

Fire Management *today*

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SAFETY FIRST!



United States Department of Agriculture
Forest Service

After many years of editing *Fire Management Today*, I am leaving the journal.

I first worked on the journal in 1994, when it was undergoing a facelift by Editor Donna Paananen and General Manager April Baily. In that year, it went from a black-and-white version to the current full-color design. The editorial style had earlier been honed by Editor Doris Celarier, working with General Manager Fran Russ.

When I took over as editor in 1998, I tried to bring a fresh focus on my own areas of keenest interest: wildland fire ecology, policy, and history. I am grateful to General Manager April Baily for her full support. I enjoyed working on the journal, but other Forest Service assignments now take up more of my time, so I'm moving on.

The new managing editor, Paul Keller, is a former firefighter and professional journalist. A new general manager, Melissa Frey, has also recently come aboard. I am sure that Melissa and Paul will make an outstanding team.

–Hutch Brown

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On the Cover:



Saving a hot helispot. In a typical wildland firefighter whirl of action and commotion and flame, the Superintendent of the Stanislaus Interagency Hotshots points out a heads-up to his fellow members of the Eldorado Interagency Hotshots—as everyone hustles to save their helispot from the approaching Codfish Fire on the Tahoe National Forest. These people whom our country depends upon to engage with wildland fire—to work inside the ever capricious wildland fire environment—must constantly heed safety on various vital levels. For a discussion of safety issues that confront firefighters and wildland fire management today, see the articles beginning on page 4. Photo: Keith Redington, Eldorado Interagency Hotshots, 2003.

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

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



Firefighter and public safety is our first priority.

CONTENTS

Safety: From Staff Rides to Fireline Fitness	4
<i>Mike Apicello</i>	
The First Pulaski Conference	
A First Step Toward Improved Fireline Safety and Efficiency.	6
<i>Paul Keller</i>	
Why We Need Doctrine Now	7
<i>Ed Hollenshead</i>	
Thirty-Thousand Firefighters Entrusting You to This Enormous Task. . .	9
<i>Tom Harbour</i>	
Pulaski Conference Chronology	10
Putting the Pulaski Conference in Perspective	13
<i>Jack Kirkendall</i>	
Where Do We Go From Here?	14
Chief of Forest Service Endorses Fire Suppression Doctrine.	15
Moving Toward a Learning Culture	17
<i>Paul Keller</i>	
Staff Ride to the Battle of Little Bighorn and Mann Gulch Fire.	21
<i>Lori Messenger</i>	
Improved Decision Support for Proactive Wildland Fire Management . .	25
<i>Tom Wordell and Rick Ochoa</i>	
Portals: Key to Safety Awareness	29
<i>Paul Chamberlin</i>	
A National Fitness Regimen Would Benefit Firefighter Safety and Effectiveness	30
<i>Paul Keller</i>	
Wanted: A Standardized Firefighter Fitness Program.	32
<i>Bequi Livingston</i>	
Rappel Academy Wins Award for Excellence.	33
<i>Paul Keller</i>	
Integrating Social Science Into Forestry in the Wildland/Urban Interface	35
<i>Jeffrey J. Brooks, Hannah Brenkert, Judy E. Serby, Joseph G. Champ, Tony Simons, and Daniel R. Williams</i>	
Wildfire Monitoring Using Wireless Sensor Networks	44
<i>David M. Doolin and Nicholas Sitar</i>	

SHORT FEATURES

Machine Provides Access to Wetlands	48
<i>Gerald Vickers</i>	
Websites on Fire.	8
Guidelines for Contributors	50
Annual Photo Contest	Inside Back Cover

SAFETY: FROM STAFF RIDES TO FIRELINE FITNESS



Mike Apicello

Although the overall theme of this issue of *Fire Management Today* is “safety,” for the most part, our authors are really addressing the collective consequences and outcomes that have emerged as safety issues during the last dozen fire seasons.

Many of the challenges facing our country’s wildland fire grounds today can be attributed to the overall changed forest and range conditions that have emerged during this period. The lessons of tens of thousands of wildfires during this time—when aggregated into what are clearly more complex and complicated landscapes and fuel arrangements—must be acknowledged *and* remembered.

Through this issue’s diversity of safety-themed articles—from staff rides, lessons learned, predictive services, and even fireline fitness—we have tried to bring the reader a broad and informative view of these important wildland fire topics. For, if there was ever a time to be more mindful of field conditions and their relationship to negative consequences or “bad outcomes” on wildland fires, it is now.

As many of the articles in this issue reveal, we must therefore:

- Evolve new fire suppression doctrine,

Mike Apicello, coordinator for this special “safety” issue of Fire Management Today, is the public affairs officer for the USDA Forest Service, Fire and Aviation Management, Washington Office, National Interagency Fire Center, Boise, ID.



Safety first. The Black Mountain 2 Fire on the Lolo National Forest the night this wildland fire blew up. Photo by Kari Greer, National Interagency Fire Center contractor, 2003.

- Incorporate new reality-based training scenarios, and
- Increase the overall collective intelligence carrying capacity of our wildland fireline leaders and program managers.

Some of our authors share information and thoughts about this

first Pulaski Conference and the need to evolve basic firefighter tactical and strategic templates. This important conference explored how we can entwine simpler philosophies that will allow for decision-making and leadership to attain their highest levels.

It is evidentially clear that the return to basics—complimented with using new methods of training, role playing, after action reports, and simply sharing lessons from the past—will eventually bring us to a higher level of consciousness in wildland fire safety and professionalism. ■



Sign of the times. Firefighter observes extreme fire behavior on the Paradise Fire in Valley Center, CA. Photo by Keith Redington, Eldorado Interagency Hotshots, 2003.

A FIRST STEP TOWARD IMPROVED FIRELINE SAFETY AND EFFICIENCY



Paul Keller

“This is the beginning of a new culture.”

That’s how Ed Hollenshead, fire operations safety officer for the USDA Forest Service at the National Interagency Fire Center in Boise, ID, gauges the potential impact of the first Pulaski Conference.

Held in Alta, UT, the second week in June 2005, the Pulaski Conference was designed to “assemble foundational doctrine upon which the Forest Service will accomplish its mission in fire sup-

Paul Keller is the managing editor of Fire Management Today.

pression,” says Hollenshead, who served as the conference’s incident commander.

“This doctrine is foundational, not operational,” he explains. “It is not yet the finished product, but rather the base upon which the finalized foundational doctrine will rest.”

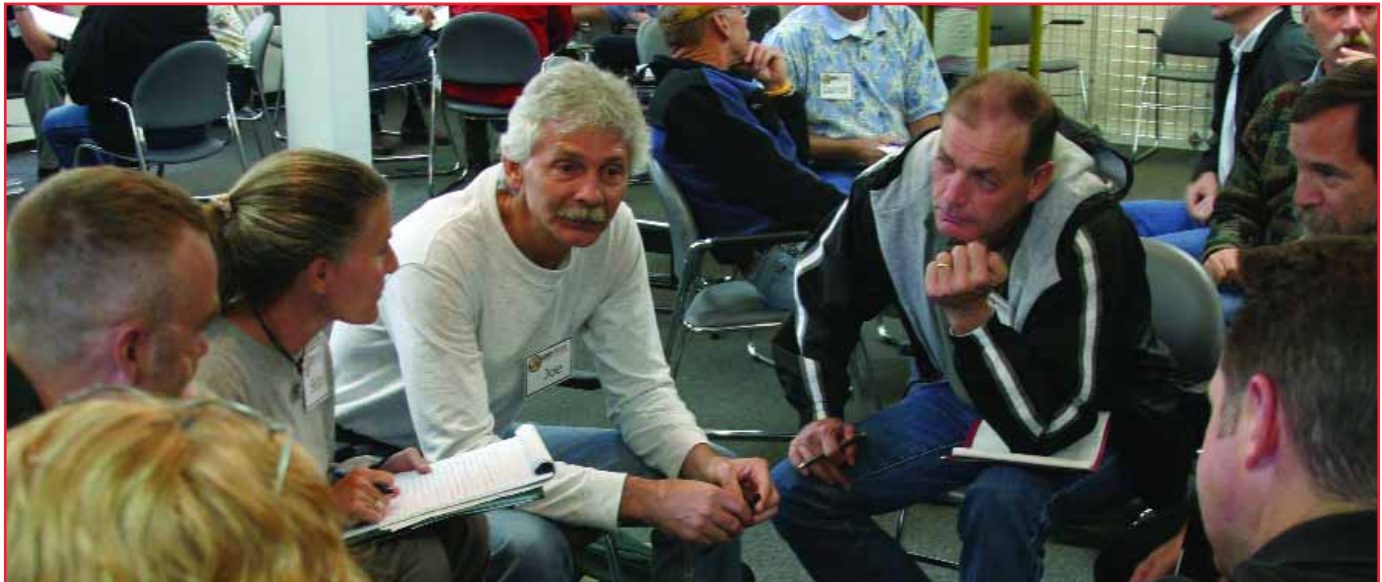
The conference’s attendees included wildland fire professionals from every Forest Service region—technicians, program managers, line officers, two regional foresters, research station employees—as well as safety and occupational health professionals.

In this safety themed issue of *Fire Management Today*, articles by Hollenshead and Tom Harbour,

Director of Fire and Aviation Management for the Forest Service’s Washington Office, Washington, DC, explain the agency’s central dilemma that prompted the need for this conference. Jack Kirkendall, fire management officer for the Bitterroot National Forest, Hamilton, MT, helps put this unique conference and its outcomes in perspective.

A chronological summary also provides an inside peek into how conference participants took this first significant step toward a framework of wildland fire suppression foundational doctrine.

Doctrine aimed directly at improving fireline safety and efficiency. ■



Brainstorming. Pulaski Conference attendees quickly learn that the pace must be fast and the hours long to accomplish their landmark objectives. Photo: Gary C. Chancey, USDA Forest Service, Black Hills National Forest, Custer, SD, 2005.

WHY WE NEED DOCTRINE NOW

Ed Hollenshead



In the last several years, the USDA Forest Service has come under enormous scrutiny in the performance of its wildland fire suppression mission. Fire and aviation operations safety, fire suppression expenditures, and accountability for decisions and procedures have all been brought into question.

Responses have largely been tactical, without clear anchoring to well understood foundational principles, or doctrine. This unfortunate approach has contributed to layers of prescriptive policies that have only added to the confusion and frustration felt among the members of the wildland firefighting workforce.

Without clearly articulated doctrinal principles in wildland fire suppression, the agency has no consistent basis for its actions or responses.

Without Clear Doctrine

The intent of agency responses to fireline tragedies has always been to correct operational error in fireline decisionmaking, leadership, and fire operations oversight. But bad outcomes still occurred. Agency leadership, in turn, became progressively more frustrated.

Without clear doctrine:

- Performance expectations and accountability are rule-defined,

Ed Hollenshead is the fire operations safety officer for the USDA Forest Service, Fire and Aviation Management, Washington Office, National Interagency Fire Center, Boise, ID.

Without clearly articulated doctrinal principles in wildland fire suppression, the agency has no consistent basis for its actions or responses.

- “Success” and “failure” are measured by the absence or occurrence of bad outcomes, and
- Personal performance is gauged by one’s adherence to—or deviation from—rules rather than by the behaviors and judgment used to accomplish the task.

Current Risk to Agency

The current risk to the agency is that improper behaviors, poor judgment,

or the lack of critical decisionmaking skills are seldom evaluated. They may go unnoticed for years—until they result in a bad outcome.

Through the illumination of clear, shared, and unambiguous doctrine:

- Decisions and actions will be connected with the overall mission and will contribute to inter- and

Two Key Terms

Doctrine

Without clear doctrine, policies and principles are viewed as interchangeable. They are not.

Doctrine is the body of principles, the foundation of judgment, decisionmaking, and behaviors that guides the actions of the organization and describes the environment in which they are taken.

Doctrine is developed from the legal and ethical mandate of the organization and the intent of its senior leaders.

Rules cover those things that senior leadership identifies as too important to leave to judgment. Doctrine, on the other hand, provides guidance for dealing with

the subjective, dynamic parts of the mission that rely on interpretation, judgment, and agility.

Policy

Policy is the body of rules that guide the objective parts of the mission. Policy serves as the structure used to put doctrinal principles into action.

Policy does not require, nor does it benefit from, interpretation or discretion. When so designed, policies (rules) are supportive of effective and safe mission accomplishment. The core operating system of any organization requires a solid, integrated framework of doctrine and policy operating in tandem.

intra-program–agency integration and coordination;

- Communication will be consistent and comprehensive and multiple interpretations of purposes, needs, and desired outcomes will be eliminated;
- The value of policy to accomplishing the mission will be enhanced;
- Policy—when developed as expressions of guiding principles—will serve to define the

The current risk to the agency is that improper behaviors, poor judgment, or the lack of critical decisionmaking skills are seldom evaluated.

context of decisionmaking rather than confine the decisionmaker;

- Decision authority, responsibility, and freedom to act will be precisely defined;
- The foundation upon which the agency establishes consistency in its response to criticism, arbitra-

tion, and litigation will be well established; and

- Firefighters and fireline leaders will be provided with an unambiguous means to evaluate risk versus gain to avoid both risk aversion and recklessness. ■

WEBSITES ON FIRE*

FIREHouse

The Northwest and Alaska Fire Research Clearinghouse (FIREHouse) is a Web-based project that provides data and documentation on fire science and technology relevant to Alaska, Idaho, Oregon, and Washington.

The project's goal is to provide "one-stop shopping" for resource

managers, decisionmakers, scientists, students, and communities who want access to the results of this group's efforts in understanding and managing fire and fuels on public lands. FIREHouse also offers server space and Web and database support for researchers who choose to post their primary data on FIREHouse.

FIREHouse currently provides online access to:

- Project and tool descriptions, contact information, and links;
- Online publications;
- Proposals and study plans; and
- Metadata.

FIREHouse is a collaboration among the:

- Fire and Environmental Research Applications Team of the USDA Forest Service Pacific Northwest Research Station,
- Pacific Wildland Fire Sciences Laboratory,
- University of Washington,
- National Park Service, and
- The U.S. Geological Survey National Biological Information Infrastructure.

Found at

<<http://www.fs.fed.us/pnw/fera/firehouse>>.

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

THIRTY-THOUSAND FIREFIGHTERS ENTRUSTING YOU TO THIS ENORMOUS TASK*



Tom Harbour

You are here to build a better future. You are entrusted to accomplish tasks that will change the way we think and act in our wildland fire suppression duties.

Today and into the future, these duties are performed with our interagency partners in a political, cultural, and physical environment that is more challenging than ever before. Today, the expectations of our performance and scrutiny of our actions are extraordinary.

You at this conference have been given an opportunity to set in motion a series of events that will lead us to develop firefighters and leaders—who match the infinite variability of the fires we face—with a sense of initiative, creativity, and accountability.

You will begin to outline a system that demands adherence to development of an understanding of “how” to think, *not* “what” to think. You will lay out how we “think” about fire suppression. To succeed, we must develop a core operating system that relies on a solid, integrated framework of both doctrine and policy.

Rules alone never ensure success. Our success depends on the ability

Tom Harbour is the Director of Fire and Aviation Management, USDA Forest Service, Washington Office, Washington, DC.

* Based on opening remarks made by the author at the first Pulaski Conference, June 5–10, 2005, in Alta, UT.



