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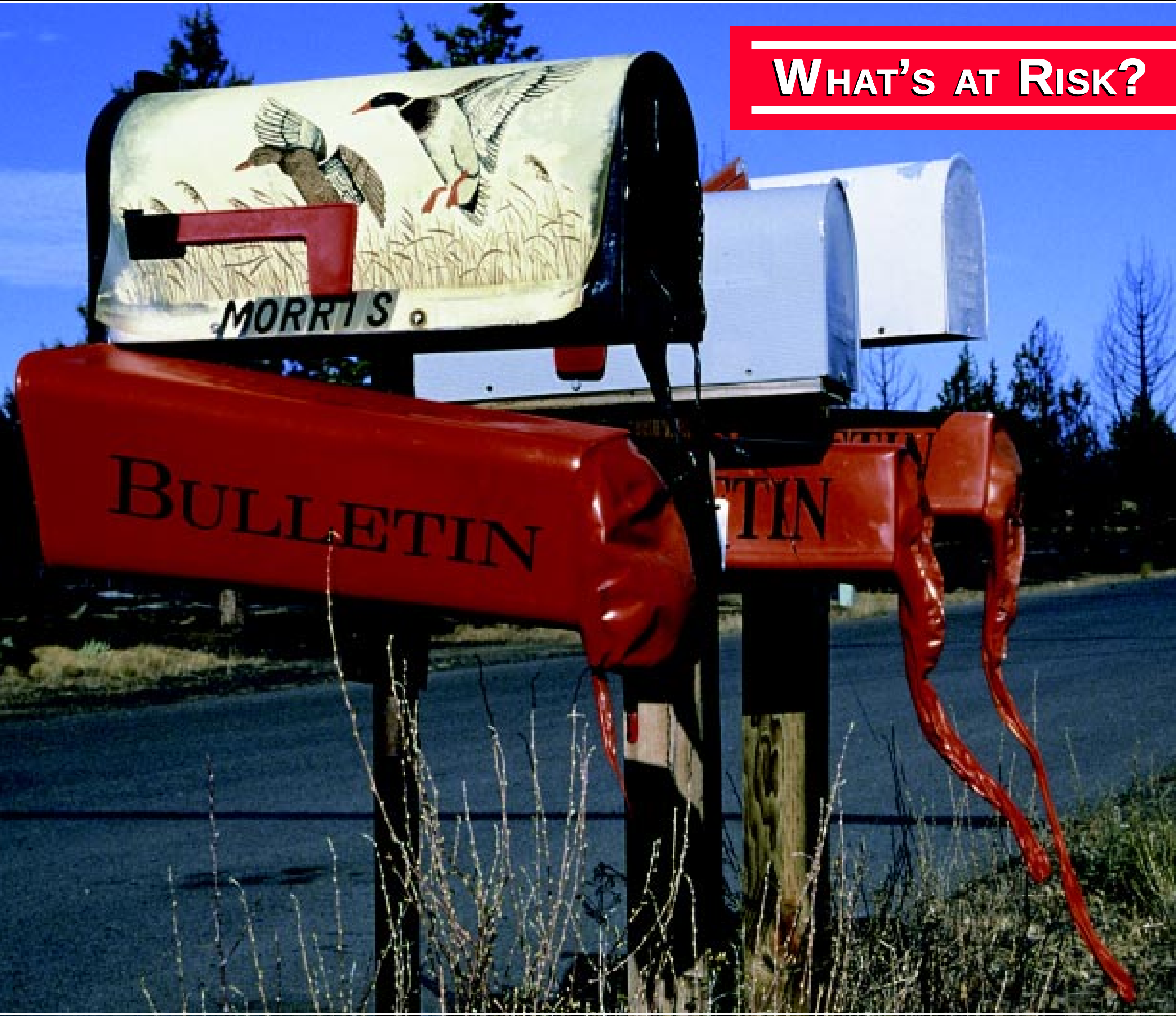

What's at Risk?

United States Department of Agriculture
Forest Service

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On the Cover:

Melted newspaper boxes bear testimony to the heat of the 1996 Skeleton Fire after it made a run through the Sundance subdivision of Bend, OR, near the Deschutes National Forest. The photo won first place for wildland/ urban interface fire in the Fire Management Today *photo contest for 2001 (see page 24). Photo: Thomas Iraci, USDA Forest Service, Pacific Northwest Region, Portland, OR, 1996.*

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

Firefighter and public safety is our first priority.

Contents

Short Features

THE WILDLAND / URBAN INTERFACE: WHAT'S REALLY AT RISK?

