro-Americans provide a weak basis for interpreting precontact Indian cultures. As Williams (2004) points out in *Fire Management Today*, "European explorers and settlers rarely saw or understood the cause-

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The case for landscape-level fire use by American Indians in all parts of North America has been dramatically overstated.

Lightning activity over the town of Thompson, Manitoba, Canada, where extreme weather conditions sparked a number of wildfires in 2003. In presettlement times, did lightning fires maintain most fire regimes in the West—or was it fires set by American Indians? Photo: Ministry of Natural Resources, Fire Management Centre, Dryden, ON 2003.

* The Summer 2004 issue of *Fire Management Today* (volume 64[3]) contains several articles on fire use by American Indians: Karl Brauneis, "Fire Use During the Great Sioux War," pp. 4–9; Gerald W. Williams, "American Indian Fire Use in the Arid West," pp. 10–14; Jon E. Keeley, "American Indian Influence on Fire Regimes in California's Coastal Ranges," pp. 15–16; and Hutch Brown, "Reports of American Indian Fire Use in the East," pp. 17–22.

The vast majority of written and oral accounts on Indian fire use are anecdotes fraught with uncertainty, subjective opinion, and bias.

and-effect relationships between traditional Indian land use practices and the landscapes they found." Clearly, their anecdotal vignettes were often heavily biased (Baker 2002). They do not bear out Williams' (2004) sweeping assertions that:

- "ecological impacts were extensive,"
- "Indians carefully chose where and when to burn,"
- "most of the acres burned were [likely] due to Indian-set fires," and
- "[i]t seems highly unlikely that the extensive fire effects observed in the presettlement West, especially at lower elevations, can be attributed to lightning."

Such general assertions are based on a scant historical record. Williams (2004) repeats Pyne's (1982) overgeneralization that "the modification of the American continent by fire at the hands of [American Indians] was the result of repeated, controlled surface burns on a cycle of one to three years." The certitude and vast geographic sweep of this statement ("the American continent") is unjustified. The vast majority of written and oral accounts by Euro-Americans are not dispassionate observations of the presettlement West, but rather anecdotes fraught with uncertainty, subjective opinion, and bias (Baker 2002). For instance, many early travelers evidently did not recognize lightning as a major cause of fires in the West, and many Euro-Americans might have therefore erroneously attributed fires to Indians, or perhaps they did so out of racism (Bahre 1994; Kaye and Swetnam 1999).

Most oral history and biological evidence of Indian fire use has been irretrievably lost with the passage of time (Baker 2002; Barrett and Arno 1999; Kaye and Swetnam 1999). What little remains seems woefully inadequate for deriving the overly broad conclusions presented by Williams (2002, 2004) and Pyne (1982).

Physical Record

We prefer to address the issue from scientific and ecological perspectives. To date, we have conducted the only studies that provide statistically based empirical data from tree rings to supplement information from oral and written accounts (Barrett and Arno 1982; Kaye and Swetnam 1999). The evidence certainly suggests that both purposeful and unintentional burning by American Indians occurred in particular places and times, but not on scales as extensive or as continuous as some would suggest.

Burning occurred in some locales, apparently with some predictability, such as in well-traveled valleys of the Northern Rockies (Barrett and Arno 1982, 1999). However, Indian fires might have been less frequent in other areas, even those dominated by ponderosa pine forests.

In the dry ponderosa forests of the Southwest, for example, purposeful burning seems to have been highly localized and unpredictable (Kaye and Swetnam 1999; Swetnam and Baisan 1996; Swetnam and others 2001). Moreover, purposeful burning was probably rare to absent in wet or cold forest types, where climate seems to be the limiting factor for fire regimes (Agee 1993; Baker 2003; Barrett and others 1991; Buechling and Baker 2004; Johnson and Larsen 1991).

Lightning fires, including onsite ignitions and lightning fires spreading from other areas, were well capable of maintaining most fire regimes in the West.