Commander's Intent. Tom Harbour opens the Pulaski Conference with strong words of encouragement. Photo: Gary C. Chancey, USDA Forest Service, Black Hills National Forest, Custer, SD, 2005.

Fire suppression duties today are performed in a political, cultural, and physical environment that is more challenging than ever before.

of men and women—skilled and experienced in the application of doctrine and policy—to make decisions in a dynamic, high-risk, high-consequence environment.

Thirty-thousand firefighters are entrusting you to this enormous task. We must give these men and women the skills and tools to be successful. ■

Renewing the Morale of Firefighters

“I believe this development of doctrine is crucial to renewing the morale of firefighters. Governance of behavior by checklists has taken the heart out of what used to be a most rewarding career—firefighting.”

—Pulaski Conference participant

“Tom [Harbour], thanks for the guts to try. This takes a lot of courage.”

—Pulaski Conference participant

“This is the biggest thing I've been involved with since ‘Safety First.’ This has that same kind of energy. We've got a big laundry list here . . . But it's just a piece of paper right now. Unless we get buy-off, it'll just stay a piece of paper.”

—Pulaski Conference participant

“It's not very often you get a chance to influence policy—especially something so auspicious and so important. This is the beginning of the beginning. This will show our people in the field that we really do care—that we listen. Yes, this is an excellent beginning.”

—Pulaski Conference participant

PULASKI CONFERENCE CHRONOLOGY



First Day – Sunday, June 5, 2005

Ed Hollenshead, fire operations safety officer for the USDA Forest Service and conference incident commander, welcomes the Pulaski Conference participants. He explains why their nametags are first names only. “Your identity is based on your contribution—not your rank.”

A subject-matter expert in the development and use of doctrine, Mark Smith of Mission-Centered Solutions, Inc., explains the concept and purpose of “doctrine.” His presentation includes how doctrine fits with our legal mandate and policy and how this week’s efforts fit into the larger scheme of things.

Hollenshead explains:

“You are here to make clearly articulated, commonly understood doctrine—foundational doctrine—upon which we can build our operational doctrine.

“We want you to move freely outside the box. By the end of the day Wednesday, we will have gathered Forest Service foundational doctrine. On Thursday you will produce a statement and develop clear guidance on how each part of the doctrine will be used.”

Second Day – Monday, June 6

Participants introduce themselves by first names only. They briefly answer: *What’s your motivation for being here?* (See sidebar.) No last

Holed Up

Workshop participants agreed that the secluded, no-distraction accommodations helped the first Pulaski Conference’s overall success.

The event was held in a (previously closed) ski lodge in Alta, UT. All meals were served there.

For 6 days, there were no televisions. No radios. No newspapers. No rental cars. No cell phones were allowed.

A winterlike snowstorm raged for most of the week. On the final day, when the finalized, future-aimed doctrine was handed to Tom Harbour, the blue sky and sun returned.

Your identity is based on
your contribution—not
your rank.

names, no job titles, no home units are voiced. As they stand up to share their motivation—often heartfelt passion—for being a part of this concerted, perhaps milestone effort, a fierce, sustained upcanyon Wasatch Range wind symbolically rattles the Pulaski Conference windows.

National Director of Fire and Aviation Management Tom Harbour—who acknowledges this metaphorical wind—welcomes

everyone and provides a highly motivational and well-received “Commander’s Intent” address that outlines his guidance to, and expectations for, the Pulaski Conference.

A vigorous brainstorming session, illuminating concerns and issues to generate potential ideas for doctrine, is facilitated by Mike DeGrosky and Faye Fentiman. From more than 70 individual-suggested doctrine ideas, seven general areas of doctrine are formed:

- Operations,
- Defining the environment,
- Leadership and accountability,
- Risk and risk management,
- Mission,
- Roles, and
- Cost management.

Ground Rules

Participants dive into a “30-Minute Mission.” Facilitated by Fentiman, each of the participants chooses which of the seven doctrine teams he or she will join. They may not be on the same team with people whom they work with daily. A minimum of three regions must be represented on each team. Teams should have a minimum of four and maximum of eight team members.

Conference participants form into the seven teams. Even though they will be working separately in these individual groups, ample opportunity will be provided throughout the week for collaborative interteam contributions and discussion.

Participant Introductions – “What’s your motivation for being here?”

On Wildfire Fatalities

“I’m tired of talking to the family members of deceased firefighters. Hopefully we can do something about that starting this week.”

“I had to deal with nine deaths in 1994. I never want to do that again.”

“I’m here for Devin, Jessica, Karen, and Tom.”*

On the Current Rule-Based Suppression Emphasis

“This is timely—if not overdue. We are experiencing an increased preoccupation with people trying to not do wrong—rather than doing what’s right. I hope we can turn that around.”

“I believe that fire suppression is a fundamental and critical part of the Forest Service. We have got to unshackle and free up the Incident Command System to

make decisions in the heat of battle. In the fire environment we have created, people don’t have time to think.”

“When I heard about the idea for this conference, I said: ‘Finally!’ I abhor the rule-based, fear-based, nonthinking approach that we’ve developed into.”

“This is a new beginning. We need to get back to a commonsense approach—rather than simply checking a rule book.”

Addressing the Fear of Liability

“Many people now believe it’s not worth the risk to be an IC 3 [type 3 incident commander] anymore. I want to remove that barrier.”

“Four-hundred fire leaders met at a conference last year in Reno. The top issue was liability, rules, and checklists. There was a fear of not checking off the box correctly. This is leading to good people leaving the fire organization. And to people not wanting to be type 3 ICs. We need to do something about this fear of liability.”

Miscellaneous

“We have drifted. What really is our focus? This is an opportunity to address this and set a course for the future.”

“I’m here after working in fire operations for several years. It seems like this week is a platform for positive change. I want to be a part of that.”

“I’m here to empower the GS-3 line digger to be accountable for his or her own personal safety. Sense of duty is a personal responsibility. In high-risk management, we start by empowering the guy on the ground.”

“This change is much needed. It’s been talked about in the field for a number of years. Management is finally listening. It reminds me of one of General Patton’s quotes: ‘If everybody’s thinking the same—somebody’s not thinking.’”

“I’m here for our troopers on the ground.”

* The firefighters who perished on the 2001 Thirtymile Fire: Devin Weaver, Jessica Johnson, Karen FitzPatrick, and Tom Craven.



No easy task. For three long days, members of the seven doctrine teams work all day and into the night. Photo: Gary C. Chancey, USDA Forest Service, Black Hills National Forest, Custer, SD, 2005.

The seven doctrine work groups depart for their individually assigned work areas. Completely self-managed, they are on their own for the next 2 days to devise, generate, and create their work independently. They are provided a variety of publications and reference materials. Facilitators and conference staff are always available to give assistance and answer questions.

All seven doctrine groups work into the night.

Third Day – Tuesday, June 7

The work groups continue developing their doctrine areas.

Besides robust dialoging among themselves, throughout the day and night, groups also visit with one another to explore ideas and to challenge each other's thinking.

Once again, all seven of these doctrine groups work into the night.

Fourth Day – Wednesday, June 9

Throughout the morning, workshop participants continue shaping their doctrine in the individual work groups. At 1 p.m., the doctrine teams all meet together. Each group has 15 minutes to present a summary of its proposed doctrine. Via an immediate straw poll feedback system, doctrine teams are matched with people who have follow-up constructive comments.

Teams return to their individual workplaces to make revisions and further hone their foundational doctrine. Their completed, final doctrine is due by 8 a.m., on the following morning. Once again, the doctrine teams work into the night.

Fifth Day – Thursday, June 9

All seven teams submit their doctrine texts to the production team, which will compile everything into a single doctrine package report to be presented to Fire and Aviation Management Director Tom Harbour on the following morning.

Conference participants reform into three new groups to develop:

- An action plan for developing operational doctrine in cooperation with agency partners.

“When you get this much intelligence and passion in a room—good things happen.”

–Faye Fentiman, management consultant–facilitator

- A system and process for establishing relationships between doctrinal elements linking to vision, mission, training, and operations.
- A doctrinal review process for developing and maintaining an infrastructure and organization to coordinate and maintain doctrine.

Sixth Day – Friday, June 10

The completed *Wildland Fire Suppression: Foundational Doctrine* report is handed to Fire and Aviation Management Director Tom Harbour. A 15-minute video presentation produced during the week that summarizes and captures the essence of the Pulaski Conference receives a standing ovation.

Conference participants have an opportunity to address Harbour with their comments. This feedback includes:

“I want to thank you, Tom, for putting this exceptional ‘pulaski’ in my hand to go forth and chop away at what we know will be a very tough but good fight. The firefighters on the ground are going to see the value of this pulaski. And they’re going to pick this tool up and they’re going to go ahead and anchor line. Continuing this metaphor, you have a large responsibility to sharpen this tool and take it forth to our government, to Capitol Hill. And that’s where I’m afraid you’re going to end up with some ‘underslung line.’ I’m hopeful that you can avoid the pitfalls and don’t get too many ‘rollers’ and ‘spots.’ I thank you from the bottom of my heart.”

–Pulaski Conference participant

“I came here to tell the story on behalf of the passion of the 45 incident management team members who I’ve interviewed the last 6 months. I saw fear in those interviews; I saw frustration; I saw dwindling hope. I heard comments like ‘we’re cut to the bone on trying to contain cost—we can’t cut anymore.’ I’ve heard about the rules that constrain these people to the point that they were choking. And my heart bled for them. I promised them that I would tell their story. I came here this week for the sole purpose of doing that. And I saw the renewed hope this week. And I think that’s so important. Because if we don’t have hope—we can’t continue. Tom and Ed, I admire your courage. And I ask you to go forth and to face the tough times in this political climate.”

–Pulaski Conference participant ■

PUTTING THE PULASKI CONFERENCE IN PERSPECTIVE



Jack Kirkendall

The first Pulaski Conference's *Fire Suppression: Foundational Doctrine* represents contributions from a wide array of fire management and agency administrator experience and leadership levels.

At this unique conference, rank was not a factor in:

- Driving the process of analyzing our current approach to fireline decisionmaking,
- Examining our current rule set for implementing and monitoring decisions and actions on the fire-ground, or
- The development of the foundational doctrine.

All who participated in the Pulaski Conference expressed a strong desire to ensure that the final product touched all levels of our agency.

Recognized Need

The need for this effort and resulting foundational doctrine could not be more timely. As far back as the first Human Factors Workshop in 1995 and the 1998 *TriData-Phase III Wildland Firefighter Awareness Study*, there has been a recognized need to reshape our approach to fireline actions and firefighter safety in a way that takes into account and recognizes:

Jack Kirkendall is the fire management officer for the USDA Forest Service, Bitterroot National Forest, Hamilton, MT. He participated in the Pulaski Conference.

The need for this effort and resulting foundational doctrine could not be more timely.

- Decisionmaking and thinking processes, and
- The appropriate levels of leadership and responsibility for all actions—or lack of action—up and down the line.

More recently, the aftermath of the Cramer incident, actions by Congress, and the still ongoing motions surrounding the

To allow our efforts and the product to languish would be a fatal flaw in the process.

Thirtymile Fire have all heightened everyone's concern over what is appropriate and what isn't.

Beyond Rule Set

What is doctrine and how does it differ from our current rule set?

Doctrine is the expression of the fundamental framework, concepts, and principles that guide the planning and conduct of operations. It is authoritative, but flexible. Doctrine is definitive in order to guide specific operations, yet adaptable enough to address diverse and varied situations—like the fire environment.

Rules dictate specific courses of action regardless of conditions or the situation. Rules are less adaptable as future changes in mission and the fire environment occur. They are specific must do's and can't do's. Sound familiar?

Fundamental Decision Framework

The doctrine that was created at the Pulaski Conference expresses a high degree of reliance on the individual and on the resilience of the organization that supports the individual. This doctrine is based on common principles. It is designed to provide a fundamental decision framework and action-oriented concepts that will guide our activities into the future. One needs to read the Pulaski Conference doctrine with this in mind.

It was recognized by all who participated in this conference that to allow our efforts and product to languish would be a fatal flaw in the process of changing the way we think and do business. There is still much work that needs to be done, including coordination with our partners in the wildland fire community and the development of more specific operational doctrine. ■

WHERE DO WE GO FROM HERE?



Two weeks after the first Pulaski Conference, its proposed *Fire Suppression: Foundational Doctrine* publication was presented to the USDA Forest Service's National Leadership Team. The team's members immediately understood and embraced the premise.

"Most importantly," says Ed Hollenshead, Pulaski Conference incident commander and national fire operations safety officer for the USDA Forest Service at the National Interagency Fire Center in Boise, ID, "this significant conceptual foundation has been launched for consideration—and adoption. This, alone, represents one huge

step into the possible future of our wildland fire suppression program."

At present, no one can know what the future holds. Hollenshead informs us that perhaps Steve Holdsambeck, fire operations safety officer for the USDA Forest Service's Intermountain Region, Ogden, UT, best sums up the current situation:

"There are those among us who say the change to principle-driven fire suppression is too great, the pace too quick. Whether caution or timidity drives them, they must be assured our fight is for the future. The environment in which we do this job is fundamentally different

than ever before. It continues to change at an unprecedented pace. Our future is stormy; our case is new. We must discard the old paradigms and move ahead." ■

Important Updates

In January 2006, two important Pulaski Conference updates occurred. The foundational doctrine that evolved from the first Pulaski Conference was adopted by the Chief of the Forest Service (see story on following page). Rotor and Wing, the second Pulaski Conference that focused on forming aviation doctrine, was held in Skamania, WA (see story on page 16).



Change agents. The Pulaski Conference participants launched a significant conceptual foundation that represents a potential huge step into the future of wildland fire suppression. Photo: Gary C. Chancey, USDA Forest Service, Black Hills National Forest, Custer, SD, 2005.

CHIEF OF FOREST SERVICE ENDORSES FIRE SUPPRESSION DOCTRINE



Dale N. Bosworth

(Editor's Note: In approving the fire suppression foundational doctrine that evolved from the first Pulaski Conference, on January 26, 2006, Forest Service Chief Dale Bosworth sent the following announcement to all of the agency's regional foresters, station directors, area director, International Institute of Tropical Forestry director, and Washington Office staff.)

Over the last several months, we have been discussing a philosophy of managing fire suppression called "doctrine," which focuses on the foundational principles that will guide our fire suppression activities.

Our discussions have revealed much about who we are as an agency and what we are about. To one degree or another, we have all struggled with the concept of principles-driven decisionmaking; our values as an agency have been challenged. However, our discussions have provided an opportunity that we cannot afford to ignore.

"By announcing his acceptance of this fire suppression doctrine, Chief Dale Bosworth has launched an unprecedented transformation of the Forest Service to an organization driven by mission-centered principles."

- Ed Hollenshead, fire operations safety officer for the Forest Service at the National Interagency Fire Center in Boise, ID. Hollenshead served as incident commander at the first Pulaski Conference held in May 2005 in Alta, UT.

Dale Bosworth is the Chief of the USDA Forest Service.

Implementing this approach to our work will take time; it will be an ongoing process.

I am accepting the principles enclosed with this letter as forming the foundational doctrine for fire suppression in the Forest Service. Externally, we are reaching out to our partners and others affected by this decision to explain the doctrine and its meaning.

Our Fire and Aviation Management program will also start work with our partners to develop an "Interagency Operational Doctrine" designed to guide application of the foundational principles on the fire-line. Internally, Fire and Aviation Management will begin review and modification of fire management policies to meet the intent of the foundational principles.

