Fire Management *today*

Volume 69 • No. 4 • 2009

Cooperation

United States Department of Agriculture
Forest Service

Coming Next...

During the past century, the Forest Service has adapted fire management strategies according to knowledge, experience, and advancements in science, always with the safety of the American people as first priority. In the next issue (volume 70, number 1), authors explore the history of fire management and the evolution of managing fire to benefit ecosystem health and sustainability. Tom Harbour reflects on the 2009 interagency strategy to manage fires for multiple objectives. Other authors provide insights on the expanded use of wildland fire in relation to the wildland-urban interface, air quality, and ecosystem restoration. While use of fire to achieve resource benefits generates much discussion nationwide, it is increasingly seen as appropriate—if not necessary—as a resource management tool.

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On the Cover:

Upper photo: *A squad of Alaska Fire Service firefighters loads a Blackhawk helicopter at the end of shift near Fairbanks, AK. Photograph: Eli Lehmann, Mount Baker-Snoqualmie National Forest, 2004. See the article "NIFC and the U.S. Department of Defense" by Neal Hitchcock.*

Lower photo: *The Forest Service's Michael Kellett (left) and Pete Robichaud (right) do soil water repellency testing on the Delburn Fire site. Photo: Ed Snook, Forest Service. See the article "Full Plate for BAER Teams in Australia" by Cathleen Thompson and John C. Heil, III.*

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.

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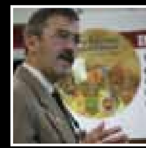


by Tom Harbour
Director, Fire and Aviation Management
Forest Service, Washington, DC

Evolution of Fire Management

The Past

In 1900, there was, in essence, no organized wildland fire protection outside of volunteer cooperatives. In many places, there was no need for protection. Fire ran free across the forests—fire was a natural part of the ecosystems. Then, between 1900 and about 1950, the Forest Service and the Nation determined that, for purposes of community and forest protection, all fires, no matter where they were located on the landscape, would be extinguished by 10 a.m. the following day. This famous "10 a.m. policy" ran from 1934 to 1972.

The unintended result of this past practice, along with changes in forest management, settlement patterns, and climate change, is obvious—larger fires and longer fire seasons. That, coupled with the rate at which communities have been built in what used to be our "wildlands," has increased the risks to communities, our firefighters, and ecosystems and has elevated our costs for fighting fire. So, what have we done and what are we doing now?

The Here and Now

Fire and Aviation Management developed the Fire Suppression Doctrine to promote an informed, shared-learning culture in which firefighters avoid unnecessary risk. Doctrine is the body of foundational principles that guide how firefighters think and act when faced with unexpected conditions. Doctrine encourages keen awareness and observation, promotes knowing leaders' intent at all times, and supports adaptable decisionmaking in unexpected situations. Doctrine is the heart of ***safe*** and effective fire management in our increasingly complex fire environments.

In addition to developing the doctrine, we have continued our work in developing a reliable toolbox for fire management officials, resulting in the Wildland Fire Decision Support System (WFDSS). The WFDSS includes an array of decision-support tools that calculate risk and probability and predict what may happen on a fire. They are science-based tools and use data such as weather and topography to estimate potential fire spread if no suppression actions are taken. These tools provide managers with better information, affording them the opportunity to manage some fires for more than one objective if authorized by land management plans. WFDSS assists managers in identifying and focusing on high-value objectives with a high likelihood of success, thereby making the best use of available firefighting resources in the safest, most cost-effective manner possible.

We remain steadfast in our work with other Federal, State, and local cooperators in order to further increase the number of "fire-adapted communities." These communities are knowledgeable and engaged; their awareness and actions regarding infrastructure, building techniques, landscaping, and surrounding ecosystems decrease the need for extensive protective actions and enable the community to safely accept fire as a part of the surrounding landscape.

How Do We Plan for the Future?

When looking to the future, we use information contained in the Quadrennial Fire Review (QFR), an interagency assessment of current and future strategies and capabilities. The QFR neither establishes policy nor makes recommendations. It does, however, identify important core mission strategies, cross-cutting strategies, and future trends and driving forces that Fire and Aviation Management can use as we look to the future and strategize for wildland fire management over the next decade.

The QFR identified five future trends and driving forces:

1. The effects of climate change will continue to result in a greater probability of longer, bigger fire seasons in more regions across the Nation.
2. Cumulative drought effects will further stress accumulated potential fuels.
3. There will be a continued risk of wildfire in the wildland-urban interface (WUI) despite greater public awareness and broader involvement of communities.

4. Our emergency response demands will escalate.
5. Fire agency budget resources—Federal, tribal, State, and local—will be strained by increased demands and rising costs during a period when government budget revenues will likely be very tight or falling.

The QFR indentified five core mission strategies:

- Expand thinking beyond continuous reinforcement of safety only as a functional and operational concern. We MUST incorporate safety and risk management into everything we do, every time we do it.
- Move beyond *appropriate management response* to strategic management response in order to create a framework for a multiphased approach to incident management.
- Bring fire management response more in line with the National Response Framework, leading to a core strategy for rebalancing emergency response within fire management.
- Reaffirm fire governance to clarify Federal, tribal, State, and local roles, responsibilities, and authorities for WUI protection; realign those roles and responsibilities where appropriate.
- Extend the reach and deepen the base for achieving fire-adapted communities.

Two cross-cutting strategies were recognized. The first outlines an integrated fuels management portfolio that would transform fuels management from a project/output perspective to a larger investment strategy in support of greater land management priorities and multijurisdictional goals. The portfolio would support multiple programs, starting with the fuels reduction zones in fire-adapted communities and reaching efforts to treat larger landscapes in wilderness areas and public lands between the WUI and the wilderness.

The second cross-cutting strategy outlines directions for creating new content, mediums, and networks for information sharing and public education using Web 1.0 and Web 2.0 Internet capabilities. While there are currently numerous applications available, we need to continually rethink public information as the public's expectations for more "real-time" information continue to expand.

Where From Here?

To succeed in the future, we need to be able to assess situations, know the objectives for each landscape, and realize the concerns of our partners in order to develop a risk-informed plan. The key: Do so quickly; think but don't hesitate; then, go out and get the work done, with safety and risk management in the forefront of everything we do each time we do it. This is the only way wildland fire professionals will be able to keep one foot firmly in the world of natural resource management and the other safely in the world of emergency management.

As I write this Anchor Point article today, we are once again mourning the tragic loss of another fellow firefighter. On July 21, 2009, on the Backbone Fire, Six Rivers National Forest, Firefighter Thomas Marovich lost his life as a result of a rappelling accident. We MUST make safety and risk management the first—the only first—step in any action we take, each and every time we take action. Tom will forever remain in our thoughts and prayers. ■

Further Information

InciWeb may be accessed at <http://165.221.39.44/>.

Partnerships in Fire Management

Sheryl Page, issue coordinator

Partnerships are nothing new to the wildland fire management community. Out of necessity, wildland fire protection programs have been working with partners outside of Federal agencies for more than a century. Over time, partnering became more formalized. The Cooperative Fire Protection Program, in particular, of the State and Private Forestry arm of the Forest Service, has been partnering in some means of fire protection with State forestry organizations for more than 75 years. The program continues to assist States in acquiring excess Federal property (especially excess military vehicles) and loaning the equipment to rural fire departments for fire protection. However, partnerships do not stop there.

Local, State, and Federal fire protection agencies have to get creative in getting projects done on the ground in this period of shrinking budgets and wild economic swings. One of the best tools we have is the partnerships we develop with others—not simply with other fire agencies but with groups like The Nature Conservancy, homeowner associations, and local community organizations. Finding the **right** partnerships is key to a successful project.

How do local fire protection organizations, with fewer resources, find those right partnerships? Well, it all depends on what they want to accomplish. Consider the following scenario: you are a member of the local volunteer fire department in a neighborhood that is at high risk of fire with no organizational funding to do a mitigation or education program. Where do you start? You have the obvious options—the Forest Service, the Bureau of Land Management, the State forestry agency—but did you consider the local Rotary Club, whose members are respected and well-connected people in your community? Local organizations such as social or service clubs can be pathways to community-based fire awareness and prevention efforts. And there are many more.

> If local organizations begin to concentrate on what is not working and the negatives, they lose sight of a truly important goal.

There are so many organizations, businesses, and agencies available that it may seem overwhelming for a local agency to identify the most effective partners for a specific project. Yet many of these organizations are willing to help. Taking the initiative to pursue partnerships is probably one of the highest hurdles that local groups have to jump: they have to invest their own time and effort to find the folks who can get things moving. Yet when they finally identify these individuals and/or organizations, they can do almost anything that needs to be done.

There will always be ups and downs to local partnerships: people move,

Who's in Your Community?

Here's a list of potential partners for fire management programs:

American Red Cross
Insurance Companies
Movie Theaters
Rotary Club
County Commissioners
City Council
Landscapers
Outdoor Recreation Businesses
Homeowners' Associations
Museums
Home Builders Associations
Parks and Recreation
Police Department
K-12 Schools
Water Board
Fire Departments
Grocery Stores
Chamber of Commerce
Kiwanis Club
Elks Lodge
Church Youth Groups
Boy/Girl Scouts
4-H Clubs
Local TV/Radio Stations
Nature Groups/Organizations
Recreation Centers
Libraries
Hardware Stores
Division of Wildlife
Sheriff's Department
Local Community College
Utility Companies
Federal Land Management Agencies
Restaurants

Sheryl Page is a fire protection specialist for the Forest Service, State and Private Forestry, Rocky Mountain Region, in Pueblo, CO.

club and business policies change, and local initiators may find themselves asking if their efforts are going down the drain. It is crucial that local groups remain flexible and focus on the reason for these partnerships. If they begin to concentrate on what is not working and the negatives, they lose sight of a truly important goal.

> To foster these programs at a local scale, fire management organizations must work with local organizations in addition to fire management agencies.

Fire management programs, such as suppression, prevention, and mitigation, are vital to maintaining the well-being of communities and the effectiveness (and safety) of firefighting efforts. To foster these programs at a local scale, fire management organizations must work with local organizations in addition to other fire management agencies. Partnerships allow us to achieve this. This issue of *Fire Management Today* is dedicated to those innovative partnerships. ■

International Union of Forest Research Organizations (IUFRO) World Congress 2010

Since 1892, IUFRO has been bringing together scientists and stakeholders to discuss priority areas of forest research, policy, and management. Enhancing the understanding of (1) forests, (2) the changing environment in which they grow, (3) how to manage their state, and (4) the manner in which they affect people are central goals for IUFRO members.

The congress is held at 5-year intervals. The XXIII IUFRO Congress will meet in Seoul, the Republic of Korea, from Monday, August 23, to Saturday, August 28, 2010. The main themes of this congress are:

- Forests and Climate Change
- Biodiversity Conservation and Sustainable Use of Forest Resource
- Forest Environmental Services
- Asia's Forests for the Future
- Forest Products and Production Processes for a Greener Future
- Emerging Technologies in the Forest Sector
- Frontiers in Forest and Tree Health
- Forests, Communities, and Cultures
- Forests, Human Health, and Environmental Security

In the past, overexploitation for wood and fuel, land conversion to agriculture, forest fire, expansion of desert areas, drought, and illegal logging were among the factors that have caused major degradation of Asia's forests. More recently, as awareness of the problems and excesses grew, efforts at rehabilitation began to emerge. Some of the rehabilitation successes started with government programs and then spread to industry, nongovernment organizations, and local communities.

The growing economies in Asia, home of more than 60 percent of the world's population but only 14 percent of the world's forests, create many challenges and opportunities–economically, environmentally, and socially–for maintenance and use of forest lands, which play an important role in these countries. Forest scientists from various regions in Asia have responded to these challenges through an initiative called Keep Asia Green and will be among those discussing the history, current status, failures, and successes of forest rehabilitation efforts in their countries at the Congress.

Further information on attending the congress, activities associated with the meeting, and submitting abstracts for presentations can be found at <http://www.iufro2010.com/>.

Full Plate for Forest Service BAER Teams in Australia

Cathleen J. Thompson and John C. Heil, III

In 2009, the Australian Government requested technical expertise from the United States to assist, supplement, and support Victoria State agencies in their bushfire recovery efforts. This was the latest exchange in a 10-year-old program to provide mutual support in fire response activities.

U.S. Fire response personnel in Australia drew from a number of disciplines. Photo: Teena van Winden, Department of Sustainability and Environment, Victoria, Australia.

In February and March of 2009, 73 U.S. Government employees provided assistance in the aftermath of devastating bushfires that burned across the Victoria State, destroying 2,029 homes and killing 210 people. Specialists from the Forest Service and the U.S. Department of the Interior were organized into Burned Area Emergency Response (BAER) teams: incident management team members, an interagency suppression crew, and liaisons. The BAER teams arriving in February were led by Carolyn Napper (Forest Service, San Dimas, CA) and Erv Gasser (National Park Service, Seattle, WA). The team arriving in March was an interagency team led by Terry Hardy (Forest Service, Boise, ID). The National Interagency Fire Center (NIFC) in Boise, ID, coordinated this U.S. Government deployment.

On the Job

Each BAER team included soil scientists, hydrologists, geologists, biologists, geographic information system specialists, archeologists, botanists, silviculturists, research engineers, and civil engineers. The specialists were all experienced and highly effective in conducting rapid assessments and analyses. Principle BAER team objectives were to:

- Assess fire effects, determine post-fire conditions, and map burn severity of soils;
- Assess overall changes to soil productivity, hydrologic function, and watershed response to precipitation events within the burned watersheds;
- Determine where and what kind of soil and watershed emergencies exist related to human health and safety conditions and natural and cultural resources;
- Alleviate emergency conditions to help stabilize soil; control water, sediment, and debris movement; prevent impairment of ecosystems; and mitigate significant threats to health, safety, life, property, and downstream values at risk; and
- Monitor the implementation and effectiveness of emergency treatments.

> The BAER teams worked with the Department of Sustainability and Environment, Country Fire Authority, and Parks Victoria to assess damage to public and private lands.

The BAER teams had a very busy time in Australia. The U.S. consulate general, Michael Thurston, greeted the teams at the Melbourne International Airport upon their arrival in February. Once deployed to the field, they assessed fire effects and post-fire concerns, met and exchanged information with the U.S. Ambassador's chargé

Cathleen Thompson is a BAER Team information officer and Forest Service paralegal at the Office of the General Counsel in San Francisco, CA. John Heil is a public affairs specialist for the Forest Service, Pacific Southwest Region, in Vallejo, CA.

d'affaires in Australia, Dan Clune, and even assisted in the treatment of injured wildlife.