Role of Lightning

Lightning fires, including onsite ignitions and fires spreading from other areas, were well capable of maintaining most fire regimes in the West.* In remote locations in the Southwest and adjacent areas in Mexico, for example, fire history studies have found no perceptible decline in fire frequency after the removal of American Indians in the late 1800s (Swetnam and others 2001). In those landscapes, lightning fires continued to burn well into the 20th century, particularly in areas without intensive livestock grazing and organized fire suppression.

Even where onsite ignitions were rare, free-ranging (and potentially long-burning) lightning fires presumably contributed to many site fire histories. Because modern society has little experience with unhindered fires, some writers seem to incorrectly assume that

* Although Barrett and Arno (1982) might have inadvertently contributed to the "inadequate lightning" myth, those authors were referring only to lightning potential in the context of wilderness restoration.

site fire history depended on local ignition sources.

Contrary Evidence

If Indian fire use was indeed ubiquitous, how does one explain the broad mix of presettlement fire regimes (Arno 1980; Agee 1993; Barrett and Arno 1999; Swetnam and Baisan 1996)? In the Inland Northwest, for example, up to 10 different regimes have been identified (Barrett 2004; Morgan and others 1998). Clearly, presettlement fires ranged from low-severity underburns to high-severity crown fires, and site fire frequencies ranged from less than 10 years to greater than 500 years.

In our view, writers such as Williams (2002, 2004) and Pyne (1982) often create the misimpression that Indians burned every last acre of the West. Consider, for instance, the suggestive title of Williams' (2002) article, "Aboriginal Use of Fire: Are There Any 'Natural' Plant Communities?" Yet most early-day accounts suggest that Indian fire use occurred largely in grasslands and adjacent dry forests. For perspective, consider that dry forest types comprise only about 25 percent of the forested terrain in the Northern Rockies (Barrett 2004). The remainder supported widely varying forest structure, composition, and fire regimes, with scant evidence of Indian-set fires.

Speculative Venture

Empirical evidence might allow us to infer which ecosystems and which geographic locales might have been most affected by Indian-set fires. However, the ecological evidence suggests that such fires were probably rare or absent in many areas.

Describing the Indian role in presettlement fire regimes will remain a highly speculative venture for ecologists and historians alike.

Fire practices also likely differed among tribes. Factors influencing fire use probably included environmental variables (such as vegetation types and climate change), evolving lifeways (for example, before and after the acquisition of horses), shifting tribal territories, and demographic changes (such as depopulation by disease).

Regrettably, most accounts of Indian fire use are vignettes allowing little more than speculation about the spatial and temporal scales of burning (Baker 2002). Consequently, describing Indians' role in presettlement fire regimes will remain a highly speculative venture for ecologists and historians alike.

References

Agee, J.K. 1993. Fire ecology of Pacific Northwest forests. Washington, DC: Island Press.

Bahre, C.J. 1985. Wildfire in southeastern Arizona between 1859 and 1890. Desert Plants. 7: 190–194.

Baker, W.L. 2002. Indians and fire in the Rocky Mountains: The wilderness hypothesis renewed. In: Vale, T.R.(ed.). Fire, native peoples, and the natural landscape. Washington, DC: Island Press: 41–76.

Baker, W.L. 2003. Fires and climate in forested landscapes of the U.S. Rocky Mountains. In: Veblen, T.T.; Baker, W.L.; Montenegro, G.; Swetnam, T.W. (eds.). Fire and climate change in temperate ecosystems of the western Americas. Ecol. Studies 160. New York: Springer-Verlag: 120–157.

Barrett, S.W. 2004. Fire regimes in the Northern Rockies. *Fire Management Today*. 64(2): 32–38.

Barrett, S.W.; Arno, S.F. 1982. Indian fires as an ecological influence in the Northern Rockies. Journal of Forestry. 80(10): 647–650.

Barrett, S.W.; Arno, S. F. 1999. Indian fires in the Northern Rockies: Ethnohistory and ecology. In: Boyd, R.T. (ed.). Indians, fire and land in the Pacific Northwest. Corvallis, OR: Oregon State University Press: 50–64.