Fire and Aviation Management will also begin work with other staff areas to modify policies associated with these principles that affect servicewide operations. Furthermore, Fire and Aviation Management will embark on a review of current training to create new approaches to developing our firefighters and fire

leadership and will seek to establish innovative processes to review and measure their performance.

Beyond Fire Suppression

Many of the doctrinal principles go beyond fire suppression. They are relevant to everything we do. In making this decision, I am therefore committing us to move toward a point where we anchor our actions and decisions to a well-understood doctrine.

Implementing this approach to our work will take time. It will be an ongoing process. We are not abandoning our current policies, procedures, and measures of success. They will not be changed until Fire and Aviation Management has completed the review and the Forest Service Manual is revised. In the meantime, we can seek to understand what this doctrinal approach means and begin to behave accordingly.

Those who have wrestled with the implementation and use of doctrine have discovered three key areas that are necessary for adopting it.

1. Understanding the Doctrine.

We need to understand the doctrine concept as a whole, as well as the pieces of doctrine we will develop over time.

Understanding begins with Forest Service leadership. I plan to bring our leaders together to develop our understanding and to arrive at a consensus as to what doctrine is and what it is supposed to do. We will then

engage the entire workforce in serious study and tough debate as part of a healthy living doctrinal environment.

2. Validating the Doctrine. We need to validate the doctrine and anchor it to our mission and our work. We need a doctrine that is sufficiently flexible yet wholly applicable to everything we do. We should constantly reassess its relevance in view of advances in knowledge and technology, changes in national objectives, and innovative thinking. Through the way we are organized, we can keep our doctrine fresh and legitimate.

3. Implementing the Doctrine. Without implementation, the doctrine is wholly worthless. The general direction provided by doctrine should be converted into specific directives and translated into concrete action. We need to develop the means to synthesize the many elements of doctrine into something that works. We need to provide centralized direction for the implementation processes to ensure that the procedures themselves reflect our doctrinal principles—that they agree, that they embrace our cooperative relationships, and that they address the full spectrum of our work—both for today and for what we anticipate for tomorrow. We need new approaches to training that emphasize the things that will make our workforce capable of accepting the responsibility of discretionary decisionmaking. We need to amend our view of accountability and measures of success to reflect not only outcomes, but also the appropriateness of the decisions and behaviors leading to them.

Aviation Management Doctrine Developed at Second Pulaski Conference

The Rotor and Wing Conference, the second in the Pulaski Conference series, was held January 22–27, 2006 in Skamania, WA, to develop doctrine aimed at aviation management.

The conference's intent: "to assemble doctrine, validate policy, and display tactics that will begin an intellectual and operational renaissance focused on risk management and effectiveness in our USDA Forest Service aviation mission."

Just as with the 2005 Pulaski Conference, the Rotor and Wing's final 24-page report of proposed aviation foundational doctrine will now be presented to the National Leadership Team for endorsement.

Each Forest Service Region nominated from six to eight individuals—from senior aviators to ground flight personnel—to



Rotor and Wing. The second Pulaski Conference, held in January 2006, focused on creating aviation doctrine. Photo: Gary C. Chancey, USDA Forest Service, Black Hills National Forest, Custer, SD, 2006.

attend the conference. They developed their proposed aviation doctrine based around:

- Defining the Operational Environment;
- Mission, Operations, and Roles;
- Leadership and Accountability;
- Aviation Risk and Risk Management;
- Training, Qualifications, and Education; and
- Relationships and Partnerships.

I am entirely confident the Forest Service is up to the task.

Exciting Journey

Operating within this system requires that leaders at all levels provide clear, unambiguous intent and that we then release a trained and capable workforce to exercise its judgment in meeting that intent. This will not lead to anarchy. There will still be rules that—in tandem with guiding principles—frame the foundation of judgment and limits of discretion.

I know that this effort is unprecedented and that many of the risks are unknown. But I am convinced it is the correct path. It is an exciting journey, and I am entirely confident the Forest Service is up to the task. ■

The complete text of the *Foundational Doctrine: Guiding Fire Suppression in the USDA Forest Service*—that evolved from the first Pulaski Conference and has been accepted by the Chief of the Forest Service—is available at <http://www.fs.fed.us/fire/doctrine/>.

MOVING TOWARD A LEARNING CULTURE

Paul Keller



Does our wildland fire organization have a defined learning agenda? Does it avoid repeated mistakes? When its key people leave, does it lose critical knowledge? And does this organization act upon what it knows?

So, just who's keeping tabs on the important answers to such vital questions? Who is tasked with the hefty chore of providing a centralized knowledge and learning base for this country's extensive community of interagency wildland fire organizations? Whom do we count on to ensure that our wildland fire community continually moves forward as a true *learning* organization?

Meet the Wildland Fire Lessons Learned Center.

Main Objectives

"Our main objectives are to improve safe work performance, expand organizational learning, share knowledge, and promote organizational change," says center manager Paula Nasiatka, a former National Park Service Chief Ranger with two decades of interagency wildland fire experience. "For the wildland fire community to successfully and safely perform its missions, it needs to be a learning organization."

She explains that three primary drivers facilitated the need for this vital interagency resource, established in Tucson, AZ, in 2002:

Paul Keller is the managing editor of Fire Management Today.



A lesson is truly learned when we modify our behavior to reflect what we now know.

www.WildfireLessons.net and www.MyFireCommunity.net and now also www.JMTCenter.net

"A lesson is truly learned when we modify our behavior to reflect what we now know."

—Paula Nasiatka, Center Manager, Wildland Fire Lessons Learned Center.

1. The interagency wildland fire community is broad and diverse, involving hundreds of wildland fire organizations at various field and management levels.
2. The *Wildland Firefighter Safety Awareness Study (TriData)*, completed in the aftermath of the 1994 South Canyon Fire fatalities, recommended that the wildland fire community create a program where lessons learned could be shared extensively with wildland fire professionals.
3. The reengineering plan for the National Advanced Fire and Resource Institute, also based in Tucson, recommended incorporating "lessons learned" and "best practices" into the fire training curriculum.

Center's Goal

The Wildland Fire Lessons Learned Center's goal is to help the wildland fire community become a true learning organization by developing a learning culture that works safer,

What Is a "Learning Organization?"

According to David Garvin, Harvard Business School professor and author of *Learning in Action* (Garvin 2000), a "learning organization" is skilled in creating, acquiring, interpreting, transferring, and retaining knowledge. In addition, this subject-matter expert says that a "learning organization" purposefully modifies its behavior to reflect new knowledge and insights.

Garvin has been providing guidance to the wildland fire community in organizational learning—mainly through the Wildland Fire Lessons Learned Center—for the past 2 years.

smarter, and is continuously improving. Six critical tasks contribute to this developmental process:

1. Collect intelligence about the environment,
2. Learn from the best practices of other organizations,
3. Learn from our own experiences and past history,
4. Experiment with new approaches,
5. Encourage systematic problem solving, and

6. Transfer knowledge throughout the organization.

By acquiring, interpreting, transferring, and retaining wildland fire knowledge, positive organizational change will take place as we act on what we know, Nasiatka notes. Her center works with both formal and informal parts of the wildland fire community by:

- Cultivating positive relationships with recognized institutions in the wildland fire community;
- Demonstrating the center's value as a venue for organized problem solving and as a resource for implementing strategies; and
- Cultivating "communities of practice" from the informal networks of professionals who share a common concern or passion about a topic, and who enhance their knowledge and expertise in this area by interacting on a regular basis.

The Wildland Fire Lessons Learned Center enables wildland fire professionals to improve their networks and enhance their skills.

The value of the center's activities to community leaders is becoming apparent as these projects align with their organizations' goals and priorities. "A strong word-of-mouth reputation is emerging that the Wildland Fire Lessons Learned Center supports and enables fire professionals to improve their networks and enhance their skills," Nasiatka reports.

"Before the wildland fire community can fully become a learning organization, it must first be open to becoming a learning culture," says Nasiatka. "If timely, candid information generated by knowledgeable people is available and disseminated, a learning culture can evolve."

The three areas that the wildland fire community needs to focus on to improve organizational learning are:

1. Adopting a culture of *continuous* organizational learning,
2. Focusing effort on the entire wildland fire profession, and
3. Expanding the pockets of learning to the entire community.

The Wildland Fire Lessons Learned Center identifies these three focus areas in its organizational structure as Collection and Analysis, Knowledge Retention, and Knowledge Transfer.



Learning in the field. Organizational psychologists Dr. Karl Weick (middle) and Dr. Kathleen Sutcliffe, authors of Managing the Unexpected: Assuring High Performance in an Age of Complexity (Weick and Sutcliffe 2001), on the Cerro Grande Prescribed Fire Staff Ride—yet another organizational learning event assisted by the Wildland Fire Lessons Learned Center. Photo: Tom Iraci, USDA Forest Service, Pacific Northwest Region, Portland, OR, 2004.

Collection and Analysis

“After Action Review ‘rollups’ and Information Collection Team assignments are the primary tools we use to collect pertinent wildland fire information,” explains the center’s assistant manager, Dave Christenson. He said that case studies and surveys also serve as important collection tools.

“After Action Reviews—or AARs—are an inexpensive, simple, systematic process that have the power to change an entire work culture,” Christenson says. “The AAR can become a cornerstone of organizational learning.”

The four questions asked in this “learning after doing” After Action Review tool:

1. What did we set out to do?
2. What actually happened?
3. Why was there a difference?
4. What are we going to do next time?

According to Christenson, AARs initiate the knowledge transfer process. Their results can be used to enhance or sustain the performance of a unit or team. “Gems and nuggets will often surface from the AAR that will be valuable to others—but only if other people can have access to this knowledge.” He says that this is where the AAR “rollup” tool comes into play. This important resource identifies key issues by presenting fire professionals with the following challenges:

1. Describe one or more of your successes from which others can learn.
2. What was one of the challenges you faced and how did you overcome it?
3. How can training be improved?

Lessons Learned Center’s “Knowledge Transfer Mechanisms”

Websites

The Website at <<http://www.wildfirelessons.net>> contains a vast array of wildland fire knowledge arranged in a user-friendly format. The Website also has significant interaction with safety, training, and leadership development sites concerning both wildland fire and nonfire incidents. The Website at <<http://www.myfirecommunity.net>> is the wildland fire online community center that includes a community directory, learning opportunities, discussion center, and a knowledge exchange.

Scratchline Newsletter

The center also publishes a quarterly newsletter that identifies new tactics, techniques, procedures, and processes. In addition, this publication shares lessons and effective practices received from the field. Scratchline’s main purpose is to inform and educate the reader in a fast and simple format. Articles come from the entire wildland fire community.

The Learning Curve

The Learning Curve is published periodically for immediate use in the field. It provides a short summary of lessons from After Action Review rollups that have been received and reviewed.

After Action Review rollups are collected and analyzed for wildfire, prescribed burns, wildland fire use events, fuels projects, and all-risk events.

4. What are your recommendations for any unresolved issues?

AAR rollups are collected and analyzed by the Lessons Learned Center for wildfire, prescribed burns, wildland fire use events, fuels projects, and all-risk events. The lessons and effective practices are then shared with the wildland fire community through the center’s two newsletter-type publications (see the sidebar) and Website.

Information Collection Teams

Information Collection Teams (ICTs) serve as another key tool for collecting wildland fire informa-

tion. A team is comprised of subject-matter experts and a member of the center’s staff. These teams collect tactics, techniques, procedures, and processes for 5- to 12-day periods at an event. An initial impressions report is then developed from this information and shared with the wildland fire community.

“The purpose of an ICT is to collect lessons and effective practices from firefighters that they believe will be of value to other firefighters. It does not investigate or review,” Christenson assures. Recent collection team efforts include:

- Hurricane responses in Georgia, Alabama, and Florida;
- Wildland fire use events;
- Alaskan wildland fires;
- Lessons and practices from the Southern and Northeastern States; and
- Southern California's 2003 firestorm.

Knowledge Retention

"What we call 'communities of practice' are often key components to how the wildland fire community learns," Christenson says. He defines a community of practice as an informal group of people with similar work-related activities and interests. "Members can belong to multiple agencies or reporting structures, yet they regularly transfer knowledge through their informal networks of peers across agencies and in different areas of the country."

In the interest of serving the various communities of practice within

the interagency wildland fire community, the Lessons Learned Center has developed an online community center at <http://www.myfirecommunity.net>.

Knowledge Transfer

The Wildland Fire Lessons Learned Center has found that the primary way to share wildland fire knowledge is through networks of professional wildland firefighters working in various organizations and communities of practice.

Recent national and regional workshops have laid the groundwork on the importance of organizational learning. Video and DVD products of these workshops are available through the Lessons Learned Center.

"It's all about organizational learning," summarizes center manager Nasiatka. "As a knowledge resource center, the Wildland Fire Lessons Learned Center is striving to help

the wildland fire community become a fully developed and dynamic learning organization."

In carrying out this significant charge, the center is constantly acquiring, interpreting, retaining, and transferring wildland fire knowledge. "As the wildland fire community becomes more involved and embraces these concepts," Nasiatka assures, "positive organizational change will take place."

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STAFF RIDE TO THE BATTLE OF LITTLE BIGHORN AND MANN GULCH FIRE



Lori Messenger

The longest hike during our Battle of Little Bighorn staff ride* takes us up to a lookout point a half mile (0.8 km) above Lieutenant Colonel George Armstrong Custer's now-famous "Crow's Nest." We are standing in southwest Montana at the final place where Custer hid and rested his troops.

From here, the infamous 7th Cavalry commander stood on that warm June morning in 1876 and tried squinting toward the enormous throng of Indian ponies where his Crow scouts were pointing. But Custer couldn't see them. These scouts told Custer that, out there in the distance, they were also seeing occasional Sioux hunting parties. Custer couldn't see them either.

The commander questioned his scouts, trying to learn as much about this enemies' behavior—and the ground they were gathering on—as he could. He seems to have sifted through this information and built as complete a situational picture as he could. Custer then made his decision and communicated it to his subordinates.

Was Custer's Decision Rational?

"Taking into account what you have learned about the Army's standard

Lori Messenger is a Missoula Smokejumper, USDA Forest Service, Northern Region, Missoula, MT.

* For more information on the staff ride learning tool concept, see *Fire Management Today* issue on the Dude Fire Staff Ride (62(4)).



Vantage point. Staff ride participants look out from the very place where Lieutenant Colonel George Armstrong Custer made his fateful operational decisions the morning of the Battle of Little Bighorn. Photo: John Grosman, USDA Forest Service, Fire and Aviation Management, Eastern Region.

Standing here now with my feet, eyes, ears—and brain—on the same piece of earth that Custer had once occupied, I begin to learn in a new way.

operating procedures in 1876, how many of you think Custer made a rational decision at this time?" asks our staff ride facilitator, U.S. Army Historian Chuck Collins. The U.S. Army Combat Studies Institute is presenting this in-depth battle examination.

Our group is 30 strong, consisting of USDA Forest Service Fire Operations Safety Council regional representatives, fire training leadership, and other Forest Service rep-

representatives; as well as fire staff from the U.S. Department of the Interior's Bureau of Indian Affairs, Bureau of Land Management, and U.S. Fish and Wildlife Service; the Montana Department of Natural Resources; and Los Angeles County.