Paul Summerfelt

Land managers and wildland fire professionals have long debated fire protection in the wildland/ urban interface (W/UI). After the release of the National Fire Plan in the fall of 2000 and subsequent congressional appropriations designed to treat hazardous fuels, new contingents have added their voices to the W/UI discussion. The W/UI, which is bigger than most people realize, can easily encompass several jurisdictions and ownerships.

A new definition of the wildland / urban interface is needed, along with a commitment to protect and preserve all neighborhood and community at-risk values.

Current Understanding

Various definitions and perceptions exist about what the W/UI is and where it is located.* A common belief is that the W/UI is a geographic area where structures, primarily homes, are next to naturally occurring flammable fuels. Some people explain that W/UI is within a "dog's walk" of a structure. Others think that the W/UI starts at the point where a golf ball hit from the porch of a structure lands. Although these perceptions about the W/UI are diverse, they all describe the W/UI as an area from 30 to 600 feet (9 to 91 m) around a structure or within sight of a structure.

Jack Cohen, a scientist with the Forest Service's Fire Sciences Laboratory in Missoula, MT, directs a research project that focuses on how structures ignite during a wildland fire.* Some people point to the results of Cohen's work to justify their position that hazardous fuel mitigation work should be limited to areas that are close to structures. Others believe that taxpayer dollars should not be spent to protect those who choose to live in areas that have a high wildland fire risk. Still others are opposed to tree cutting for any purpose.

Plume from the 1994 Star Gulch Fire in Idaho, viewed from the Oregon border (above) and the wildland/urban interface (below). Such enormous fires can easily blow from the backcountry into the wildland/urban interface, threatening homes and communities—and making the interface bigger than most people realize. Photos: USDA Forest Service, 1994.

However, most people agree that landowners must build wisely and implement vegetative treatments adjacent to their structures. Additionally, to be truly effective, vegetative treatments must occur on both sides of the boundary line. Work done close to a structure can prevent its loss, whereas work done at a distance can prevent or mitigate the other damaging effects of a severe fire.

Structure damage or loss is not the only risk from wildland fire. Public safety is an even more important concern. The threats from a wildland fire might endanger public safety during the incident and for many years thereafter. Other immediate and secondary fire threats help illustrate the need for revising the definition of the W/UI.

Paul Summerfelt is the fuel management officer for the Flagstaff Fire Department, Flagstaff, AZ.

* For a set of definitions used in the West, see Brian F. Weatherford, "Types of Wildland–Urban Inter-face," *Fire Management Today* 62(1) [Winter 2002]: 11.

* For information about Cohen's research project, see <**http://www.firelab.org**>.

Immediate Fire Threats

Fires can be dramatic and frightening for neighborhoods and communities. The immediate threats go well beyond the palpable danger to homes.

Structures/Infrastructure. Many wildland fires threaten not only structures, but also fences, powerlines, communication sites, or other infrastructure. Because the threat to homes is often the most dramatic and compelling part of a news story from a wildland fire incident, reports often lead with "structures threatened," with accompanying graphic photographs.

Treatments that reduce fire intensity in the immediate area around structures might dramatically improve their survivability. However, treating only these areas does not protect other at-risk values, which might be as important or even more important to a neighborhood and community.

Public Panic. Wildland fires can produce fear, concern, and panic, increasing calls to the local dispatch center. If this happens, other emergency responses are compromised. In addition, people might clog access routes as they flee or try to return home. Examples of chaos and confusion caused by wildland fires include the Florida fire siege in 1998; the firestorm near Spokane, WA, in 1991; and the Oakland Hills Fire in California, also in 1991.

Public Health. During the 2000 fire season, residents of Montana's Bitterroot Valley incurred the health risks associated with living in an active fire zone. Besieged by many fires, people were exposed to heavy smoke for weeks during August and early September. The number of doctor visits and hospital admissions rose dramatically during and immediately after the fires. Many of those affected lived a considerable distance away from the fires.

Firefighter Safety. In 1997, the *TriData Study: Wildland Firefighter Safety Awareness Study* was commissioned to find ways to improve firefighter safety.** Of the 114 recommendations, the need to "implement a large-scale, long-range fuel management program" was the most important. Fire and land managers must conduct hazardous fuel reduction on a landscape scale to improve firefighter safety.

Fire Behavior. Fire spread can be rapid and spectacular. In May 2000, the Viveash Fire on the Santa Fe National Forest in New Mexico traveled an estimated 8 miles (13 km) in one burn period (typically from 10 a.m. to sundown), incinerating approximately 18,000 acres (7,300 ha) of forest. The convection column during that period was larger than what many veterans had ever witnessed.