Barrett, S.W.; Arno, S.F.; Key, C.H. 1991. Fire regimes of western larch–lodgepole pine forests in Glacier National Park, Montana. Canadian Journal of Forest Research. 21: 1711–1720.

Bessie, W.C.; Johnson, E.A. 1995. The relative importance of fuels and weather on fire behavior in subalpine forests. Ecology. 76: 747–762.

Buechling, A.; Baker, W.L. 2004. A fire history from tree rings in a high-elevation forest of Rocky Mountain National Park. Canadian Journal of Forest Research. 34: 1259–1273.

Johnson, E.A.; Larsen, C.P.S. 1991. Climatically induced change in fire frequency in the southern Canadian Rockies. Ecology. 7(1): 194–201.

Kaye, M.W.; Swetnam, T.W. 1999. An assessment of fire, climate, and Apache history in the Sacramento Mountains, New Mexico. Physical Geography. 20(4): 305–330.

Pyne, S.J. 1982. Fire in America: A cultural history of wildland and rural fire. Princeton, NJ: Princeton University Press.

Morgan, P.; Bunting, S.; Black, A.; Merril, T.; Barrett, S.W. 1998. Fire regimes in the Interior Columbia River Basin: Past and present. In: Fire management under fire (adapting to change). Proceedings of the Interior West Fire Council Meeting and Program; 1–4 November 1994; Coeur d'Alene, ID. Fairfield, WA: International Association of Wildland Fire: 77–82.

Swetnam, T.W.; Baisan, C.H. 1996. Historical fire regime patterns in the Southwestern United States since A.D. 1700. In: Allen, C.D. (ed.). Fire effects in southwestern forests. Proceedings of the Second La Mesa Fire Symposium; 29–31 March 1994; Los Alamos, NM. Gen. Tech. Rep. RM–GTR–286. Fort Collins, CO: USDA Forest Service, Rocky Mountain Research Station.

Swetnam, T.W.; Betancourt, J.L. 1990. Fire—Southern Oscillation relations in the Southwestern United States. Science. 249: 1017–1020.

Swetnam, T.W.; Baisan, C.H.; Kaib, J.M. 2001. Forest fire histories in the sky islands of La Frontera. In: Webster, G.L.; Bahre, C.J. (eds.). Changing plant life of La Frontera: Observations on vegetation in the United States/Mexico borderlands. Albuquerque, NM: University of New Mexico Press: 95–119.

Williams, G.W. 2002. Aboriginal use of fire: Are there any "natural" plant communities? In: Kay, C. (ed.). Wilderness and political ecology: Aboriginal influences and the original
state of nature. Salt Lake City, UT: University of Utah Press: 179–214.
Williams, G.W. 2004. American Indian fire use in the arid West. *Fire Management Today*. 64(3): 10–14. ■

Additional Reading

Editor's note: The following works also pertain to the debate over practices and ecological impacts associated with fire use by American Indians.

- Boyd, R., ed. Indians, fire, and the land in the Pacific Northwest. Corvallis, OR: Oregon State University Press.
- Lewis, H.T.; Ferguson, T.A. 1988. Yards, corridors, and mosaics: How to burn a boreal forest. Human Ecology. 16(1): 57–77.
- Stewart, O. 2002. Forgotten fires: Native Americans and the transient wilderness. Norman, OK: University of Oklahoma Press.
- Pyne, S. 2001. Fire: A brief history. Seattle, WA: University of Washington Press.
- Pyne, S. 2003. Review of Thomas Vale, ed., Fire, Native Peoples, and the Natural Landscape. Restoration Ecology. 11(2): 257–259.