Some participants have never experienced a staff ride before. During introductions, these novices say they hope to learn how this training tool works. The military began developing staff rides in the early 1900s and now administers them in three phases:

1. Preliminary study,
2. Field study, and
3. Integration.

In the Northern Region, we began seriously developing staff rides for wildland firefighters in 2003. That's when we started flying firefighters

and staff from a variety of agencies to the fatal 2001 Thirtymile Fire site. With this week's staff ride, we are now adding two more sites to our list of events to learn from—the Battle of Little Bighorn and the Mann Gulch Fire, which we will visit next.

The previous evening, our staff ride Incident Commander Jeff Scussel, assistant director of Fire and Aviation Management, USDA Forest Service, Northern Region, welcomed us to this week-long two-incident staff ride. He explained our objectives, to:

- Further the development of decisionmaking and leadership skills;
- Provide case studies in human factors (leadership, cohesion, and communications);
- Review high-risk, low-frequency situations and actions;
- Study and review key decision gates leading to fire management actions;
- Illustrate the value of staff rides as a national wildland fire training tool;
- Provide a team-building opportunity to regional training officers and members of the National Fire Operations Safety Council; and
- Provide selected individuals an opportunity to understand the staff ride concept and be able to apply it to their own situations.

Our required reading packet includes battle accounts from both Army soldiers and American Indians. Local tribal members Marvin Dawes, of the Crow Nation, and Linwood Tall Bull, of the Northern Cheyenne Tribe, join us to provide further insight from the Indian perspective. In addition, our facilitator Chuck Collins briefs us with background information about what the Army learned from 1866 to 1876 fighting Indian battles.

Learning in a New Way

We stand atop this ponderosa pine-covered hill, on an equally sunny, spring morning, looking miles ahead to where we know Custer and his troops will be killed.

Chuck asks us to think solely about the intelligence that Custer would have had here—without knowing what would happen next. Once again he asks, “How many of you think Custer made a rational decision?” Most of us grudgingly raise our hands. We have to acknowledge that, from all we had seen and studied so far, Custer's orders—at this decisive point—seem reasonable.

Being on the Little Bighorn Battlefield had been eerie, but for a Missoula Smokejumper, this place—Mann Gulch—hits much closer to home.

We know that frankness and honesty are important components to successful staff rides. Many of us therefore admit how, when we first arrived here this morning—even though we had been coached to remain open-minded—we were strongly biased against George Armstrong Custer. For myself, standing here now with my feet, eyes, ears—and *brain*—on the same piece of earth that Custer once occupied, I begin to learn in a new way.

For about 10 minutes, our discussion percolates. Then Chuck says it's time to move on. He has secured permission for our group to drive through private ranches so that we can better examine Custer's actions prior to the final battle.

Part of the staff ride learning phenomenon seems to be that for every question answered, three new questions arise. Facilitators need to keep the group moving, resist drawing simple conclusions, and be persistent in not allowing anyone to talk ahead of historical chronology.

At each stand Chuck follows a similar pattern:

1. Orient the ground. Show and explain what things looked like before.
2. Tell the historical story.
3. Analyze what happened before and apply these lessons to how we operate now.

Chuck also continues asking us to raise our hands if we think Custer's decision at each new point was a rational one. He explains how Army leadership made decisions in the late 1800s and how its leaders do so now. This provides for interesting comparisons to our current wildland fire organization.

Crucial Mistakes

As the staff ride hours pass, it becomes more and more clear to us that as Custer's day wore on, he started making crucial mistakes. He failed to see the evidence that the situation he faced was different than he—or any other Army leader at that time—had ever encountered. The Indians were not running. They were aggressively defending their ground.

In our staff ride prestudy information, we learned how Sitting Bull, a spiritual leader, had motivated his people to new heights of determination and organization. On the other hand, Custer's situational awareness had narrowed. He became eaten up with “*Victory Disease*.” Poor relationships with many of his follow-

ers—and even fellow leaders—caused his operation to deteriorate.

Gradually, as the staff ride continues, fewer of us raise our hands to say that Custer is still behaving rationally. We ask each other:

“When have we reached this point as fireline leaders and followers?”

Integration Phase

During integration, the staff ride’s third phase, the discussion bounces back and forth between our pre-reading, the day’s field experience, and challenges faced in the modern fire organization. Topics include:

- The importance of promoting and maintaining good relationships with your coworkers;
- The need for constant intelligence gathering and a willingness to change plans accordingly;
- Resisting assumptions about what you expect the day’s outcome to be; and
- Admitting defeat for the day and retreating before anyone gets killed—especially in fighting wild-land fires.

Many also talk about how this staff ride has allowed them to develop more important experience “slides” in their minds—to be used to compare to future incidents. One participant praises staff rides by proclaiming: “We’re not sending you to the movies; we’re putting you *in* the movies.”

Mann Gulch Fire

The next day we travel from Billings to a Helena hotel where we gather for the final portion of our Mann Gulch prestudy work. My role switches from participant-learner to facilitator-learner. Paul Fieldhouse, fire suppression and incident management training specialist for the Bureau of Indian Affairs in the

Northern Rockies, opens by asking the group to discuss how we might apply to our fire organization the concepts outlined in Karl E. Weick and Kathleen M. Sutcliffe’s book *Managing the Unexpected*.

We watch a 15-minute video of Bob Sallee, survivor of the Mann Gulch Fire, telling us what kind of young men became smokejumpers back in 1949. He reveals what this experience meant to him.

Next, Dave Turner, retired Helena National Forest employee, tells us the Mann Gulch Fire story from the imaginary viewpoint of 1949 USDA Forest Service District Ranger Bob Jansson who was in charge of the Canyon Ferry Ranger District where Mann Gulch is located. For him, the tragedy never seems to have ended. Turner’s presentation sets the tone for one of the next day’s assignments. We had asked each staff ride participant to arrive prepared to tell the story of one Mann Gulch firefighter.

Thursday dawns gray and misty. Just before 8 a.m., we drive our caravan of green vans and “six-pack” pickups to The Gates of the Mountains boat launch. Paul Chamberlin, Northern Rockies fire operations safety specialist for the USDA Forest Service, reminds us about ticks, snakes, loose rocks, and steep terrain. He instructs us to wear our hardhats.

As we motor up the river, the fog continues to rise—separating and dissipating like smoke released from its nighttime inversion. We pass through deep limestone cliffs. Our boat operator points to a cave he says contains 1,400-year-old Indian pictographs.



Paying respects. At the end of the Mann Gulch staff ride, participants negotiate the steep—fatal—hillside to honor the fallen firefighters where they died. Photo: John Grosman, USDA Forest Service, Fire and Aviation Management, Eastern Region.

Touching Sacred Ground

The history we are coming to study took place only 56 years before. I am hopeful we can trace the paths taken back then by foreman Wag Dodge and his smokejumper crew well enough to learn our own vital lessons.

As we step off the boat onto a stump and down to the river bank, there is a sense of touching sacred ground. Standing on the Little Bighorn Battlefield had been eerie, but for a Missoula Smokejumper, this place hits much closer to home.

We hike a few hundred feet into the mouth of Mann Gulch. Here, Dave Turner briefs us about what the weather and fuel load had been like back on August 5, 1949. Several of us pull marauding ticks off our arms and legs. We break into two prearranged groups: “the hares” take the lead with facilitator Paul Fieldhouse; I follow more slowly with “the tortoises.” To keep logistics smooth, we send Missoula

Smokejumper Dave Bihl ahead with a radio to help us locate important landmarks. Missoula Smokejumper Dan Cottrell brings up the rear, helping me herd the slower group and monitoring progress on our planned timeline.

We stop our groups for 30 minutes to an hour at each of the four pre-selected stands—all chosen where important decisions had been made. At each, Paul and I (sometimes utilizing Dave Turner's expertise) review significant events. We also invite two to three participants to tell the story of the "person of interest" they had been assigned. One creative soul pretends he is a ghost, providing him the analytical perspective to say retrospectively what he thought about the men's decisions and actions on that fateful day.

Leadership Key Topic

To give participants practice making and communicating decisions, we had prepared three tactical decision games. Paul and I had also developed several questions for each stand. Many center around whether or not our modern fire organization is adequately preparing people for the kinds of situations that the historical firefighters and managers faced in Mann Gulch.

We also discuss situational awareness, communication, crew cohesion, risk assessment, moral courage, and—always—leadership. We talk about where both Custer and the smokejumpers had reached their point-of-no-return.

The final stand takes place just above the rimrock where Bob Sallee, Walter Rumsey, and Bill Hellman passed through and made their final dash from the flame front. I invite participants to choose their own route up—just as those

I invite participants to choose their own route up—just as those 1949 smokejumpers had done once it became apparent that they were running for their lives.

1949 smokejumpers had done once it became apparent that they were running for their lives.

Even though the day has turned warm, chilly wind gusts buffet us at the top. Our group discusses rescue efforts. We wonder if those men died for any good reason. Then we all wander slowly back down the gulch, each of us stopping in silence to pay our respects at the monuments of the fallen firefighters.

Down at the river, we board the boat a few minutes after 4 p.m. From the chatter buzzing around me, I glean that people feel they have learned some things.

During our hour-long integration discussion at the boat dock picnic tables, most people agree that the chance to walk the physical ground instilled the lessons more deeply than any amount of reading alone could do. At the same time, participants also say that the reading helped prepare them to better understand what they saw once they arrived on the steep Mann Gulch slopes.

There is general agreement that we need to keep working on our tactical decision games so that firefighters can be clearer about what they are supposed to be doing—and *why*. We talk about the importance of communicating the commander's intent, about how we are working at developing crew cohesion, about how humans respond to life-or-death emergencies, and about how to keep situations from evolving to that point.

As the formal integration discussion concludes, dusk begins to slip around us. Informally, conversations will continue into the days and weeks ahead.

Change Fire Suppression Safety

In a follow-up staff ride report, participant John Grosman with the Fire and Aviation Management staff in the USDA Forest Service's Eastern Region, writes:

"Understanding the behind-the-scenes energy to investigate, honor, and protect this event and this site by so many folks gives me a new admiration for the people involved in this staff ride—and to those who are working to make it a standard learning exercise." Grosman also talked about the value of the prestudy phase and how *real* learning "requires personal investment of time."

The commander's intent for this Battle of Little Bighorn and Mann Gulch Fire Staff Ride is that the human factors lessons we learned will cling tenaciously to us as we advance onto our future fire grounds. We hope that participants can work to change the culture of fire suppression safety in their respective organizations. We see it happening already.

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IMPROVED DECISION SUPPORT FOR PROACTIVE WILDLAND FIRE MANAGEMENT



Tom Wordell and Rick Ochoa

In the aftermath of the notorious 2000 fire season, the National Fire Plan identified the need for a more proactive approach to anticipate fire activity. Specifically, it recognized the need to improve how wildland fire agencies preposition firefighting resources through the integration of fire weather, fire danger, and fuels information and intelligence.

The concept of “predictive services” was born.

In 2000, funding was appropriated to hire 20 fire weather meteorologists under the National Fire Plan to team with intelligence specialists and wildland fire analysts to form special “Predictive Services” units at the National Interagency Coordination Center (NICC) in Boise, ID, and within all of the country’s 11 Geographic Area Coordination Centers (GACCs).

This coordinated national Predictive Services program now integrates fire weather, fire danger, and resource information for strategic resource allocation and prioritization to:

- Assess fuels and fire danger;
- Generate daily, weekly, monthly,

Tom Wordell is a wildland fire analyst for the USDA Forest Service, National Interagency Fire Center (NIFC), Boise, ID; and Rick Ochoa is the national fire weather program manager for the U.S. Department of the Interior, Bureau of Land Management, NIFC.

Predictive Services’ greatest strength is its ability to distill voluminous amounts of weather, fuels, and fire danger information into short, concise documents that pinpoint problem areas.

- and seasonal fire weather–fire danger outlook products;
- Anticipate and predict critical fire weather events; and
- Identify fire threat areas.

Before Predictive Services

Predictive Services was born out of a need to provide both short- and long-term decision support information to fire managers and firefighters. Prior to the 2000 fire season, meteorologists, fire behavior

specialists, fuels specialists, and long-term analysts would often be assembled into regional “fire risk assessment teams.” These groups would be responsible for assessing the current and projected fuel conditions and fire activity over a broad geographic area.

However, for appropriate decisions to be made, these assessments were actually needed *before* fire activity developed. By the time these teams had assembled, analyzed the data,



Figure 1—The country’s 11 Geographic Area Coordination Centers.

and finalized their reports, much of their information was often outdated. In addition, these analyses and projections were usually a one-time effort. Information was not routinely updated. While fire managers recognized these inherent problems, the constraints of tight budgets and higher priorities prevented pursuing an immediate solution.

Continually Improving

Today, through collaborative leadership—with input from user groups at all levels—Predictive Services strives to continually improve the quality, accuracy, and relevance of decision support products provided through the multiagency coordination system to fire managers and users nationwide.

This is achieved by the development and issuance of weekly, monthly, and seasonal fire weather and fire danger outlooks, daily briefings, and various wildland fire resource and intelligence reports. While these products and information are routinely used to support wildland fire resource allocation decisions, they can also help firefighters elevate their situational awareness, especially when they move from one assignment to the next—into unfamiliar locations and fuel types.

Useful to Managers and Firefighters

Perhaps Predictive Services' greatest strength is the program's ability to distill voluminous amounts of weather, fuels, and fire danger information into short, concise documents that pinpoint problem areas with information on:

- Fuel dryness,
- Critical fire weather events,
- Location and timing of events,
- Degree of wildfire potential, and

These important events join climatologists, fire managers, and the Predictive Services personnel who coordinate preseason outlooks.

- Forecast confidence and verification information.

These documents also predict the areas that will likely be showing improvement.

Many of these products are useful to geographic area managers who want to proactively allocate resources *prior* to a fire event occurring. As previously mentioned, they are also useful to firefighters traveling to incidents outside their local area who want to gain situational awareness of weather and fuel conditions for where they are going—and even fuels and weather information on what to expect at these places throughout the following week.

Fire management is somewhat analogous to military operations in

that one must anticipate the location and time of the battle and preposition the right amount of resources to deal with the threat. By prepositioning forces ahead of dry lightning or high-wind events, fire managers can:

- Maximize public and firefighter safety,
- Reduce losses, and
- Lower costs.

Seven-Day Outlook

During the summer of 2004, Predictive Services units started developing a new “7-Day Significant Fire Potential” product. This “outlook” capability, updated daily, provides information about fire danger, weather triggers, anticipated resource needs, and other factors for the next 7 days. Fig. 2

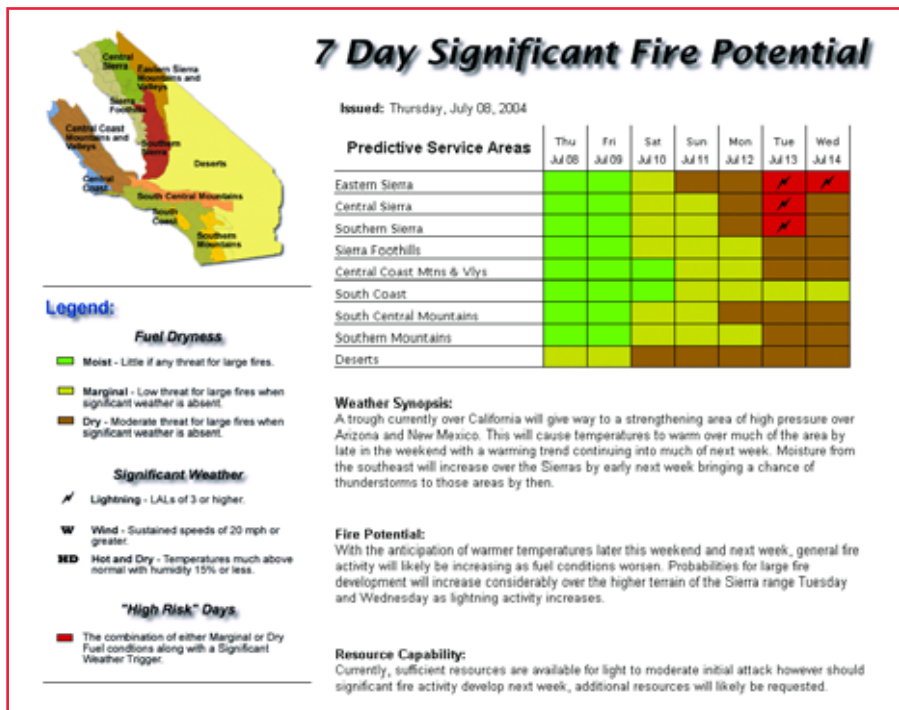


Figure 2—Example of the 7-Day Significant Fire Potential Outlook for southern California.

