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On the Cover:



The Southwest Conservation Corps, Veteran's Fire Corps program leverages the military leadership experience of veterans returning from Iraq and Afghanistan to meet pressing conservation needs on public lands.

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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ALIGNING FIRE DYNAMICS AND LAND MANAGEMENT— WHAT DOES IT MEAN AND WHY IS IT IMPORTANT?

Nearly a year ago, I outlined the key themes to the future success of Fire and Aviation Management—building the National Cohesive Wildland Fire Management Strategy, continuing implementation of doctrine and risk management, developing a professional organization, maintaining our role as world leaders in wildland fire management, continuing with our leadership in the Quadrennial Fire Reviews, and better aligning fire dynamics with land management. In the past three issues of *Fire Management Today (FMT)*, I've covered three of the six—the National Cohesive Wildland Fire Management Strategy and how it will ultimately help us to come together, regardless of agencies or jurisdictions, to solve America's wildfire problems across all lands (*FMT* winter 2011); the importance of fire doctrine and risk management to safe and effective wildfire management, and the importance of applying those two factors in everything we do, every time we do it (*FMT* spring 2011); and, in the last edition, about what it means to professionalize wildland fire management (*FMT* summer 2011). This issue, I'd like to discuss the alignment of natural fire

Fire managers and resource managers have never been positioned as well as we are today to develop a common understanding of the role of fire in shaping the patterns of vegetation on the landscape.

dynamics and land management, and why this alignment is so vital to our stewardship of the National Forest System.

What Does It All Mean?

If we align our resource management objectives with the natural fire dynamics of the land, we will create a foundation that allows us to respond effectively and efficiently to wildfire. Our current efforts to revise our land management plans and the development of the cohesive strategy provide us with the opportunity to do just that. Three decades of ecological research provides us with the analytical tools and knowledge that was unavailable at the inception of our land management planning efforts in the 1980s. Fire managers and resource managers have never been positioned as well as we are today to develop a common understanding of the role of fire in shap-

ing the patterns of vegetation on the landscape.

Why Is It Important?

Both land managers and fire managers must deliberately plan for realistic outcomes that are based upon the potential of the landscape to achieve our resource objectives. If we align our land management strategies with the dynamics of the fire regime, we stand a better chance of success in managing landscapes to meet the needs and priorities of the Nation. Understanding our landscapes and the role of fire in shaping them is vital; if we choose to ignore them, we will continue to experience the catastrophic fires we've seen over the past decades.

As fire professionals, it is our duty not only to engage in emergency management activities with the fire services but also to engage land management planners and community leaders in a science-based ecological dialogue. Our profession requires us not only to be exceptional emergency responders, but excellent natural resource managers as well. ■

Our profession requires us to be not only exceptional emergency responders, but excellent natural resource managers as well.

Evolution in Position Qualifications

Progressive workforce development is a cornerstone of Forest Service, Fire and Aviation Management (FAM). In March 2011, representatives from the National Federation of Federal Employees—Forest Service Council (NFFE-FSC), Forest Service Human Resource Management, and FAM drafted a new occupational series plan. This plan charts the course forward to meet current Office of Personnel Management (OPM) regulations and ensure that fire management skills, experience, and education remain integral parts of various career pathways in FAM.

The plan has two phases: *near term* and *long term*. The near-term phase of the plan outlines an interim strategy that provides employees viable career ladders that meet the requirements of OPM regulations. Briefly, the Forest Service will continue to

use the 0462 Forestry Technician series for certain positions within certain grade levels. For positions that require leadership in both natural resource management and emergency management, the agency will use the 0301 Administrative/Managerial occupational series. Use of the 0401 Natural Resource Specialist series for other positions will continue. This series is appropriate for positions that require specific formal education and technical knowledge of land management science and principles.

Meanwhile, the agency and NFFE are working to develop the long-term phase of the plan: a new, unique occupational series for Forest Service wildland firefighters. This series would be consistent with OPM classified specialist positions in unique occupational series—e.g., 0408 Ecologist, 1712 Training Specialist, 2101 Aviation Program Specialist, 2181 Pilot,

and 2003/2005 Cache Manager. Significant work must be completed before recommendations are made to OPM, and target dates for the recommendation have not yet been established.

Professionalism remains a core value of FAM. Just as entry-level positions (such as engine, helitack, and hotshot/hand crews) are considered foundational for many positions, formal education is necessary for others. Although OPM maintains distinct definitions of professional, technical, and administrative positions, FAM considers all employees engaged in the management of wildland fire to be *professionals* in their positions.



A jack pine seedling 5 months after the Meridian Boundary Fire on the Mio Ranger District, Huron-Manistee National Forest. Philip W. Huber, Huron-Manistee National Forest, 2010.

LEADING IN THE WILDLAND FIRE SERVICE: THE FIRST 10 YEARS



Jim Cook and Larry Sutton

Leadership is one of the most essential elements for success in the wildland fire service, and the importance of developing competent and confident leaders has been echoed in many venues. The 1995 Findings from the Human Factors Workshop (Putnam 1995), the 1998 Wildland Firefighter Safety Awareness Study (TriData 1998), and the 2004 U.S. Fire Administration Firefighter Life Safety Summit (National Fallen Firefighters Foundation and U.S. Fire Administration), along with a number of accident investigations, have all identified leadership development as an issue that wildland fire agencies need to address. For the past 10 years, the Wildland Fire Leadership Development Program (WFLDP) has done so by working toward its mission: to promote cultural change in the workforce and to emphasize the vital importance of leadership concepts in the wildland fire service by providing educational and leadership development opportunities.

Recognizing the Need for Effective Leaders

From 1995 to 2000, various wildland fire agencies undertook a number of independent initiatives

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The L-580 Gettysburg Staff Ride in 2010. More than 90 individuals who occupy command and staff positions on national incident management teams participated in this event.

With an eye to what has been learned in the past, the wildland fire service can now meet the challenge of developing future leaders for an increasingly complex and high-tempo work environment.

that revolved around the topics of human factors, decisionmaking, and leadership. However, this increased awareness regarding the need to develop our next generation of leaders was not equally pursued in all sectors of the wildland fire service.

In 1999, the executive board of the National Wildfire Coordinating Group (NWCG) began discussions about an interagency strategy for developing new leaders. The following year, an interagency task group was chartered to analyze the existing wildland fire training curriculum for leadership content,

identify alternatives, and make recommendations. Early in 2001, that task group published the “Report of the Leadership Task Group to the Training Working Team,” which articulated 14 specific recommendations for leadership development in wildland fire agencies. Later that year, the newly minted NWCG Leadership Committee began the process of building the WFLDP.

In pursuit of the WFLDP mission, the committee developed three program components:

- A set of core values that support principle-centered leadership

- actions in a high-risk work environment,
- Formal curriculum that provides leadership skills training and education at all stages of an individual's career, and
- Nontraditional leadership development opportunities that allow individuals to strive for a higher performance level as a leader through self-directed, continuous learning.

Since the program's inception in 2001, most of the 14 recommended actions have been implemented, and the program has made a noticeable impact within the wildland fire service. This initial effort has taught us much about the art and science of leader development. With an eye to what has been learned in the past, the wildland fire service can now meet the challenge of developing future leaders for an increasingly complex and high-tempo work environment.

We realized that the study of human behavior is as important as the study of fire behavior.

Conduit: Ideas to Action

The WFLDP began as an intensive research effort, with the overarching vision to build a high-quality, integrated leadership development process that firefighters could follow from the entry level to the senior leader level. This entailed examining best practices from a number of organizations that operate in high-tempo work environments, including the U.S. Marine Corps University, the Wharton Center for Leadership and Change Management at the University of Pennsylvania, the U.S. Air Force Human Factors Research Lab, the U.S. Army Training and Doctrine Command, the National Aeronautics and Space Administration Astronaut Development Center, the National

Fire Academy, the Institute of Nuclear Powerplant Operators, and various nationally recognized leadership development consultants. This benchmarking and adapting of best practices allowed the wildland fire service to implement proven leadership development techniques along a relatively quick timeline.

Following this research phase, a large network of field practitioners was recruited to work closely with the NWCG Leadership Committee and experts from outside the wildland fire service to build a leadership development program that is relevant to wildland firefighters. In many cases, this meant establishing ad hoc task groups to develop the specific products within the WFLDP. Local units fund all involvement from the field level, demonstrating the strong buy-in at the field level for this program.

Wildland Fire Leadership Values and Principles	
Values	Principles
Duty	<ul style="list-style-type: none"> •Be proficient in your job, both technically and as a leader. •Make sound and timely decisions. •Ensure that tasks are understood, supervised, and accomplished. •Develop your subordinates for the future.
Respect	<ul style="list-style-type: none"> •Know your subordinates and look out for their well being. •Keep your subordinates informed. •Build the team. •Employ your subordinates in accordance with their capabilities.
Integrity	<ul style="list-style-type: none"> •Know yourself and seek improvement. •Seek responsibility and accept responsibility for your actions. •Set the example.

The WFLDP values and principles illustrate what "right" looks like to guide the actions of leaders in the wildland fire service.

Guiding Principles: Distilling Success From Others

The initial research experience exposed the WFLDP to a wide array of techniques and provided an opportunity to distill the higher level common denominators that contribute to the success of leadership development programs in various organizations. Based on those common denominators, the WFLDP established six guiding principles that steer decisions regarding where to invest limited program resources:

- Establish a set of leadership values and principles to provide a model of what is right.

- Invest early in development opportunities for junior leaders.
- Provide formal training that is relevant and gives firefighters an opportunity to practice and develop decisionmaking skills.
- Recognize that risk and human error are an integral part of working in the wildland fire service and prepare leaders for those decisionmaking challenges.
- Foster a student-of-leadership attitude by providing self-directed development resources.
- Work with and learn from outside organizations.

Communication: Information Is Power

The WFLDP has utilized the power of the Web since the program's beginning in order to reach out directly to the primary audience, wildland fire field operators. The key communication resource is the Web site <<http://www.fireleadership.gov>>. First and foremost, this Web site provides the Leadership Toolbox, a menu of online self-development tools available to all users. The Web site also provides support for the formal L-course training curriculum, updates on new initiatives within the WFLDP, links to other leadership Web sites, a full program description, and administrative information. This Web site is hosted at the National Interagency Fire Center and has become one of the most visited wildland fire Web sites,



Discussion time at a South Canyon Staff Ride. There are multiple staff rides conducted at this site every year, including this one with the Redding Hotshot Crew, the Redmond Hotshot Crew, and the Prineville Hotshot crew in 2008.

running about 150,000 hits and 15,000 visits each month. In addition, the WFLDP supports a “Blog About Leadership” feature and has started to maintain a presence on Facebook.

Opportunity: Making It Happen

The most important role of the WFLDP is to ensure that actual leadership development opportunities are available for wildland fire personnel across the country and across agency boundaries. While this entails many initiatives, the formal L-course curriculum is the foundation, providing development opportunities for participants from

entry level to senior leader level. For young firefighters coming into the business, the L-180 and L-280 courses challenge individuals to examine the team behaviors necessary to succeed in a high-risk work environment. The mid-level L-380 and L-381 courses help prepare first line leaders for the challenges of leading cohesive crews and rapid teambuilding during emergency incident response. Finally, the advanced L-480 and L-580 courses are educational opportunities for organizational leaders to reflect on techniques for establishing an effective command climate while dealing with complex incidents.

Other significant efforts include:

- Designing and maintaining the “Leadership Toolbox” as an online resource providing a wide variety of leadership self-development tools for use by individuals at their home unit;

What duty do you have toward other firefighters and toward your organization? Do you respect your subordinates, and do you put their needs before your own? Do you act with integrity when you encounter conflicting expectations?

- Sponsoring the Paul Gleason Lead by Example award that annually recognizes leaders from the field who exemplify the WFLDP's three leadership core values—duty, respect, and integrity;
- Coordinating with wildfire academies and training centers around the country to provide high-quality L-course cadres;
- Providing national train-the-trainer events to assist all NWCG agencies in their efforts to use tactical decision games and sandtable training techniques, to improve simulation design capability, and to support high-quality local L-280 courses;
- Promoting the after-action review concept and developing the supporting training package in cooperation with the Wildand Fire Lessons Learned Center;
- Establishing the Staff Ride as a premier educational technique within the wildland fire service;
- Assisting with the NWCG refresher training project;
- Assisting with the Advancing Fire Training for Rural Departments initiative to help secure leadership training funding and to provide train-the-trainer cadres for non-Federal fire agencies;
- Publishing the “Leading in the Wildland Fire Service” book to articulate a concise and universal leadership doctrine; and



Firefighters engage in a tactical decision game using a sandtable as the delivery platform.