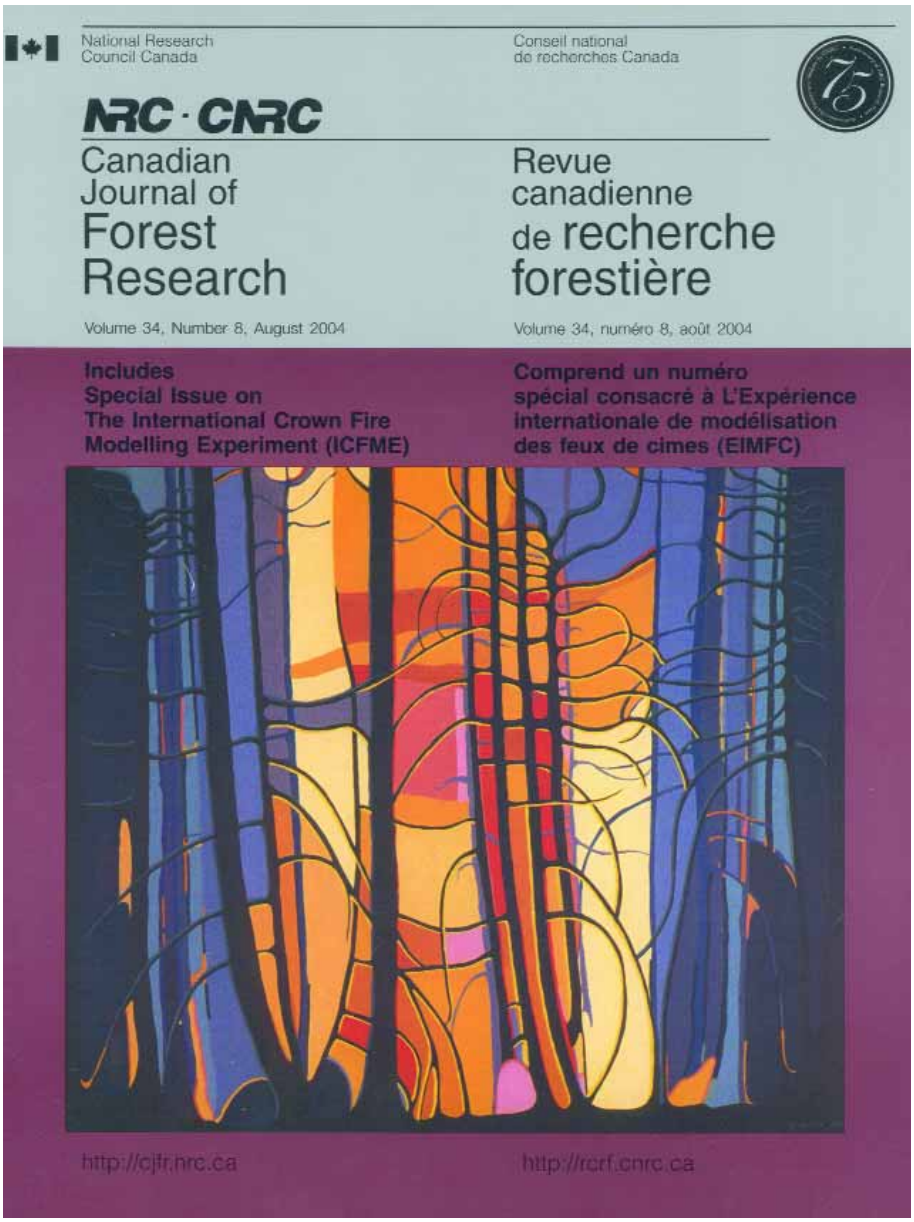
Long-Term Experiment Takes Some of the Mystery Out of Crown Fires

Martin E. Alexander

The August 2004 issue of the *Canadian Journal of Forest Research* (volume 34[8]) is devoted to a special topic: "The International Crown Fire Modelling Experiment (ICFME) in Canada's Northwest Territories: Advancing the Science of Fire Behaviour." Running from 1994 to 2001 at a site about 30 miles (50 km) north of Fort Providence, the ICFME was a major international wildland fire research effort organized by the Canadian Forest Service and the Forest Management Division in the Department of Resources, Wildlife and Economic Development (DRWED) of the Government of Northwest Territories (GNWT), with substantial cooperation from the USDA Forest Service.