Information Tools

Predictive Services meteorologists utilize a variety of sources of weather information, including two primary systems called FX-Net and the Real-Time Observation Monitor and Analysis Network (ROMAN).

Forecasters use personal computer workstations running FX-Net software—provided by the National Oceanic and Atmospheric Administration’s Forecast Systems Laboratory—that allows quick and easy satellite imagery viewing, numerical weather models, observations, and radar information.

ROMAN is a Web-based application (found at <http://raws.wrh.noaa.gov/roman>) for displaying weather observations in an easy-to-understand and user-customized format from a variety of observation networks, including Remote Automatic Weather Stations near fire incidents.

Fire analysts utilize several sources of fuels, fire occurrence, and fire danger information. One important tool is the Wildland Fire Assessment System, found at an excellent Internet site (<http://www.fs.fed.us/land/wfas>), for weather, fire danger, vegetative “greenness” maps, and other fire-related information.

In addition, KCFast (found at <http://famweb.nwcg.gov/kcfast/mnmenu.htm>) provides a key source for fire weather and fire occurrence data. These data are often analyzed using FireFamily Plus, a PC program that imports weather and fire occurrence data to compute and display fire danger indices and a variety of other outputs. Other sites that display experimental gridded National Fire Danger Rating System forecasts include:

- <http://www.wrh.noaa.gov/mso/fireweather/nfdrs.php>, and

- <http://www.cefa.dri.edu/data/NatIERC/natIErc.html>.

Resource information is available via routine geographic area summaries and incident management reports available at FAMWEB (found at <http://famweb.nwcg.gov>) and the NICC and GACC websites (found at the URLs listed in the box on page 26).

A program called “CHEETAH” was also developed specifically to help Predictive Services units to assess fire occurrence and resulting resource needs. The CHEETAH program allows analysts to estimate the number of resources needed per fire episode in various geographic or sub-geographic areas.

shows an example of this outlook product for southern California.

Some of the GACCs are posting the data used to generate the graphics for the 7-Day Significant Fire Potential Outlooks. Some units also issue daily outlook reports and graphics that summarize the forecasted weather and fire behavior across the area.

Seasonal Outlooks

Monthly and seasonal outlooks are also issued by each GACC and incorporated into national products. Seasonal assessment workshops are typically held during the winter for the Eastern and Southern States and spring for the Western States and Alaska. These

One scenario that demonstrated the strength of Predictive Services occurred in the Pacific Northwest during a dry lightning outbreak in August 2001.

important events join climatologists, fire managers, and the Predictive Services personnel who coordinate preseason outlooks.

National seasonal assessments are periodically issued by NICC throughout the year. The GACCs issue these assessments prior to

their fire seasons, including one or more midseason updates. An example of a monthly national outlook—along with an overlaid plot of the large fires which occurred during that period—is illustrated in Fig. 3.

Because large fires routinely occur even under normal conditions during fire season, these maps are not intended to depict the areas in which all large fires will occur. They do, however, attempt to illustrate areas with elevated fire potential—the areas where wildland fire situations will require out-of-area resources.

Another Success Story

One scenario that demonstrated the strength of Predictive Services

occurred in the Pacific Northwest during a dry lightning outbreak in August 2001. Four days prior to this lightning event, the Northwest Area Predictive Services Unit warned fire managers about the potential for dry lightning in areas already experiencing very high to extreme fire danger.

This information—including various scenarios, confidence levels, and recommendations—allowed managers to preposition these resources:

- Air tankers;
- Contract crews and engines;
- Five task forces, each comprised of two crews, five dozers, and a water tender; and
- The staging of two type 2 incident management teams.

As forecast, the dry lightning did occur—triggering more than 200 fires. Within 3 days, 18 fire complexes were scattered throughout Washington and Oregon. But, by prepositioning firefighting resources, fire managers were able to suppress a large number of small fires and thus prevent them from becoming large, costly project-sized fires.

Presuppression Support

There's no question that Predictive Services products help fire managers make sound resource allocation and prioritization decisions for

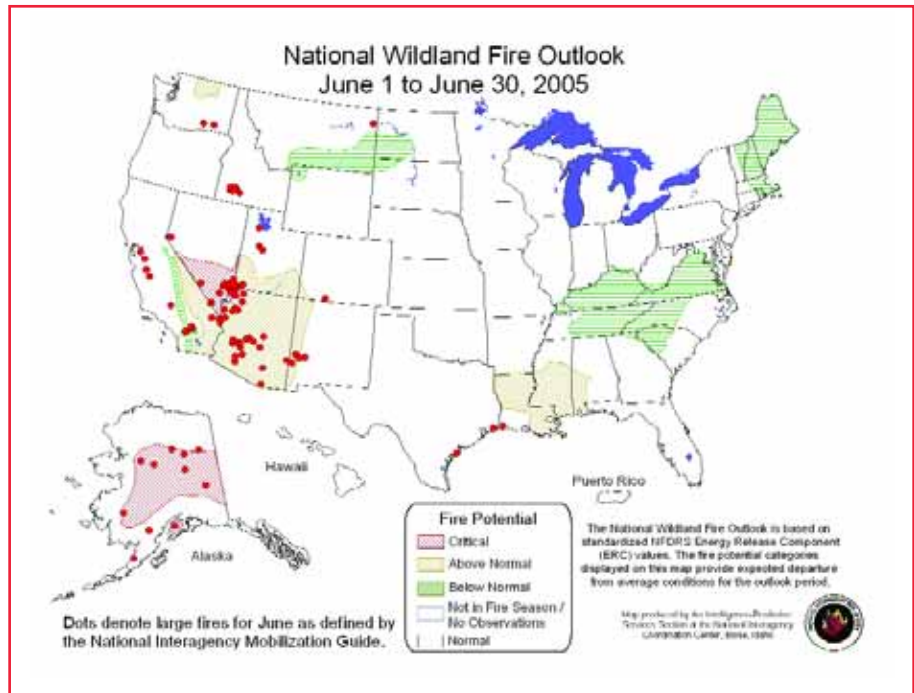


Figure 3—Example of monthly outlook overlaid with large fire occurrence (dots).

Predictive Services products help fire managers make sound resource allocation and prioritization decisions for both short- and long-range strategies.

both short- and long-range strategies.

As illustrated in the 2001 Pacific Northwest example, this vital program can help improve safety, reduce loss, lower suppression costs, and provide key situational wildland fire information to resources responding to incidents in unfamiliar areas.

For more information on Predictive Services and the associated infor-

mation tools shown in the sidebar on page 25, contact Tom Wordell, National Interagency Fire Center, Predictive Services Group, 3833 S. Development Ave., Boise, ID 83705-5354; tel. 208-387-5816; fax 208-387-5663; e-mail: twordell@fs.fed.us. ■

Predictive Services products can be obtained at
<<http://gacc.nifc.gov>> and
<<http://www.nifc.gov/nicc>>.

PORTALS: KEY TO SAFETY AWARENESS*

Paul Chamberlin



In science fiction, “portals” are amazing. Pass through an undulating portal or wormhole—or even Dorothy’s tornado—and you experience altered realities and see new dimensions. You see the universe from a whole new perspective.

Career wildland firefighters usually pass through a portal of sorts: a “safety awareness portal” that gives them new perspectives, altering their reality. Transiting the portal is often related to traumatic events, such as South Canyon or Thirtymile or a personal, more intimate close call. It may have happened to you, a coworker, or someone you read about. Some people think there is no significant emotional growth without a traumatic experience first.

Wakeup Call

Once you are through the portal, you finally comprehend how veterans whom you previously considered bland and worrisome *do* understand the severe implications of risk. You come to see why they demonstrate an absolute commitment to safe practices. Transiting the portal is like a wakeup call. Suddenly, you see the forest as trees that will grow back ... buildings as things that can be rebuilt ... but each human life as precious and irreplaceable.

Paul Chamberlin is the fire operations safety specialist for the USDA Forest Service, Northern Rockies Fire Operations, Missoula, MT.

* This article is based on the September 2004 issue of “Safety Zone,” the newsletter of the USDA Forest Service’s Fire Operations Safety Council.

Can you transit the portal without personal trauma? Herein lies the objective of every safety course ever written; the intention of all strategy and tactics; and the reason why we promote staff rides, distribute investigative findings, and ask for after-action reports on “lessons learned.” The 10 and 18, the downhill and indirect fireline guidelines, complexity analyses, fire behavior

Transiting the portal is like a wakeup call.

pocket cards, LCES (lookouts, communications, escape routes, and safety zones), and other types of safety guidance all have deep personal foundations. All were invented by compassionate individuals who have been through the portal and articulately shared their voyage.

However, involvement in a traumatic event is no guarantee that you will pass through the portal. Transiting a portal is a deep personal experience, an absolute process; it is career changing. When you cross this plane, compliance with safety guidelines is no longer a struggle. You emerge as a motivated leader with the courage to do the right thing. Driving regulations, the Interagency Helicopter Operations Guide, and the 10 and 18 become obvious and automatic—like fastening your seatbelt.

After transiting the portal, complacency is buffered by deeper insight,

often called core values, with “core” meaning all the way to the bone. Your human tendency to rationalize, succumb to peer pressure, or miss incremental changes is restrained. Oddly enough, production improves. Decisions improve. Your core values give license for confident, aggressive firefighting.

New Understanding

Wildland firefighters who have learned these lessons, either through personal experience or by studying momentous events, understand the fear that firefighters can feel. They can visualize a wall of flames bearing down, and they can run many “what-if” scenarios in their heads. They will never identify safety zones without considering such implications. They intrinsically understand the timing and trigger-point elements that are critical for escape routes; they know what a lookout must see, and they intuitively recognize when communications are compromised.

Science fiction writers rarely leave their characters out in new dimensions. At the last possible moment, their heroes make it home. However, there are no climactic escapes back from the “safety awareness portal.” Once you “get it,” you will never trade tactical objectives for safety. You will never put firefighters into situations where last-minute heroics are necessary.

Such is the altered reality of transiting a portal. ■

A NATIONAL FITNESS REGIMEN WOULD BENEFIT FIREFIGHTER SAFETY AND EFFECTIVENESS



Paul Keller

Most people like to gripe about the way it is. Others would rather do something about it. Meet Bequi Livingston.

In 1984, the former Nike “Body Elite” representative and Nike-sponsored runner was working as an engine crew member for the Smokey Bear Ranger District in Ruidoso, NM. She realized that a well-structured wildland firefighter fitness program was—unfortunately—lacking.

A multisport athlete, certified aerobics instructor, and national aerobics-fitness consultant, Livingston also knew that physical fitness and overall wellness are critical to the safety of all fire and aviation management personnel. She wanted to do something about the obvious need for a coordinated firefighter-specific fitness program.

So she did.

Thanks to Livingston, “Fireline Fitness”—an exciting, innovative, and novel approach to physical health and conditioning for wildland firefighters—was born.

Improve Effectiveness and Safety

“It’s a known fact that physical fitness plays an important role in improving firefighter effectiveness and safety both on and off the fire-

line,” says Livingston, who is now the wildland fire operations health and safety specialist for the USDA Forest Service’s Southwestern Region. “There is no better time than now to become proactive and commit to the personal responsibility of both personal health and wellness.”

“The intent of the Fireline Fitness program is to provide wildland firefighters with the basic information

“Fireline Fitness” is an exciting, innovative, and novel approach to physical health and conditioning for wildland firefighters.

for empowering them to develop a fitness regime that is basic and balanced—while still meeting the demands of wildland fire,” she notes.

Livingston emphasizes that her program is all about the basics. “It’s nothing fancy. It’s nothing extreme,” she assures. “It basically just utilizes good old common sense and moderation.”

Her Fireline Fitness program has continued to evolve over the years—taking into account valuable lessons learned from the wildland fire community. Today, it provides guidelines to help develop both

individual and crew firefighter fitness programs. It is a fitness regime that incorporates cardiovascular endurance, muscle strength and endurance, and flexibility—while simultaneously emphasizing overall wellness.

Off-Season Guidelines

To ensure that firefighters maintain an acceptable level of fitness, this unique program also provides guidelines on how to continue implementing a fitness regime during the off-season. “This also encourages overall health while making it easier to transition into fire season,” says Livingston. “In doing so, Fireline Fitness empowers the firefighter to take personal responsibility for his or her own fitness level.”

Once implemented, she says, the potential benefits are immediate. Direct savings to the USDA Forest Service and interagency partners occur through:

- The decline of Occupational Workers Compensation claims,
- Minimizing lost time due to injuries and incidents related to the Work Capacity Test, and
- Remedying improper physical fitness training, and the overuse of injuries.

“It is a proven fact that physically fit firefighters have fewer injuries and illnesses when a proper fitness program is in place—and supported,” says Livingston. She points out

Paul Keller is the managing editor of Fire Management Today.

that when a consistent fitness and wellness program is implemented and supported by management, these benefits also include:

- Lower absenteeism,
- Increased morale,
- Crew cohesion, and
- Improved productivity.

Healthy Workforce

Other benefits to an established wellness program include fatigue management and mitigation, proper hydration, good nutrition, and stress management. “These are all critical factors related directly to decisionmaking and human factors during incidents,” says Livingston.

By promoting a healthy wildland fire workforce, the Fireline Fitness program benefits the agency as well as the individual.

She adds that she believes Fireline Fitness would also be a beneficial supplement to the current policies and procedures associated with work-rest guidelines and driving policies.

Bottom line: by promoting a healthy wildland fire workforce, the Fireline Fitness program benefits the agency as well as the individual. ■

More information on the Fireline Fitness program—including its pretest, weekly workout, and exercise logs—is linked to the USDA Forest Service Website <<http://www.fs.fed.us/fire/safety/>>. Or contact Bequi Livingston at 505-842-3412; blivingston@fs.fed.us.

WANTED: A NATIONAL STANDARDIZED FIREFIGHTER FITNESS PROGRAM

Bequi Livingston

As fire season progresses and multiple assignments and traveling begin to take their physical toll, so do the physical and mental demands on our fire personnel.

Believe it or not, we currently have no standard guidelines for developing a consistent, well-balanced, and structured fitness program for our interagency wildland firefighters that incorporates wellness and safety together.

Furthermore, we have few recommendations that promote year-round physical fitness and wellness during the wildland fire off-season.