- Partnering with the NWCG Distance Learning Unit to design the entry-level L-180 course as an online platform to provide access to a wider audience of wildland fire personnel.

Leading: Into the Future

Where do we go from here? Are leader development efforts ever really “done”? At some point in the last couple of decades, we realized that the study of human behavior is as important as the study of fire behavior. Leadership is all about human behavior for both leaders and followers. The focus on leadership has also become a way to address some of the ethical issues associated with wildland firefighting, issues that are often not addressed elsewhere. What duty do you have toward other firefighters and toward your organization? Do you respect your subordinates, and do you put their needs before your

own? Do you act with integrity when you encounter conflicting expectations?

The wildland fire service doesn't appear to be confronting fewer or less-complex problems with the passage of time. Most people agree that it is just the opposite: the challenges we face have never been greater. Excellent leadership skills will be required at many different levels in order to meet those challenges. We now accept as truth that the development of leaders is a critical function supporting the effectiveness and sustainability of any organization. As we seek to be world class in how we prepare our people for leadership roles, it will be important to emphasize to our agencies that they need to continue to make adequate resources available to support this goal. In times of declining budgets and shifting priorities, it would be unwise to lose sight of the need for a vibrant and effective leadership development program. It is in times like these that good leadership is needed the most.

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In times of declining budgets and shifting priorities, it would be unwise to lose sight of the need for a vibrant and effective leadership development program. It is in times like these that good leadership is needed the most.

THE FIRE CREWS AT SCHENCK JOB CORPS CIVILIAN CONSERVATION CENTER



Carly Allen

The Schenck Job Corps Civilian Conservation Center is located in the heart of the Pisgah National Forest in western North Carolina. It is 1 of 28 Job Corps Centers managed by the Forest Service in 18 States to provide education, job training, and career opportunities to more than 6,000 economically disadvantaged young Americans each year. The students training at Job Corps Centers have diverse interests, but many are dedicated to some of the most vital work of the Forest Service—wildland firefighting. Like many other Job Corps Centers, Schenck has a type II fire crew trained and ready for action. Unique to Schenck is the Davidson River initial attack crew, the only advanced fire management training program of all Job Corps Centers in the country.

The Davidson River Initial Attack Crew

The Davidson River initial attack crew is composed of a diverse group of 20 students selected from Job Corps Centers across the country. The primary motivation driving the Davidson River initial attack crew is to provide quality training and exposure to the environments of wildland fire, prescribed fire, fuels, all-risk assignments, and land management to highly motivated Job Corps students who seek a career with the Forest Service. The crew's

Carly Allen is the liaison specialist at Schenck Job Corps Civilian Conservation Center in Pisgah Forest, NC.

Unique to Schenck is the Davidson River initial attack crew, the only advanced fire management training program of all Job Corps Centers in the country.

mission is to provide field units, such as ranger districts, inter-agency hotshot crews, helicopter crews, and other fire organizations, with a group of individuals who are well qualified, highly motivated, and possess a strong foundation in fire, all-risk, and land management practices.

The application process for the Davidson River crew is quite com-

petitive—each year the number of applications greatly exceeds the number of positions available. Candidates must submit a professional resume, records of meeting academic standards, an essay stating their personal goals and objectives, and recommendations from staff members at their home Job Corps Centers. All applicants must complete their trade and education requirements from their previous



Davidson River crewmembers hold the west flank of the Sam Knob Prescribed Fire, Pisgah National Forest, NC. Photo: Anthony Conte, Acting Crew Superintendent, 2009.

Job Corps Centers and must be eligible for Federal employment before applying to the program. After the selection panel reviews applications, they interview each applicant and choose the 20 crewmembers.

A High Level of Physical Fitness

The job of a Davidson River crewmember is very demanding and requires a lot of stamina; thus, one of the crew's highest priorities is physical fitness. All students are expected to be in top physical condition and meet strict physical fitness requirements in order to maintain a safe and productive work environment. Before reporting for the first day of work, crewmembers are expected to be able to do 7 pull-ups, 25 push-ups in 1 minute, 45 sit-ups in 1 minute, and a 1.5-mile (2.4-km)

The crew maintains a 15-minute dispatch time during regular working hours and a 2-hour dispatch time after regular duty hours and on days off.

run in 10.5 minutes. In addition, crewmembers are required to pass the arduous duty work capacity test (pack test) every year, which consists of a 3-mile (4.8-km) hike with a 45-pound pack in 45 minutes or less. Most Davidson River crewmembers surpass all the physical fitness requirements. During the training period, their daily physical training regimen consists of 3- to 5-mile (5- to 8-km) hill runs, physical training hikes with full line gear, weight training, and stretching.

Wildland fire and all-risk training for the Davidson River crew is broken up into fall, spring, and summer phases and lasts 9 to 12 months.

Fall Training

In the fall, each student goes through basic wildland fire training, physical training, and field training, which includes 80 National Wildfire Coordinating Group training hours. Following training, the students also work on local and regional assignments.

Spring Operations

In the spring, students officially become members of the Davidson River fire crew, a fully recognized Forest Service initial attack crew that meets all Fire and Aviation Management standards. From



A Davidson River crewmember conducts ignition operations on the Compartment 27 Prescribed Fire, Apalachicola National Forest, FL. Photo: Anthony Conte, Acting Crew Superintendent, 2010.

January to May, the crew is available nationally for wildland fire, prescribed fire, project work, and all-risk assignments, on which crewmembers gain valuable on-the-job training. When an incident occurs, the Davidson River crew will get orders to report to the incident from either the regional or local dispatch center. All crewmembers are expected to be available 24 hours a day while the crew is on board. The crew maintains a 15-minute dispatch time during regular working hours and a 2-hour dispatch time after regular duty hours and on days off. It is vital for each crewmember to have his or her equipment ready and be prepared for dispatch at any time.

The Davidson River crew takes on all types of assignments and prioritizes assignments to ensure that training needs are met, that the crew is available for national wildland fire or all-risk dispatches, and that they can complete prescribed fire and project work for requesting units. Local, regional, and national fire suppression; all-risk assignments; and prescribed burns are the first priority at all times. Project work, such as trail construction or maintenance, site preparation on prescribed burn units, facility maintenance, and hazardous fuels reduction, is a lower priority, but is still very important.

During the spring operational period, the crewmembers go on approximately 40 assignments across the country. Since 2008, crewmembers have traveled to more than a dozen States, including New Mexico, California, Minnesota, Florida, Virginia, and Texas. In the past year alone, crewmembers worked more than 35 prescribed burns and wildfire assignments in Florida, Virginia, and Texas, and at least



Davidson River crew photo following the Unit 3 Prescribed Fire at Kings Bay Nuclear Submarine Base, St. Marys, GA. Photo: Schenck Job Corps, 2010.

During the spring operational period, the crewmembers go on approximately 40 assignments across the country.

3 prescribed burns and wildfire assignments in western North Carolina.

In 2009, the Davidson River crew worked on two special projects with the U.S. Department of Defense. The crew was assigned to two prescribed burning assignments, one at Kings Bay Naval Submarine Base in Georgia and the other at Tyndall Air Force Base in Florida. Crewmembers burned more than 2,000 acres (800 ha) for each assignment. On average, the Davidson River Crew covers more than 30,000 acres (12,000 ha) per year on prescribed burning assign-

ments, and the crew fights more than 20 wildfires every operational period.

The majority of the crewmembers' work is on Federal land, but that is not always the case. For instance, the Davidson River crew returned in the spring of 2011 from fighting wildfires on private land in Texas. For this assignment, the crew was called up by the National Incident Management Team and was 1 of 30 other Forest Service crews fighting the Texas fires.

The Davidson River crew is also available for all-risk assignments. In the past few years, the crew worked on search and rescue cases on national forest land, on hurricane assignments for Hurricane Gustav and Hurricane Ike, and on one tornado assignment in Florida. The crew works long and hard within the constraints of the wildland fire work and rest policies. In an average year, each crewmember will work 700 hours of overtime.

Summer Assignments

In June, crewmembers leave the Davidson River crew and spend the summer training phase on temporary duty assignments with the Federal Government, State governments, or private companies. Most crewmembers gain Student Career Experience Program (SCEP) or Student Temporary Employment Program (STEP) assignments with the Federal Government. Upon completion of these programs, crewmembers become eligible for permanent fire positions. Since the advanced fire management training program started in 2008, the program has trained approximately 70 students. All of the students who successfully completed the program have obtained full-time employment, and 98 percent of these graduates are working in forest or fire-related positions.

All of the students who successfully completed the program have obtained full-time employment, and 98 percent of these graduates are working in forest or fire-related positions.

Schenck's Type II Fire Crew

In addition to the advanced fire management training program, Schenck Job Corps Civilian Conservation Center also has a type II fire crew composed of students in various vocational trades at the center. At this time, Schenck Job Corps has 25 type II fire crewmembers.

Students on the type II fire crew must pass many of the same training standards as the Davidson River crew, including S-130 (Firefighter

Training), S-190 (Introduction to Fire Behavior), I-100 (Introduction to ICS), L-180 (Human Factors on the Fireline), and IS-700 NIMS (National Incident Management System). The students must also pass the arduous duty pack test and various field exercises on the mountain.

Students that are members of the type II fire crew are eligible to go out on wildfire assignments, prescribed burns, and all-risk assignments, such as assignments for Hurricane Katrina and Hurricane Rita. Schenck's type II crew can be expected to be called up from February to late fall on local, regional, and national assignments. Schenck's type II fire crew provides local assistance throughout the year to the Pisgah, Uwharrie, and Croatan National Forests in North Carolina. They also assist in local search and rescue efforts with the Brevard Rescue Squad and conduct trail maintenance with Forest Service ranger districts.

The staff and students at Schenck Job Corps are proud of their contributions to wildland fire management. This program is one of many ways the Forest Service trains and develops the fire managers and wildland fire leaders of the future. For more information on Job Corps, visit <<http://jobcorps.gov>>, and for specific information on Schenck Job Corps Civilian Conservation Center, visit <<http://schenck.jobcorps.gov>>. ■



*Structure protection at Buffalo Trail Scout Ranch, Rock House Fire, Fort Davis, TX.
Photo: Anthony Conte, Acting Crew Superintendent, 2011.*

VETERANS FIRE CORPS HELPS VETS TRANSITION INTO THE CIVILIAN WORKFORCE

Amy Foss



The Veterans Fire Corps is a collaborative initiative of the U.S. Department of Agriculture (USDA), the U.S. Department of the Interior (DOI), Veterans Green Jobs, and various conservation corps that engage recent-era veterans on priority hazardous fuels projects. The program builds upon the knowledge, leadership, experience, and training of military veterans, retraining them and refocusing their mission to protect our public lands from the threat of wildfire. The conservation corps that operate Veterans Fire Corps programs recruit, hire, and train the crews and provide insurance, tools, and gear. Federal agencies (from USDA or DOI) provide funding, help with training, and coordinate fire assignments and interaction with local agency crews.

Brief History

The Veterans Fire Corps program has been referred to as the “minor league hot shots” for Federal wildland firefighting. In 2009, the Southwest Conservation Corps partnered with Veterans Green Jobs to launch a series of Veterans Green Corps programs intended to help veterans (primarily those recently returning from Iraq and Afghanistan) transition to civilian

life by leveraging their military leadership experience to meet pressing conservation needs on public lands. From 2009 to 2011, the Forest Service, Rocky Mountain Region, awarded the Southwest Conservation Corps, in partnership with Veterans Green Jobs,

The continued development and implementation of the Veterans Fire Corps vision—engaging and training veterans on meaningful projects while training them to replace an aging workforce—will leave a strong legacy for all involved.

more than \$900,000 to operate 13 Veterans Green Corps crews, providing jobs to more than 100 veterans. The Bureau of Land Management (BLM) followed suit in 2010 with awards of \$350,000 for fuels mitigation work in Arizona, Colorado, and New Mexico.

It quickly became evident that there was a strong match between veterans looking for post-military job opportunities and the employment needs in fuels mitigation and wildland firefighting. In addition to providing training and jobs for

veterans, these programs helped local land managers meet their yearly quotas for acres thinned and treated. Initial corps projects were split between fuels mitigation, trail maintenance, and construction. Although all the projects were successful, the highest priorities were identified as fuels mitigation and the retention of veterans on these crews.