The BAER teams worked with the Department of Sustainability and Environment, Country Fire Authority, and Parks Victoria to assess damage to public and private lands and analyze post-fire effects that may threaten assets at risk from potential floods, accelerated erosion, and landslides. They also shared and exchanged post-fire assessment methodologies and procedures.

After a few days working with the two initial BAER teams, the Australian authorities requested that another BAER team be activated and deployed. This team arrived in Melbourne on March 7 to provide rapid recovery assessments and analyses for the unprecedented extent of burn areas within Victoria State.

Putting Expertise to Work

The BAER teams represented contributions of various land management agencies within the U.S. Departments of Agriculture and of the Interior. Forest Service BAER team members included Judy Hallisey, Richard Pyzik, Terry Hardy, Dana Butler, Dave Kennell, Amy Nowakowski, Will Reed, Regina Rone, Eric Schroder, Carolyn Napper, Todd Ellsworth (assistant team leader), Bob Davidson, Michael Kellett, Tom Koler, Greg Napper, Jason Pyron, Pete Robichaud, Jim Schmitt, Liz Schnackenber, Ed Snook, Dave Young, and Cathleen Thompson.

The Napper BAER team performed assessments at various fire locations, including the Delburn Fire, the Churchill-Jeeralong Complex fires, the East Tyers-Thomson Fire near Traralgon, and the Bunyip-Noojee Complex fires, which burned primary catchments of the Melbourne water supply.
The Hardy BAER team assisted the Victorian Government with post-bushfire recovery efforts in the southern portions of the Kilmore East-Murrindindi Complex fire.

"The team did a great job," said soil scientist and BAER team leader Carolyn Napper (San Dimas Technology and Development Center). "We were a very cohesive group and motivated to do a good job. Spirits were up and everyone rallied to the challenge. This really was a great team. I haven't ever seen people work together as well. It really was a tremendous experience."

Wildlife Interlude

Not all work by BAER team members was strictly analytical. While completing field work, hydrologist Liz Schnackenberg (Medicine Bow-Routt National Forest), geologist-economist Tom Koler (Eldorado National Forest), and research scientist Pete Robichaud (Rocky Mountain Research Station) encountered a young wombat in distress and took steps to help it survive.

Wombats are nocturnal: to find one in the middle of the day was unusual and concerned the three natural resource specialists. After collecting global positioning system (GPS) data for transmission to an animal rescue organization, Robichaud poured water for the wombat to drink into a bowl-shaped piece of wood. Schnackenberg, Robichaud, and Koler left the youngster in order to complete their field work.

The Forest Service's Michael Kellett (left) and Pete Robichaud (right) do soil water repellency testing on the Delburn Fire site. Photo: Ed Snook, Forest Service.

Forest Service engineer Greg Napper measures road culvert dimensions in the Churchill-Jeeralang Complex fire. Photo: Jason Pyron, Forest Service.

A young wombat encountered by the Napper BAER team in the aftermath of a fire. Photo: Pete Robichaud, Forest Service.

On finishing the work, Koler returned to the site about an hour later to check on the status of the wombat. It had gone—as had the water in the bowl—and the specialists hoped for the best.

In another wildlife experience, the Napper BAER team biologists Jason Pyron (Stanislaus National Forest) and Michael Kellett (Boise National Forest) went to the Morwell Animal Clinic and met with members of BADGAR, a highly skilled volunteer wildlife rescue and protection group. While there, volunteers brought in two koalas from the Churchill Fire area suffering from dehydration and burns to their feet. The veterinarian and his assistants administered fluids intravenously and cleaned and dressed the koalas' burns. After treatment, the animals were transported to a rescue facility to recuperate prior to release.

Fire Aftermath and Analysis

The extent of resource loss was made plain by what was unburned.

BAER teams worked with their Aussie counterparts to analyze the satellite-derived Burned Area Reflectance Classification (BARC) maps for each of the fires.

"There are over 700 species of eucalypts there, plus a lot of eucalypt and radiata pine plantations," said soil scientist Dave Young (Pacific Southwest Region, Regional Office). "The river basins were beautiful, but the fire contained large areas of vegetation mortality; the unburned natural forests were truly spectacular. The soils were in pretty good condition, other than a strong water repellency like I've never seen before. Potential watershed damage was tremendous, and there is a high risk of flooding this winter for a couple communities, so we emphasized preparedness and public education."

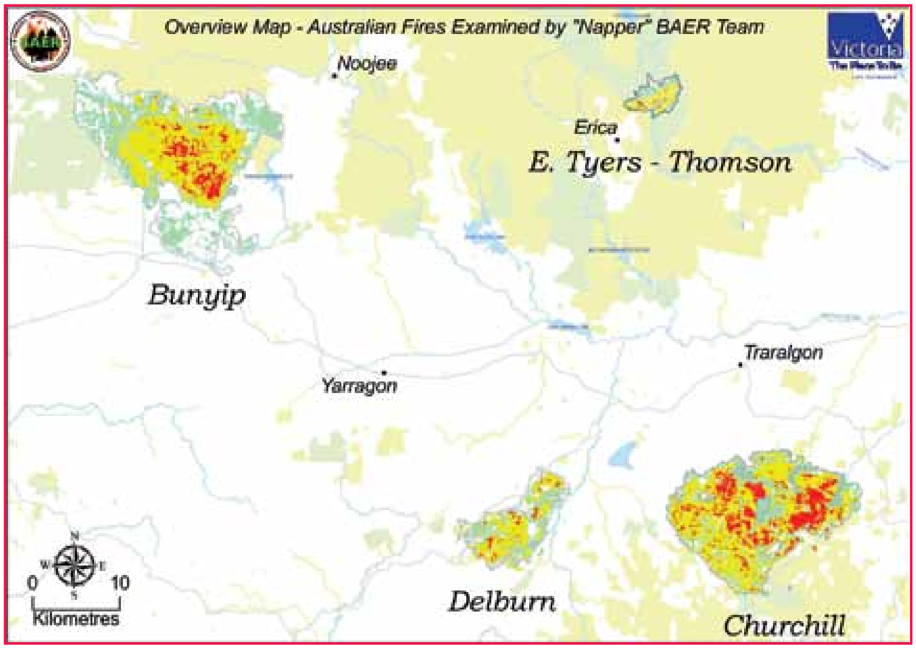
BAER teams worked with their Aussie counterparts to analyze the satellite-derived Burned Area Reflectance Classification (BARC) maps for each of the fires. This technology is of high interest to the Australians. The maps are used by BAER team specialists to assess post-wildfire watershed response and erosion potential to develop soil burn severity map products. The initial BARC imagery was provided by Jess T. Clark (Forest Service Remote Sensing Applications Center) and Randy A. McKinley (U.S. Geological Survey Earth Resources Observation and Science Center).

The Connection Continues

Since returning back to the States, BAER team members have continued to stay in contact with their Australian colleagues and provide additional assistance, such as coordinating the continued use of BARC technology for Victoria State post-bushfire efforts; also, Liz Schnackenberg has provided additional information on run-off predictions for the Churchill Fire area. Working with Dom Blackham of Alluvium Consulting in Australia, Schnackenberg provided additional information for larger storm flows. Pete Robichaud has provided information on spatial calibration of erosion models that may help in the design of longer term rehabilitation efforts beyond the emergency treatments.

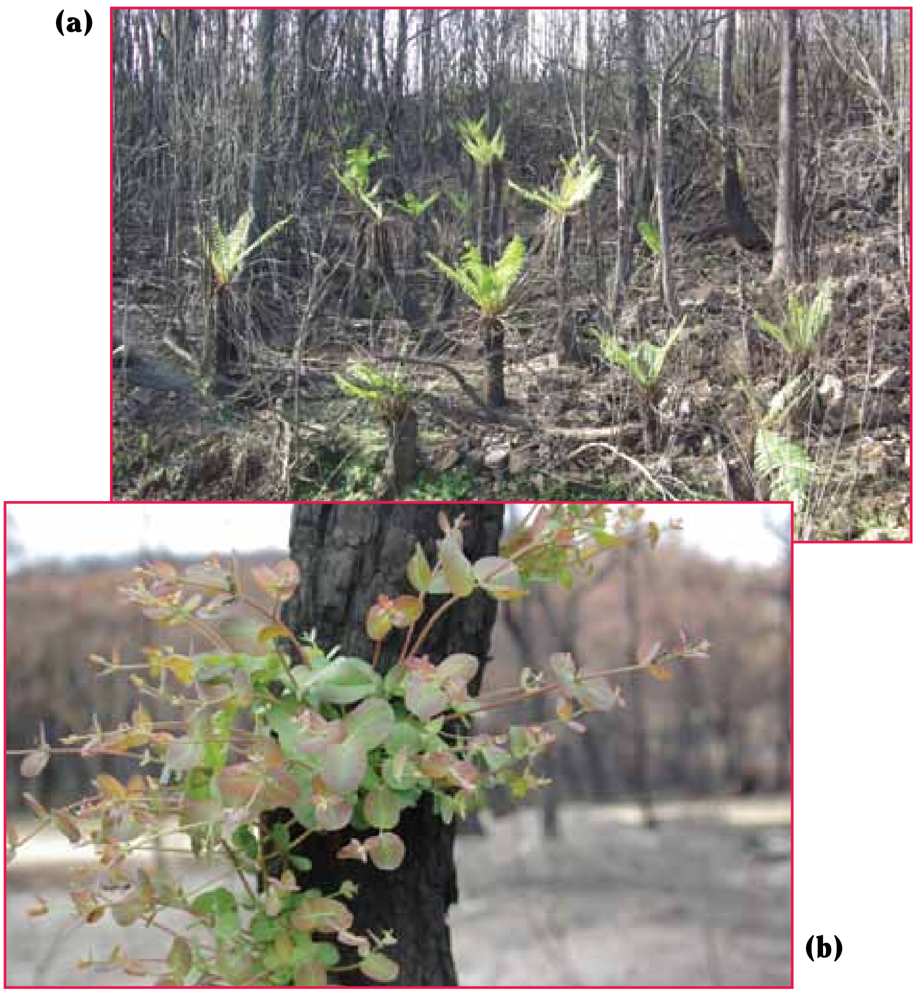
Many Forest Service BAER team members have given presentations to help share lessons learned from their Australian experience. Napper BAER soil scientists Bob Davidson

Jason Pyron helps a Morwell veterinarian treat an injured koala. Photo: Jason Pyron, Forest Service.



The Napper BAER team assessed fires across Victoria State, including the Bunyip Fire, the Delburn Fire, and the Churchill-Jeeralong Complex.

(a)



(b)

Tree ferns (a) and eucalyptus trees (b) resprouting soon after the February 2009 Victoria State bushfires. Photos: Craig Campbell, Parks Victoria.

(Uinta-Wasatch-Cache National Forest) and Dave Young (Shasta-Trinity National Forest) revised a spreadsheet application, which incorporates field data that will be included in the upcoming general technical report for mapping soil burn severity.

Parks Victoria ranger for the West Gippsland District, Craig Campbell, has kept in touch with the Napper BAER team to inform members of progress in landscape recovery from the bushfires in the Latrobe area. Craig recently mentioned that he was at a meeting in which "they were talking about implementing the recommendations from your BAER reports."

Official Recognition

On March 26, Agriculture Secretary Tom Vilsack welcomed Australian Prime Minister Kevin Rudd to the U.S. Department of Agriculture headquarters at an event to recognize the U.S. Government employees who were deployed to aid Australia during this difficult bushfire season. "We are thankful to have such a partnership with Australia and very proud that American firefighters were asked to assist across the globe in a time of need," said Vilsack. Prime Minister Rudd thanked the U.S. Government for its support in fighting and aiding in the recovery of the recent bushfires. The cooperation will continue well into the future.

Additional information can be found at <http://www.inciweb.org/incident/1582/> and in the February and March 2009 Spotlight at <http://www.fs.fed.us/r5/spotlight/>. ■

Cooperation in Action

Reghan Cloudman

Following the Big Elk Fire near Estes Park in 2002, residents in the area realized the importance of fuels management in the forests and around their homes. The work of the Canyon Lakes Ranger District's Estes Valley Fuels Reduction Project and that of the residents of Little Valley, a local subdivision, is a great example of what can be accomplished when the Forest Service and local landowners work together.

Since 2007, the Canyon Lakes Ranger District has contracted over 2,800 acres (1,100 ha) of fuels treatments in the Estes Valley project area—treatments that predominately involve thinning trees and piling the resulting slash. Beyond those contracts, Forest Service crews have thinned over 200 acres (80 ha) of forest and provided 50 acres (20 ha) of aspen enhancement. Forest Service crews have been burning slash piles left over from the large amount of fuels reduction work already completed, and more than 6,000 piles have been burned there in the last 2 years.

Landowners Take Action

While the Forest Service has been doing work on land adjacent to Little Valley, the landowners have been busy creating defensible space throughout the subdivision. Landowners have worked cooperatively with the Forest Service, Larimer County, and the Colorado State Forest Service to plan the hazardous fuels mitigation activities.

Since 2003, 76 of the 84 parcels in Little Valley have undergone some form of fuels mitigation, and owners of 92 percent of the 66 homes have created some form of defensible space around their homes. In 2006 and 2007, the Little Valley Owners' Association contributed more than $47,000 for mitigation work. The Western Wildland Urban Interface Grant Program provided an additional $20,800 in grant money.

Little Valley also received a Stevens Grant from the Colorado State Forest Service worth approximately $20,000 to reduce fuels on steeper slopes in the subdivision. At least 144 slash piles are now set to be burned as a result of the work done with this grant.

Since 2003, 76 of the 84 parcels in Little Valley have undergone some form of fuels mitigation, and owners of 92 percent of homes have created defensible space around their homes.

A member of the Canyon Lakes Ranger District fuels crew cuts trees near the Little Valley subdivision as part of the Estes Valley Fuels Reduction Project in August 2007. Photo courtesy of the Canyon Lakes Ranger District.

Reghan Cloudman is a public affairs specialist for the Arapaho and Roosevelt National Forests and Pawnee National Grassland in Fort Collins, CO.