Recent surveys of wildland fire crews reveal a high rate of “over-use” injuries as well as decreased productivity due to poorly planned and executed fitness programs. The unfortunate results are further exaggerated out on the actual fireline—adversely impacting the overall productivity of wildland fire crews and compromising health and safety.

Bequi Livingston is the fire operations health and safety specialist for the USDA Forest Service's Southwestern Region.



Fitness guru. Bequi Livingston's "Fireline Fitness" program offers a novel approach to physical health and conditioning for wildland firefighters. Photo: Gary C. Chancey, USDA Forest Service, Black Hills National Forest, Custer, SD, 2005.

No Cohesive Program

While there are several informative publications currently available that address the physical fitness and training necessary to perform the job of firefighting, they do not provide comprehensive guidelines or direction for the development of a balanced fitness program that integrates all the necessary components of fitness that are applicable and realistic at the field level.

In addition, we currently have a “mish mash” of physical fitness programs developed by various wildland fire crews across the country. Some promote a well-balanced fitness program and incorporate wellness. Others, however, provide inconsistent guidelines that can be conducive to injury and over-training.

The increasing demands of “all-risk” incidents and implementation of the Work Capacity Test and Medical Qualifications Standards further the agency's current need for a comprehensive and cohesive national wildland firefighter fitness program.

We Have a Solution

Originally developed in 1984, “Fireline Fitness,” could be the solution. This novel approach to firefighter fitness has evolved and gained support over the years. It is currently being implemented by interagency firefighters nationwide.

Fireline Fitness is being developed into a special Southwest Region publication. In addition, the Federal Fire and Aviation Safety Team is considering incorporating this wildland firefighter fitness program into a national interagency publication. ■

RAPPEL ACADEMY WINS AWARD FOR EXCELLENCE



Paul Keller

A new approach to training has earned the Pacific Northwest Regional Rappel Academy the National Fire Plan annual “group award” for Excellence in Firefighting Preparedness, Training, and Safety.

Assistant Secretary of the U.S. Department of the Interior Rebecca Watson presented this national award to the academy staff in a special ceremony in Albuquerque, NM, in February 2005. The academy, located in John Day, OR, was credited for enhancing the quality and consistency of firefighter training for rappellers throughout the Pacific Northwest Region.

“We continue to demonstrate our commitment to the high standards of the National Fire Plan,” says Bonnie Wood, National Fire Plan executive director for the Pacific Northwest Region. “This is a high-risk program. We are developing and implementing a rappellers’ training program that provides high-quality, intensive instruction, mentoring, and coaching—all designed to continually enhance our program’s safety.”

Reducing Risk and Cost

Beginning in 2003, efforts to meet standardization goals—along with improved training methods—led the academy cadre to identify traditional procedures that could be adjusted and fine-tuned to reduce both risk *and* costs. These benefi-

Paul Keller is the managing editor of Fire Management Today.

Our goal is to produce rappellers who can support other bases with minimum disruption and lost time during high initial-attack activity.

cial results were achieved while simultaneously graduating rappellers with the appropriate levels of skills, training, and the versatility to operate from multiple rappel platforms.

The academy has also been a fertile environment for new and innovative approaches to rappel instruction, standardization, equipment, and procedures. “A primary goal of our rappel training is to put highly

qualified firefighters on the ground with minimum risk,” says Jon Rollens, assistant director for aviation for the Pacific Northwest Region. “Our academy’s goal is to produce rappellers who are as versatile as possible—rappellers who can support other bases with minimum disruption and lost time during high initial-attack activity.”

In 2003, the academy’s enlightened training approach resulted in fewer



Academy concept. Rappellers training at the Pacific Northwest Regional Rappel Academy. The Academy concept came to fruition with the construction of this rappel simulator tower at the USDA Forest Service-leased air-base in John Day, OR. National Fire Plan facilities funding in 2001 paid for the construction.

training rappels and a subsequent savings of almost \$50,000. These training rappels were cut by 540—a 41-percent decrease over the academy's 2002 totals. The net savings to the 2003 academy for flight time, per diem, salary, and other expenses totaled \$48,000 saved.

In 2004, employing this same training plan and adding a Bell 206L-IV helicopter to the academy aircraft, resulted in an additional reduction of 180 rappels with an estimated \$59,000 savings over 2002 costs.

“In addition to these financial savings,” adds Rollens, “a noteworthy benefit is the significant reduction in risk exposure to both agency and contractor personnel.”

Required Training

The rappel academy is required training for all of the region's rappellers. Conducted in two phases,

the region's permanent and permanent-seasonal rappellers attend a “veteran academy” in late March or early April. In early June, a “rookie academy” is hosted for the region's first-time and returning seasonal rappellers.

Support from the local John Day community for the cadre and trainees has been a key to the success of the academy's approach to training.

The academy incorporates initial training, evaluation, and certification for rookie rappellers, as well as refresher training, evaluation, and recertification for veteran rappellers. Evaluation and certification of spotter trainees is also provided.

The academy training program prepares these aerial-delivered firefighters for working interchangeably between the five regional rappel bases and several helicopter platforms. “This enhances preparedness and provides a highly mobile response in areas with multiple initial-attack fires,” Rollens says.

“Support from the local John Day community for the cadre and trainees has also been a key to the success of our academy's approach to training,” explains executive director Wood. She said that the area's schools, the county fair board, and local food service vendors have all provided room and board for academy participants.

“This,” Wood points out, “has resulted in a much-needed economic boost for the local resource-dependent economy.” ■

INTEGRATING SOCIAL SCIENCE INTO FORESTRY IN THE WILDLAND/URBAN INTERFACE



Jeffrey J. Brooks, Hannah Brenkert, Judy E. Serby, Joseph G. Champ, Tony Simons, and Daniel R. Williams

A different kind of storm—neither fire nor wind—brought 60 forestry practitioners who work in wildfire risk prevention and several social science researchers together near Lyons, CO.

Brainstorm.

This unique retreat—a meeting of the minds—commingled these two groups to share and tackle ideas concerning social issues that shape decisions and behaviors regarding wildland fire risk mitigation across Colorado's wildland/urban interface communities.

The 2-day “Are you FireWise? Understanding Social Values” retreat began with two general questions:

1. We understand the biological science necessitating fuels reduction in the wildland/urban interface. How can we better understand social values so that we are more effective working with interface communities?

Jeffrey Brooks is a social science analyst and Daniel Williams is a research social scientist for the USDA Forest Service, Rocky Mountain Research Station, Fort Collins, CO; Hannah Brenkert is a graduate research assistant at the Institute of Behavioral Science, University of Colorado, Boulder, CO; Judy Serby is supervisor of the Conservation Education Division, Colorado State Forest Service, Fort Collins, CO; Joseph Champ is an assistant professor in the Department of Journalism and Technical Communication, Colorado State University, Fort Collins, CO; and Tony Simons is a wildfire safety specialist for Larimer County, Fort Collins, CO.

Forestry practitioners expressed frustration over a lack of concrete solutions from research findings for reaching fuels mitigation mandates.

2. How can we increase FireWise behaviors at a level higher than one homeowner at a time?

Four Central Objectives

This event—sponsored by the Colorado State Forest Service,

Key is Communication and Trust

The success of collaborative forestry and wildland fire and fuels management depends on long-term communication and relationships of trust among diverse stakeholder groups (Shindler and Toman 2003; Wondolleck and Yaffee 2000).

The 2003 strategic framework for the USDA Forest Service Rocky Mountain Research Station described six research and development areas of focus, including communicating with stakeholders.

One communication strategy is to build relationships between social science researchers and the users of the research—practitioners—to ensure the implementation of social science findings (Alexander 2003).

Larimer County, CO, and the USDA Forest Service—had four central objectives:

1. Reveal obstacles to effective wildland fire mitigation in Colorado,
2. Share alternatives among practitioners facing similar barriers,
3. Open lines of communication between practitioners and social scientists, and
4. Provide opportunities to build agendas for further social science research and future workshops.

Four studies were presented that addressed the human dimensions of wildland fire and fuels management in various parts of Colorado's Front Range. The studies were agency–university collaborative efforts conducted by social scientists from Colorado State University, the University of Colorado, and the USDA Forest Service. (These research presentations can be viewed at <<http://www.colostate.edu/Depts/CSFS/FWeducators.htm>>.)

Frustrations Expressed

Forestry practitioners expressed frustration over a lack of apparent, concrete solutions from the research findings to address the

challenges that they face in their efforts to reach fuels mitigation mandates. Questions of when, where, and for whom practitioners can increase participation in mitigation projects were not directly answered. A “how-to cookbook” or “silver bullet” was not provided by any of the social scientists.

Furthermore, some practitioners seemed frustrated by a lack of social science research in their specific geographical areas. Concern was voiced about the differences across communities and counties. Statements such as “*what works in Gilpin County won’t work in Boulder County*” were voiced again and again. Thus, to explore the social and ecological diversity in the State—particularly in western Colorado—a common desire surfaced to see these studies conducted in a wider variety of settings.

Wildland Fire Risk Perceptions

Researchers and community practitioners also shared interest in research that describes how individual homeowners perceive, process, and respond to information about wildland fire risk. Participants learned that age, income, and education might be less useful for predicting mitigation behaviors than a resident’s familiarity with the information about mitigation.

More research is needed, however, to better understand what general factors might increase interface residents’ FireWise behaviors and their management of fuels.

In general, the panel and the audience discussed the importance of collaboration—or partnering—to identify barriers to communication. Many of the practitioners agreed that relationship building and

It appears that the research needs of forestry practitioners are primarily unknown or misunderstood by researchers.

developing trust are paramount when working with interface communities. Some practitioners described their successes as long-term efforts that involve regular interactions with communities.

Important Tool

The researchers and practitioners tended to agree that before education programs or fuels projects are initiated, it is important to understand the multitude of ways that people and communities define the problems that affect them. “Framing”—defining the issue based on what is important to a group of stakeholders—was identified as an important tool to help understand this problem of definition.

The general consensus seemed to be that frames of reference can affect responses to information about possible fuels reduction projects. Practitioners now realize that paying attention to how stakeholders *frame* wildland fuels issues in their own communities helps them to better tailor their interactions with community members.

Some practitioners think that a case-by-case community-level approach can be successful in the long term. They discussed the importance of learning two-way communication skills as they proceed in their work to build relationships and to develop projects that fit a community’s needs and values. A second group of practitioners, however, wanted more generalized solutions to barriers that might be applied across communities.

Both approaches to the problem were represented in the research presentations. Depending on what question is being addressed, both mindsets can be appropriate.

Key Themes and Lessons

Key Theme

It appears that the research needs of practitioners are primarily unknown or misunderstood by researchers. This could be due, in part, to a key theme of the “Are you FireWise? Understanding Social Values” retreat that practitioners appear to be fundamentally divided regarding the kind of social science research that is relevant—case studies of individual communities, or studies that identify solutions and develop tools that can be applied across differing communities.

Some of the issues raised by practitioners are not researchable questions. And, in some cases, findings might exist in the social science literature but have not yet been summarized and made accessible to practitioners.

Key Lesson

Forestry practitioners and social science researchers need to talk more and collaborate better about the specific questions and problems practitioners are trying to solve *before* the social scientists design research studies and summarize existing social science findings.



Breakout Session. Retreat participants discuss communication barriers to fuels mitigation. Photo: Joseph Champ, Assistant Professor, Department of Journalism and Technical Communication, Colorado State University, 2004.

Breakout Sessions

During the retreat's second day, participants—in smaller group discussions—were instructed to:

- Discuss how research can benefit community projects,
- Identify additional research needs, and
- Develop a list of barriers to implementation, along with possible solutions.

Facilitators took notes on flipcharts and researchers video-recorded each session. The notes and videos from all sessions were independently studied and discussed by three of the researchers. Their analyses and results were summarized and organized into themes that are illuminated and discussed in this article.

Common Goals and Definitions of Success

The failure to mutually agree on goals and to define success *before* funding fuels projects was identified as one of the most notable barriers to successful implementation of these efforts. For example, why spend money to thin timber in communities in lodgepole pine forests when evidence exists that thinning is not effective for that vegetation type?

Standard definitions of success, however, presented a problem for some participants. Once again, practitioners discussed a conflict between wanting to develop consistent goals across administrative agencies and the problem of differences in ecological, community, and organizational conditions and values across Colorado. (For related issues and proposed actions, see sidebar.)

Appropriations Mentality

Participants identified a tendency to want to solve problems through the allocation of funds as a political barrier to successful fuels management in communities. This “appropriations mindset” operates under the faulty assumption that allocating money will fix the wildland/urban interface fire problem.

While adequate funding is important for solving this problem, because management of wildland fire risk in the interface is uncertain and complicated, it will not be solved solely because funds are appropriated.

Timelines

Timelines for community projects are important on two levels:

1. The distinction between short-term and long-term goals needs to be clearly communicated. Short-term goals are to reduce fuels here and now. Long-term goals are to develop community capacity to sustain fuels mitigation projects and to foster fire-safe decisions as communities evolve—and vegetation continues to grow, residents leave, new residents move in.
2. Organizations are beginning to understand that success related

to understanding wildland fire risk in communities is based on building relationships and trust. Therefore, organizations need to redesign project goals to ensure that they have the flexibility to meet community timeframes.

Aesthetic Values

Concern among interface residents about the impact of fuels reduction on their private property has been an issue consistently heard by practitioners and researchers. Practitioners are generally aware that the goals of communities to maintain certain aesthetic features often do not match the programs that encourage thinning and defensible space on private property. Interestingly, there appears to be a fundamental difference of opinion among practitioners about how to address this.

One set of practitioners feels that partnering and education have overcome the aesthetic values issue. They cite evidence from their experiences that some residents tend to appreciate the look and qualities of their properties even more after vegetation thinning.

The other group of practitioners indicates that, despite increased awareness and partnering, resistance by some residents to alter the landscape continues. This group asserts that they cannot necessarily change the social values of residents who insist that the experience of living in natural-looking forests is worth the risk of wildland fire.

Outreach to Communities

For forestry and other natural resource practitioners, outreach to communities is difficult, expensive,

and time-consuming. Most practitioners agreed that they do not have the appropriate tools to help them effectively identify leadership and organization in their target communities.

There was agreement that diagnostic or assessment tools might be important to help practitioners identify community strengths, leaders, resources, and readiness to collectively manage fuels.

Practitioners expressed another concern that attempting to meet project goals that were determined prior to learning about a community's capacity and history might be shortsighted. Some practitioners believe that this shortsightedness can stall forward motion or diminish the progress communities have already made.

An important lesson that was shared by several participants reflected a similar plan or path to success. This path entailed several years of relationship building within the communities for proposing fuel reduction and FireWise programs. One successful strategy described by practitioners is to initially share information about basic forest ecology that is relevant to the local context. As interest emerges, the practitioner can present more specific risk reduction and fuel management plans.

Communication Dilemmas

Practitioners in the field interact with communities and residents on a regular basis. Thus, they have accumulated a wide variety of experiences and insights that are useful for accomplishing their goals. It appears, however, that they can undervalue their own experiences and insights or might not know

how to best communicate their experiences to others.

Rather than sharing with each other, some practitioners tend to look to academic social scientists to tell them what works. Such communication barriers among practitioners can prevent recognition of what they already know from experience. Furthermore, when the experiences of practitioners match up with those of their peers, their

Practitioners can start by honestly telling communities that there is no guarantee that enough resources exist to stop all interface fires.

confidence is bolstered regarding their own solutions to the challenges they face.