In the summer of 2010, the Southwest Conservation Corps, in partnership with San Juan Public Lands (Forest Service and BLM) and Shawna Legarza, Columbine District fire management officer, piloted a Veterans Fire Corps program that trained and prepared veterans specifically for future opportunities as wildland firefighters. Veterans enrolled in the program received all the mandatory training and equipment to become certified as type 2 wildland firefighters. They worked on thinning projects, pile-burning projects, and prescribed burns. The local fire managers, led by Legarza, quickly realized the value of having this extra help on the forest and the potential for the participants to become strong candidates for future positions as Federal wildland firefighters.

The Current Program

In 2011, the Forest Service allocated \$1.5 million to expand the Veterans Fire Corps program to a national demonstration project. Demonstration projects will occur in the Forest Service Rocky

Amy Foss is the executive director of inter-regional initiatives with the Southwest Conservation Corps in Durango, CO. She worked as a logistics coordinator and as program director with the Southwest Conservation Corps before moving into her current position.

Mountain, Southwest, and Pacific Southwest (California) regions. These regions will partner with the Southwest Conservation Corps, the Student Conservation Association, and the California Conservation Corps to accomplish priority projects and train veterans via Veterans Fire Corps programs.

The Need

The Veterans Fire Corps addresses two major issues currently facing public land management agencies: (1) the need for highly qualified and well-trained future employees and (2) the need for additional resources to complete priority hazardous fuels projects.

The program helps land management agencies meet the 2009 Presidential Executive Order that directed agencies to assist veterans in securing employment and helping with their re-entry into civilian life. The program also meets the need for Federal agencies to hire employees with experience.



Tony Lagouranis, Veterans Fire Corps participant, lights fuels on a prescribed burn. San Juan National Forest, 2010.

In a recent example of a win-win situation resulting from the program, staff from the San Juan Public Lands realized they had a great opportunity to assess potential future employees after working closely with the Veterans Fire Corps participants on fuels projects on the forest. Managers encouraged the program participants to apply for jobs on their crews and engines and hired all qualified program graduates who wanted positions. The San Juan Public Lands staff were grateful to know that they were hiring trained, qualified squad members who were well adjusted to the nature of the work.

Transferring Military Experience to a Civilian Job

Veterans have served the country and sacrificed for others abroad; once they return stateside, they are looking for meaningful employment that fits their interests and backgrounds. For veterans who are interested in careers in the fire management industry, the Veterans Fire Corps program provides that training and opportunity.

Recent-era veterans have tremendous and varied experience; however, military training and experience does not always translate well into the civilian sector. Veterans need training to help enable a successful re-entry into civilian life, as evidenced by the backgrounds of past participants.

For example, as a former Army medic, Sarah Castinada jumped out of planes into drop zones with the 82nd Airborne. Tony Lagouranis served in difficult conditions as an Army interrogator in Iraq. Lew Sovocool was an officer with the U.S. Army Corps of Engineers and

possesses technical skills attractive to employers, but will likely never replicate the level of responsibility he had as a program manager of a \$200 million Afghan Army infrastructure program. These people and other veterans can capitalize on their military experience and use it in their civilian work setting, but they must have the right guidance and training opportunities.

The Model

The Veterans Fire Corps firefighter leadership development program focuses on providing incrementally more challenging experiences for program participants. The curriculum, made up of three 12-week training tiers, was carefully designed to build upon established skills so no individual is put in a situation for which he or she is not prepared.

The first tier focuses on introductory fuels reduction work, leadership training, and minimum exposure to fire suppression. The two advanced tiers include increased levels of fire response, additional leadership training, higher level certifications, and additional time spent on fire-specific assignments with local fire crews. The tiered model allows for gradual exposure to challenging situations and allows individuals to self-select in or out of circumstances according to their comfort level.

One important component of the model is interaction between Federal land management agency staff and crews and the Veterans Fire Corps program. In the 2010 pilot program, the San Juan Public Lands Columbine District hand crew worked directly alongside the Veterans Fire Corps participants on thinning projects and a few pile-burning assignments. This was

a critical component for veteran training and development. It was equally important for the current Federal employees, as they were able to recognize the high levels of ability and competence of the veterans working next to them. These interactions were incredibly important in the hiring process of the Veterans Fire Corps participants for 2011 positions on San Juan Public Lands and helped the pilot program participants gain employment on local fire squads for the upcoming fire season. This interaction between participants and land management agency partners will be critical to the continued success of the program.

The Participants

To date, there have only been two female participants in the program; however, the program actively recruits males and females. Participants receive a small living stipend while in the program, but it is generally not enough to support more than one person. Thus, the most successful participants do not enter the program with any significant family or financial commitments.

The veterans have a strong connection to each other. During their military service, these men and women may have served in different places, but they all understand each other. This understanding allows the crew to coalesce into an efficient working team and helps form a bond of trust formulated by past experience. “We ‘get’ each other,” said Mike Bremer, a member of the Veterans Fire Corps. His words are often echoed by other participants. “Vets speak a common language,” said Tony Lagouranis. “They are given a responsibility and they do it.”



A Veterans Fire Corps member looks on during a prescribed burn assignment. San Juan National Forest, 2010.

Veterans have served the country and sacrificed for others abroad; once they return stateside, they are looking for meaningful employment that fits their interests and backgrounds.

Lagouranis also addressed a more serious issue shared by his crew members. “Most combat vets have problems,” he said bluntly, “and being with other vets helps.” It is this connection that kept one former Marine Corps sniper in the program. He had a six-figure job offer in the oil drilling industry but chose to join the Veterans Green Corps program in 2009. He spent the summer working on trails for \$300 a week because he realized that his anxiety around post-traumatic stress seemed to fade the longer he spent living with his “comrades” among trees and streams.

The Summary and Future

The Veterans Fire Corps program provides training opportunities for reentry into civilian life while completing important project work on our public lands. The program promotes veteran employment, builds future fire management leaders, and accomplishes priority hazardous fuels mitigation.

Looking forward, there are many veterans who will be looking to find meaningful employment in the civilian sector to find a new way to serve our country. The Veterans

Meet the Veterans Green Corps

Descriptions of the corps' experience as explained by past participants best describe the importance of the program:

Ross Schumacher: Lightwheel mechanic and combat water survival instructor in the U.S. Marine Corps, deployed twice to Iraq.

"The Veterans Fire Corps has helped me out in many ways. Since being hired on the crew in March 2010, I have obtained many classes that include S-130, S-190, S-212, S-211, S-131, S-133, I-700, S-290, L-180, and L-280. In addition to this, the contacts I have made throughout the wildland firefighting world have been outstanding. With the combination of all the classes, contacts, and [my tough stamina and perseverance], I have

landed a job on a fire engine for the upcoming season and plan on making wildland firefighting my career. I do owe a lot to the program and will forever be grateful for the time, effort, and money everyone at the Southwest Conservation Corps has put forth into our projects."

Lew Sovocool: Combat Engineer in the U.S. Army, deployed twice to Iraq and once to Afghanistan.

"I knew from experiences during college that I wanted to pursue work in the natural resources field after I separated from the Army, but I didn't know which track to follow. After being involved with the Veterans Green Corps/Veterans Fire Corps program for the last year, I now have the training, credentials, experience, and exposure to make a well-informed decision about which career to begin transitioning to.

"The majority of our project work was in fuels reduction/fire mitigation. I got really interested in how all of the many factors work together to influence the make-up and structure of our forests and how they have changed since people have moved in and began settling areas that had previously been left to natural influences. I've been researching graduate school programs and decided to work for a few years as a wildland firefighter to gain more on the ground experience. I'll be working on the handcrew for the Columbine District of the San Juan National Forest this season. The opportunities provided through the program opened my eyes to different careers within Federal land managing agencies and gave me the tools to successfully apply and get hired so that I can pursue those interests."

Fire Corps program helps these veterans redefine their mission here at home, retraining them to serve our public lands, communities, and each other. As public land management agencies look to complete priority projects, it is evident that the Veterans Fire Corps program can meet a variety of needs while providing a meaningful experience for all involved. The continued development and implementation of the Veterans Fire Corps vision—engaging and training veterans on meaningful projects while training them to replace an aging workforce—will leave a strong legacy for all involved. ■



Veteran Fire Corps members and Forest Service personnel pause for a picture on a prescribed burn assignment. San Juan National Forest, 2010.

VISUALIZING POST-FIRE LANDSCAPES: NOTES FROM THE FIELD



Peter Goin and Megan Berner

On June 24, 2007, in the vicinity of Seneca Pond, located near North Upper Truckee Road in the Angora Lakes area at Lake Tahoe, CA, unnamed persons failed to supervise an illegal campfire. The result was a wind-driven fire-storm punctuated by a rapidly moving crown fire. This conflagration destroyed 254 homes, caused \$140 million in property damage, and scorched 3,100 acres (1,300 ha). The fire threatened the watershed of Lake Tahoe, and the consequences remain under investigation.

Description of the Project by Peter Goin

In 2008, Research Associate Scott Hinton and I proposed a project to present a time-based, visual study of the Angora post-fire landscape development. It was funded by the University of Nevada, Reno (UNR) Academy for the Environment, and work on the project continues to this day. We selected 10 sites in the post-fire landscape on which to digitally photograph the same vantage points over a period of multiple years, providing investigators and the general public with an opportunity to assess post-fire change and development.

Peter Goin is a foundation professor of art at the University of Nevada, Reno. Megan Berner is an artist, writer, and educator. She spent a year working for the Nevada Conservation Corps combining photography and conservation efforts in Lake Tahoe.

The objective of this project was to present, for the first year, a digital database of a minimum of 24 rephotographs at a minimum of 10 sites. This would provide both individual photographs and a time-based merge of each site's rephotographs. For the second year, from June 2009 to June 2010, we moved the photography schedule to once

I want students to understand that the fine arts is not an isolated, rarified field considered nonessential by the general public, but instead a vital field of study employing a complex visual language ideally suited for interdisciplinary collaboration.

a month. Starting June 2010, we moved the photography schedule to every other month: June, August, October, December, February, April, and June. On February 12, 2011, Scott Hinton completed the 39th survey of the Angora Fire, which brought the project total to 390 photographs.

The team has been compiling additional folders of images that are not of the specific sites, but detail plants, construction, water, and

other changes around the Angora Fire site. This will allow investigators to evaluate the photographs individually or collectively as a time sequence. A selection of five sites will be printed as digital pigment prints, showing the first image, a middle sequence, and an ending sequence. These will be printed in a panorama format for visual display, according to the highest standards of archival permanence.

The Value of a Visual Study

It is surprising how few resources are dedicated to evaluating post-fire landscapes. The visual ramifications of fire are obviously evident, yet rephotographed post-fire landscapes are rarely presented in scientific journals or within the popular media. This proposal initiates a solution; that is, to present a visual study of post-fire development on the Angora Lake Fire. An important sidebar—it is extremely rare for visual artists to join in the investigative process of landscape management, a domain usually reserved for quantitative scientists. This project, while modest on many levels, initiates a process of including the refined visual language of the visual arts (photography) in evaluating landscape change. The underlying premise of this secondary advantage is that art does, indeed, matter. I know from my work conducting the project, *Stopping Time: A Rephotographic Survey of Lake Tahoe* (1992 University of New

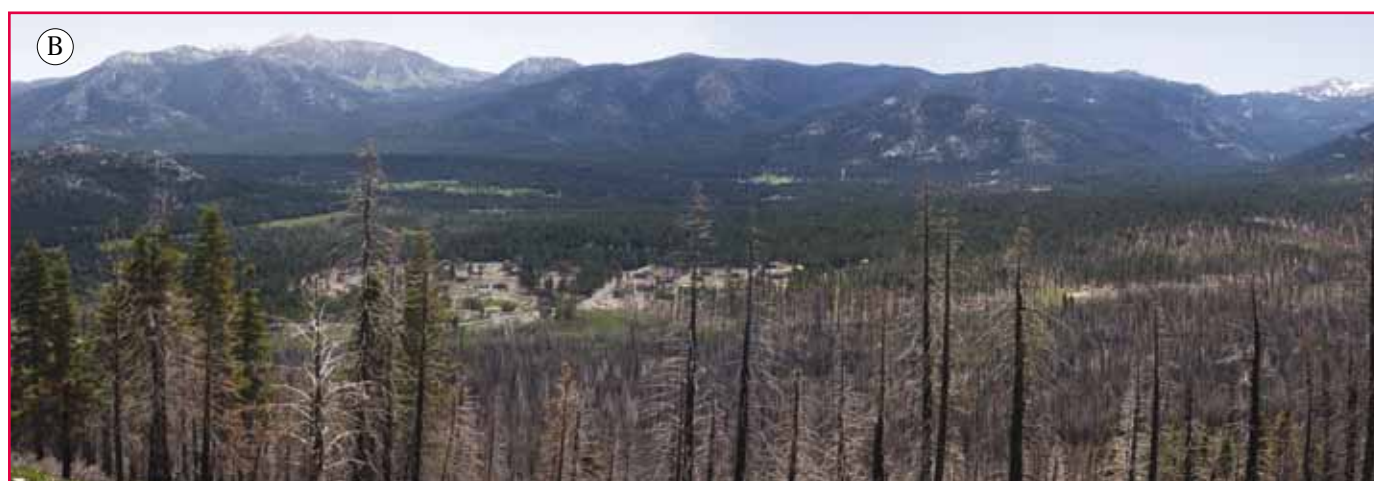
Mexico Press) that scientists are in need of a visual baseline for future analysis. I still receive multiple requests for the use of historical and contemporary comparative views. Our collective point is that visual analysis of post-fire landscapes is sorely needed, and there are currently no published, dedicated, skilled, professional visual comparative views of post-fire redevelopment in the Tahoe Basin.