Secondary Fire Threats

After a fire is controlled and both the media and suppression resources have gone home, community recovery can be long and difficult.

Financial Losses. Every fire season, the loss of revenue suffered by local businesses due to fire activity is the subject of many reports. Losses can be particularly crippling at the height of a summer tourist season. As the multiplier effect ripples through a community, the result might be catastrophic. Chambers of commerce, tourism bureaus, and merchant associations often spend considerable time and money to bring visitors back following a fire.

Depending on a fire's severity, State and Federal money might be available to help offset recovery costs. However, the amount of staff time needed to document losses and meet accounting requirements is often extensive, and it might be years before a settlement is reached and payouts are made.

Transportation. Fires can often disrupt air, rail, or vehicle travel corridors. Shortly after the 1994 South Canyon Fire on Colorado's Storm King Mountain, debris flowed from the fire site and blocked the westbound lanes of Interstate 70, causing significant delays in the flow of goods and services and in personal travel.

Recreation. Many people cherish the opportunity to enjoy the outdoors. Outdoor activities are as diverse as those who seek them. However, most individuals will not travel to fire-blackened sites for any type of recreation experience. The recreation opportunity is "lost" until most of the visible fire effects are healed.

Rebuilding. In most areas, structures and infrastructure damaged or destroyed during a wildland fire will be repaired or replaced. For many communities, this involves rezoning requests, public hearings, new permits, and work-related inspections. Building and engineering departments are quickly overtaxed, which is frustrating to everyone involved.

** For the complete report, now called the SAFE Initiative, see <**http://www.nifc.gov/safety_study/phase**>.

Environmental Costs. A devastating wildland fire carries a variety of environmental costs. One of the most obvious is destruction of wildlife and plant habitat. Some sites most at risk are home to various threatened, endangered, or sensitive (TES) species. Too often, TES species habitat listed as threatened in daily summary reports is later noted as destroyed in postfire narratives.

Watershed values are another important environmental concern. An example of fire damage to watersheds was the 1996 Buffalo Creek Fire, which raged across 11,000 acres (4,450 ha) outside Denver, CO. The fire burned through part of the South Platte River drainage, a major contributor to metropolitan Denver's water supply. Following fire control, the area experienced severe soil erosion. Cheeseman Reservoir was drained and dredged. In 5 years following the fire, 13 100-year flood events occurred in the area, and two lives were lost. The 2002 Hayman Fire in the same watershed threatens to make the situation worse.

In the aftermath of a wildland fire, forest health suffers. Although fires occur naturally, many western ecosystems did not evolve with the fire intensity recently experienced. In the past 120 years, fire exclusion, grazing, and logging practices have altered stand composition and compromised native plant communities. Dense stands of small trees now proliferate in many western coniferous forests. The current fuel loads support stand-replacement fires where low- or mixed-severity fire regimes once prevailed. These unnatural conditions are not sustainable, as the increasing size and severity of forest fires show.

Public Confidence/Support. Following any major incident, the public might review the effectiveness of incident management officials and programs. People often question the level of confidence placed in individuals, institutions, and activities. Private groups that have either opposed or advocated a particular course of action are

A large wildland fire (above) can have devastating results in the wildland/urban interface (below). Photos: USDA Forest Service.

usually quick to scrutinize incident management. Although postevent scrutiny is beneficial, efforts to prevent the event or to mitigate its effects before the event occurs should be encouraged.

Scenic. Picturesque vistas are an important component of our landscape. Many people travel great distances to enjoy the beauty of our national parks and forests. For some, long-distance vistas might be a daily experience—an open-space area passed on their daily commute. For others, they might be altogether out of reach; but simply knowing that scenic, undeveloped places exist is important. Although property insurance helps to rebuild homes that have survived a wildland fire, there is no fix but the passage of time for a black, desolate landscape ravaged by fire.

Emotional/Spiritual. Many people have a special bond to a particular site. Damage caused by a wildland fire to these sites can cause mental or even physical pain to an individual, a family, or a culture. For example, the San Francisco Peaks are sacred to American Indian tribes living in the Four Corners area of the United States.

Rethinking the W/UI

Based on immediate and secondary fire threats, a good definition of the W/UI might be:

An area in and adjacent to a neighborhood or community where the immediate or secondary effects of a wildland fire threaten at-risk values and will be a serious detriment to the area's overall health and sustainability.