Leading by Example

Ima Matthies, Little Valley Owners' Association President, estimates that more than 200 trees have been cut on her and her husband's 1.75 acre (0.7 ha) property, making their home more defensible should a wildfire approach. The owners' association shows an audio-visual presentation to all new residents to encourage them to follow the lead of homeowners like the Matthies. Responsible homeowners are leading by example in the fight against hazardous fuels.

While the Forest Service has been doing work on land adjacent to Little Valley, the landowners have been busy creating defensible space throughout the subdivision.

Working in cooperation with the Forest Service, Larimer County, and the Colorado State Forest Service, local residents continue to make positive impacts on the landscape to help mitigate the effects of extreme fire behavior. ■

Both Forest Service and contract crews have completed work, including piling slash, within the Estes Valley Fuels Reduction Project. Photo courtesy of the Canyon Lakes Ranger District.

Canyon Lakes Ranger District firefighters returned to these thinned areas and burned all of the piles that were dried and ready. The Little Valley homeowners were very supportive of these burns. Photo courtesy of the Canyon Lakes Ranger District.

Colorado Wildland Fire and Incident Management Academy: Education for the Future of Fire Management

Laura McConnell

The Colorado Wildland Fire and Incident Management Academy (CWFIMA) has been the driving force in wildland fire education for more than a decade. What began as a handful of classes for less than 100 students from the Rocky Mountain Region has evolved into the largest wildland fire training event in the Nation. Since it began in 1994, the CWFIMA has issued more than 16,000 certificates of training completion.

Each year, the CWFIMA offers two wildland fire academies for training presented by volunteer, paid, and retired individuals, from Basic Wildland Firefighting to Advanced Incident Management. In recent years, the academy has expanded to offer classes on National Incident Management Response and the National Response Plan, sand table exercises to develop critical thinking and response tactics, and higher level National Wildfire Coordinating Group courses to provide individuals opportunities to develop knowledge and skills in positions that have seen a decline in the numbers of qualified individuals.

Laura McConnell is a public information officer in Boulder County, CO, and for a Rocky Mountain Area Incident Management Team.

Students learning fire suppression tactics.

Tactical Decisionmaking in Wildland Fire: Students work through wildland fire simulations using sand table exercises.

As Wendy Fischer, the academy coordinator, stated: "Our academy is designed to run like an incident in order to expose students early on to the structure of the Incident Command System (ICS). Students have the opportunity to serve as trainees in various positions and receive mentoring from qualified individuals. This allows individuals the chance to work on specific tasks, learn new skills, and enhance their knowledge of how these positions work within ICS."

As a result of the high-caliber training CWFIMA provides, wildfire academies in New York, Texas, Arizona, and Utah have used it as a model for their own programs. These sister academies share resources and staff to ensure that high-quality and affordable training is made available to firefighters nationwide. The academies are sponsored by the Upper Arkansas Valley Wildfire Foundation, a nonprofit organization.

Academy Incident Commander Todd Richardson stated that "the academies would not be possible if it was not for the hard work and commitment of people from all areas of fire management. The academy staff consists of individuals from volunteer organizations—local, State, and national—who all have the same focus and desire: to offer quality training so that we can be the most effective on the ground. The CWFIMA is an organization that is successful because of interagency cooperation."

For more information on the CWFIMA or other academies being offered, visit our Web site at <http://www.cwfima.com>. ■

Internet-VSMOKE: A User-Oriented System for Smoke Management

James T. Paul, Alan Dozier, and Daniel Chan

Smoke from wild and prescribed fire has been an increasing concern in public health and safety over the last few decades. The Georgia Forestry Commission (GFC) encourages safe use of fire on forest lands in Georgia and provides a number of smoke management tools to support it. Information on some of these tools may be viewed at <http://weather.gfc.state.ga.us/>.

A smoke dispersion model was developed at the Southern Forest Fire Laboratory and published by Leonidas Lavdas in 1996. It was developed for the smoke management professional before the widespread use of the Internet. Recently, to encourage due regard to air quality in the use of prescribed fire, the GFC developed a Web-based, user-friendly version of VSMOKE.

The guiding philosophy in developing the system was to promote ease of use for nonprofessionals, flexibility in planning prescribed burns, and sufficient sophistication to appeal to professionals in forestry and smoke management. A number of additions and modifications were required to extend the use of VSMOKE to general landowners in Georgia.

The guiding philosophy in developing the system was to promote ease of use for nonprofessionals, flexibility in planning prescribed burns, and sufficient sophistication to appeal to professionals in forestry and smoke management.

To use the original VSMOKE model, one must:

- Set certain dispersion model parameters,
- Provide fuel loading data,
- Provide emissions data, and
- Provide weather data (Harms and Lavdas 1996).

In the new version, VSMOKE runs with only minimum user inputs based on data stored on the GFC weather computer. Alternately, fuel, emissions, and weather data can be input manually from any source, including Web sites. Input and output maps are easy to read and use, and specific geographically located features of concern can be displayed. Feature enhancement is ongoing.

System Components

There are four main components in the system: the input processor, VSMOKE, VSMOKE-GIS, and FALCON VIEW. The first of these is interactive and allows the user to input a number of parameters to define the location and nature of the existing or planned fire. The second component tracks smoke dispersion on an hour-by-hour

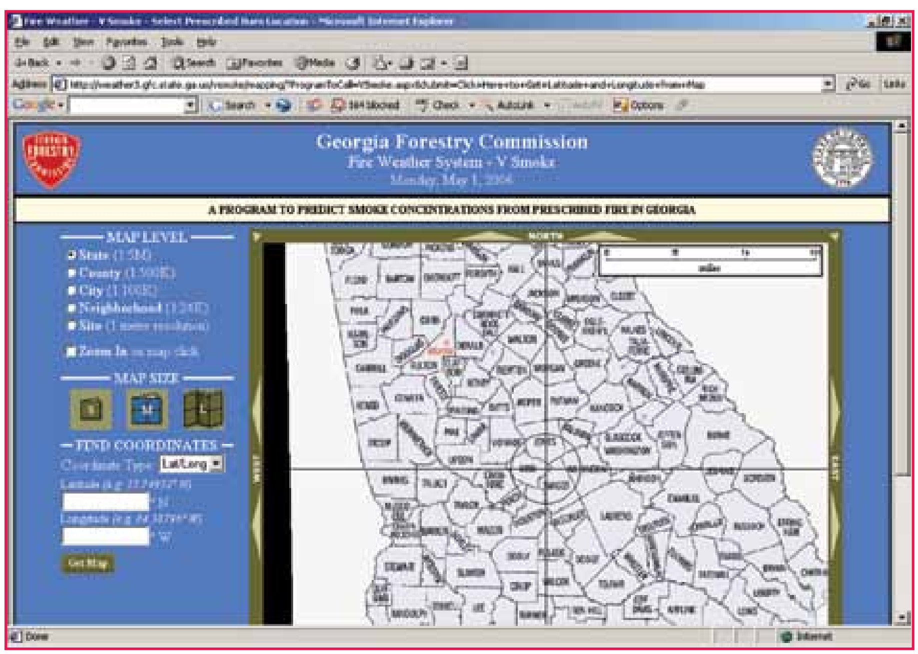


Figure 1—*Map with County names for burn site selection in Georgia Forestry Commission's Internet-VSMOKE.*

James Paul is president and chief scientist for SCITRAN, in Gray, GA. Alan Dozier is the chief of Forest Protection and Daniel Chan is a meteorologist for the Georgia Forestry Commission, Macon, GA.

basis. The third component displays digital isolines of smoke concentrations, and the last component maps the output of smoke concentration isolines generated by VSMOKE-GIS.

Inputs and Outputs

A series of increasingly detailed maps establishes the geographic location of the fire (fig. 1), and the user's selections automatically extract the latitude and longitude of the burn. The finest resolution of the series is a photographic image of the ground, on which terrain is easily visible (fig. 2).

The date and time, area, and type of burn (headfire, back fire, or flankfire) help establish baseline conditions to assess the progress of the fire.

Because fuels provide the primary source of smoke, the user can input the fuel type quickly from example photographs (fig. 3) or—where conditions are known—the characteristics of the existing fuels (basal area, age of rough, height of understory vegetation, and Society of American Foresters cover type) or simply the tons of fuel per acre present and their emission factor. Weather conditions that drive smoke dispersion are automatically supplied from the GFC weather database or entered manually.

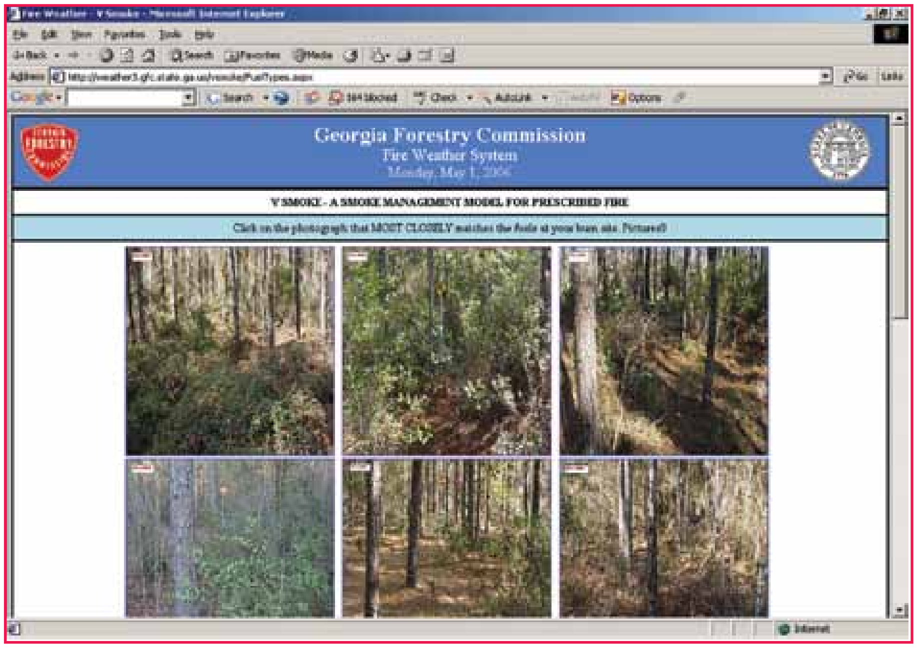


Figure 3—*Fuel photo screen for fuel data input.*

Just as the location of the fire is selected from a series of maps, so too the plume resulting from the fire is displayed on a topographical map (fig. 4). This allows the user to view nearby features such as roads, businesses, dwellings, and other locations of public activity.

Benefits

Results of the smoke dispersion model identify downwind areas of concern and allow law enforcement agencies, firefighters, and other responders to concentrate their control and mitigation efforts—particularly to ensure safe driving conditions. Even where there is no direct threat from fire, reduced visibility and breathability can generate further public health concerns. The VSMOKE system can help identify sensitive locations requiring specific attention (fig. 5). In this way, smoke modeling can help avoid potential damage and loss of life in areas of high human population.

Cautions

Some cautions are in order. First, smoke dispersion models are an attempt to represent concentrations as a set of mathematical equations.

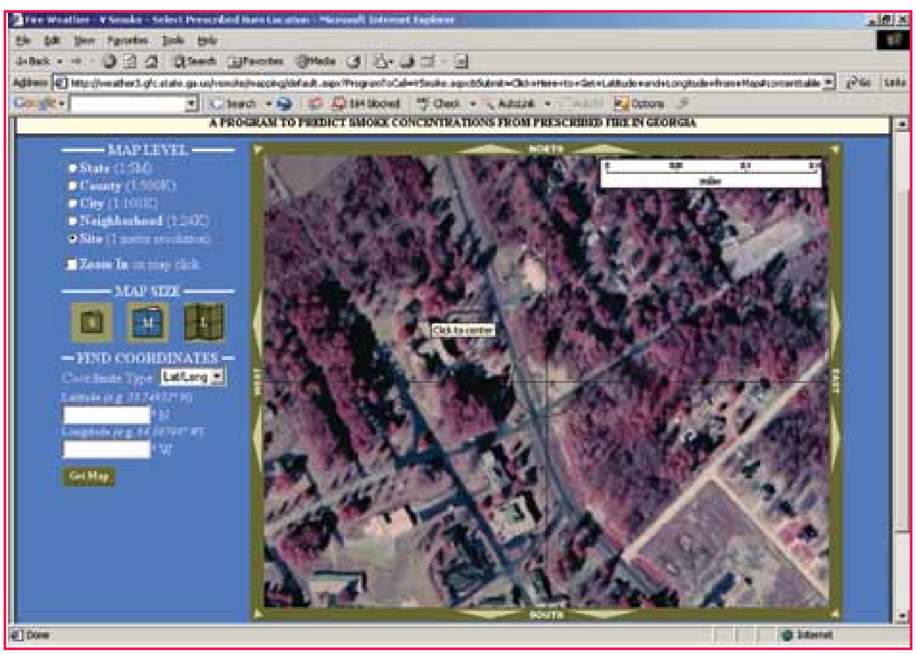


Figure 2—*The most detailed site-selection map in Georgia Forestry Commission's Internet-VSMOKE, an aerial photo at 3-foot (1-m) resolution.*

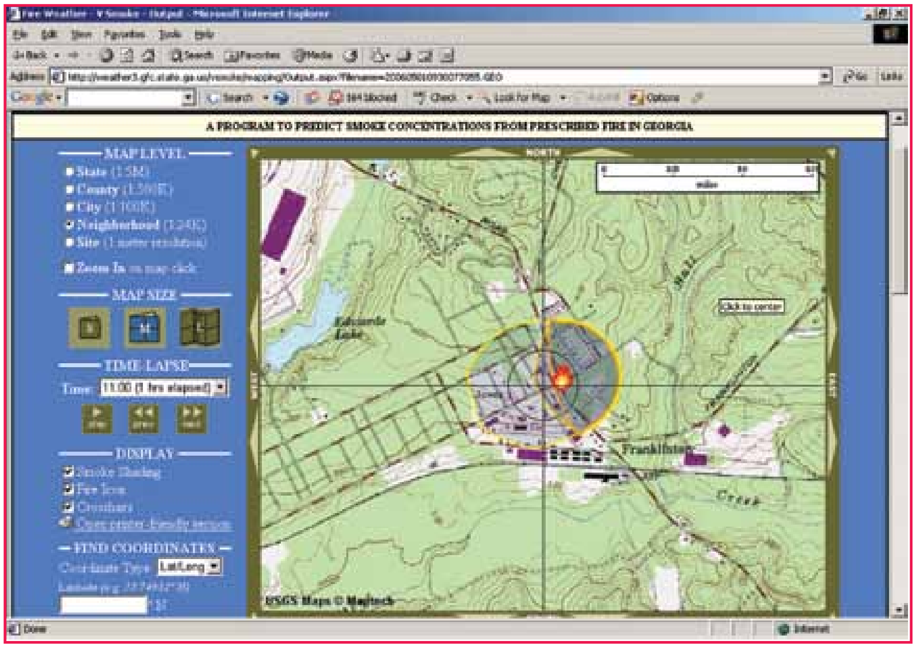


Figure 4—*Plume output screen.*

The system is structured as a series of stand-alone modules with a master calling routine integrated into the system. Consequently, the fuels, weather, emissions, or dispersion modules can be replaced as desired with minimum effort.