The hypothesis is visually simple. The Angora Lake Fire landscape is currently undergoing considerable change from decisive redevelopment to passive regrowth.

Documenting this evolution should provide a dramatic visual analysis useful beyond the structure of the collaboration. The visual database will be made available for reputable researchers, any other governmental entity, and the media and general public. An exhibit of panels of the photographs will be prepared.

I supervised the site selection and the digital rephotography. Research Associate Scott Hinton supervised the fieldwork, and Megan Berner served as a team leader (her fieldnotes follow this section). Sites were rephotographed more frequently in summer, early fall, and

spring to capture seasonal activity, and less frequently in winter. All photographs were taken in color with advanced digital technology, and each site was rephotographed from its own, exact vantage point. During one phase of the project, two advanced photography students from UNR, Richie Bednarski and Kathy Gordon, were employed to assist with the field photography and final project assembly. This was a great opportunity for them to gain experience in a professional environment. During subsequent summers, students from the Research Experience for Undergraduates program (funded



Site of the Angora fire viewed from the Angora Ridge fire lookout on (A) September 5, 2008, and (B) June 24, 2009. Note the rapid redevelopment in the valley, plus spring green-up in the valley meadows and understory vegetation creeping up the hillsides beneath the burned forest. Photographs by Richie Bednarski and Kathy Gordon.

in part by the National Science Foundation) participated in Angora Fire rephotography as members of our fieldwork team.

This type of project is a cornerstone of my teaching and research. I commonly work with disciplines from history to geography to urban studies to landscape architecture. I want students to understand that the Fine Arts is not an isolated, rarified field considered nonessential by the general public, but instead a vital field of study employing a complex visual language ideally suited for interdisciplinary collaboration. The benefits to the greater northern Nevada community, including Lake Tahoe, are rooted in historical documentation and public education. Collectively, the community should see what is happening in post-fire development, and the results of this study will be available for the media, via published articles, and through dedicated Web-based sites. The visual baseline offers an opportunity for future rephotography, providing the groundwork for greater analysis and more significant funding.

Notes From the Field by Megan Berner

Starting in the summer of 2010, I had an opportunity to work in a unique position as visual research associate for the Nevada Conservation Corps (an Americorps program) and the Great Basin Institute. The position was created to allow a trained artist to teach photography classes and work in the field on special projects in the UNR photography department.

One of the projects I spent my time working on over the course of my year with Americorps was the Angora Lake Fire landscape visual

While the images appear to be straightforward, they reveal a lot not only about the post-fire landscape but also about history, natural phenomena, and culture.

study. As an artist, opportunities to work on projects like these are rare because most scientific-based research projects don't include visual artists in the process. Participating in this project allowed me to use my photography and visual expertise and to engage with it in a different way than I previously had. It also illuminated the significance of the visual arts within the scope of interdisciplinary collaboration, research, and beyond—something that is often not considered or is easily dismissed. This visual research has the potential to open new doors for future collaborations between artists and scientists—ones that can lead to beautiful discoveries and ways to present information to the general public in a more universal way.

As an artist, I am always looking at things and thinking about how to present them to others so they can see them from an artist's perspective. This may not seem important in a project that appears to be straightforward and visually simple: to present the change happening in a post-fire landscape through photography. Surprisingly, some of the visual subtleties became the most interesting parts of the project.

In June 2009, 2 years after the Angora Fire in South Lake Tahoe, I first visited the 10 rephotographic survey sites with a research group from UNR. Initially, I was struck with the seeming randomness of the fire. The area where the fire

took place is fairly developed, mixed with neighborhoods, open space, and recreational land. The rephotographic sites were chosen strategically to show different views of the area—some focusing more on close-up views of redevelopment, some focusing on areas of tree and other flora regrowth, and others focusing on the combination of the two. It was interesting to see how in one spot, a large number of homes had been destroyed, while in some areas only one house among many was no longer there. The patterns of development and fire both have an impact on this landscape, and led me to think about the way humans had developed, controlled, and interacted with the landscape up until now. Over the course of the year, I was able to observe changes reflecting how humans continue to interact with the landscape.

During the summer, most of the rephotographic sites for this project were relatively easy to access. The roads were open and clear of snow, paths were visible, and landmarks—such as rocks and stumps—were easy to locate to aid in positioning the camera in relation to the landscape. Just 2 years after the fire, some major changes had already taken place in the area. Most obvious was the rebuilding that was happening in the neighborhoods damaged by the fire. These areas had a more rapid pace of change than the areas that were further from the immediate vicinity of human development.

In fact, over the course of the year that I was photographing the sites, one of the views became completely obstructed by a house that was rebuilt. Although, at that point, the site was no longer useful as a tool for tracking change, it was 1 of the 10 sites that changed at a very dramatic pace. Many of the other sites had much subtler rates of change that had more to do with natural processes unrelated to human intervention. The subtle changes for me were perhaps the most striking.

Some sites would be virtually no different from month to month except for a shift in light depending on time of day and weather. Some months, noticeable changes would have taken place. For example, a tree may have toppled over or lost a limb or, in the more developed areas, houses would spring up suddenly and portable toilets would migrate. In summer, wildflowers in an empty lot planted for erosion control would be so tall they would be visible in the photograph, while in winter, snow blanketed everything and the tree line remained relatively unchanged.

The photographing experience changed every month. When I started in the summer, I spent more time in the car getting to each site and the short walk to Seneca Pond was easy to navigate. In the summer, comparing previous views and setting up the camera based on meticulous instructions from those who had previously documented the sites was relatively easy: Find this mark on the road, line up the left tripod leg with this rock, and lens height should be 67 inches from the ground. Once in a while, landmarks would move and all of these changes were noted, taken in as part of the experience,



Some photograph points were slow to change, but others, like this one taken at Lookout Point Circle, changed drastically from year to year. Seasonal differences in vegetation are evident in the backgrounds of these photographs, but human development overwhelms the site. Photograph A by Richie Bednarski and Kathy Gordon September 5, 2008; Photograph B by Richie Bednarski and Kathy Gordon June 24, 2009; Photograph C by Scott Hinton, February 16, 2010.



but the days were also shorter and time and light were more of an issue. Snow has the ability to make everything look more uniform; on one visit, I actually got off track and wandered around for an extra half-hour looking for the outlet to where I had parked my car. More than once, I saved the hike up Angora Ridge for last and barely made it back down before sundown. Some days I would rotate the order that I rephotographed, resulting in completely different light from the previous month's photograph.

The road up to Angora Ridge remained closed through May. I probably spent most of my time during that year of rephotographing hiking up and down that ridge. The rephotographic site from the fire lookout on the ridge was one of my favorite spots. It is a sweeping view of the valley below, looking down toward Seneca Pond. The rephotograph consisted of two panels that are stitched together in a panorama (the first photographs presented in this article). Upon hiking to the top of the ridge, I would spend some time just sitting and observing the skies and the light. In the winter, storms would sometimes form at the southwest end of the valley, moving northeast. Sometimes the wind would whip through the trees and blow cumulus clouds across the sky. Some days, it was completely still and clear save for a jet contrail evaporating in the atmosphere. As spring came and summer approached, the light lingered longer. Snow started to melt and underbrush began to grow.

One of the most interesting artifacts from my year in the field was the notebook that was passed on to me when I started photograph-

Sometimes the most striking difference between rephotographs is the lighting. Here, on Mt. Diablo Circle, the low autumn light in Photograph A, taken on September 5, 2008, contrasts with the bright light of summer in Photograph B, taken June 24, 2009. Photographs by Richie Bednarski and Kathy Gordon.

though often they are invisible in the photographs.

When the winter came, everything changed. With the first big snow came road closures and more difficult access to the more remote sites. The rephotographic site on Angora Ridge Road that had once been an easy, 20-minute drive round trip became a hike with snowshoes that took a little less than 2 hours. Many landmarks used

for positioning were also obscured, and new strategies had to be found for framing the rephotographs.

Everything slowed down in the winter. It took longer to get to the sites, and change happened at a much slower pace. But, because I had to spend more time at each site setting up, I became more observant of what was going on around me. Not only was planning research trips around weather essential,

ing the fire sites. It contained the notes and instructions for framing the rephotographs, positioning the camera, and finding the landmarks used. Some of the landmarks were stumps or rocks; other times it was a marker that had been placed by construction workers or the Forest Service, such as a fire hydrant, a plastic fence, or a metal plant hanger that was left charred by the fire. Some of these landmarks remained in place; others were moved or removed, and the snow covered almost all of them in the winter, making them useless as tools for locating. The notes changed as we found new landmarks. Personal observations were interspersed in various scribbled notes among more fact-based information. And then, there were different printed versions of photographs from each site to aid in accurately reframing the image. As changes took place in the landscape each month, we added new layers to the printed photographs—perhaps a circle around a tree with a note that it had fallen, an arrow pointing out that a post was no longer in place for positioning purposes, or a note that a new house was now in the background, changing the points to pay attention to when reframing. The notes tell a story about the experience of being in the field, another layer of the time spent observing and photographing.

For me, some of the most interesting discoveries came while editing the rephotographs on the computer. While being in the field offered an incredibly unique experience, the impact of that experience grew from being able to look at the multiple rephotographs together.



At the end of the first warm season following the Angora Fire (Photograph A), homeowners were well on their way to rebuilding their homes, as shown in this view of Elk Point Drive and Lookout Point Circle from September 5, 2008. Early in the next summer on June 24, 2009 (Photograph B), homes neared completion, dead trees were removed, and home site preparation continued. Photographs by Richie Bednarski and Kathy Gordon.

That's when the subtle differences in light and sky, color and mood really appeared. To me, that is one of the most beautiful side effects of this project. The different rates of change happening in each image create an intense layering of complexity. While the images appear to be straightforward, they reveal a lot

not only about the post-fire landscape, but about history, natural phenomena, and culture. The visual has the ability to convey information in an immediate, visceral way. While these photographs serve a scientific purpose, I imagine that they can and will be viewed in many different contexts. ■

THE EXPOSURE INDEX: DEVELOPING FIREFIGHTER SAFETY PERFORMANCE MEASURES



Dave Calkin, John Phipps, Tom Holmes, Jon Rieck, and Matt Thompson

A cornerstone of effective institutional learning and accountability is the development, tracking, and analysis of informative performance measures. In a previous issue of *Fire Management Today* (“A New Look at Risk Management,” Winter 2011), a series of articles highlighted the importance of organizational safety and risk management and the challenges of balancing safety, efficiency, and effectiveness in the wildfire management environment. Assessing risks to firefighter safety can be difficult, especially in the complex, uncertain, and dynamic environment of active incident management. Programmatic evaluation of firefighter safety is likewise difficult. Additional concerns regarding efficiency and escalating wildfire management costs pose challenges for the Forest Service.

In this report, we briefly review ongoing work to establish a performance measure that directly relates to firefighter safety, efficiency, and effectiveness. The measure is termed “Exposure Index,” recognizing that firefighting is a

dangerous endeavor and that the more time firefighters are exposed to the inherent danger of the fireline, the higher the likelihood of an injury or fatality. The research underway is part of a broader body of work undertaken by the National Fire Decision Support Center fire economics team to inform decisionmaking and ideally to improve wildfire risk management.

“Reduced firefighter exposure to unnecessary risk during fire incidents continues to guide fire management decisions and anchors our actions.”

- Jim Hubbard, March 30, 2011

What Is the Exposure Index?