Another important communication issue is the gap between social science researchers and practitioners. Differing language and goals are some of the challenges that keep social science researchers and practitioners from effectively working together. Some practitioners, looking for the “silver bullet,” expressed concern that they had not learned anything new from the research presented at the retreat. Others, however, found these studies to be useful because they confirmed some of their assumptions and dispelled others.

A third communication issue involves the length of time it takes for a message to reach and be adopted by the public. This lag time is problematic because defensible space and firesafe norms change

over time—as do the products available to interface residents. Keeping the public up to date with current county regulations and the products or options available to address these norms is an enormous challenge.

Barriers

The primary problem preventing communities from properly addressing wildland fire risk is inadequate communication at three levels:

- Organizational,
- Community, and
- Individual homeowner.

Common goals and definitions do not exist among these three groups to appropriately address wildland fire risk. Barriers to communication at the highest organizational levels filter down to the community level. This presents challenges for practitioners and community members working together to manage the risks on the ground. Finally, an overemphasis on individual homeowners is a barrier to effective relationship building and collective action in communities.

Organizational—Beware Appropriations Mindset. Several organizational issues became apparent during our analysis of the retreat. An appropriations mindset has resulted in considerable amounts of funding targeted to interface communities—without a clear understanding of the capacity and ownership needed to organize and sustain projects that people regard as successful.

Project goals defined under these broad organizational plans primarily measure success through the treatment of acres. As long as acres treated remains the only measure

of success, the practical goal of treating acres and the true goal of reducing risk for people living in the interface will remain at odds.

This problem is further complicated by the fact that practitioners trained in forestry and technical natural resource management are being asked to reduce fire risk through community outreach. Yet, problems of community outreach and organization are not well suited to concrete technical solutions such as thinning acres of trees to produce desired outcomes. Due to their disciplinary training, some practitioners therefore lack the skills and knowledge needed for making social assessments. Furthermore, specific tools do not exist to evaluate the communities targeted for fuel reductions and FireWise programs.

Working with interface communities to develop collective management of fuels and to reduce the risk of wildland fire is a problem of long-term coexistence between people and fire in the interface. The timelines for the accomplishment of tasks must be carefully considered. Long- and short-term goals must be identified and documented. To foster success and sustainability for community wildland fire mitigation projects, longer timelines should be considered.

Many of these barriers are administrative, organizational, and political in nature. They are beyond the influence of many practitioners and social science researchers. Acknowledging and documenting these issues, however, can help clarify barriers to effective communication and the collective management of wildland fire risk.

The practical goal of treating acres and the true goal of reducing risk for people living in the interface will remain at odds.

Communities—Establishing Trust.

Because communities are the main target for outreach efforts, communities and practitioners need more ways to talk about, measure, and report successes—in addition to counting acres treated.

Because of their lack of clear measures for success, community programs are often difficult to define and evaluate. This dilemma presents a significant challenge to working with communities. On private land, practitioners should consider community-defined success as the priority for projects. The administrative goals should be of secondary concern.

Differences among communities will continue to make concrete solutions difficult to attain. Community-specific knowledge that is collected by practitioners is particularly useful. Time spent with community members, relationship building, and attending community events all constitute locally relevant research that is invaluable to the successful implementation of projects.

As practitioners work in communities and establish relationships of trust, they will achieve understanding with residents regarding how the community actually sees its situation, above and beyond the appearance of individual properties. This perception will allow practitioners to better mold their education programs and fuels projects to more appropriately fit individual communities. Furthermore, this practice can also provide practition-

ers with a heightened ability to understand and clearly report on realistic community timeframes for success.

A significant challenge to practitioners is the changing composition of communities and community leadership. Similarly, job turnover and organizational changes might lead to several different practitioners working within the same community for short periods of time. This could jeopardize consistent relationship building and the establishment of trust among practitioners and community members.

Community members should be brought into the research process as much as possible. Applied action research principles and techniques (Stringer 1996) can be learned by practitioners to help them increase community members' participation and strengthen the partnering process. One strategy might be to document and share the process of partnering and assessment as it unfolds between practitioners and residents in similar places.

Individual Homeowners. Aesthetic values are particularly important to individual homeowners. In fact, aesthetic concerns regarding the impact of fuels treatment on private properties might be more important to some residents than the expense of mitigation when deciding whether to thin trees.

A small number of vocal residents could refuse to alter the appearance

Continued on page 42

Issues and Proposed Actions

Common Goals and Definitions of Success

Issue

Practitioners are concerned with a lack of alignment between generalized goals as defined in the broad funding plans of the organizations and the varying, more specific goals that exist within communities. These often emerge according to how a community has framed both the issue and acceptable solutions.

Proposed Action

Fuels management projects and education programs should be evaluated based on what communities consider successful. While the higher level goals of the organizations remain important, community-defined success stories should be given equal weight for evaluating community projects.

Appropriations Mentality

Issue

Retreat participants discussed a concern that seems to have roots in the history of appropriating money for wildland fire suppression in the Western United States. The apprehension is that a lack of incentive exists for some counties to invest in wildland fire risk mitigation because of a belief that Federal funds will clean up the costs—or simply prevent destruction by containing large wildfires. Does a suppression

mentality reinforced with agency funding send conflicting messages to interface communities being told that it is *their* responsibility to help mitigate the risks of wildland fire?

Proposed Action

Directing funds at the wildland/urban interface problem in a community before it has a sense of ownership for a fuels project can complicate the situation. Time should be invested to foster ownership and responsibility for risk reduction projects *before* approaching communities with grants. Practitioners can start by honestly telling communities that there is no guarantee that enough resources exist to stop all interface fires that might threaten them.

Timelines

Issue

Short-term goals often undermine the success of long-term goals. Treating acres on 2-year grant cycles can conflict with the goal of sustainable and self-organized communities who continue to make firewise decisions.

Proposed Actions

Social science studies and longitudinal data are needed to track whether or not communities that have been considered short-term successes continue to manage fuels over the long term.

Organizations need to identify and state their goals according to long-term and short-term consid-

erations and, thus, take the appropriate action.

Aesthetic Values

Issue

It appears that some practitioners are narrowly defining social values in terms of aesthetics. This frustrates their efforts to engage the community in discussing broader concerns. When practitioners define social values only in terms of viewsheds, privacy, and natural appearing forests, they oversimplify the problem.

Proposed Actions

Practitioners can discover the broader visions of communities by learning about and respecting their residents' environmental values, opinions, and preferences for land management.

Responding to how communities define the problem involves tailoring fuel reduction messages to match these definitions, and exploring with residents how their values and concerns might already be compatible with mitigation plans.

Outreach to Communities

Issue

Practitioners want some indication or measure of general community readiness and capability to partner on fuel reduction projects. A primary concern is that without such tools, money that is being allotted to programs will not be well spent.

Proposed Actions

Social science research is needed to establish how response to risk, partnering, and readiness to manage differ by:

- General demographics,
- Level of community organization,
- Region, and
- Amount and type of skills and resources in communities.

Issue

Practitioners are concerned that predetermined project goals can undermine community work. Lack of consistency between community goals and organizational goals creates obstacles.

Proposed action

Early in the partnering process, practitioners need to understand what communities have accomplished in identifying leadership and resources, how they work together, and how—as a community—they define the problem. Social science researchers can help through case studies.

Path to Success

Issue

Successful community projects depend on long-term relationship building and the establishment of trust between practitioners and community members.

Proposed Action

It appears that the best way to build relationships and to perform assessments is for practitioners to be present in communities on a regular, long-term,

and interactive basis. To facilitate success, organizations should also consider the need for long-term consistency in personnel. One strategy might be to allow practitioners to work within the same communities for 5 to 7 years—while adjusting funding cycles accordingly.

Communication Dilemmas

Issue

There are interorganizational communication barriers that prevent practitioners from relying on each other as resources.

Proposed Actions

To facilitate sharing, FireWise and mitigation professionals need to ensure that project information is accessible in a central location. If documented and shared, models of success and failure can serve as invaluable tools among practitioners. Short stories of successes or mistakes could be posted on Websites maintained by education and multimedia specialists. Such actions could help to transform the current state of wildfire risk management into a well-organized community of professional practitioners.

Research and Practitioner Gap

Issue

An important communication link is missing between community practitioners and social science researchers working on the wildland/urban interface fire risk problem.

Proposed Actions

Make the time for researcher and practitioner interactions. Find a common, jargon-free language that both groups can understand. Outreach social scientists with extension experience need to assist practitioners to bridge the divide between the models, findings, and recommendations of academic research and actual implementation in communities.

Issues

Practitioners feel that the basic concepts communicated in the brochures should be consistent where appropriate, but must also reflect any current differences in ecological and regulatory conditions across the State. FireWise publications and brochures must be current and contemporary to reflect this information.

Proposed Actions

Standard FireWise information developed for certain regions of the State should be carefully discussed and adapted by practitioners and communities to match local project conditions—such as elevation and forest type. In addition to standard FireWise brochures, preferences for types of media and multiple media outlets (local newspapers, TV, radio, Internet, and new electronic technologies) should be reviewed and

of their land. These people might not trust partnering with outsiders. They might never participate.

Solutions for Improving Communication

Communication problems within organizations at higher levels of administration often present frustrating situations for practitioners trying to build effective and appropriate programs for more local levels. State, regional, and local levels, however, present many opportunities to develop potentially successful plans to address the interface wildland fire mitigation problem.

The primary challenge is integrating communication, management, and education programs across these hierarchies of organization. It is clear that partnering and sharing information—across organizations, with communities, and between practitioners—have improved. These efforts need to remain top priorities when addressing the interface wildland fire mitigation problem.

There is a general need for better communication and partnering between practitioners and social science researchers in defining research goals. Social science research findings need to be given to practitioners more quickly in a centralized location to be used as internal resources. For some studies, this means making findings and practical recommendations available in a format that is accessible—and understandable—to practitioners, before academic publication.

Research and Practitioner Communication Gaps

Because they often do not know what types of information or tools are useful for practitioners, researchers struggle to translate social science research into usable tools. Research agendas could therefore be refocused to work with practitioners' needs. And social scientists could consider interviewing more community practitioners to inform early stages of study development.

Social science research has the potential to contribute new insights for understanding the human dimensions of wildland fire risk reduction. Research findings from social science studies that could be applied to more than one community beyond the case study are sought by practitioners.

Social scientists can also conduct program evaluation studies and practitioners can document when communities feel they have achieved success. However, even when social science is able to contribute important findings about general demographic characteristics (level of community organization, leadership, etc.), this information can only be useful to practitioners if they know something about local demographics and community organization.

In other words, practitioners still have to know their communities to decide what general findings from studies are appropriate for local conditions and values. A key lesson for practitioners is that research findings always need to be interpreted in the context of their particular situations. Most social sci-

tists will not be able to do that for practitioners.

Practitioners' Invaluable Insights

The knowledge and insights of practitioners currently in the field should not be underestimated. Their personal research in communities provides invaluable insights. Practitioners who are open to the possibility could receive training to improve their techniques. Their insights—and success stories—should be documented and shared among all stakeholders.

These insights could be developed into rapid assessment tools or into screening tests to determine which communities are ready to begin relationship building. For example, before proposing a community project, a general checklist of key considerations about a community could be developed and used.

Furthermore, opportunities also exist to build collaborative relationships with nontraditional partners, such as:

- Environmental groups,
- Realtors,
- Homebuilders,
- Natural resource and landscape planners,
- Insurance company representatives, and
- Retail businesses.

Such a variety of partners could help update and share information about the various aspects of mitigation in the interface. Some particularly relevant topics would include FireWise construction materials and the development of markets for utilization of small-diameter wood byproducts.

More Retreats Recommended

Leaders from both the research and management communities who work in wildland fire risk mitigation should consider organizing and attending future retreats and workshops to build upon our October 2004 retreat.

In future meetings, researchers could listen to presentations from practitioners about their community projects. The meetings and discussions should be analyzed and

documented for lessons learned—similar to the findings of this article.

We must integrate the shared knowledge of social scientists and practitioners to develop summarized tutorial themes. Such undertakings could be used in training courses and assessment guides to help diagnose community capacity and barriers to collective risk management that is considered both successful and sustainable by all stakeholders.

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WILDFIRE MONITORING USING WIRELESS SENSOR NETWORKS



David M. Doolin and Nicholas Sitar

Effectively managing wildland fire requires understanding fire behavior well enough for predicting and controlling fire occurrence, rate of spread, combustion of fuel, and other factors. Safely controlling fires requires both understanding fire behavior and managing firefighters and firefighting equipment.

Recent advances in computer technology have spurred the development of small low-power computers, 0.8 inches by 2 inches (2 x 5 cm) in size, called “motes”. They host a wide variety of sensors, including:

- Temperature,
- Humidity,
- Barometric pressure, and
- GPS-determined location.

Motes communicate using high-frequency low-power radios. They may be programmed with applications allowing them to self-organize into wireless networks for reporting data to remote clients.

This article describes the architecture and field trials of a wildfire-monitoring system built with off-the-shelf sensor mote technology. A set of unique data collected using this system during prescribed burns is also discussed.

David Doolin is an assistant research engineer and Nicholas Sitar is a professor of civil and environmental engineering and the Director of the Earthquake Engineering Research Center, University of California, Berkeley, CA.

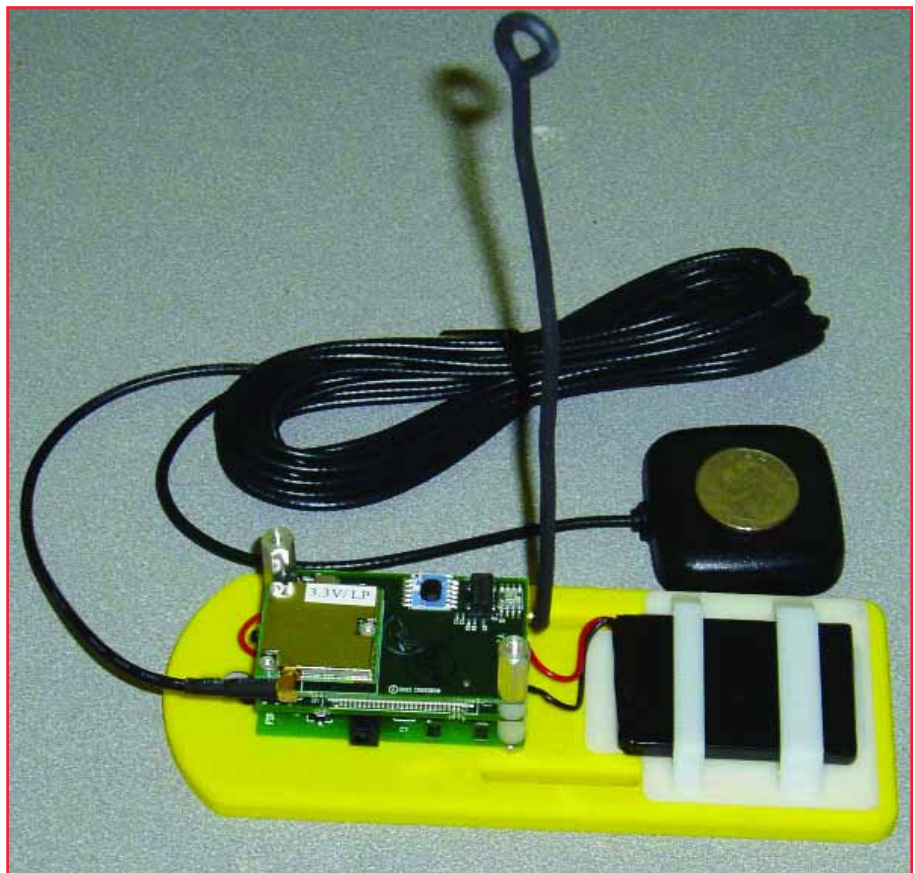
Wildfire-Monitoring System

The wildfire-monitoring system is comprised of a wireless sensor network coupled to visualization client software running on personal computers. The data collected by instruments in the sensor network

are stored in a database, which is then queried by the client application.