Most models in use by the forestry community do an acceptable job of representing this rather complex process, yet two sources of error can have a large impact on the results. First, fuel data (including emission factor, emission rate, and available fuel) are potential sources of error. The authors regard the fuels inputs, which were largely gleaned from the literature, as "best operational available" but recognize this as an area in need of major improvement.

Secondly, the model is obviously sensitive to errors in forecasting wind direction. By viewing the output plume, one can easily imagine that a small change in wind direction might drive the plume in an unanticipated direction. Lavdas (1997), in an analysis of National Weather Service forecasts at the Macon, GA, airport, observed that wind direction adhered to forecast (plus or minus 22.5 degrees) about 38 percent of the time. When the variance was extended to plus or minus 67.5 degrees, the accuracy increased to about 79 percent. He also found that, at higher wind speeds (15 miles per hour or 24 km/h and greater), accuracy increased by about 15 percent.

In a recent in-house study, the GFC staff found similar differences in observed versus daily district forecast wind at Dawsonville, GA (see the following table). In this case, the wind was accurate (plus or minus 45 degrees) 79 percent of the time. These studies draw attention to the need for caution in interpreting the plume impact, especially at low wind speeds.

Use and Interpretation

VSMOKE output estimates ground-level smoke concentrations outward from the source 62 miles (100 km). With VSMOKE, prescribed burners will have a good idea of the where smoke from their burn will or will not go. This opens opportunities for

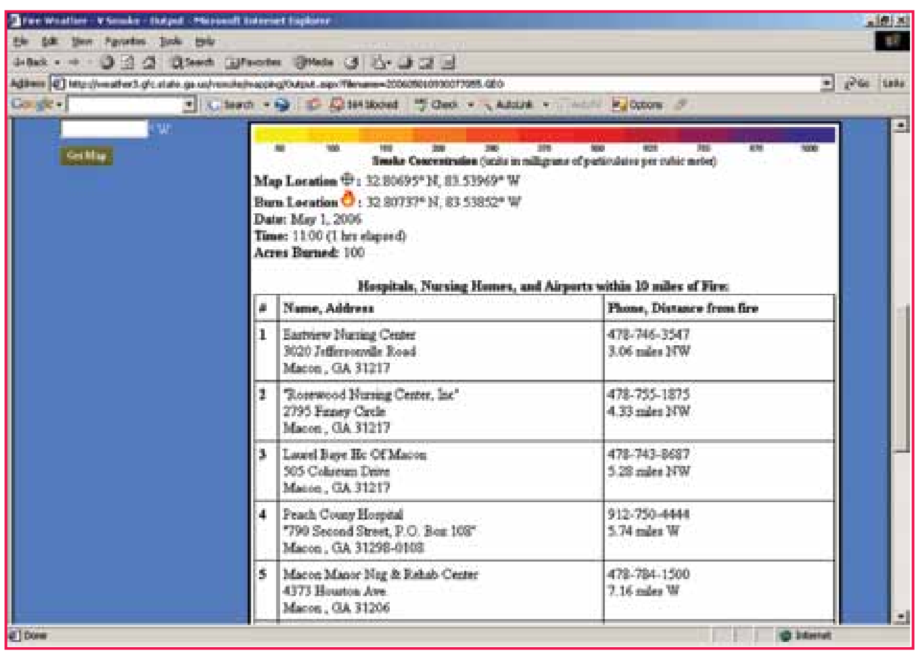


Figure 5—*Tabular listing of smoke-sensitive addresses.*

Degrees of Difference	Months												
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
-91 <	1	0	2	1	3	2	1	1	1	2	1	1	16
-46 to -90	2	3	5	4	2	0	2	1	1	1	3	1	25
-1 to -45	4	7	9	8	6	2	3	3	3	9	3	6	63
HIT	11	11	6	14	9	14	5	3	7	5	13	14	112
1 to 45	4	7	8	1	2	3	5	5	2	5	3	6	51
46 to 90	0	0	0	1	2	0	2	0	0	2	0	1	8
> 91	4	0	1	0	1	0	0	0	0	3	1	2	12
Total	26	28	31	29	25	21	18	13	14	27	24	31	287

Wind direction (observed vs. forecast) frequencies for the Georgia Forestry Commission's weather station at Dawsonville, GA, January 2002 to December 2002. A "HIT" indicates no difference between observed and forecast wind directions. All other incidents are grouped according the degree of difference between the values. For example, in July there were five occurrences in which the forecast and observed wind directions were the same. In the same month, there were five occurrences in which the difference between observed and forecast winds was between 1 and 45 degrees.

safer burning even in densely populated areas.

The plume depiction provides a method to quickly evaluate what areas will likely be impacted by smoke from a prescribed fire. Smoke typically extends outward to about 0.25 to 0.50 miles (0.4 to 0.8 km), creating unsafe highway visibility, but under poor dispersion, smoke can extend much further.

The light- to dark-gray portions of the plume are the areas of greatest concern. If the output depicts a small shaded area around the fire, it is a good indication that most smoke is being lofted high in the atmosphere and an indication of minimal surface visibility problems except in the area very near the fire. At the other extreme, a narrow pencil-shaped plume would likely indicate very poor dispersion, and appropriate cautionary measures should be adopted. If this portion of the plume crosses a roadway, the burn manager should defer burning until more favorable conditions exist, take special precautions—such as placing warning signs along the highway or perhaps employing a traffic management officer to monitor the fire on site, reroute traffic, or close the road, as necessary. Specific output visibility values refer to daytime conditions; additional information should be evaluated for nighttime conditions.

Future Development

The system is structured as a series of stand-alone modules with a master calling routine integrated into the system. Consequently, the user can employ the fuels, weather, emissions, or dispersion modules as desired with minimum effort. Potential improvements include loading the output from weather models such as MM5, finding better ways to estimate fuel loading and available fuel, and improving the integration of emission factors.

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Acknowledgments

The authors are indebted to Lee Lavdas for his valuable suggestions during the development of Internet-VSMOKE and for his perceptive and helpful review of this paper. ■

Proving the Value of Partnerships

Robert Vogltance

Oftentimes, we have a job to do that is beyond our time constraints, yet we know it is important and must be done. Do we just do what we can and go home at 5:00, or do we search for a way to get the job completed? In my case, I decided to form a partnership. With no funding, I had to find people willing to volunteer their time and expertise on nights and weekends to teach fire prevention. This is a story of a partnership with a group of volunteers who became known as the "Partners in Prevention."

Fire Prevention: To Hinder or Keep Fires From Happening

I did not imagine the impact this group would have when I first implemented the program more than 10 years ago. Even my superiors were doubtful the program could be successful. They asked, "Where are you going to get people who will work for nothing? Who has time to donate to such an undertaking?" My response was, "I'll find them." And find them I did! They are Rhonda Cerny, Bill Fortune, Mark Graf, Linda Pasewalk, and Stuart Wilsman*. They have passion, they have commitment, they are the Partners in Prevention.

They are dedicated to teaching fire prevention—they started by teaching in the communities where they lived, and soon they were getting calls from around the State. They have driven thousands of miles and attended hundreds of fire department and community meetings to speak the prevention message—all on their own time. They believe in prevention; they know it makes a difference. And make a difference they did, all across Nebraska.

Partners in Prevention knows the truth about fire prevention. It's not fire safety, it's not knowing how to use a fire extinguisher or when to stop, drop, and roll—these are all reactions to fire. Fire prevention is about working with people to stop fires from happening. As the partners spread the word around Nebraska, people began to understand the message. We could see it firsthand as the numbers of wildfires and structure fires in Nebraska decreased, the amount of money spent putting fires out decreased, and public relations with fire departments improved across the State. Their vast accomplishments were just beginning.

The Partners' Vast Accomplishments

Well, great programs can't be kept secret for long. As people learned what the program accomplished, organizers in Colorado, Montana, Oregon, and Washington began to invite the Partners in Prevention to teach fire prevention workshops. The partners developed teaching methods, ideas, programs, and materials about preventing structure fires and wildfires, all on a very slim budget—nothing!

The Partners in Prevention: Bill Fortune, Rhonda Cerny, Linda Pasewalk, Mark Graf, and Stu Wilsman (left to right).

Bob "Ro-bear" Vogltance is a fire resource manager specializing in prevention and public fire education for the Nebraska Forest Service in West Point, NE.

* Two of the original Partners in Prevention who are no longer a part of the group need to be recognized for their contribution to the development and success of this program: Jay Templar (Gering, NE) and Don Kuhl (Wakefield, NE).

Locally, the partners looked for creative ways to spread awareness for fire prevention. They looked for help from local businesses and formed more partnerships, realizing that every business in a community can be a partner in getting out the fire prevention message. Partners in Prevention developed yearly "Wildfire Awareness Month" and "Fire Prevention Month" slogans and printed and distributed them on posters. They became partners with Affiliated Foods of Norfolk, NE, a large food warehouse firm with additional warehouses in Kansas and Wisconsin, which services nearly 900 stores in 13 States. Affiliated Foods agreed to print the yearly fire prevention messages on plastic grocery bags for distribution at each store. The first year, they printed 5 million bags with the prevention message on them—marketing worth over $120,000—at no cost to the education effort.

> Their name says so much—this program is successful because throughout the year (and behind the scenes) the Partners in Prevention develop, build, and maintain partner relationships.

"Neighbor to Neighbor" was another successful partnership venture. Without any guidance on how to reach out to rural communities, the partners decided to produce cardboard boxes with carrying handles, featuring attractive fire prevention designs and pictures, fire prevention education materials, and an original fire prevention DVD, to deliver the fire prevention message directly to farmers and ranchers. They enlisted the high school computer class in Franklin, NE, to design the packaging. The class produced three wonderful designs, and instead of choosing just one, the partners decided to use all three! The partners made a special presentation to Franklin High School and recognized the individual students who collaborated on the project. Although, the "Neighbor to Neighbor" program started out as a way to share fire prevention education with rural areas, it is now more a "door-to-door" program. In towns, the boxes move through schools, libraries, churches, fire departments, and community organizations to spread the message.

The Partners in Prevention at work at the Pacific Northwest Fire Prevention Workshop in Gleneden Beach, OR. These fire prevention signs, based on the old "Burma-Shave" advertising approach, caught the eye of attendees at their Fire Prevention Class for Federal, State, and local agency professionals.

As the program continued to grow, Partners in Prevention worked with the Northeast Nebraska Fire Prevention Cooperative to develop a Fire Prevention Day Camp held outdoors at Ponca State Park. Soon other States began requesting help to plan similar events. The Forest Service's Rocky Mountain Region requested that the partners teach a 2-day course on fire prevention education with attendees from Colorado, Kansas, Wyoming, South Dakota, and Nebraska. And, each year, the partners assist in teaching a 12-hour fire prevention class at the Nebraska State Fire School. This is a 3-day school with 34 classes running at the same time. Nearly 2,000 people, including firefighters and emergency responders, rural boards, city council members, attorneys, and anyone else connected with fire, attend this function each year.

The Rest of the Story

Already, the Forest Service has presented the Partners in Prevention and their program coordinator with two Bronze and two Silver Smokey Bear Awards for their outstanding work. Their accomplishments nationwide are a testimony to the great job they are doing.

But this is just part of the story of

Designed by a high school computer class in Franklin, NE, "Neighbor to Neighbor" boxes helped get the word out not only to farmers and ranchers, but also to schools, libraries, churches, and community organizations.

They are dedicated to teaching fire prevention—they started by teaching in the communities where they lived, and soon they were getting calls from around the State. They have driven thousands of miles and attended hundreds of fire department and community meetings to speak the prevention message—all on their own time.

partnerships. Their name says so much—this program is successful because throughout the year (and behind the scenes) the Partners in Prevention develop, build, and maintain partner relationships with:

1. *Communities and fire departments* to develop ongoing year-round fire prevention programs.
2. *Fire prevention cooperatives* that maximize the use of fire prevention resources, produce successful programs, and eliminate duplication of effort.

   Groups of fire departments and communities work together to:
   - Identify priority fire problems and select fire prevention target areas,
   - Define appropriate fire prevention actions for fire services,
   - Develop interagency fire prevention action plans to utilize the resources available from each fire service member, and
   - Measure the effectiveness of prevention efforts implemented by the cooperative.
3. *Fire prevention personnel in other States* to coordinate teaching.
4. *Media outlets*, like the Nebraska Farm Radio Association, with radio stations in West Point, Lexington, and Scottsbluff, which has agreed to broadcast fire prevention messages read by local firefighters as a public service.
5. *State agencies*. We value our solid partnership with the Nebraska State Volunteer Firefighters Association and the Nebraska State Fire Marshals office.
6. *Local businesses.* The program has developed wonderful partner opportunities throughout the community with grocery stores, hospitals, medical clinics, beauty shops, barber shops, garages, car dealerships, banks, churches, schools, parent-teacher associations, service organizations (Rotary Club, Kiwanis, Knights of Columbus, etc.), phone companies, senior citizen centers, women's groups, and farm/ranch organizations.
7. *The Nebraska Firefighters Museum and Education Center*. The Partners in Prevention are assisting with the design of the fire prevention education display for the Museum.

Where Do We Go From Here?

The list of partnerships can be endless, and to be successful in any venture, we need to consider creating partnerships. The public and your target audience will see and recognize the effectiveness of working with other organizations. When more than one person or group delivers the same message, the message is heard.

In the words of Vista M. Kelly, "Snowflakes are one of nature's most fragile things, but just look what they can do when they stick together."