Exposure Index (EI) is a quantitative measure comparing the contained fire perimeter (CFP) to the total productive capacity (TPC) of the assigned firefighting resources. CFP is equal to the overall length of the final fire perimeter, while TPC represents the cumulative capacity of assigned resources for the duration of the fire event calculated as the sum of total daily productive capacity. EI is calculated as

the ratio of CFP to TPC, as shown below.

$$EI = \frac{CFP}{TPC}$$

EI is an integrated measure of both the relative productivity of resources in building fireline and the relative effectiveness of fireline in containing the fire. For instance, fireline may be burned over or the built contingency line may not intersect with a final fire perimeter. Thus, resources could work at full productive capacity yet have an EI less than 1.0. Alternatively, if a wildfire is allowed to burn itself out on a portion of the fireline, the portion of the contained perimeter that did not have built fireline will still contribute to EI, and thus EI could potentially exceed 1.0.

How the Exposure Index Works

We obtained data to estimate exposure levels for individual fires by identifying daily levels of all ground-based resources identified in incident status (ICS-209) reports for fiscal years (FYs) 2003 to 2010, which describe the incident location, weather, projected spread, firefighting resources, and other critical incident information. Many of the fire events were missing daily entries, and we excluded a number of fire events because too many dates were missing. However, if there appeared to be sufficient

Dave Calkin and Matt Thompson are research foresters at the Forest Service, Rocky Mountain Research Station in Missoula, MT. John Phipps is associate deputy chief, Forest Service, State and Private Forestry in Washington, DC. Tom Holmes is a research forester at the Forest Service, Southern Research Station in Research Triangle Park, NC. Jon Rieck is a biological scientist with the Forest Service, Rocky Mountain Research Station, in Missoula, MT.

information with a small number of missing days, we interpolated daily resource use based on use information from neighboring days. Suppression resources likely conducting mop-up operations and fireline rehabilitation assigned after the event was declared 100 percent contained were not counted towards TPC. In total, we identified 483 Forest Service large wildfires (fires larger than 300 acres [120 ha]) with data quality suitable for calculating EI.

To compute resource productive capacity, we used production rates provided by George Broyles of the San Dimas Technology Development Center. Production rates vary by fuel model. To identify the dominant fuel type (brush, grass, timber), we cross-walked ICS-209 reports with the fuel model recorded within the National Fire Occurrence Database.

Final fire perimeters were not available for all fires within the sample, so we estimated final perimeter length statistically. Fire perimeters are not smooth and, in many cases, are quite rough or convoluted. In a related study, we developed a statistical regression model that links final fire perimeter to final fire area, and the parameters of the model provide estimates of the fractal dimension, or roughness, of fire perimeters. For the EI study reported here, we ran this model using 461 large Federal fires between the years 2005 and 2009. Because we had data on final fire area for all fire events, we were able to use the parameter estimates from the regression model to estimate final fire perimeters (CFP) for the 483 wildfires in this dataset.

Exposure Index Trends, 2005 to 2010

Figure 1 provides average EI by fiscal year. The annual EI is calculated as the sum of CFP for all fires divided by the sum of TPC on all fires for the identified year. EI was highest in FY 2005 (approximately 18 percent) and then trended downward to a low point in FY 2009, at 6 percent, with a modest recovery in FY 2010. Total EI over the 8-year period was computed to be 10.6 percent and indicates that the total productive capacity of ground-based firefighting resources was roughly 10 times the amount of fireline constructed along the final fire perimeter.

Figure 2 presents EI for individual fires, plotted against final fire perimeter size (in chains). This figure demonstrates that large fire events are typically characterized by relatively low EI values, whereas EI values on smaller fire events appear to be highly variable. Across all fires and across all years, EI for individual fires had a minimum value of 0.02 (2 percent), a maximum value of 14.77 (1,477 percent), a mean value of 0.49 (49 per-

cent), and a median value of 0.21 (21 percent). We note that mean and median values are higher than annual averages due to lower EI values for large fires, which carry more weight in the annual average computations due to larger CFP and TCP values. A total of 54 fires (11 percent of fires in our sample) had EI values greater than 1.0.

Related Studies and Future Work

In 2010, we conducted a research study to estimate daily productivity for individual firefighting resources using ICS-209 data for 46 fires that burned during FY 2008. In particular, we estimated the parameters of a well-known economic production function (known as the Cobb-Douglas production function), and then used the parameter estimates to compute the productivity of ground-based firefighting resources. Although these estimates differ from the EI estimates in that they allocate overall productivity to specific resources, the results are generally consistent with the EI analysis. In particular, resource productivity estimates from the Cobb-Douglas model suggest that

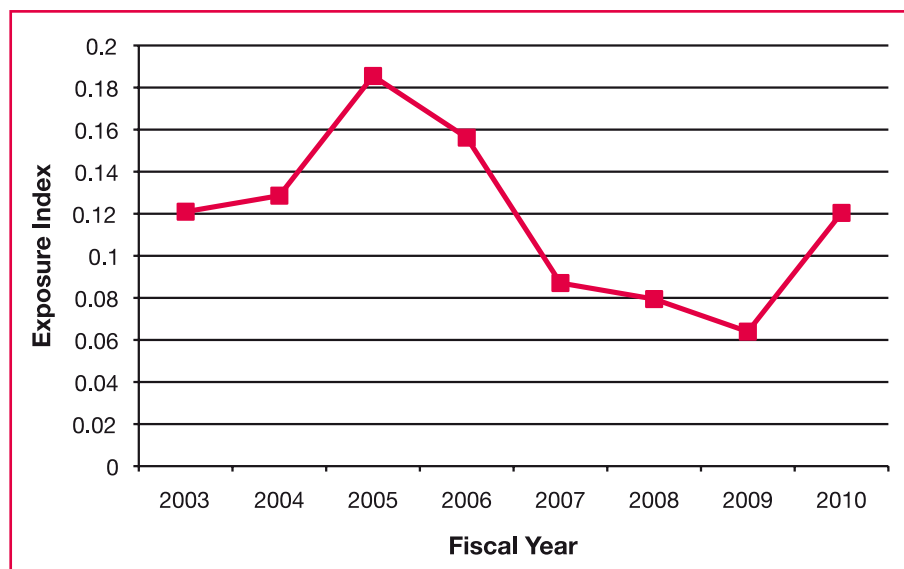


Figure 1—Average exposure index (EI) by fiscal year.

the productivity of suppression resources ranged from 8 percent (engines) to 51 percent (helicopters) of the San Dimas production estimates (fig. 3). Handcrew productivity in the Cobb-Douglas model was about 19 percent of the San Dimas production estimates, and dozer productivity was about 13 percent of the San Dimas estimates. Results from this study are currently being prepared for publication in a peer-reviewed journal (preliminary results are available from the authors).

Also related to these efforts, we conducted a field study in 2010 with additional data collection scheduled for 2011 to estimate daily resource productivity at the division level for large wildland fires. This study is unique because it allows us to estimate the amount of fireline constructed relative to the productive capability as well as the proportion of built fireline that actually engages the final fire perimeter. The analysis will include spatial and temporal measures of how different types of firefighting resources are deployed on a large wildland fire in terms of the terrain, fuels, weather, and fire progression. By matching resource assignments from the daily shift reports with the fire perimeter and developed firelines, the productivity and effectiveness of resources can be measured. Beyond measuring productivity and efficiency, geo-spatial analyses allow for enhanced evaluation of exposure of firefighters to fireline dangers. Figure 4 demonstrates how we estimated wildfire efficiency for the Tecolote Fire on the Santa Fe National Forest in New Mexico.

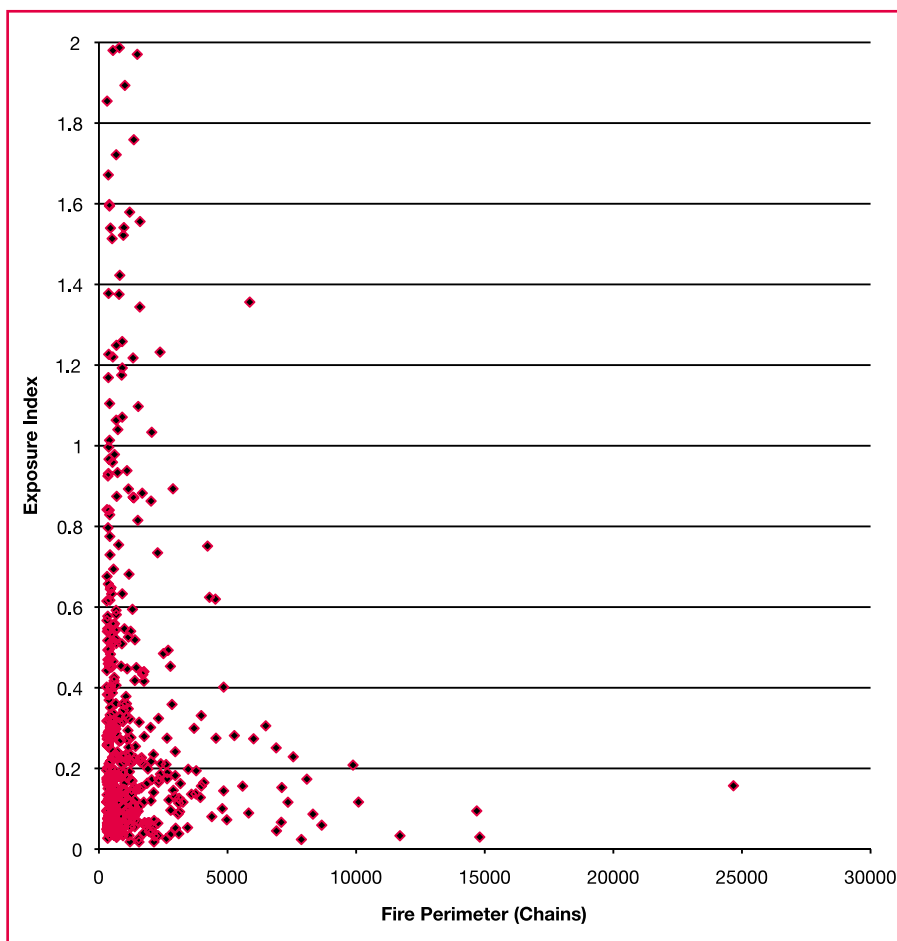


Figure 2—Exposure index (EI) versus fire perimeter, in chains, for individual fires in fiscal years 2003 to 2010. Eighteen fires with EI exceeding 2.0 were removed to allow for improved resolution for the majority of the data. One chain equals 66 feet or 20 meters.

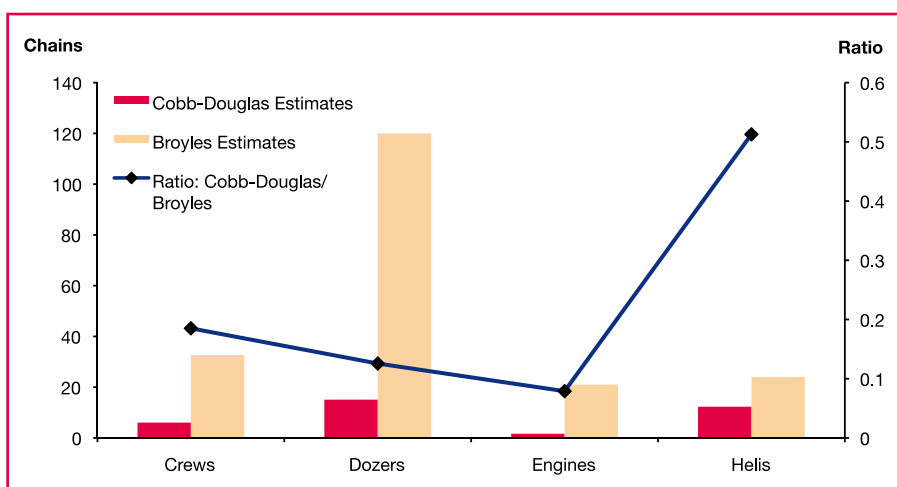


Figure 3—Resource efficiency estimates from the Cobb-Douglas production model as compared to production rates estimated by Broyles (San Dimas Technology and Development Center). Note: all rates are for a single resource. Broyles' estimates for crews and helicopters are for type II resources. In the Cobb-Douglas production model, all crew and helicopter types were aggregated. One chain equals 66 feet or 20 meters.