> "What you guys envisioned and so many of us worked on will make fire history. Lots of excellent work, data, concepts and techniques to stoke the research fires for a long time to come."
>
> – Dr. Ted Putnam (2004)

Dr. Marty Alexander is a senior fire behavior research officer with the Canadian Forest Service, Northern Forestry Centre, Edmonton, Alberta, Canada. At the time of this writing, he was on assignment as a senior researcher with the Wildland Fire Operations Research Group, Forest Engineering Research Institute of Canada, Hinton, Alberta, Canada.



The special issue features 10 articles. The first article presents an overview and introduction to ICFME (Stocks and others 2004a). The other nine articles focus on some of the main research studies carried out during the course of the ICFME, including:

- Several aspects of crown fire behavior (Butler and others 2004a, 2004b; Stocks and others 2004b; Taylor and others 2004);
- Firefighter safety (Putnam and Butler 2004);
- The wildland/urban interface (Cohen 2004);

"And I believe that the fire pioneers, wherever they may be, would have to share some awe (and perhaps some envy) over the International Crown Fire Modelling Experiment…"

– Dr. Phil Omi (2004), closing address at the 22nd Tall Timbers Fire Ecology Conference

- Smoke chemistry (Payne and others 2004);
- Tree regeneration (de Groot and others 2004); and
- Charcoal deposits in lake sediments (Lynch and others 2004).

Article abstracts are available at <http://pubs.nrc-cnrc.gc.ca/cgi-bin/rp/rp2_tocs_e?cjfr_cjfr8-04_34>. To obtain a single copy, contact André Séguin, Subscription Office, NRC Research Press, National Research Council Canada, Montreal Road, Building M-55, Ottawa, Ontario K1A 0R6, 613-993-9084 (voice), andre.seguin@nrc-cnrc.gc.ca (e-mail). For more information, visit the ICFME Website at <http://fire.cfs.nrcan.gc.ca/research/environment/icfme/icfme_e.htm>.

The proceedings of the 22nd Tall Timbers Fire Ecology Conference (Engstrom and others 2004) also contains 18 papers from the poster session (e.g., Lavoie and Alexander 2004) and a special session on ICFME (e.g., Beck and Armitage 2004) organized and comoderated by the author and Rick Lanoville (GNWT-DRWED Forest Management Division). The conference proceedings are available for purchase from the Tall Timbers Research Station (<http://www.ttrs.org>).

Finally, for a detailed description of the jack pine–black spruce fuel type associated with the experimental burning carried out during the ICFME project, one should consult Alexander and others (2004). A copy can be ordered through the Canadian Forest Service online bookstore at <http://bookstore.cfs.nrcan.gc.ca/default.htm>.

References

Alexander, M.E.; Stefner, C.N.; Mason, J.A.; Stocks, B.J.; Hartley, G.R.; Maffey, M.E.; Wotton, B.M.; Taylor, S.W.; Lavoie, N.; Dalrymple, G.N. 2004. Characterizing the jack-pine–black spruce fuel complex of the International Crown Fire Modelling Experiment (ICFME). Inf. Rep. NOR-X-393. Edmonton, AB: Canadian Forest Service, Northern Forestry Centre.

Beck, J.A.; Armitage, O.B. 2004. Diurnal fire fuel moisture and FFMC characteristics at northern latitudes. In: Engstrom, R.T.; Galley, K.E.M.; de Groot, W.J., eds. Proceedings of the 22nd Tall Timbers Fire Ecology Conference: Fire in Temperate, Boreal, and Montane Ecosystems, 2001 October 15–18; Kananaskis, AB. Tallahassee, FL: Tall Timbers Research Station: 211–221.