For further information on any of the programs mentioned, contact Bob Vogltance at 402-372-5665. ■

A New Fire Engine for Walsh, Colorado

Donna Davis and Jill Olson

The town of Walsh, CO, recently received a new 2½-ton, 878-gallon, 6x6 fire engine, compliments of the Colorado State Forest Service Fire Equipment Shop and mechanics Matt O'Leary, Paul Rodriguez, Nate Taggatz, Charlie Rossi, and Jay Davis. The Fire Equipment Shop, managed by Sergio Lopes, builds approximately eight Federal Excess Personnel Property engines each year, which then are assigned to local fire departments throughout the State. These engines are fabricated using U.S. Army vehicles acquired by the Forest Service through the Defense Reutilization and Marketing Service, loaned to State forest services and, through them, to local fire departments. Upon delivery, Jay Davis provided instruction on use and minor maintenance of the Type 4 firetruck to Walsh Volunteer Fire Department (VFD) firefighters.

Lance James, chief of the Walsh VFD said, "We're excited to receive the new equipment and particularly excited by the water tank design—it allows for lower weight distribution of the vehicle. This newer design is safer than the older design for firefighters. There is also additional room on the flatbed for equipment."

An equipment agreement between the State of Colorado, Colorado State Forest Service, and the town of Walsh—signed by the mayor of Walsh, the Baca County sheriff, and the Baca County commissioners—allows placement of fire equipment for the benefit of emergency use within Baca County. The engine is one of 140 engines maintained in the State of Colorado by the Colorado State Forest Service under the Cooperative Forestry Assistance Act of 1978. This act provides a mechanism for local use of federally owned equipment for emergency and fire-related protection. The agreement also provides for a yearly maintenance inspection and repairs due to normal wear and tear. In return, the town of Walsh pays a $200 annual inspection fee.

Under the terms of the agreement, the town of Walsh agrees to use the equipment only for fire protection or other emergency situations in which life or property are threatened, maintain the equipment in good operating condition, provide adequate year-round housing for the equipment, pay for all operating costs and minor maintenance, maintain liability insurance, maintain tools and hose on the engine, and submit fire reports after use of the equipment.

One of the firetrucks built by the Colorado State Forest Service to be loaned to a local fire department for fighting wildfires. Photo: Donna Davis, Colorado State Forest Service.

If available, the engine also may be dispatched for emergency mutual aid or initial attack responses outside its normal jurisdiction. In 2008, the Walsh VFD responded to 43 fires; the fire department has used the equipment as many as 73 times in 1 year.

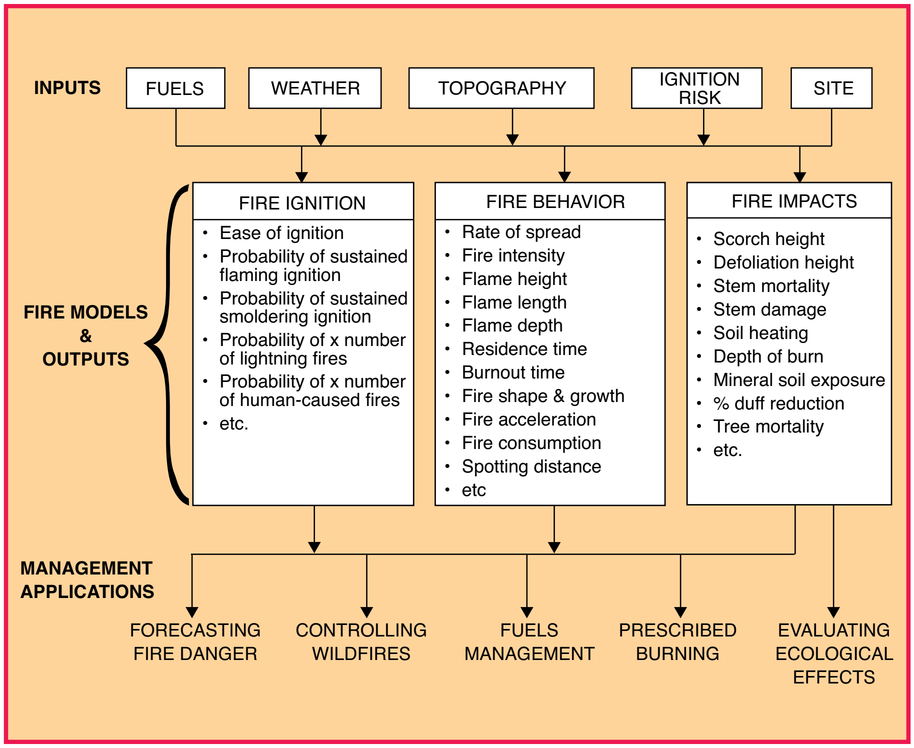
Additional engines provided to communities in southeastern Colorado are located at Campo, Wiley, Eads, Hasty-McClave, Sugar City, and Kim. ■

Donna Davis is a forester with the La Junta District, Colorado State Forest Service, La Junta, CO. Jill Olson is an administrative assistant at the Fire Equipment Shop, Colorado State Forest Service, Fort Collins, CO.

Are We Abusing Our Use of Models and Modeling in Wildland Fire and Fuel Management?

Martin E. Alexander

A whole host of computerized decision support systems and tools have emerged in recent years for use in wildland fire and fuel management (Peterson and others 2007). Few would argue with the notion that models and modeling are an integral component of modern day management practices (see figure). The question is, even with technical guidance (e.g., Stratton 2006), are we properly using such technology in light of the importance of the human element in the decision-making process?



Conceptual model of scientifically based forest fire management (adapted from Burrows 1994).

Two remarks continually remind me of the limitations of modeling. While I was attending forestry school at Colorado State University in the early 1970s, Dr. Alexander T. Cringan, a professor of wildlife biology, made the following remark in connection with the modeling of fire impacts and effects: "If you end up with a 300-pound coyote, you know something is wrong." Then, about 15 years ago, I was having a discussion with Dr. A. Kare Hellum, professor emeritus of silviclulture from the University of Alberta, about an article dealing with the modeling of a particular fire impact in relation to fire behavior. He remarked to me that "Modeling is fine as long as you know what you are doing."

These remarks have stayed with me to this day. So have the contents of an article by John J. Garland that appeared in the "My Chance" section of the April 1988 issue of the *Journal of Forestry*. I have often distributed a copy of Garland (1988) at various training courses and workshops as part of my presentation to impress upon folks the pitfalls of explicitly using and trusting models and modeling (Alexander 2000).

While the context of Garland's article, which focused on the broader issues of natural resource management, does not specifically deal with fuel and/or fire management, it now seems important for the messages contained in this article to receive wider circulation. So, towards this end, a copy of "A Modeler's Day in Court" is reproduced here for the benefit of the *Fire Management Today* readership.

At the time his original article was published, John Garland was a Timber Harvesting Extension Specialist in the Forest Engineering

Dr. Marty Alexander is an adjunct professor of wildland fire science and management in the Department of Renewable Resources at the University of Alberta, Edmonton, in Alberta, Canada. He was on leave of absence from his position as a senior fire behavior research officer with the Canadian Forest Service, Northern Forestry Centre, in Edmonton, when he wrote this article.

A Modeler's Day in Court*

John Garland

Scene: Courtroom of a district judge, a learned jurist especially noted for his natural-resource decisions. A resource professional who is in mid-career stands before the bench.

Judge: I have read the complaints against you. How do you plead? Guilty or not guilty?

Resource Professional: I don't understand what I'm doing here. I was just doing my job!

Judge: You are charged with seven offenses:

- Inappropriately using "models" for your natural-resource decision-making.
- Using these models outside the range of data for which the model was built.
- Using models that have not been validated or thoroughly tested for consistency.
- Failing to identify the assumptions upon which the models were dependent.
- Building your own "model" by picking and choosing relationships out of thin air or based on very little research.
- Overextending the results of these model outputs by making decisions about thousands of acres with models that oversimplify the relationships among natural variation, time, and space.
- Impressing your colleagues with these models to the point where they believe anything you do with a computer must be correct. You misrepresented your intelligence just by speaking computerese.

How do you plead?

Resource Professional: I'm not guilty. Some of the models I used weren't even mine. They were recommended to me and I didn't understand how they worked. Researchers should have validated those models before they made them available. Besides, it's a matter of policy at my organization to use models. They came from higher up. And about the one I put together: I didn't have the time to really do it right. I used the best information available. For the rest, I asked the specialists for their opinions. I was just doing what everybody in the organization was doing.

Judge: These reasons are not sufficient for dismissing the charges. There is substantial evidence against you. Not only did you extend the model decisions to thousands of acres at large financial expense and with adverse effects on the resources, you also never checked to see how these models worked in practice. Instead of getting your boots muddy, you buried your head in the computer and came up with reports, statistics, and graphs to impress supervisors and colleagues. The enormous time spent on dubious models kept you and your organization from decisions incorporating on-site conditions. Misuse of poor models actually prevented better models from being developed.

Resource Professional: Nobody ever told me I was doing anything wrong. I did have some questions and concerns, but I had to get the job done.

Judge: That is the essence of the professional statutes. (Will it come to regulation of professionalism?) The appropriate use of models and computer technology must be blended with a human system of resource management. Perhaps you should consider a common-sense approach to resource management that includes the following list:

- Identify land-management goals and objectives.
- Determine the compatibility of forest operations and associated best management practices with land-management goals. Resolve conflicts of facts and values in advance of operations.
- Construct a contract for a sale or for services that reflects best management practices.
- Provide training to land managers and contract administrators so their expectations are aligned with actual, reasonable results. Identify potential areas of difficulty for heightened awareness and enforcement actions.
- Train contractors and operators to the level of the "machine operator" in how best management practices are developed and executed.
- Develop an enforcement system with adequate contractual clout and sufficient supervision. Seek ways to reinforce positive actions by contractors with appropriate rewards.
- Develop a system to monitor land management based on important and adequate measurement, not a pseudoscientific, computer-based approach.

- Provide for auditing of operations and periodic monitoring without advance warning by outside experts.
- Review and revise policies, procedures, and contracts as needed using the best scientific information available.

Resource Professional: There seems to be plenty of opportunity for using high technology in that approach.

Judge: Indeed! Good, professional resource management requires that kind of blend. Now in the matter before me ——

(The verdict is still pending, but the resource professional is buying a new pair of boots.)

**From Garland (1988).*

Old Cowboys, Cows, and Fire Behavior Forecasting: Supplementing Models With Local Knowledge

Tim Greer

In August 2003, I accepted an assignment as a wildland fire behavior specialist in the interior of British Columbia. This was my first assignment in mountainous terrain. After receiving the customary orientation, I was assigned to the Venables Fire near Cache Creek, BC. The Venables Fire had started in the Venables Valley and made about a 6-mile (10 km) run north along an east-facing slope.

The area of concern was in a north-facing bowl at 5,000 feet (1700 m) elevation. The fire behavior prediction system indicated an impending blow-up: the fire was going to burn up everything for miles around, but day after day passed without any significant fire activity. I took a copy of the fire map and visited the meteorologist who was supplying the spot forecasts. What I needed to know was: "When is the wind going to get into the bowl and move this fire?" He did his best to give me an answer and I did mine, but still, most days the fire was quiet and our forecasts weren't borne out by reality.

Tim Greer is a wildland fire behavior specialist with the New Brunswick Department of Natural Resources.

Venables Fire near Cache Creek, British Columbia, on the afternoon of August 31, 2003. Photo: Tim Greer, New Brunswick Department of Natural Resources.

I realized that I desperately needed some knowledge of local weather patterns. Thinking about who would have such knowledge, I thought that some of the loggers in the area might include a person who could give me such information. Further thought brought me to the realization that today's loggers don't mingle much with the weather while working in modern harvesting machinery, with its climate-controlled cabs. Then it hit me! There are cows grazing throughout the area, and cows need regular tending: I needed to find an old cowboy!

To find one, I went down to the home of the owner of the biggest ranch in the area. I drove into the yard, shook off a couple of nipping cow dogs, and knocked on the door. A young man in cowboy attire answered. I introduced myself and told him what I was looking for. He said, "You have to talk to Al." Al happened to live right in town; he was in his eighties and had been a cowboy in the area for 50 years.

After a phone call from the young man to ensure that Al was home and up to a visitor, down to Al's I went. Again, I introduced myself and informed Al of my mission. After some tea, cookies, and the usual formalities, we got down to business. I asked, "When does it get windy up there, and what are the indicators that this is about to happen?"

Al indicated that the wind didn't get into that bowl much until December, and then told me a few stories about hunting strays in that area in December. (I got the distinct impression that Al didn't have a real passion for hunting strays.) Then he said, "No trouble to tell when it is going to be windy up there: the cows will be gathered down at the Prioux Camp and be a-bawling." Turns out, the Prioux Camp was an old abandoned cowboy camp.

Cows congregating near the old abandoned Prioux cowboy camp (center of photo) located adjacent to the Venables Fire near Cache Creek, British Columbia, August 2003. Photo: Tim Greer, New Brunswick Department of Natural Resources.

With this new-found knowledge I didn't spend much time running more computer models, I just headed up the mountain in my truck to see what the cows where doing. If the cows were down near the Prioux Camp and "a-bawling," I'd send out the warning that things were going to be active in the bowl that afternoon. In the coming days, the cows were right every time!

The lesson is clear. When the models have reached their predictive limits, you have to find another way to get the information you need. I always seek out local knowledge and add it to what I already know.

Department at Oregon State University (OSU) in Corvallis. He went on to obtain his Ph.D. degree in 1990 and full professor status in the department. Dr. Garland, now retired from OSU but serving as a professor emeritus within the department, is presently a consulting forest engineer. He maintains that, "after more than 35 years at OSU working with models of various kinds, I still feel the same sentiments as in the article." I appreciate Dr. Garland's permission to share this thought-provoking article with the wider wildland fire community.

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An Evaluation of the Predictive Services Program

Patricia L. Winter and Thomas A. Wordell

Wildfires remain a considerable threat to natural resources, firefighters, and human communities across the United States. To those involved in fire management, decision support tools that address wildland fire threats in a coordinated fashion and proactive approaches that transcend agency boundaries to facilitate coordinated responses to wildland fire incidents are of significant value. Predictive Services (PS) produces and provides access to these resources. PS units act as centers of expertise to produce short- and long-range integrated planning and decision tools, enabling proactive resource allocation and safe, cost-effective fire management.