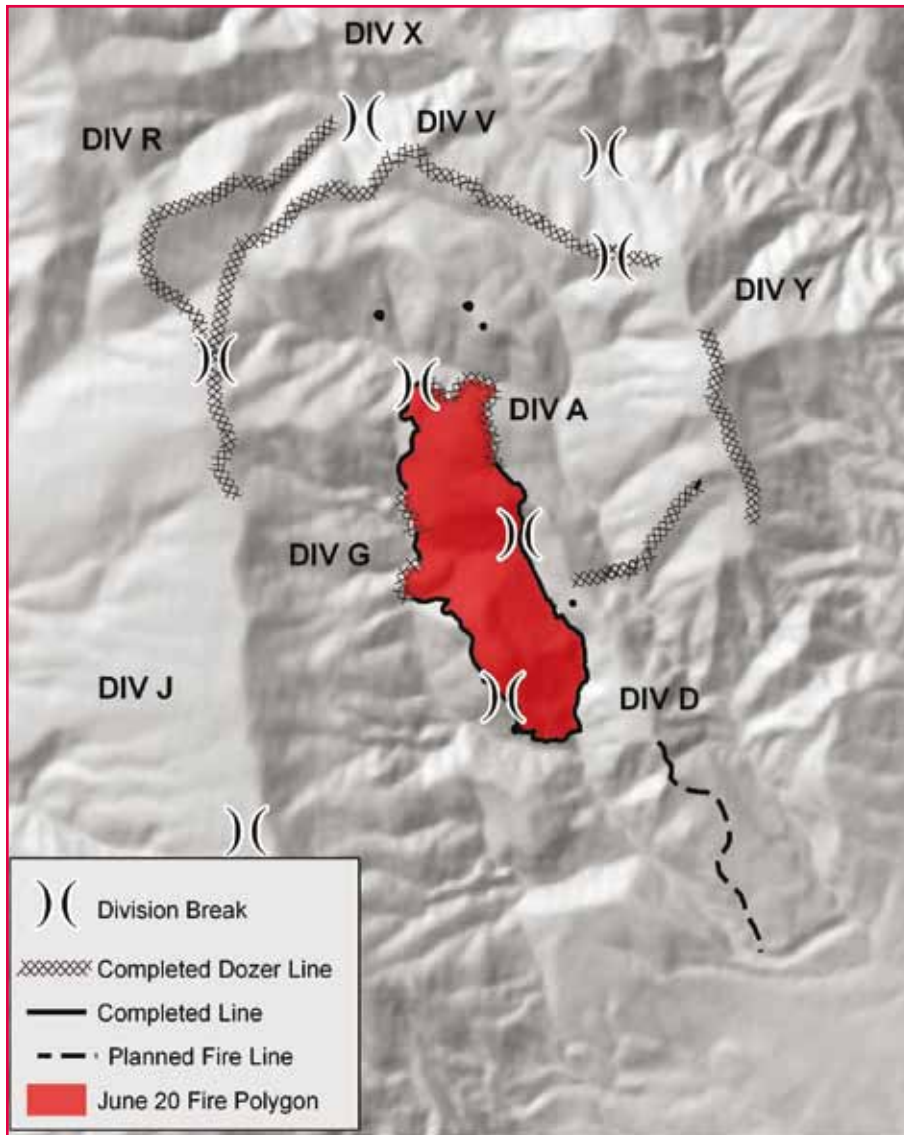


Figure 4—Mapped fireline and perimeter for the Tecolote Fire on the Santa Fe National Forest in New Mexico. Productive efficiency of resources in producing fireline was estimated at 17 percent. Total fireline built was approximately 2.4 times the total fire perimeter, resulting in an overall efficiency rating of 6.9 percent.

The Value of Understanding EI

Although EI is a relatively simple value to calculate, interpretation can be more complicated. Low EI values could indicate relatively unproductive use of resources, ineffective fireline construction, or both. Such results could imply unnecessary expenditures and have budgetary implications for nonfire programs. Alternatively, a low EI could be driven by the complexity of the fire environment (e.g., values at risk requiring that extensive sup-

pression resources be deployed for point protection), or operational constraints, such as extreme fire weather or difficult terrain and access. However, we propose that EI is a useful aggregate measure of firefighting resource efficiency and exposure to hazard. Initial results suggest that ground-based firefighting resources currently operate at around 11 percent efficiency when considering the theoretical productive capacity of all assigned resources relative to the final contained fire perimeter. A working hypothesis driving our research is that an

increase in the efficiency of ground-based resources will translate into a lower level of exposure of these resources to fireline hazards as they will be engaging the fire for a lesser amount of time, thus reducing annual injury and fatality rates.

An important caveat to the EI measure is that production rates for aviation resources on large wildfires are not available. Thus, our initial results leave out two important factors: (1) aviation resources can be quite productive at building fireline relative to other resources, and (2) aviation is potentially the most dangerous component of the wildfire suppression enterprise. We maintained count data on aviation resources assigned to individual fires; however, incorporation into the existing EI model is currently not feasible and will require additional research.

Ensuring that firefighter exposure is justified by the values protected from suppression efforts remains a key objective for wildfire management. Our expectation is that higher EI values would indicate enhanced firefighter safety, in that fewer firefighters would be exposed to the harms of travelling or direct or indirect line building. It is reasonable to expect that there are different relationships between level of exposure and injury and fatality rates for the different categories of firefighting resources. We recognize that fire complexity and other concerns will limit our ability to increase EI significantly and that on a case-by-case basis, low EI values may be entirely defensible. Nevertheless, in general, reducing unnecessary exposure should result in higher EI and lower aggregated fatalities. Future work could expand this investigation into issues concerning aviation exposure. ■

FATIGUE MANAGEMENT DURING EMERGENCY OPERATIONS



Peter H. Lawrence

Risks From Fatigue

Anyone who has been a wildland firefighter for any period of time has experienced the effects of fatigue first hand. From the complete lack of sleep when engaged in the often-times chaotic initial attack on a major fire to the seemingly never-ending night shifts on a campaign fire and the fitful daytime sleep that comes with it, fatigue starts to take its toll on firefighters the moment the alarm goes off. In the best-case scenario, the assignment ends with no one getting injured, and normal sleep patterns eventually return. In the worst-case scenario, bad things happen and people are injured or killed. Poor outcomes are most often not due to incompetence, lack of training, or bad leadership skills, but from a combination of factors, many of which can be traced back to fatigue and the effects it has on decisionmaking abilities. This is not just a fire service issue. The news media has been filled lately with stories of air traffic controllers who have fallen asleep in the control tower, tour bus drivers who crash after driving too many hours, or

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Firefighters need to recognize that fatigue does not affect your ability to make decisions; rather it affects your ability to make *good* decisions.

pilots who have missed their destinations because they had fallen asleep.

The lack of proper sleep takes its toll on the ability to make decisions and has played a part in several major disasters in the United States. The Three Mile Island nuclear accident and the Exxon Valdez tanker accident and oil spill are notable examples of situations where fatigue experienced by several of the participants was a root cause of the accident. Several years ago, in an accident that had a major role in bringing to light the issue of fatigue in the chemical and refining industries, a cloud of hydrocarbon vapor exploded at British Petroleum's Texas City, TX, refinery, killing 15 workers and injuring more than 180 others. When the Chemical Safety and Hazard Investigation Board released its report on the incident, they identified fatigue as a major factor explaining why otherwise competent workers could not recognize and mitigate the events preceding the explosion. The effects of fatigue on decisionmaking abilities were summed up nicely when the report stated "... it is common for a person experiencing fatigue to be more rigid in thinking, have greater difficulty responding to changing or

abnormal circumstances and take longer to reason correctly" (EHS Today 2007)

Closer to home, the wildland fire community saw four of its own killed and several other firefighters charged with criminal offenses following the 2001 Thirtymile Fire on the Okanogan-Wenatchee National Forest in northeastern Washington. While a significant number of people have focused primarily on the decision to file criminal charges against some of the incident leadership, more important in my mind is the fact that high fatigue levels were cited in the investigation report as playing a major role in the poor decisionmaking during the events leading up to the entrapment. Even today, many firefighters feel that fatigue is just another factor that comes with the territory of fighting wildland fires. Hopefully, when these same firefighters read the section of the findings in the report that states "the single overwhelming physiological factor that impacted upon this mishap was fatigue caused by sleep deprivation," they will realize that fatigue must be managed during all phases of the incident if personnel are to avoid repeating these same mistakes.

The Effects of Fatigue

One of the worst things about fatigue for firefighters is the higher possibility of poor decisionmaking that comes from being fatigued. When the National Institutes for Occupational Safety and Health (NIOSH) published *Plain Language About Shiftwork* back in 1997, one of their findings was “the risk from fatigue is not simply a matter of falling completely asleep. After sleep loss, it is possible to have very brief periods of sleep that last only a few seconds. Most people may not even realize these short sleeps are happening. During those few seconds of sleep, they are not paying attention at all.” If that “brief period of sleep” occurs while driving or while listening to radio traffic or a briefing, that lapse can have disastrous results.

Firefighters need to recognize that fatigue does not affect the ability to make decisions; rather, it affects the ability to make *good* decisions. In the Missoula Technology and Development Center’s (MTDC) *Fatigue Awareness* program, the list of the effects of fatigue on decisionmaking include spatial disorientation concerning the proximity and location of hazards, escape routes, and safety zones; a loss of vigilance leading to an impairment of self-preservation behavior and reduced situational awareness; and errors in workload monitoring leading to miscalculating task requirements (MTDC 2008). Other reports have associated firefighter fatigue with an inability to focus, reduced communications skills, degraded cognitive functions, and slowed reaction times.

In an effort to quantify the effect fatigue has on decisionmaking ability, several researchers have performed studies on fatigued individuals and how fatigue affects their cognitive abilities and reaction times. The U.S. Air Force developed a testing method combining known sleep length with future sleep amounts in order to predict the ability of its aircrews to function at a certain point in time, such as during a bombing run or landing after a long mission. This testing method was applied to the sleep patterns of the main players assigned to the Thirtymile Fire before the entrapment occurred.

With a cognitive performance level of 90 percent reflecting the point at which an individual should normally be expected to cease work

Understanding Both Sleep and the Lack of It

While everyone in the fire service has a tremendous amount of experience with sleep, few really understand the dynamics of sleep. There are two types of sleep: nonrapid eye movement (NREM) and rapid eye movement (REM). NREM should occur each night in four stages that get progressively deeper the longer that you are asleep. REM sleep follows each stage of NREM sleep and is the stage when dreaming occurs, emotions are processed, and memories consolidated. The REM stage is important for both learning and well-being. The typical person alternates between the NREM and REM stages while asleep, and both are required in order to get quality sleep.

The average adult should get between 7 and 9 hours of sleep per night. Anything less than that is considered a “sleep debt.” Sleep debt results in acute and chronic sleep deprivation. Acute sleep deprivation is defined as less than 4 hours of sleep in a 24-hour period. Chronic sleep deprivation is defined as decreasing sleep time by 1 hour per night for multiple nights in a row. Acute and chronic sleep deprivation can be correlated to each other in that studies have shown that one week of consecutive chronic sleep deprivation is equal to staying up for 24 hours straight once a week (USCG 2008).

Just as the accumulation of a sleep debt does not occur over a single night, simply getting one good night’s rest following a period of

chronic sleep deprivation will not erase the debt or the effects. A Walter Reed Army Institute of Research study showed that individuals performing strenuous duties and receiving less than 8 hours of sleep for each of 7 days took more than 3 consecutive full nights of sleep to recover their cognitive performance.

Wildland firefighters typically experience acute sleep deprivation when involved with initial attack activities, and they will often suffer from chronic sleep deprivation when involved in multiday assignments on extended attack incidents. Both types of sleep deprivation pose risks to firefighter’s health and decision-making capabilities.

and begin sleeping, the results showed that the cognitive effectiveness of the assigned supervisors on the Thirtymile Fire was between 65 percent and 78 percent at the time of shelter deployment (USDA Forest Service 2001, pages 80–86; U.S. Air Force 2001). This level of “impairment” explains why these firefighters failed to put all of the various pieces of information together to determine that they were in a very dangerous situation and were making poor decisions.

Another group of researchers found that there are similarities in the decline in cognitive function due to sleep deprivation and the decline in cognitive function due to alcohol consumption. In their research paper on “Fatigue, Alcohol, and Performance Impairment,” authors Dawson and Reed (1997) found that there were striking similarities between the cognitive performance of fatigued individuals and the performance of individuals who had been consuming alcohol. Their research involved individuals who were subjected either to set periods of sleep deprivation or consumed alcoholic beverages and then had their blood alcohol content (BAC) measured.

Both sets of individuals performed the same tests designed to measure reaction time and cognitive performance. The researchers found that after long periods of sustained wakefulness, cognitive performance could be compared with a measured BAC. A 17-hour period of sustained wakefulness correlated to a BAC of .05 percent. After 20 hours, the BAC equivalent rose to .08 percent, and 24 hours of wakefulness produced a cognitive performance level equivalent to an individual with a BAC of .1 percent.

“My mind clicks on and off. I try letting one eyelid close at a time while I prop the other open with my will. But the effect is too much, sleep is winning, my whole body argues dully that nothing, nothing life can attain is quite so desirable as sleep.”