The client application combines the data with GIS information to display the environmental conditions at each mote in near-real time. The

Low-power wireless sensor technology can be successfully deployed in wildland fires to collect local environmental conditions such as temperature, relative humidity, and barometric pressure.



Advanced Technology. Sensor mote with Lithium-ion battery and charging system mounted on a development chassis.

network uses hubs to forward sensor data to a tablet computer base station running packet collection and database interface software and a database server.

Sensor data collection and network applications are written in the nesC (Gay and others 2003) programming language to run in TinyOS, the Tiny Operating System (Levis and others 2004; Levis and others 2005). The sensor board collects:

- Temperature,
- Relative humidity,
- Barometric pressure,
- Light intensity, and
- A GPS-determined location on an approximately 2-second sampling interval.

Each sensor mote in the network communicates to the base station mote—possibly using neighboring motes to forward data packets when out of direct communication range of the base station. Because the passage of the flame front can quickly destroy a mote, algorithms for “multihop” data transmission—to ensure reliable delivery of data—are under active development.

More details of the hardware and software developed for this project are presented in Doolin and others (2004) and Doolin and Sitar (2005). The system was designed to be simply operated for fast deployment and increased reliability.

Field Testing

Point Pinole Regional Shoreline is located approximately 15 miles (24 km) northeast of San Francisco on a peninsula extending into San Pablo Bay. The prescribed burns at Point Pinole were conducted by the East Bay Regional Parks District Fire Department. (Participating in

Testing the system required collaboration with numerous governmental agencies and many rehearsals to ensure the system worked correctly during the controlled burn events.

The wildfire-monitoring system tool chain consists of many commercial off-the-shelf hardware and software components that communicate through customized interfaces:

- Wireless sensor motes.
- Stargate hub with base station mote.
- 802.11b Stargate to PC application server.
- Application server to Internet link.
- The monitoring system Web application toolset.

prescribed burns required the authors to earn type 2 wildland firefighting certification.)

The burn site at Point Pinole was a flat field with primarily annual grasses with sparse poison-oak and coyote bush shrubs, best characterized by National Forest Fire Laboratory (NFFL) fuel model 1—fuels weighing approximately 1 ton per acre (2.2 t/ha) (Anderson 1982). Fires in this fuel type are characterized by fast rate of spread with relatively short flame lengths.

Deploying the motes required considering flame length, rate of spread, and radio communication range. Horizontally, motes should

be located far enough apart to allow estimating rate of spread, while being close enough to a base station collecting data transmitted with low-power radios. Vertically, motes have to be deployed far enough above the fuel to allow radio communication, but not too far above the flames to prevent environmental fire data from being collected.

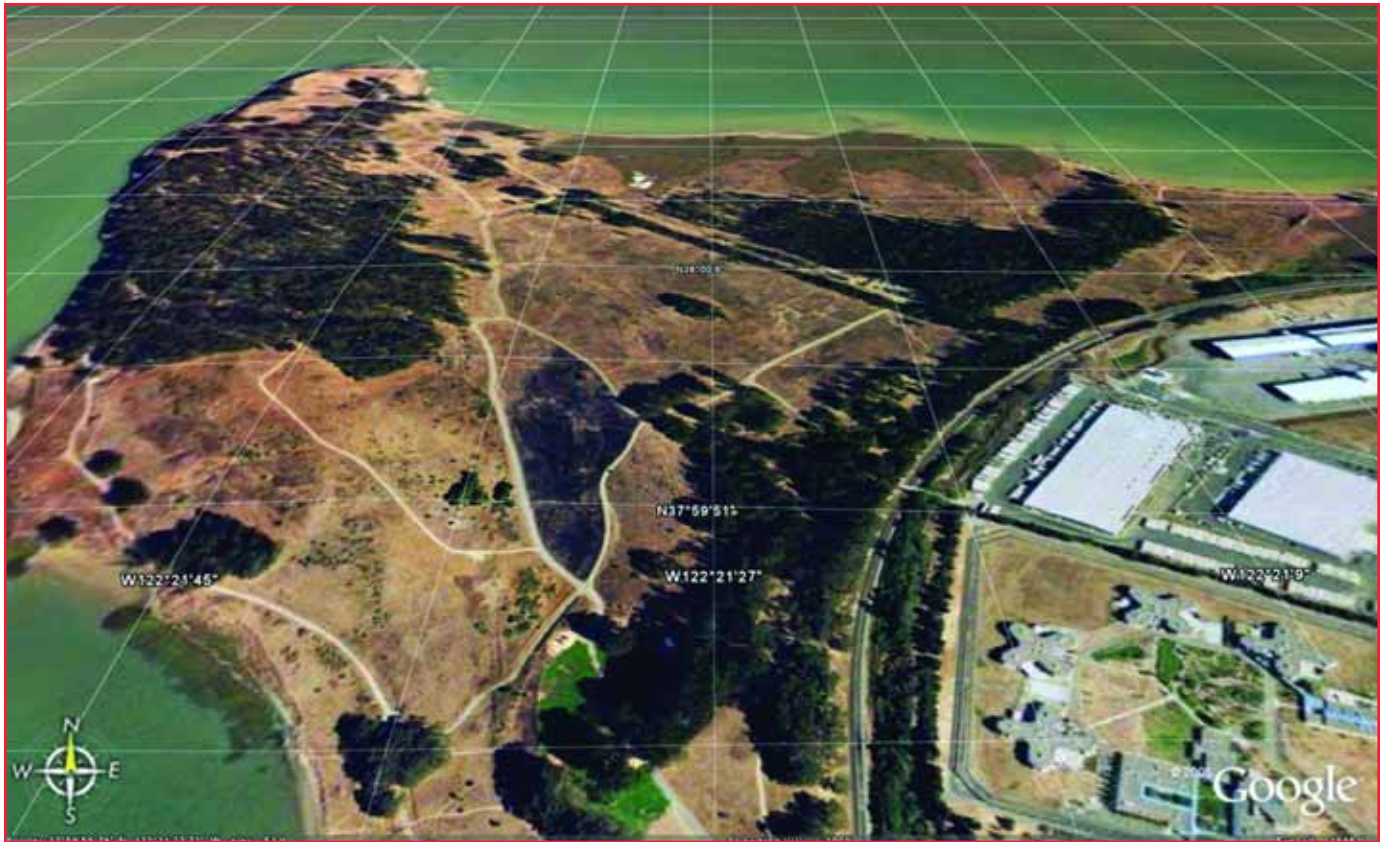
For NFFL fuel model 1 fuels consisting of half-meter (1.6-ft) grasses, motes were deployed on cedar stakes approximately 5 feet (1.5 m) from the ground. The estimated flame length was approximately 5 feet (1.5 m).

Controlled Burn Data

Test burns at Point Pinole were conducted on September 16 and 30, 2004. The passage of the flame front across the mote field is clearly shown in the temperature and relative humidity responses.

The response of motes 2 and 10 illustrated how the temperature, relative humidity, and barometric pressure react as the fire progresses. An upward trend in the temperature during the time interval from 11:17 a.m. to 11:19 a.m., followed by a downward trend from 11:19 a.m. to 11:21 a.m. was also shown.

Our preliminary interpretation (Doolin and Sitar 2005) is that the initial upward trend results from radiant heat of the flame front, followed by local weather conditions as indicated by the downward trend. The relative humidity shows exactly inverse behavior from temperature. The barometric pressure data have too much scatter to indicate subtle changes in the local weather conditions.



Burn Site. Looking north toward the Point Pinole burn testing area's annual grasses from approximately 2,000 feet elevation. Image with superimposed latitude and longitude lines courtesy © Google Earth. (The use of trade, firm, or corporation names in this publication is for the information and convenience of the reader. Such use does not constitute an official endorsement of any product or service by the U.S. Department of Agriculture. Individual authors are responsible for the technical accuracy of the material presented in Fire Management Today.)

Future Trends and Developments

The following will help calibrate and improve existing fire propagation models:

- Quantitative data measuring the rate of wildfire propagation,
- The local temperature and relative humidity distributions at each mote as the flame front travels, and
- The radiant heat produced by the fire as it grows in size.

Existing fire propagation models include BEHAVE (Andrews and Bevins 1999), FARSITE (1999), as well as newer models for simulating wildfire behavior on hectare-scale areas developed at the University of California, Berkeley (John Radke, personal communication).

The small size of the mote package allows deploying motes onto individual firefighters. The simplicity of the system permits deploying a network of motes with a team or engine. One or more motes could also be used as a “lookout” system.

For example, Eckert (2004) suggests that a lookout could have provided earlier warning for the hot-shot crew forced to deploy fire shelters during the 1988 Brewer Fire—possibly allowing enough time to escape. Wireless sensor motes reporting temperature, relative humidity, and barometric pressure can function as unmanned lookouts—reporting dangerous conditions to firefighter teams and the incident command simultaneously.

Summary

Low-power wireless sensor technology can be successfully deployed in wildland fires to collect data on local environmental conditions such as temperature, relative humidity, and barometric pressure. The sensor network was composed of newly available commercial off-the-shelf motes and sensors, as well as publicly available Web and database server applications. Testing the system required collaboration with numerous government agencies and many rehearsals to ensure that the system worked correctly during the controlled-burn events.

Fuel types and topography influence horizontal and vertical deployment of sensors. In extreme conditions, when the physical survival of the sensor is unlikely, the termina-

Wireless sensor motes can function as unmanned lookouts—reporting dangerous conditions to firefighter teams and the incident command simultaneously.

tion of data reported from a mote provides an indication of the location of the flame front at a particular time.

In future tests, we anticipate using failure times for an array of sensors to estimate the speed and direction of the hot, fast-moving flame fronts. Because each unit has GPS capability accurate to 5-meter (16-ft) resolution, data from arrays of sensors can help during case studies for reconstruction—supplementing traditional methods described by Alexander and Thomas (2003).

The data collected from the sensor arrays at Point Pinole appear to be unique in scope regarding:

- Density of sensor coverage,
- Speed and accuracy of sampling,
- Simplicity and speed of deployment, and
- Unit cost per data point.

We expect both the quality and quantity of data collected will improve as the technology matures, for order of magnitude or more cost reductions.

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MACHINE PROVIDES ACCESS TO WETLANDS



Gerald Vickers

Twenty-five years ago, the oil industry needed an off-road vehicle that could carry several people and equipment over land, water, and marsh inside its Louisiana swamp testing grounds. In 1981, Coast Machinery, Inc., delivered its first “Marsh Master” to an oilfield surveying company in Lafayette, LA.* “That machine is

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* The use of trade, firm, or corporation names in this publication is for the information and convenience of the reader. Such use does not constitute an official endorsement of any product or service by the U.S. Department of Agriculture. Individual authors are responsible for the technical accuracy of the material presented in *Fire Management Today*.

Beginning in the mid-1990s, the machines were used to help suppress large marsh wildfires and to assist in prescribed fire operations.

still in use today,” says John Coast, Coast Machinery president.

The U.S. Department of the Interior, U.S. Fish and Wildlife Service purchased its first machine in the early 1990s. Since then, Marsh Masters have become known for their high-quality engineering and high-flotation, low-ground-pressure capabilities.

Today, due to its customers’ needs, the company has developed three different models, specialized mow-

ers, and fire suppression packages to support prescribed and wildland fire operations.

How It Works

The Marsh Master utilizes a rubber belted track running on a wheel system that encircles a pontoon. This track and pontoon system—coupled with an all-aluminum frame design—allows for high flotation and good stability in open water. The machine requires very low maintenance.



Safe space. A Marsh Master provides structure protection during interface prescribed fire operations at Blackwater National Wildlife Refuge, MD.

Due to its high-flotation, high-ground-clearance, low-ground-pressure design, the Marsh Master can traverse various wetland terrains that would challenge other all-terrain vehicles. Thus, Marsh Masters have become a valuable tool supporting various refuge operations in the U.S. Fish and Wildlife Service's Northeast, South East, and Great Lakes Big Rivers regions. They are routinely used in:

- Managing wildland fire,
- Posting remote refuge boundaries,
- Managing invasive wetland species, and
- Assisting in refuge management and maintenance activities in sensitive wetland areas.

Beginning in the mid-1990s, the machines were used to help suppress large marsh wildfires and to assist in prescribed fire operations.

Newest Model

Today's Marsh Master III:

- Carries 300 gallons of water in its pontoons for fire suppression;
- Has a hydraulic power system used for its drive train, winch, fire suppression pump, and mower deck—making it easy to operate and maintain;
- Is equipped with a 9.5-foot (2.8-m) custom-built mower for cutting firebreaks through vegetation up to 3 inches (7.6 cm) in diameter;
- Boasts a production rate of one-half to 2 acres (0.2–0.8 ha) per hour—depending on vegetation size and thickness;
- Can travel 13 miles per hour (21 km/h) on land and 2 miles per hour (3 km/h) in open water;
- Is powered by a 165-horsepower Cummins, 6-cycle, water-cooled, turbo diesel engine that can turn the mower blades at 1,400 rounds per minute; and
- Has a payload capacity of 3,000 pounds (1,361 kg).

Proven Record

Marsh Master IIIs are currently maintained at Wallkill River National Wildlife Refuge, NJ, and the Great Dismal Swamp National Wildlife Refuge, VA, for use throughout the U.S. Fish and Wildlife Service's Northeast Region. Each of these machines is equipped with a 110-gallon (416-L) fire suppression unit and an easy-loading tilt-bed trailer that can be towed with a half-ton or larger pickup truck—without needing oversized permits.

Each machine weighs approximately 5,100 pounds (2,300 kg) and has a 1,500-pound (680-kg) payload capacity. All Marsh Master models are designed to carry two people. "Our machine has over 700 hours and reports no major breakdowns or high maintenance costs in the past 9 years," reports Keith Morris, engineering equipment operator, Blackwater National Wildlife Refuge, MD. ■

GUIDELINES FOR CONTRIBUTORS

Editorial Policy

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

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Style. Authors are responsible for using wild-

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

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

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

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

Contributors Wanted

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

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

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

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 judges with photography and publishing experience 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 a release statement granting the USDA Forest Service rights to use your image(s). Mail your completed release with your entry or fax it to 970-295-5815 at the same time you e-mail your digital image files.

Mail entries to:

USDA Forest Service
Fire Management Today Photo Contest
Karen Mora
2150 Centre Avenue
Building E, Suite 008
Fort Collins, CO 80526

or

e-mail images and captions to:

<kmora@fs.fed.us> and
fax signed release form to
970-295-6799 (attn: Karen Mora)

Postmark Deadline

First Friday in March

Sample Photo Release Statement

Enclosed is/are _____ (number) image(s) for publication by the USDA Forest Service. For each image submitted, the contest category is indicated and a detailed caption is enclosed. I have the authority to give permission to the Forest Service to publish the enclosed image(s) and am aware that, if used, it/they will be in the public domain and appear on the World Wide Web.

Contact information:

Name _____

Institutional affiliation, if any _____



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