In 2005, the National Predictive Service Group (NPSG)—an 11-person interagency committee chartered by the National Wildfire Coordinating Group (NWCG) to provide leadership to the PS program—sponsored an assessment of user needs. Pat Winter and Heidi Bigler-Cole, Ph.D., a social scientist on the Wallowa-Whitman, Umatilla, and Malhuer National Forests, conducted the assessment. The final assessment report was issued in July 2007 (Winter and Bigler-Cole 2007).

This article presents a brief overview of the findings from the user needs assessment. The assessment relied upon users and prospective users of PS products and services issued through Web sites, briefings, and emails by the National Interagency Coordination Center (NICC) and Geographic Area Coordination Centers (GACCs). The approach guided a formative evaluation process; it provided the opportunity to hear about products and services that the target audience would find of particular interest and will drive modification of existing products and services (Quinn Patton 1986, Rossi and others 1999).

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Predictive Services Background

Throughout the 1990s, ad hoc attempts to blend weather, fuels, and resource information into effective fire management planning were complicated by increasing hazardous fuel treatment targets, declining budgets, more complex and restrictive policies, and a restructuring of the National Weather Service (NWS) Fire Weather Program. The need for integrated planning and decision tools for fire management increased further as "all hazard response" incidents increased in number and began to compete for the available resources. In recognition of this need, the concept of PS emerged in the late 1990s from discussions among staff members at the GACCs.

The severity and extent of the 2000 fire season further revealed the need for a more holistic approach to managing wildland fires, as national fire management resources were overwhelmed and many destructive fires ensued. The update of the National Fire Plan following the 2000 season provided the funding and incentive to create and implement the National Predictive Services Program by hiring 20 agency fire meteorologists to join with the existing intelligence staff at the GACCs and the NICC. Since then, a number of wildland fire analysts have been added to the program at various locations. The program represents a multiagency collaborative approach to information distribution that is available across Federal and non-Federal sectors at all levels of fire management. (For additional information, see Wordell and Ochoa 2006.)

Survey Methods

Names and information were gathered using key contacts and a "snowball" approach (in which initial contacts referred us to other possible contacts). The study was

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Table 1—*Ratings of products and services by respondents categorized as familiar or unfamiliar with the products and services of Predictive Services. Means are reported from a range of 1 to 5, in which 1="strongly disagree" and 5="strongly agree."*

	Federal Respondents		Non-Federal Respondents	
	Familiars	Unfamiliars	Familiars	Unfamiliars
Easy to understand	4.1	2.7	4.0	3.7
Complete	4.0	2.6	4.0	3.7
Accurate	4.0	2.6	3.9	3.7
Timely	4.0	2.7	4.1	3.7
Relevant	4.0	2.7	4.3	3.9
Accessible	4.1	3.4	4.4	3.8

conducted in two phases. In the first phase, Federal employees were questioned through a Web-based survey, with emails sent to prospective respondents. In the second phase, a modified survey for non-Federal contacts was conducted, again using a Web-based survey (with fewer items than the Federal survey to reduce respondent burden).

Federal sector respondents (n=1,078) were employed primarily in the Forest Service (53.4 percent), National Oceanic and Atmospheric Administration and National Weather Service (14.3 percent), and the U.S. Department of the Interior, Bureau of Land Management (12.6 percent) and National Park Service (10.0 percent) (Winter and Bigler-Cole 2007). Non-Federal sector respondents (n=305) worked mostly in State (73.1 percent) and county (9.5 percent) agencies. Geographic location of respondents spanned the United States.

Levels of Familiarity With Predictive Services

Both the Federal and non-Federal respondents indicated their degree of familiarity with the products and services provided through Web sites, briefings, and emails. Using a scale from 1 to 5 (in which 1="not at all familiar" and 5="very familiar"), overall, respondents were moderately familiar with the briefings and Web products (means [M] ranged from 3.0 to 3.2) and somewhat less familiar with email services (Federal M=2.4; non-Federal M=2.5). Emails were sent to a specific fire audience and, therefore, were likely to be less familiar to the majority of respondents than the other two modes of delivery. We assessed overall familiarity based on the average of these three ratings. We created two groups on the basis of a median split: those most and least familiar with the products and services.

> The Predictive Services program is young and still trying to determine the best way to serve the fire management community. Conducting and utilizing an assessment to understand the needs and preferences of its users will help guide its success in the future.

Opinions of the Products and Services

Most respondents rated the information provided by PS positively, particularly those most familiar with the products and services. A majority or near-majority agreed that PS information was easy to understand, complete, accurate, timely, relevant, and accessible. Each of these attributes was rated more positively (on a 1-to-5 scale, in which 1="strongly disagree" and 5="strongly agree") among those who were most familiar with the products and services (table 1), at $p < 0.05$. The only exception was in perceived accuracy between those more and less familiar among non-Federal respondents, in which there was no significant difference.

Trust and Confidence in the Information

Most respondents expressed some to a great deal of trust and confidence in PS information (73.9 percent of Federal and 82.5 percent of non-Federal respondents). Familiars had significantly higher trust and confidence in the information (M=3.8 for Federal familiars versus M=3.2 for unfamiliars;

M=3.7 for non-Federal familiars versus M=3.1 for unfamiliars; on a scale from 1 to 5, in which 1="not at all" and 5="a great deal").

Reliance and Taking Action

Most respondents indicated they relied some to a great deal on the information provided by PS (59.0 percent of Federal and 69.4 percent of non-Federal respondents). Similarly, most were somewhat to very likely to take action based on PS information (62.8 percent of Federal and 77.7 percent of non-Federal respondents). Familiars were far more likely to rely upon and take action on information from PS than unfamiliars.

Familiarity Influenced by Job Function

Initial categorization of job type ensured that our sample represented a range of potential users and customer needs. However, we asked respondents to identify their primary job function in the fire management community. This step ensured that we would be able to understand the unique needs of various stakeholder groups.

Familiarity with PS products and services varied significantly by job function. Least familiar among both sectors were the public affairs/information officers. Most familiar within both sectors were the fire behavior analysts and long-term analysts (including, in the Federal sector, fire danger analysts). This finding suggests that certain stakeholder groups (based on levels of familiarity and links to trust, reliance, and taking action) are less likely to use PS.

Perceived Overlap

About half of the respondents felt that there was at least some overlap in the type of information that can be obtained from PS and other sources (46.4 percent of Federal and 51.2 percent of non-Federal respondents). Not perceiving the unique features of the service might impede its use.

Table 2—*Reasons that Federal and non-Federal respondents had not used Predictive Services' products and services and percentages of Federal and non-Federal respondents that provided response.*

Reason	Percent	
	Federal	Non-Federal
I never thought about it.	26.9	40.0
My current management practices don't require the types of information provided by Predictive Services.	14.7	10.8
I need information that is site specific.	13.5	31.5
I am not mandated to use these products.	9.6	22.3
I don't have the time to use these products.	9.3	9.5
I don't know where to get advice about using these products.	9.1	9.5
I don't know where to get the technology to use these products.	5.5	5.2
I don't have the technology I need to use these products.	4.0	4.6
I don't trust the products and services.	3.5	1.0
I don't want to use these products.	3.2	1.6
I don't think these products support my agency's current practices.	1.7	4.3
Agency directives/guidelines instruct me to use other information.	1.5	5.9
I don't have the money to use these products.	1.4	4.6
I don't trust the advice I get about using these products.	1.4	.7
I don't trust information that is generated by multiple agencies.	.9	1.3

Barriers to Use of Products and Services

We specifically asked respondents in both sectors to tell us which possible barriers were reasons that they had not used the products and services (table 2). The most frequent reason provided was not having thought about using the products and services. Awareness might increase consideration of use, as would addressing the knowledge- and awareness-related barriers of "I don't know where to get advice about using these products," and "I don't know where to get the technology to use these products." Trust might also be increased among those aware of and familiar with the products, although this was rarely cited as a barrier.

Additional Barriers to Use of the Products and Services

In spite of the majority use among both sectors, a considerable number of respondents were not familiar with, and did not rely upon, PS information. Several possible reasons for this, in addition to those discussed above, were uncovered.

Applying the User Needs Assessment Findings

Respondents who were more familiar with PS products and services viewed them more favorably, trusted them more, and were more likely to rely upon and take action based upon the information that these provided. The link between familiarity, trust, and the use of products underscores the benefits of standardizing certain products, providing information about products and their use, sharing information about the program, and developing marketing strategies.

In light of these findings, PS developed a series of actions as part of the goals associated with their strategic plan. Outlined below are some of the actions that have been taken or are currently underway to address the assessment findings.

1. **Identify, establish, and implement standardized products, services, and performance standards that satisfy user needs.**
   - ❒ *Define standard terminology.* Nine glossary terms were submitted, approved, and added to the NWCG Glossary of Wildland Fire Terminology (PMS 205) available at <http://www.nwcg.gov/pms/pubs/glossary/index.htm>.
   - ❒ *Standardize GACC Web sites.* A National GACC Web site committee (fig. 1) was formed to:
     - ■ Develop standardized Web site template and maintenance procedures for GACC Web sites;
     - ■ Periodically review the National GACC Web site to ensure that it is up to date, accessible, compliant, and easy to navigate;
     - ■ Review GACC sites to ensure that each site is being maintained to the established standardized format;
     - ■ Offer new and innovative ideas for GACCs to use in the ongoing development of their individual Web sites;
     - ■ Resolve issues that may arise with respect to GACC Web sites; and
     - ■ Develop a network of GACC Web site contacts to disseminate information pertaining to Web management.
   - ❒ *Develop national standards and implement the 7-Day Significant Fire Potential.* This product was released in 2007 and updated in the summer of 2008 (fig. 2).
   - ❒ *Define protocols for issuance and posting of products.* This is being accomplished through policies and guidelines outlined in the National Mobilization Guide, the Interagency Standards for Fire and Fire Operations (Redbook), the Predictive

Figure 1—*A National GACC Web site committee moved the PS toward its strategic plan goals. The committee developed a standardized Web site template and maintenance procedures for GACC Web sites under the overarching goal of identifying, establishing, and implementing standardized products, services, and performance standards that satisfy user needs.*

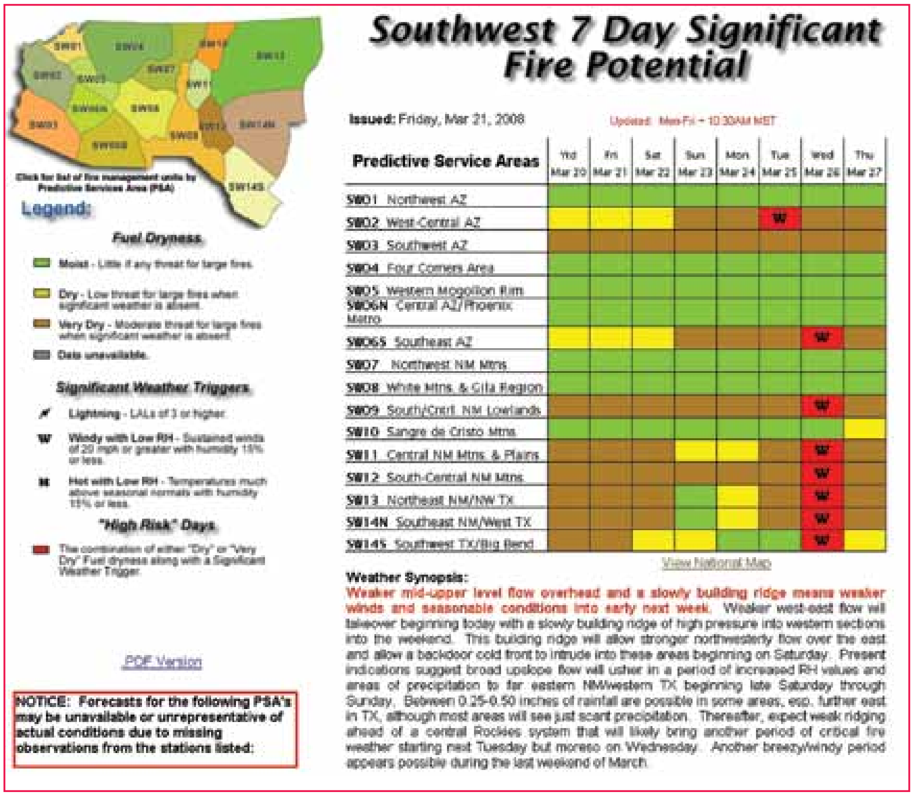

Figure 2—*The 7-Day Significant Fire Weather Potential product is now operational. This is another standardized product that will help to meet the needs of PS clients.*

Services Handbook, and agency directives.

- ❒ *Establish verification standards for PS products.* NPSG funded and the Desert Research Institute developed a Web verification page in 2007 to post model output statistics and enable GACC meteorologists to view forecast verification statistics in order to improve forecasting skill. This information is available at <http://cefa.dri.edu/Operational_Products/MOS/txtmosfcsts.php>.
- ❒ *Identify and prioritize a list of products and services for which performance standards still need to be developed.*

2. Determine organization, resource, and programmatic requirements.

- ❒ *Develop a PS Handbook.* The PS Handbook was finalized and approved by NWCG in 2007. It outlines:
  - Program management and organization;
  - Roles and responsibilities;
  - Products and services; and
  - Communication, training, and support requirements.

The handbook can be found at <http://www.nifc.gov/nicc/predictive/NPSG/npsg_pdf/PSHandbook_Web.pdf>.

> Most respondents rated the information provided by Predictive Services positively, and those most familiar with the products and services were even more likely to assign positive ratings.

3. Enhance communication with PS internally and externally.

- ❒ *Host annual workshops and monthly conference calls.* Annually there are two seasonal assessment workshops, one NPSG meeting, and monthly conference calls to help foster interaction between geographic areas and other countries (e.g., Canada and Mexico).
- ❒ *Provide information about PS at training sessions and workshops.*
  - Lesson plans have been developed and presented during various courses, including Intermediate Wildland Fire Behavior (S-290), Advanced Fire Danger Rating System, and Advanced Fire Behavior Interpretation (S-590).
  - A special segment was devoted to PS at the 2nd Fire Behavior and Fuels Conference held in San Destin, FL, in 2007.
  - Numerous oral papers and posters have been presented at conferences and meetings in the United States and other countries (e.g., Spain, Australia, and Canada).

4. Improve the marketing and understanding of PS products and information.

- ❒ *Develop product fact sheets.* Fact sheets have been developed and posted at PS Web sites to explain what the products were designed for and how to interpret outputs. For an example, see: <http://nwccweb.us/content/products/fwx/guidance/DLProduct.