—Charles Lindbergh writing about fatigue encountered during his 1927 transatlantic flight

Unfortunately, many firefighters are regularly exposed to these long periods of wakefulness in situations where they are not only driving, working, and operating dangerous equipment, but are doing so under the added stress of doing all three in the already dangerous environment of a wildland fire. Clearly then, it is incumbent upon the individual firefighter and incident leadership personnel to realize that after long periods on the line, decisionmaking degrades due to lack of sleep and fatigue. Armed with that recognition, all three groups need to gain a better understanding of the root causes of fatigue and the measures that can be taken to mitigate them.

Night Shift Issues

For emergency responders, especially wildland firefighters, fatigue management is a serious issue when deployed on long-duration incidents. Due to established work-rest guidelines, Federal incidents tend to be run on 12-hour operational periods with a day and night shift. Since it is difficult to transfer

crews and personnel between day and night shift without losing productivity, once a crew is assigned to a particular shift, they tend to remain on that shift throughout their assignment to the incident. For crews who work prolonged night shift assignments, their natural sleep cycles (circadian rhythms) will be turned upside down and rest periods will take place during times that they normally would be awake. In 2008, the MTDC identified in their Fatigue Awareness training program that “it takes weeks for the body to adjust to the night shift” (slide 19).

The National Institute for Occupational Safety and Health (NIOSH) has spent a great deal of time studying shift work and the effect it has on fatigue and accident rates. In their publication “Plain Language About Shiftwork” (2007), NIOSH researchers found that “crews assigned to night shifts will have the opportunity for approximately 8 hours of sleep time per day, but will only receive between 5 and 6 consecutive hours on average.” Further, they have found

Many firefighters are regularly exposed to these long periods of wakefulness in situations where they are not only driving, working, and operating dangerous equipment, but are doing so under the added stress of doing all three in the already dangerous environment of a wildland fire.

that “sleep after night work usually is shorter and less refreshing or satisfying than sleep during the normal nighttime hours” and that “day sleep also is lighter (less REM) than night sleep.” Even if given enough time off between shifts to get adequate rest, NIOSH researchers found that “workers beginning a series of night shifts generally sleep poorly following each of their night shifts.” This lack of quality sleep for night shift personnel has implications for accident rates. Researchers have found there is a “... higher accident rate observed with each successive night shift worked...” to where “... *by the fourth night the risk is increased*

36 percent above the first night” (Folkard and others 2005). While these studies mainly involved manufacturing and service sector workers, supervisors need to be aware of the potential for accidents or errors not just as the incident goes on, but also in the first couple of days following a crew being assigned to night shift work.

As part of its Crew Endurance Management System (CEMS) program, the U.S. Coast Guard has identified 15 Crew Endurance Risk Factors in the maritime work environment. All of these factors have been found to be root causes of fatigue and a concurrent lack

of situational awareness. Wildland firefighters working on emergency incidents are subjected to 12 of these endurance risk factors, and 7 of the 12 relate directly to sleep or fatigue issues. Research conducted by the U.S. Coast Guard and Walter Reed Army Hospital found that individuals receiving only 6 hours of time in bed for a 14-day period showed “...steady performance degradation throughout the 14 days with levels comparable to 2 days without sleep in the last 5 days of the study period” (Rivera 2008). Based on the NIOSH studies concerning the amount of sleep night shift workers actually receive, incident personnel need to moni-

How Federal Agencies Manage Fatigue in Wildland Firefighting

Larry Sutton

Wildland firefighters have long recognized the heavy burden that fatigue places on their cognitive abilities, but, in the past, had few options other than to tough it out. During a busy fire season, long shifts with no days off were the norm.

After the Thirtymile Fire in 2001, significant changes were made to Federal policies on fatigue management in wildland firefighting. Current policies include a 2:1 work:rest ratio and a 14-day length-of-assignment limitation. Typically, the 2:1 work:rest ratio means that if a firefighter works 16 hours, he or she must receive the next 8 hours off. Although

this does not translate to “8 hours of sleep” it is a vast improvement over the debilitating long shifts that were all too common in the past. The policy allows firefighters to work longer than 16 hours in one shift, but they must subsequently meet the 2:1 work:rest ratio.

Night shift operations have seen a steady decline over the years, for a variety of reasons. Many incident managers recognize the challenges associated with disruption of circadian rhythms and the logistics of providing adequate day sleeping facilities. It is also widely recognized that while fire behavior may moderate at night, there are a number of other hazards unique to nighttime operations.

With the advent of fire management doctrine in 2005 (see *Fire*

Management Today, issue 71(1)), fire managers and crew leaders also feel more empowered to manage fatigue. For example, after a number of consecutive 14-day assignments, it is now an accepted practice for a crew to be provided more than 2 consecutive days off. This assists not only with managing fatigue from sleep, but with recuperation of the other aspects of body and spirit that can accrue from extended firefighting campaigns. After all, fatigue due to sleep deprivation is not the only recognized human factor that can adversely impact firefighters’ decisionmaking abilities. Recent research has shed more light on the role that fitness, diet, and hydration play in firefighter fatigue and performance.

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On initial attack incidents, incident commanders and division supervisors should re-evaluate their resource needs by 22:00 to see if resources already on the line can be rested or released for rollover to the day shift.

tor their night shift personnel to ensure they are receiving adequate rest.

Fatigue Management Strategies and Considerations

Once the effects of sleep loss and fatigue, as well as the dynamics of sleep itself, are understood, supervisors and incident leadership personnel can take measures to mitigate them. Recognizing that fatigue is caused by both acute and chronic sleep deprivation, mitigation measures need to be applied to both initial attack and extended attack incidents. On initial attack incidents, incident commanders and division supervisors should re-evaluate their resource needs by 10 p.m. to see if resources already on the line can be rested or released for rollover to the day shift. While incident leadership often want to keep all of their resources working throughout the cooler and often less active nighttime, unless one is working in an area with lots of available resources or those resources are ordered early, sufficient quantities of resources might not arrive the next morning in time for relief. If sufficient relief does not arrive in time the next morning, crews that have received some rest or were rolled over to day operations before midnight will be much more capable of continuing to perform until the needed resources do arrive than will units who were awake continuously through the night.

Even if resources cannot be completely released from their line operations during initial attack incidents, simply allowing personnel to take controlled and coordinated naps can be an effective way to mitigate fatigue and maintain a higher level of cognitive performance. Studies have shown that 6 hours of sleep in a day, augmented with a nap, can partially mitigate the lack of a full night sleep (MTDC 2008). However, unless you control the naps taken by your crews, you may not achieve the maximum benefit or may even create other problems. To begin with, shorter duration naps of approximately 20 minutes, or longer duration naps of approximately 90 minutes, are best to avoid waking during the deeper stages of NREM sleep. Have someone on each crew or strike team manage the napping times to stay within these timeframes. Additionally, if your crews are going back to emergency operations after their nap or may have to be awakened during their nap if conditions change, limit their naptime to no more than 2 hours. An individual who naps for periods of more than 2 hours may be so groggy from the

effects of sleep inertia when he or she wakes up that it takes too long to recover sufficiently to react to changing conditions.

Conclusion

The issue of sleep deprivation and the effect it has on firefighters and their decisionmaking abilities is an important topic. However, as aptly identified in the preface of the International Association of Fire Chiefs' study on sleep deprivation (Elliot and Kuehl 2007), the fire-fighting "culture" ingrains in all of us from the first day we show up at a fire station that we are supposed to "keep working until the job is done." The fire service is a proud culture that places the strongest, the best, the most productive, the most experienced, and the busiest at the top. No one wants to be the person to tell a line supervisor or incident leader, especially one from another agency, that they are tired and need to rest. That is seen by many firefighters, especially the younger ones, as being weak. I have found this to be especially true in agencies that do not adhere to the 2:1 work-rest ratio and where 24-hour shifts are the norm. But I have even seen it among crews from the same agency, maybe from a different forest or district, who are working alongside each other on a line assignment. Dropping the stigma associated with admitting one is fatigued and speaking up is precisely what needs to happen if

"Unfortunately for the fire service, our drive and desire, combined with a culture that says keep working until the job is done, can create situations where we don't take care of ourselves under the pretext of helping others. This tendency can extend to the amount of sleep that we get."

—From the preface to the IAFC's "Effects of Sleep Deprivation on Firefighters and Other EMS Responders"

we are to ensure our personnel are prepared to make the best decisions possible in the tough environment that is wildland firefighting.

The best move in the direction of de-stigmatizing fatigue was contained in an “Interagency Aviation Safety Alert on Fatigue in Aviation Operations” issued by the U.S. Department of the Interior and the USDA Forest Service on April 21, 2008. The bulletin succinctly describes the problems associated with fatigue and, then, concludes with the best summary I have found to date: “Remember, fatigue is a physiological state; not due to motivation or attitude.” Take fatigue management concerns seriously and be responsible for making sure rest is a priority for your personnel. It may just save someone’s life, quite possibly even your own.

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Contributors Wanted!

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LONG-TERM INTERAGENCY FIRE SAFE COUNCIL COMMITMENT TO FIRE-ADAPTED COMMUNITIES: LESSONS FROM THE BULL FIRE



J. Keith Gillless, Rachel C. Smith, and Derrick Davis

The Kernville, CA, network of shaded fuel breaks is the result of years of interagency collaboration and the efforts of local stakeholders all working through the Kern River Valley Fire Safe Council (KRVFSC). A crew from Kern County Fire Department (KCFD) had nearly completed the 35-acre (14.2 ha) Burma Interagency Extension fuel break, extending a prior Forest Service fuel break to create one that ran, uninterrupted, along the western boundary of the community of Kernville, when the Bull Fire ignited on the afternoon of July 26, 2010. Weather and fuel conditions prompted extreme fire behavior, allowing the fire to escape early containment efforts by jumping a dozer line. By the time the Bull Fire was fully contained on August 9, 2010, it had consumed 16,442 acres (6,654 ha) and destroyed 14 structures. The Governor of California, Arnold Schwarzenegger, declared a county-wide state of emergency. But, even incomplete, the upper Kernville network of fuel breaks effectively halted the advance of the Bull Fire



A Forest Service firefighter ignites a backburn during the 2010 Bull Fire, Kern County, CA. Photo: Casey Christie, *The Bakersfield Californian*.

near Kernville with no loss of life or infrastructure.

A Fire-Prone Geography

The community of Kernville is roughly 160 miles (257 km) north of Los Angeles in central California, situated in the mountains of the State's third largest county. According to the 2010 U.S. Census, the town of Kernville has 1,072 dwellings and a population of 1,395, a number that swells during summers as a result of tourists visiting the picturesque south Sierra Nevada community.

The Kernville area experiences some of the highest fire danger indices in the United States each year, and, since 1990, four large wildfires have burned in the local area. Encouraging the development of fire-adapted communities is an important priority throughout the fire community and was identified as one of three national goals in the National Cohesive Wildland Fire Management Strategy (USDA and DOI 2011). As found in Kern County, interagency partnership with local fire safe councils can significantly curb fire losses (Everett and Fuller 2011).

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Even incomplete, the upper Kernville network of fuel breaks effectively halted the advance of the Bull Fire near Kernville with no loss of life or infrastructure.

The KRVFSC was formed in 2000, and area agencies representing county, State, and Federal interests have been significantly involved with the council from the start. The KCFD represents both local and State interests, as it is under contract to the State of California to provide initial attack in areas of State responsibility. The Bureau of Land Management (BLM) and the Sequoia National Forest are also partners significantly involved with the KRVFSC.

Working with agency partners and area stakeholders, KRVFSC completed a pioneering Community Firesafe Plan in 2002. One of the areas of concern identified in the plan was the town of Kernville, located in an area with heavy fuel loading. It was noted in the plan that, aside from several areas experiencing smaller fires, the steep slopes adjacent to the town had not burned in nearly 80 years, and a suggestion was made to create a network of shaded fuel breaks.

With the endorsement of KRVFSC, Forest Service representatives from the Sequoia National Forest developed a plan to create shaded fuel breaks in upper Kernville. Work began on the Forest Service's Burma Segment Hazardous Fuels Treatment Area after the environmental compliance process was completed in 2005. KRVFSC's community wildfire protection plan (CWPP), formally certified by KCFD and BLM in 2008, included mention of continued risk in the upper Kernville area. Forest Service crews completed the Burma Segment in 2009, and it was expected to be maintained by KCFD crews contracted with KRVFSC to execute National Fire Plan-funded projects.

Area agencies representing county, State, and Federal interests have been significantly involved with the Kern River Valley Fire Safe Council.