Butler, B.W.; Cohen, J.; Latham, D.J.; Schuette, R.D.; Sopko, P; Shannon, K.S.; Jimenez, D.; Bradshaw, L.S. 2004a. Measurements of radiant emissive power and temperatures in crown fires. Canadian Journal of Forest Research. 34: 1577–1587.

Butler, B.W.; Finney, M.A.; Andrews, P.L.; Albini, F.A. 2004b. A radiation–driven model for crown fire spread. Canadian Journal of Forest Research. 34: 1588–1599.

Cohen, J.D. 2004. Relating flame radiation to home ignition using modeling and experimental crown fires. Canadian Journal of Forest Research. 34: 1616–1626.

de Groot, W.J.; Bothwell, P.M.; Taylor, S.W.; Wotton, B.M.; Stocks, B.J.; Alexander, M.E. 2004. Jack pine regeneration and crown fires. Canadian Journal of Forest Research. 34: 1634–1641.

Engstrom, R.T.; Galley, K.E.M.; de Groot, W.J. (eds). 2004. Proceedings of the 22nd Tall Timbers Fire Ecology Conference: Fire in Temperate, Boreal, and Montane Ecosystems; 2001 October 15–18; Kananaskis, AB. Tallahassee, FL: Tall Timbers Research Station.

Lavoie, N.; Alexander, M.E. 2004. Experimental reburns 1–4 years after high-intensity crown fire. In: Engstrom, R.T.; Galley, K.E.M.; de Groot, W.J., eds. Proceedings of the 22nd Tall Timbers Fire Ecology Conference: Fire in Temperate, Boreal, and Montane Ecosystems. 2001 October 15–18; Kananaskis, AB. Tallahassee, FL; Tall Timbers Research Station: 229

Lynch, J.A.; Clark, J.S.; Stocks, B.J. 2004. Charcoal production, dispersal, and deposition from the Fort Providence experimental fire: interpreting fire regimes from charcoal records in boreal forests. Canadian Journal of Forest Research. 34: 1642–1656.

Omi, P.N. 2004. Reflections on Tall Timbers 22 and September 11—a conference summary. In: Engstrom, R.T.; Galley, K.E.M.; de Groot, W.J., eds. Proceedings of the 22nd Tall Timbers Fire Ecology Conference: Fire in Temperate, Boreal, and Montane Ecosystems. 2001 October 15–18; Kananaskis, AB. Tallahassee, FL: Tall Timbers Research Station: 324–326.

Payne, N.J.; Stocks, B.J.; Robinson, A.; Wasey, M.; Strapp, J.W. 2004. Combustion aerosol from experimental crown fires in a boreal forest jack pine stand. Canadian Journal of Forest Research. 34: 1627–1633.

Putnam, T. 2004. Personal written communication. Fire equipment specialist (retired), USDA Forest Service, Missoula Technology Development Center, Missoula, MT.

Putnam, T; Butler, B.W. 2004. Evaluating fire shelter performance in experimental crown fires. Canadian Journal of Forest Research. 34: 1600–1615.

Stocks, B.J.; Alexander, M.E.; Lanoville, R.A. 2004a. Overview of the International Crown Fire Modelling Experiment (ICFME). Canadian Journal of Forest Research. 34: 1543–1547.

Stocks, B.J.; Alexander, M.E.; Wotton, B.M.; Stefner, C.N.; Flannigan, M.D.; Taylor, S.W.; Lavoie, N.; Mason, J.A.; Hartley, G.R.; Maffey, M.E.; Dalrymple, G.N.; Blake, T.W.; Cruz, M.G.; Lanoville, R.A. 2004b. Crown fire behaviour in a northern jack pine–black spruce forest. Canadian Journal of Forest Research. 34: 1548–1560.

Taylor, S.W.; Wotton, B.M.; Alexander, M.E.; Dalrymple, G.N. 2004. Variation in wind and crown fire behaviour in a northern jack pine–black spruce forest. Canadian Journal of Forest Research. 34: 1561–1576. ■

Treatment Area Saves Ranger Station

Paul Keller

When the Rodio-Chediski Fire raced toward the Black Mesa Ranger District on Arizona's Apache-Sitgreaves National Forest, the outlook for the ranger station and other buildings was grim. Suddenly, the crown fire dropped and skipped and burned its way through the trees past the buildings.