Figure 3—*PS established a logo to improve the nationwide recognition and marketing of PS products and information.*

pdf#zoom=100>.

- ❒ *Develop a program logo.* A logo was established to help "brand" products nationwide so that users could easily recognize that the products were issued by PS (fig. 3).
- ❒ *Provide information about PS to a broad audience.* The 2008 Annual Fire Refresher video included a short section on PS to help members of the wildland fire community become familiar with the program.
- ❒ *Develop and implement a communications plan.* This task is currently underway, and a PS brochure is being designed to help provide information about the program.

The actions outlined above were designed to help standardize products, determine the requirements to be successful, enhance awareness of products and services through marketing and communication efforts, and provide fact sheets and other materials to clearly explain products and how to use them. The PS program is young and still trying to determine the best way to serve the fire management community. Conducting and utilizing an assessment to understand the needs and preferences of its users will help guide its success in the future.

If you have comments or questions concerning PS products, please contact your geographic or national-level PS staff at one of the coordination centers.

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NIFC and the U.S. Department of Defense

Neal Hitchcock

During the course of a fire season, situations can arise in which firefighting resources available within natural resource agencies cannot meet firefighting resource demand. Through a cooperation agreement among many resource agencies and the U.S. Department of Defense (DOD), DOD can deploy resources under its control in support of Federal firefighting efforts.

> Since 1975, the U.S. Departments of Agriculture and of the Interior have had an interagency master agreement with the U.S. Department of Defense (DOD) that allows DOD to provide firefighting support to the wildland fire management agencies when needed.

History

The Bureau of Land Management (BLM) created the Boise Interagency Fire Center (BIFC) in 1965 to coordinate fire management activities in the Great Basin States. Recognizing the value in this approach, the Forest Service and National Weather Service joined the BIFC to reduce the duplication of services, cut costs, and coordinate national fire response planning and operations. The National Park Service and Bureau of Indian Affairs joined BIFC in the mid-1970s, and the U.S. Fish and Wildlife Service joined in 1979. To more accurately reflect its national scope, the center's name was changed in 1993 to the National Interagency Fire Center (NIFC).

Since 1975, the U.S. Departments of Agriculture and of the Interior have had an interagency master agreement with the DOD that allows the DOD to provide firefighting support to the wildland fire management agencies when needed. Through this agreement, NIFC can place requests for DOD support to the Joint Director of Military Support at the Pentagon through Northern Command (NORTHCOM). The Joint Director's office reviews and validates requests and assigns forces as available. The military may contribute aerial resources—including the Modular Airborne Firefighting Systems (MAFFS) or helicopters—and personnel to firefighting efforts.

The agreement is neither reciprocal nor binding; the arrangement simply allows the DOD to support the wildland fire agencies at its discretion. However, agreements between DOD installations and local agency offices (national forests, wildlife refuges, etc.) do allow mutual aid response—that is, cooperation in fighting fires on DOD lands. Meanwhile, each installation commander can decide whether and when to provide material support, and as commanders change, the arrangements may too.

Authorities and Coordination

One of the roles of the U.S. military is to support civilian authorities in times of need. Natural resource agencies typically request DOD support for the wildland fire program when civilian resources are already committed to fires and there is need of further resources. The agencies involved in wildland fire view this as "surge capability." Such support is authorized under the terms of the Economy Act of 1932, which allows exchanges of goods and services within and among Federal agencies (31USC1535).

The National Multi-Agency Coordinating (NMAC) Group at NIFC is responsible for requesting support from military units. In the early days of the arrangement, the DOD assigned a liaison officer to NIFC to provide coordination with the National Interagency Coordination Center (NICC) when

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activation was pending. In the 1990s, the Senior Army Advisor to the State of Idaho was assigned this responsibility. In 2006, the Region X defense coordinating officer in Bothell, WA, was assigned to NIFC, and in 2007, a permanent NORTHCOM liaison was assigned to provide daily DOD representation.

The Air National Guard also can provide support upon request. Agreements between Forest Service regions or BLM State offices and local Air National Guard units are written to be consistent with the DOD master agreement. Because the Air National Guard is controlled on a State-by-State basis by each State's governor, working with the Air National Guard is sometimes advantageous as it is more geographically focused and mobilization can be coordinated locally. In addition, aircraft pilots usually stay with the Air National Guard for long periods, making enhanced training possible and promoting greater familiarity and improved proficiency and performance in firefighting operations.

The agencies and military installations have developed their own plans for conducting firefighting operations. Although the organizations may share administrative similarities, their unique characteristics require careful coordination. NIFC has produced operations guides, such as the Military Use Handbook and the MAFFS Operating Plan, which must be considered in joint operations. In many areas of the country, agencies have developed specific guidelines for working with the Air National Guard at a local level.

> NIFC hosts a spring meeting and invites all participants to review plans and procedures for the year and build personal relationships. This communication is especially useful in preparing for work in unanticipated situations because no plan can address every possible contingency.

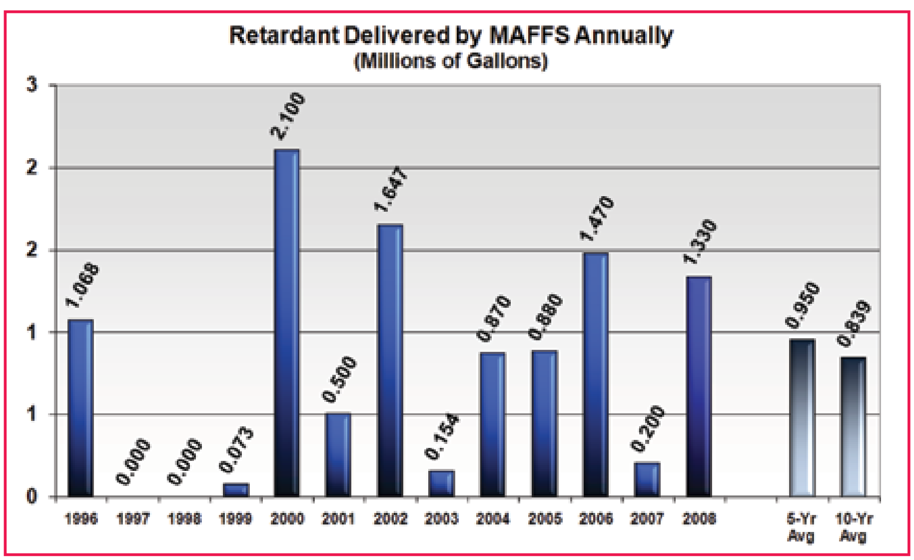
Airtankers

The military supports aerial firefighting efforts through the MAFFS program. MAFFS is a tanking system that can be loaded onto DOD aircraft, allowing them to operate as airtankers delivering fire retardant. Air National Guard and Air Force Reserve units fly military C-130 aircraft to support wildland fire suppression activities. Aircrews practice operations yearly and are certified for this mission.

MAFFS, developed in early 1970s and still in place today, was designed to supplement the purpose-built commercial airtanker fleet in periods of high demand (see figure). The California Air National Guard and the Colorado Springs Air Force Reserve Unit are now using a new system, MAFFS II, which improves retardant delivery, increases operational flexibility, and lowers maintenance costs. Wyoming- and North Carolina-based units will be the next to employ the new system. The figure shows the use of MAFFS on an annual basis in delivering fire retardant.

MAFFS-equipped aircraft may be mobilized in two ways: from the State level and from the Federal level. The governors of California, North Carolina, and Wyoming have the authority to request MAFFS use for fires on State lands at any time. On the Federal level, when civilian airtankers are unavailable to meet the demand, NICC can apply for MAFFS intervention to meet incident requirements for initial attack, extended attack, or large fire support.

As with any deployment, protocol is strictly defined. During firefighting operations, firefighting



MAFFS, tanking systems loaded into DOD aircraft, deliver hundreds of thousands of gallons of fire retardant during critical fire seasons.

agencies update the status of the civilian airtanker fleet within 15 minutes of any change. If the agencies cannot fulfill the need for airtankers locally or within one of the neighboring geographic areas, NICC can submit a request for MAFFS to the Director of Military Support, who contacts the appropriate military units. Usually, MAFFS equipment is mission-effective (that is, ready to fly) within 36 hours of the initial request.

Likewise, cooperating units carefully coordinate flight operations. Military and Forest Service operations personnel confer on the selection of specific airports for the operation. Operations managers request civilian management personnel, retardant plants, and lead plane assignments simultaneously, and complete these steps to coincide with the arrival of the military aircraft.

Helicopters

Procedures to request military helicopters for transporting firefighters and equipment are similar to those used with the MAFFS. State governors can mobilize Air National Guard helicopter units to support firefighting operations on State lands. Federal fire managers can request military assistance when the need for helicopters cannot be satisfied by existing civilian contractors. In some cases, Federal agencies utilize Air National Guard aircraft until civilian aircraft are available to replace them.

There is no formal program similar to the MAFFS program regarding helicopter operations. Full-time and reserve military units rarely have the opportunity to add fire operations training to their existing mission requirements. Experience has shown that full-time military helicopter units are better suited to nontactical fire missions, such as hauling personnel and equipment, rather than fighting fires directly with water buckets or fire retardant. Federal agencies have developed training in nontactical operations for military pilots to explain fire behavior, response tactics, communications protocols, and incident management. Agency personnel can present this training over a few days following a general orientation.

Some military bases have their own firefighting programs, which may include training military pilots in firefighting operations. Local agreements between national forests and these bases are effective ways to integrate individual capabilities in a safe and efficient manner.

Typically, agencies request Air National Guard unit support for tactical missions before military support due to a greater familiarity with the firefighting mission and firefighting operations. Currently, Forest Service regions work with Air National Guard units to train personnel, establish avionics capability, and certify skills. This has proven to be an effective practice because Air National Guard personnel do not change duty locations often, and the retention rate of trained personnel is high.

Aside from Air National Guard units, which often mobilize on an annual basis, agencies have utilized military helicopters only sporadically. This is largely due to the investment time required to integrate the helicopters into incident operations. The peak year for such use was in 1988, when the National Park Service assigned 57 military helicopters to fight the Yellowstone National Park fires. In 1989, Fort Campbell, in Kentucky, deployed 19 helicopters to fight fires in Idaho and Oregon. Recently, the U.S. Marine Corps and Navy have deployed helicopters as part of regular DOD involvement in fighting fires in California.

Ground Forces

When agencies require supplemental ground firefighting support, NMAC can request military personnel resources, which is typically provided at battalion strength—equivalent to twenty-five 20-person crews and their command and control elements. Each battalion fields about 550 personnel, though NMAC may request fewer firefighters. Troops go through a compressed firefighting training schedule and are led by agency crew bosses and strike team leaders during operations.

Command orientation, personnel training, and operational deployment take approximately 1 week. Once NMAC makes the decision to request ground forces and DOD assigns a unit to the mission, a liaison team travels to the designated DOD base and, during the first day onsite, briefs the unit command personnel on the incident and the work to be done. Command personnel split the battalion, and on the morning of day 2, one group goes through basic firefighting training while the other collects personal protective equipment. The two groups switch assignments in the afternoon. On day 3, the battalion travels to the incident staging site and sets up camp. Personnel continue their training on firefighting skills on cold parts of the fire during days 4 and 5. The incident command team begins integration

Military support of firefighting activities from 1987 through 2006.

Year	Unit	Number of Battalions	Name and Location of Incident(s)
1987	Ft. Ord	1	Silver Fire, Oregon
1988	Army/Marines	6/2	Yellowstone National Park fires, Wyoming and Montana; Canyon Creek Fire, Montana
1989	Ft. Lewis/Ft. Carson/Ft. Riley	2/1/1	Idaho and Oregon
1990	Ft. Lewis/Ft. Carson	2/2	California and Oregon
1994	Camp Pendleton/Ft. Hood/ Ft. Lewis/Ft. Riley	2/2/2/1	Washington, Idaho, and Montana
1996	Camp Pendleton/Ft. Carson	1/1	Idaho
2000	Ft. Hood/Camp Pendleton/ Ft. Campbell/Ft. Bragg	2/1/1/1	Burgdorf Junction and Clear Creek fires, Idaho; Upper Nine Mile, Bitterroot, and Troy South fires, Montana
2001	Ft. Lewis	2	Virginia Lakes Fire, Washington
2002	Ft. Riley	1	Monument and Tiller Complex fires, Oregon
2003	Ft. Hood	1	Montana
2006	Ft. Lewis	1	Tripod Complex Fire, Washington

of the battalion into incident operations on day 6.

Assignments typically last no more than 30 days. The military has provided firefighters and MAFFS support during several critical fire seasons, including 1987 through 1990, 1994, 1996, 2000 through 2004, and 2006 (see the table).

Coordination and Planning

Coordinating agencies in firefighting operations requires careful planning, and cooperation between the firefighting agencies and the DOD requires patience and good communication. Plans help document approved procedures and processes and are helpful in defining a common terminology. Plans such as the MAFFS Operating Guide and the Military Use Handbook help capture necessary detail to make operations safe and successful.

Preseason and postseason meetings are key opportunities for communication. NIFC hosts a spring meeting and invites all participants to review plans and procedures for the year and to build personal relationships. This communication is especially useful in preparing for work in unanticipated situations because no plan can address every possible contingency. Command personnel who have developed personal relationships in the course of preseason training can generally resolve emerging issues quickly.

Postseason meetings allow participants to capture experience gained over the course of the summer. Participants can update plans and improve training based on lessons learned. These sessions identify specific actions to be addressed over the winter, and participants in the following preseason meeting can review them in the spring to promote follow-through, completing the cycle of improvement.

The relationship between NIFC and the DOD is an example of good government at work. In times of need, it is an opportunity to boost firefighting capability for the wildland fire agencies. For the DOD, it is an opportunity to work with civilian agencies and gain an understanding of the Incident Command System. The relationship is strong and will continue so into the future. ■

Live Fuel Moisture Sampling Methods: A Comparison

Annie Brown, Philip N. Omi, and Jolie Pollet

Live fuel moisture (LFM) content influences fire behavior in fuel types dominated by living vegetation, such as in Great Basin shrublands (Countryman and Dean 1979; Loomis and others 1979; Norum and Miller 1984; Brown and others 1989; Cohen and others 1995). However, the magnitude of this influence is unknown due to an apparent threshold for fire spread in live fuels: at some point in the flame front, live fuels stop acting as a heat sink and become a heat source, thereby contributing to fire spread and intensity (Brown and others 1989; Burgan 1979; Cohen and others 1995).