During the KRVFSC's 2009 annual project planning meeting, the interagency group considered the proposal of a shaded fuel break extending the Burma Segment across private lands. The group ranked the proposed Burma Extension project as its second most important priority for 2009. That same year, KRVFSC proposed funding the Burma Extension through a community protection grant, reasoning that the completed shaded fuel break would better protect both the community of Kernville and the surrounding wildlands from wildfires.

KRVFSC applied for grant funding from the National Fire Plan through the California Fire Safe Council to support the creation of

the Burma Interagency Extension Fuel Break. They noted that the project would offer direct protection to 135 homes, 405 community members, and \$30.9 million worth of at-risk property (Kern River Valley Fire Safe Council 2009). Matching contributions pledged by KCFD and the KRVFSC strengthened the grant request. KRVFSC's grant proposal was approved and funded, and in 2010, a KCFD crew contracted by the Fire Safe Council began work on the fuel break (Kern River Valley Fire Safe Council 2011). The establishment of the Kernville shaded fuel break network reflects an enduring commitment to inclusive fire risk planning.

By July 2010, the majority of the work on the Burma Extension



Kern County Fire Department fire crews conduct fuel abatement as part of the National Fire Plan-funded Kern River Valley Fire Safe Council grant project in 2010. Photo: Derrick Davis, Kern County Fire Department.

project had been completed. The crew had removed all dead and down material to a width of 150 to 200 feet (46–61 m) in the Burma Extension fuel break area and pruned live trees to a height of 6 feet (1.85 m), creating 50 brush piles prepared for a proposed winter prescribed burn.

Test by Fire

First reported at 2:30 p.m. on July 26, 2010, the Bull Fire spread quickly, burning through flashy fuels with heavy fuel loading. Though the cause of the fire is still under investigation, it is likely that the ignition was human-caused.

Spurred by extreme weather conditions, including low humidity and erratic gusting winds (USDA Forest Service 2010), the Bull Fire resisted early suppression efforts by both ground and aerial resources. It grew quickly as it moved down a steep slope into the Bull Run Creek drainage. Intense downslope wind conditions drove the fire east toward the town of Kernville and northeast toward the smaller, unincorporated community of Riverkern. Firefighters sought to halt the eastern spread of the blaze, putting in dozer lines at the top of an adjacent ridge, but the wind-driven blaze jumped the dozer lines and crested the ridge.

By 4 p.m., as the eastern flank of the fire approached the network of interagency fuel breaks protecting Kernville, the already low humidity had dropped to 9 percent. As the leading edge of the fire approached, firefighters from KCFD, BLM, and the Forest Service prepared to defend the town at the shaded fuel break, building hand and dozer fireline near outlying homes. Inside the Burma Interagency Extension Fuel Break's perimeter, 50 brush



A Kern County Fire Department helicopter attacks the 2010 Bull Fire, Kern County, CA. Photo: Casey Christie, The Bakersfield Californian.

piles scheduled for prescribed burning during winter 2010 caught fire, increasing the Bull Fire's intensity, but the brush piles had been deliberately constructed far away from homes and property and did not pose a problem for suppression forces.

While the Burma Interagency Extension Fuel Break was not completed by July 26, crews working on the project had prioritized clearances adjacent to homes and

other structures, providing the defensible space firefighters needed to work safely and effectively. The Kernville network of shaded fuel breaks, together with the firefighters' direct suppression efforts and aerial attack from helicopters making strategic water drops, stopped the eastern spread of the Bull Fire at the fuel break with no loss of life or property. Elsewhere that afternoon, the fire burned eight homes and six outbuildings, but the long-term, collective efforts of Federal,

State, and county agencies and local stakeholder groups all worked to avoid potentially serious losses around Kernville.

The Wider Effort

An interagency commitment to collaboration, as well as public education and outreach, helped foster a culture of mutual trust between area residents and land management agencies, something that has been shown to promote public support for fuel management activities (Winter and Fried 2000, Toman and others 2006, Shindler and others 2009). The fire safe council, agency partners, and stakeholders worked collaboratively, cognizant that the risk of unwanted fires is continuous and requires a long-term commitment to control measures.

Although 70,000 communities in the wildland-urban interface are at risk of wildland fire today, just 6,000 have created CWPPs (Tidwell and Brown 2010). By developing strong interagency relationships, as well as a long-term commitment to collective action in partnership with area stakeholders, members of the fire community can encourage the evolution of fire-adapted communities.

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Construction of a fire safe zone saved this house from damage during a 2010 wildfire, Kern County, CA. Photo: Derrick Davis, Kern County Fire Department.

WYOMING STATE FORESTRY DIVISION SUPPORTS WILDLAND FIREFIGHTERS



Cathy Lujan

Utilizing the Federal Excess Personal Property (FEPP) program, Wyoming State Forestry Division (WSFD) re-manufactures and paints excess military trucks for firefighting use and builds fire-response packages for the vehicles. WSFD also provides field service, training, and parts to Wyoming counties to maintain this fleet of fire suppression equipment.

Cathy Lujan is a public information officer for the Wyoming State Forestry Division in Cheyenne, WY.

Together, WSFD and FEPP ensure that fire departments across the State have the necessary equipment to fight fires. Once WSFD acquires the vehicle through the FEPP program, the WSFD mechanic shop provides a full-scale overhaul of the military vehicle. "These trucks are all ready to fight fire right out of the door," said FEPP Manager Steve Stowe, WSFD. A key feature on the truck is a 750-gallon (2,839 L) fire-fighting package. This is a tremen-

dous asset when fighting rural fires where water is scarce.

With input from Wyoming communities, Steve Stowe prepares a needs list for the counties state-wide. From this list, equipment is distributed where it is most needed, but otherwise not affordable. "When a wildfire is reported, the first firefighters on the scene are usually from volunteer fire departments. The initial attack role those



A newly arrived surplus truck in preparation for rebuilding.



Wildland engines travel in rugged terrain in rural Wyoming, often in areas that lack a natural water supply.



A re-manufactured truck is ready for delivery.

fire departments play in fighting Wyoming wildfires is significant,” said Stowe. “The cost savings from this program reaches out to all counties and, most importantly, to small communities across the State that have limited funds.”

FEPP fire trucks help protect 3.6 million acres (1.45 million ha) of State Trust land and 25.5 million acres (10.3 million ha) of private land. The primary function of the rugged wildland fire engine is to be a first responder and for water supply. During 2010, 541 fires burned 67,062 acres (2,712 ha) of State and private land in Wyoming; 98 percent of the fires were contained within the first burning period.

Reliable equipment such as the refurbished vehicles helps volunteer firefighters across the State protect people and resources. The FEPP has helped extend the capability of firefighters throughout Wyoming. ■



The Wyoming State Forestry Division mechanic shop is outfitted to remodel wildland engines.

All parts of FEPP trucks are inspected and rebuilt as necessary.



Success Stories Wanted!

We'd like to know how your work has been going! Provide us with your success stories within the state fire program or from your individual fire department. Let us know how the State Fire Assistance (SFA), Volunteer Fire Assistance (VFA), the Federal Excess Personal Property (FEPP) program, or the Firefighter Property (FFP) program has benefited your agency. Feature articles should be up to about 2,000 words in length; short items of up to 200 words.

Submit articles and photographs as electronic files by email or through traditional or express mail to:

USDA Forest Service
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email: <firemanagementtoday@fs.fed.us>

If you have any questions about your submission, you can contact one of the FMT staff at the email address above or by calling 202-205-1547.

BEYOND FIRE BEHAVIOR AND FUELS: LEARNING FROM THE PAST TO HELP GUIDE US IN THE FUTURE



Martin E. Alexander

The third installment in the International Association of Wildland Fire's (IAWF) Fire Behavior and Fuels Conference series was held in Spokane, WA, October 25–29, 2010, and commemorated the 100th anniversary of the 1910 fires in the Northern Rocky Mountains. The theme of the conference was appropriately titled “Beyond Fire Behavior and Fuels: Learning From the Past to Help Guide Us in the Future.”

The 1910 fires were a precedent-setting event and have since had far-reaching implications on how the wildland fire community and society as a whole views and deals with wildland fires regionally, nationally, and internationally. According to Bramwell (2010), “the 1910 fires killed all debate over whether or not to fight fires and loosened Congress’ penurious funding of the agency responsible for protecting the country’s forests.”

The 1910 fires were the impetus for the Forest Service fighting wildfires with every resource available.

Marty Alexander is an adjunct professor of wildland fire science and management in the Department of Renewable Resources and the Alberta School of Forest Science and Management at the University of Alberta in Edmonton, Alberta, Canada. He served as the program committee chair for the International Association of Wildland Fire’s 3rd Fire Behavior and Fuels Conference.



The War Eagle Mine in northern Idaho, where Ranger Edward Pulaski and his crew of 42 men rode out the “Big Blowup” of August 20–21, 1910. Photo: J.B. Halm, Forest Service.

It seemed only fitting that on the 100th anniversary of this historic event that we reflect on lessons learned from the past as we implement innovative and contemporary best practices with managing wildland fires in the future.

The conference featured a special panel discussion specifically related to its theme. A report summarizing the panel discussions entitled “Can history help guide our fire management future?” was produced by the Wildland Fire Lessons Learned Center (Keller 2010). Some of the key obstacles to leveraging knowledge gleaned from history were

expounded upon by Karen Cerulo, Department Chair and professor of Sociology at Rutgers University. She presented three cultural patterns that firefighters have been socialized to that may keep them from using all they can from the historical fire. These three patterns according to Cerulo are:

1. Our culture is future oriented.
2. Our culture rewards a type of ingenuity that is free of history.
3. Our culture values speed in problem solving, which is incompatible with history.

This conference encouraged participants to pay attention to history and mine it for all it's worth as we step into the future of firefighting. Panel member Steve Pyne, Regents Professor in the School of Life Sciences at Arizona State University in Tempe, said that the art and craft of history is not unlike the art and craft of science. "You've got a difficult phenomenon out there; how are you going to model it?" he said. "You don't make anything up, you don't leave out anything that needs to be there—and it needs to be there if it changes the story."

The first IAWF Fire Behavior and Fuels Conference was held in Portland, OR, in March 2006 and focused on "how to measure success" in fuels management. The second IAWF Fire Behavior and

Fuels Conference was held a year later in Destin, FL, in March 2007 and focused on innovations in technology, management, and policy related to the wildland fire environment. The proceedings from both of these conferences were published by the Forest Service (Andrews and Butler 2006; Butler and Cook 2007). Contact the IAWF (<<http://www.iawfonline.org/>>) for information on obtaining a copy of the proceedings of the third Fire Behavior and Fuels Conference (Wade and Robinson 2010).

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Proceedings of International Association of Wildland Fire's 11th International Wildland Fire Safety Summit Available Now!

The International Association of Wildland Fire's (IAWF's) 11th installment of the International Wildland Fire Safety Summit series was held in Missoula, MT, April 4–8, 2011. The conference theme was "Promoting the Story of Wildland Fire Safety ... From the Local to the Global."

The summit proceedings contain a total of 35 written contributions resulting from the various oral and poster presentations. The CD-ROM of the proceedings also includes copies of the proceedings from all of the previous wildland fire safety summits.

Contact IAWF at <<http://www.iawfonline.org/>> for more information.

GUIDELINES FOR CONTRIBUTORS

Editorial Policy

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

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

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Fire Management today

ANNOUNCING THE 2011 PHOTO CONTEST!

The Fire and Aviation Management branch of the USDA Forest Service began conducting photo contests in 2000 for its quarterly publication, *Fire Management Today (FMT)*. Over the years, we have had hundreds of photos submitted, giving us an inside look at your wildland fire experiences.

This year, we look forward to seeing your best fire-related images in our 2011 Photo Contest. Photos in the following categories will be considered: Wildland Fire, Prescribed Fire, Aerial Resources, Ground Resources, Wildland-Urban Interface Fire, and Miscellaneous (fire effects, fire weather, fire dependent communities, etc.). The contest is open to everyone, and you may submit an unlimited number of entries taken between 2009 and 2011.

Guidelines for contributors and the mandatory release form can be found on the *FMT* Web site: www.fs.fed.us/fire/fmt/index.html. Entries must be received by 6 p.m. eastern time on Friday, December 2, 2011.

Winning images will appear in *FMT* and may be publicly displayed at the Forest Service national office in Washington, DC. As appropriate, we may use a photo contest image in an *FMT* article or as a cover photo. If your photo is used in *FMT*, we will supply you with a free copy of the issue so that you can see your contribution to the publication.

Winners in each category will receive the following awards:

- 1st place: One 20- by 24-inch framed print of your photograph
- 2nd place: One 16- by 20-inch framed print of your photograph
- 3rd place: One 11- by 14-inch framed print of your photograph
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