The district removed smaller trees and prescribe-burned, saving the ranger station from crown fire when Rodeo-Chediski burned through.

District Forester Dave Maurer credited the 100-acre (41-ha) Southside Demonstration Treatment Area with altering the fire's behavior and saving the buildings. The treatment area was a public showcase to illustrate the function and appearance of managed stands. Saving the ranger station was an unexpected bonus.

To create the treatment area, the district removed the smaller trees… every tree up to 16 inches (41 cm) in diameter…and then prescribe-burned. The treatment method reduced the basal area of the forest from 250 square feet (23 m2) to 40 square feet (9 m2) per acre.

"If we had only thinned up to 12 inches [31 cm] in diameter, these stands would still have been too dense," said Maurer. "They would have carried the fire."

The openings created within the treatment area were clear of brush and ground fuels. That, said Maurer, "enabled us to burn out in a fairly safe manner." He added, "There's no question that this stand [treatment] contributed to stopping the fire from entering the ranger station." ■

A 100-acre (41-ha) treatment "thinning and burning" saved these ponderosa pines from Rodeo-Chediski by keeping the fire out of their crowns. Photo: Tom Iraci, USDA Forest Service, Pacific Northwest Region, Portland, OR, 2002.

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

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Photo Contest Announcement

Fire Management Today (FMT) invites you to submit your best fire-related images to be judged in our annual competition. Judging begins after the first Friday in March of each year.

Awards

All contestants will receive a CD with the images remaining after technical and safety reviews. Winning images will appear in a future issue of FMT and will be publicly displayed at the USDA Forest Service's national office in Washington, DC. Winners in each category will receive:

- 1st place—Camera equipment worth $300 and a 20- by 24-inch framed copy of your image.
- 2nd place—A 16- by 20-inch framed copy of your image.
- 3rd place—An 11- by 14-inch framed copy of your image.
- Honorable mention—An 8- by 10-inch framed copy of your image.

Categories

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

Rules

- The contest is open to everyone. You may submit an unlimited number of entries taken at any time. No photos judged in previous FMT contests may be entered.
- You must have the right to grant the Forest Service unlimited use of the image, and you must agree that the image will become public domain. Moreover, the image must not have been previously published.
- We prefer original slides or negatives; however, we will accept duplicate slides or high-quality prints (for example, those with good focus, contrast level, and depth of field). Note: We will not return your slides, negatives, or prints.
- We will also accept digital images if the image was shot at the highest resolution using a camera with at least 2.5 megapixels or if the image was scanned at 300 lines per inch or equivalent with a minimum output size of 5" x 7". Digital image files should be TIFFs or highest quality JPGs.
- You must indicate only one competition category per image. To ensure fair evaluation, we reserve the right to change the competition category for your image.
- You must provide a detailed caption for each image. For example: *A Sikorsky S–64 Skycrane delivers retardant on the 1996 Clark Peak Fire, Coronado National Forest, AZ. Photo: name, professional affiliation, town, state, year image captured.*
- A panel of experienced judges determines the winners. Its decision is final.
- We will eliminate photos from competition if they are obtained by illegal or unauthorized access to restricted areas; lack detailed captions; have date stamps; show unsafe firefighting practices (unless that is their express purpose); or are of low technical quality (for example, have soft focus or show camera movement).
- You must complete and sign the release granting the USDA Forest Service rights to use your image(s). Mail your completed release with your entry or fax it (970-295-5815) at the same time you e-mail digital images.

Mail entries to:

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Fire Management Today Photo Contest
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Fort Collins, CO 80526 or
e-mail images and captions to:
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and fax signed release form to
970-295-5815 (attn: Madelyn Dillon)

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First Friday in March

Sample Photo Release Statement

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