Existing Sampling Methods

In 1995, a task force reported to the Interagency Management Review Team (IMRT) of the South Canyon Fire in Colorado on the utility of LFM data (Cohen and others 1995) in helping to predict fire behavior. The task force found that "currently available, operational fire behavior prediction methods in the U.S. are not generally reliable for predicting fire behavior in fuels dominated by living vegetation" (Cohen and others 1995, p. 3). The task force report recommended implementing an LFM monitoring program to gather data throughout the West, with plans eventually to develop correlations between fuel moisture content and fire behavior in specific vegetation types (Norum and Miller, 1984). The first step was to standardize sampling methods. However, developing standard sampling methods isn't enough; it is important to know how different sampling techniques affect their resulting data.

> Due to the lack of additional protocols, most fuel moisture monitoring programs rely on some combination of published methods, even though the fuel types addressed can be markedly different, in terms of phenology and seasonal drying patterns, from the region where fuel moisture collection is taking place.

Two key publications in the last 25 years recommend specific procedures for LFM data collection. Countryman and Dean (1979) published a field user's manual on measuring LFM in California's chaparral with sampling procedures based on phenological variations specific to that vegetation type. Alternatively, Norum and Miller (1984) recommend sampling procedures based on physiological properties specific to vegetation in Alaska. Cohen and others (1995)

The flame front and ignition in Artemisia tridentata *as water in the shrub is driven off. Photo: Greg Zschaechner, Bureau of Land Management (retired).*

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Note: This article is a synthesis of the results from a project funded by the Joint Fire Sciences Program. Portions of this article were adapted from a Master of Science degree thesis of the same title, written by Annie Brown in 2007.

Table 1—*Live fuel moisture collection procedures in this study.*

Procedure	Clipped vs. Pulled	Old, New or Mixed	Branchwood or No Branchwood
1	Clipped	Mixed	Branchwood
2	Pulled	Mixed	Branchwood
3	Clipped	Old	Branchwood
4	Clipped	New	Branchwood
5	Clipped	Mixed	No Branchwood
6	Pulled	Mixed	No Branchwood

also suggest several methods for measuring LFM in various fuel types, though Cohen's methods are based on Norum and Miller's work in Alaska. Due to the lack of additional protocols, most fuel moisture monitoring programs rely on some combination of these methods even though the fuel types addressed can be markedly different, in terms of phenology and seasonal drying patterns, from other regions.

Standardization of Sampling in the Great Basin

Fuel analysts practice a variety of LFM sampling methods within Utah and the Great Basin. No standard method exists, yet LFM values are often compared across land management boundaries. Furthermore, current methods to quantify LFM through field sampling have been based on methods developed for fuel types that are very different than those found in the Great Basin.

It is important for fire managers to be confident that LFM data collected in the field is consistent and comparable. This study was initiated to establish a consistent means of collecting LFM data.

The Study

The overall objectives of this study are to:

- Explain how variations in data collection affect LFM values in Wyoming big sagebrush (*Artemisia tridentata* ssp. *Wyomingensis),*
- Increase comparability between sampling areas throughout the Great Basin, and
- Recommend standard techniques for LFM data collection to allow for consistent comparisons across land management boundaries.

LFM sampling currently involves several steps in which errors and inconsistencies may occur. This study involved collecting samples using several commonly employed methods to determine:

1. Whether there is a significant difference in LFM values when vegetation has been clipped as opposed to being hand-pulled or stripped,
2. Whether there is a significant difference in LFM values when old and new vegetation are collected and mixed together in each sample versus old and new vegetation separated out into different samples and their LFMs averaged,
3. Whether there is a significant difference in final LFM values when small diameter (< 1/8 inch or 3 mm) branchwood is included in the samples, and
4. Whether weighing samples in the field immediately after collection as opposed to later in the field office yields different LFM values.

We formulated six collection procedures combining three variables for comparison (see table 1): samples were mechanically clipped or pulled by hand, old and new vegetation were collected separately or mixed, and branchwood was included or not included in the samples. Then, we weighed samples immediately after collection and afterward at the field office. Finally, we performed a statistical analysis of the resulting LFM data to determine the influence of each procedure on measured LFM values.

Study Area

We collected samples at one site in the Bureau of Land Management's Salt Lake Field Office (SLFO) management area. The site is located in northwestern Utah, approximately 60 miles (96 km) west of Salt Lake City, and is characterized by Fire Behavior Fuel Model 6 (Anderson 1982).

Methods

We collected the samples during the green-up period (near the end of May), when shrubs were losing moisture (at end of June), and when shrubs were beginning to cure and lose ephemeral leaves (during the middle to end of

August). Samples collected during each of these months were collected during the same 24-hour period between 1100 and 1600 hours. We included only foliage and branchwood up to 1/8 inch (3 mm); no flowers, flower buds, fruit, or dead twigs.

We collected the samples with the following collection procedures in mind:

- Samples from several shrubs were included in each sample can.
- For procedures with clipped vegetation, small pruning shears were used to remove vegetation (foliage and/or branchwood). No part of the clipped sample was hand-pulled.
- Pulled vegetation involved hand-pulling all vegetation to be included in the sample. No pruning shears were used in gathering these samples.
- Mixed vegetation is defined as a mix of old and new vegetation collected in each sample can. New and old vegetation were collected in proportion to what was visually observed on the shrub.
- Old vegetation was identified as the previous year's perennial growth as well as more lignified branchwood (< 1/8 inch or 3 mm) that still supported leaf growth. In August, old vegetation may have included some early ephemeral leaves that had not dropped.
- New vegetation was identified as large ephemeral leaves and green pliable branchwood during the May and June collection periods. Newer vegetation was harder to identify and collect during the August collection period due to its location (farther down in the shrub), lack of availability, and smaller size than the more obvious early ephemeral leaves. New vegetation in August included available late ephemeral leaves, new perennial leaves, and green, pliable branchwood.
- Branchwood was limited to less than 1/8 inch (3 mm) in diameter and was measured using a transparent ruler.
- When branchwood was excluded from the sample, only leaves were included in the sample.

We weighed every sample in the field and then weighed it again back at the field office. Samples were then dried at 221 °F (105 °C) for 24 hours to establish their dry weights.

We calculated two fuel moisture values: one using the field-measured wet weight and the other using the shop-measured wet weight. Moisture values were calculated according to the standard equation in Norum and Miller (1984) and Countryman and Dean (1979):

$$LFM\% = \frac{(\text{wet weight} - \text{dry weight})}{\text{dry weight}} x100$$

Results

A comparison of collection methods is shown in Table 2. Criteria included relative ease of collection and consistency of results. Conclusions from analysis of the sampling procedures include the following:

- Variation among LFM values from the procedures tested decreased as the fire season progressed (see fig. 1). In May, different sampling procedures can produce very different results; however, by August, the effects of individual sampling procedures are mitigated by the overall decrease in available vegetation and the drop in LFM throughout all parts of the shrub. Based on this trend, the differences between clipping and pulling vegetation or between including and excluding branchwood may be negligible as shrubs lose moisture toward the height of fire season.

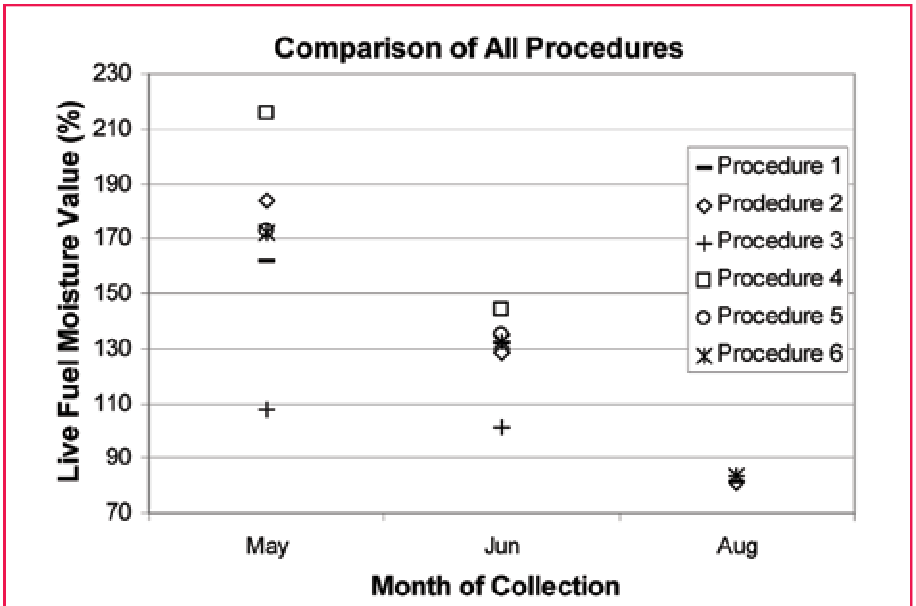

Figure 1—*Average trend in live fuel moisture values for each procedure. Mean fuel moisture values appear to converge as the season progresses. Variation among procedures decreases later in the season.*

- Sample weights taken in the field were an average of .007 ounces (0.2 g) lighter than when the same samples were weighed approximately 2 hours later, after being transported back to the field office, indicating the absorption of ambient moisture. This time difference translates to LFM values that are an average of 5 percentage points higher when using weights taken after storage and transport.
- Collecting a mix of old and new vegetation in proportion to what is found on the shrub is preferable to collecting separate samples of old and new vegetation for each sample and then averaging the two to get fuel moisture values.
- No definite conclusion could be made regarding the effects of including versus excluding branchwood, nor for clipping versus pulling samples, as results varied for each comparison.

These results do not consider the comparative ease with which samples were collected in each of the various procedures. While not directly relevant to the final data, the level of difficulty and speed of collection may influence future decisions concerning use of one procedure rather than another.

Because it was not possible to come to definite conclusions regarding the inclusion or exclusion of branchwood or between clipping and pulling vegetation samples, it is hard to characterize the advantages or disadvantages of any of the sampling procedures. Though different sampling techniques may yield similar LFM values, a standard method would still be beneficial to fire managers where LFM data collection is mandated. For the reasons listed in table 2, either Procedure 1 or Procedure 6 could serve as a standard procedure for use across land management boundaries.

In terms of data, Procedures 1 and 6 seemed to give the most consistent results of all procedures, and there were no significant disadvantages to using either of them. In the procedure compari-

Table 2—*Comparison of the advantages and disadvantages of each collection procedure in the study. The length of time to collect samples, as well as the relative ease of using each procedure, can be important in choosing a procedure for a sampling program.*

Procedure	Advantages	Disadvantages
1	Easy and quick to collect. Methodical collection, likely the most representative of what is on the shrub.	Must use clippers to collect samples.
2	Fairly easy and quick to collect.	May introduce some bias into samples as technicians try to pull off branchwood.
3	None.	Very time-consuming. Resulting values are so much lower than every other procedure that comparison isn't possible. Potential averaging with Procedure 4 is unnecessary work, as statistically similar results can be obtained collecting one sample with a different procedure.
4	Quick and easy to collect early in the season.	Difficult to collect "new" vegetation later in the season, as it is less abundant. Resulting values are so much higher than every other procedure that comparison is not possible. Averaging with Procedure 3 is unnecessary work, as statistically similar results can be obtained collecting one sample with a different procedure.
5	None.	Most difficult to collect, as leaves have to be clipped off branches. Takes longer than any other procedure.
6	Easy and quick to collect.	Samples may be biased toward collecting the vegetation on the outside of the shrub, which likely includes more new vegetation.

son, Procedure 1 results in slightly lower average fuel moistures than Procedure 6. Though the difference between the two is not significant, we would recommend erring toward the lower, more conservative, fuel moisture value.

In addition, Procedure 1 allows for more methodical and representative samples as clipping the vegetation focuses more attention on what and where shrub samples are clipped. Using Procedure 6, field technicians tend to pull the vegetation that is easiest to collect, which is generally on the outside and top of the shrub. For these reasons, we recommend Procedure 1 (clipping; mixed vegetation; including branchwood) as the standard method. In addition, we recommend weighing all samples in the field to avoid obtaining false, higher LFMs that result from waiting to weigh samples.

Fuel moisture data collection programs that have a large amount of existing data from previous years may choose not to change their collection procedure. Changing sampling procedures may not allow for accurate comparison between past and future data unless both procedures are examined together and correlations between the two are performed to convert past data values. In continuing to use data derived by existing methods, fire managers should recognize the effects of their sampling and weighing techniques in comparison to others.

Conclusion

By implementing Procedure 1 and weighing samples in the field, fire managers can be assured that their LFM data is consistent, giving them confidence when making strategic decisions, such as requesting severity funding to provide for extra or extended staffing. In addition, fire managers will know that valuable time isn't being taken up with inefficient procedures.

This LFM information is also useful to fire behavior analysts who travel between geographic areas during the fire season and need to be confident that the information they receive is consistent and accurate.

This LFM information is also useful to fire behavior analysts who travel between geographic areas during the fire season and need to be confident that the information they receive is consistent and accurate. This increases comparability between management areas and agencies and ensures consistency and appropriateness of response.

Recommendations

According to the preferred sampling method chosen, collection procedures should include the following:

- Samples should be weighed as soon as collection is completed to ensure accurate measurement and avoid false higher moisture values obtained after storage. Portable scales are easily transported with other collection equipment.
- Procedure 1 (clipped; mixed vegetation; including branchwood) is recommended as a standardized procedure because it is easy to collect, provides for methodical and representative collection of vegetation, and results in relatively low average fuel moistures typical of field conditions, compared to other procedures.

Fuel Moisture Collection in the Eastern Great Basin

The Utah BLM State Office wrote the *Fuel Moisture Sampling Guide*, which contains standardized collection procedures for use in fuel types typically found throughout the Eastern Great Basin. The recommended procedures and equipment may be of use to fuel moisture collection programs in other geographical areas. The *Utah Fuel Moisture Guide* is posted in PDF format on the National Fuel Moisture Database (NFMD) Web site (<http://72.32.186.224/nfmd/public/index.php>).

Fuels specialists throughout the Eastern Great Basin update the online NFMD whenever new data is collected. This database is a Web-based query system that enables users to view sampled and measured live- and dead-fuel moisture information and has become an indispensable tool for fire managers in the Eastern Great Basin. For additional information about the NFMD, contact your geographic area predictive services unit.

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