This definition broadens the perspective of what the W/UI is and where it is located. It implies the need for action outside the "structure envelope."

The goal in the W/UI must be to protect all at-risk values, not just structures. Those who are accountable to the public and have a responsibility to act during wildland fires must reduce the fire threat across jurisdictions and ownerships and at considerable distances from structures. Anything less neglects our duty and jeopardizes the health and sustainability of our neighborhoods and communities. ■

Fuels Management in Flagstaff

Flagstaff, AZ, takes a successful approach to mitigating the fire threat in the wildland/urban interface (W/UI). With several hundred incidents each year in and around the city, wildland fire is the area's number one fire threat. The Flagstaff W/UI extends for several miles outside the city's corporate limits. It includes private, county, State, and Federal lands.

The Flagstaff Fire Department's Prevention Bureau has a fuel management program for protecting all at-risk values threatened by fire within the W/UI. The program has a full-time staff of 5, augmented by a 10-person seasonal crew plus 1 or 2 university student interns. Annually, the program treats more than 1,300 acres (520 ha) through selective tree thinning, brush disposal, and prescribed fire.

An active public outreach and education effort encourages Flagstaff's property owners to implement treatments around their homes. New housing developments must complete fuel hazard reduction before occupancy. Fire personnel receive ongoing classroom and field training, including membership on regional and national interagency incident management teams, to help ensure proper response to W/UI fires.

In addition, the city participates in efforts to reduce dangerous fuel accumulations and to restore forest health outside city limits, but within the W/UI. If a project is within the threat zone of the city, Flagstaff's fuel management specialists provide advice, prepare forest stewardship plans, designate trees for cutting, oversee treatments, and conduct prescribed burns. For more information, contact Paul Summerfelt by e-mail at <psummerfelt@ci.flagstaff.az.us>.

Historical Fire Regime in Southern California

Jon E. Keeley and C.J. Fotheringham

The historical variability in fire regime is a conservative indicator of ecosystem sustainability. Understanding the natural role of fire in chaparral ecosystems is therefore necessary for effective fire management.

In December 2001, we published two papers (Keeley and Fotheringham 2001a, 2001b) that contradict earlier studies suggesting that the "natural" fire regime in southern California was one of frequent small fires that fragmented the landscape into a mixture of stand age classes, thereby preventing large, catastrophic crown fires.

Stand-Replacing Fire Regime

It has been claimed that the natural fire regime in chaparral was lost because of overly effective fire suppression, and that if fire managers could "restore" it with widespread prescription burning, they could eliminate the hazard of catastrophic fires. The primary supporting evidence is a comparison of contemporary burning patterns in southern California (subject to fire suppression) with patterns in northern Baja California, Mexico (without effective fire suppression).

Jon Keeley is the station leader for the USDI U.S. Geological Survey, Sequoia and Kings Canyon Field Station, Western Ecological Research Center, Three Rivers, CA; and C.J. Fotheringham is a graduate student in the Department of Organismic Biology, Ecology and Evolution, University of California, Los Angeles, CA.

In southern California, fire suppression has not even come close to excluding fire—unlike in many coniferous forests of the Western United States.

After reviewing the evidence, we concluded that the degree to which fire regimes vary between the two regions is debatable. Moreover, any differences that exist cannot be conclusively attributed to differences in fire suppression. Indeed, wildland fire records from the USDA Forest Service and the California Department of Forestry and Fire Protection show clearly that in the ecosystems of southern California, fire suppression has not even come close to excluding fire—unlike in many coniferous forests of the Western United States.

Historical records show that the natural fire regime in southern California shrublands included large, high-intensity fires. In fact, the historical fire regime was not substantially different from the contemporary fire regime. There is no evidence that fire management policies have created the contemporary fire regime dominated by massive fires driven by Santa Ana winds. Increased expenditures on fire suppression, and increased loss of property and lives, are the result of human demographic patterns that place increasing demands on fire suppression forces.*

* See Jon E. Keeley, "We still need Smokey Bear!", *Fire Management Today* 61(1): 21–22.

Management Implications

We question the claim that destructive wildfires in southern California are a modern artifact of fire suppression. Our findings suggest that landscape-scale prescribed burning is not an effective means of preventing large, stand-replacing fires in southern California's shrublands. Limited and strategically placed prescribed burns are more cost-effective for protecting communities and wildland resources. One of the most important roles for fire managers of chaparral ecosystems is to educate land planners on the inherent limitations of fire hazard reduction in these natural crown fire ecosystems.

References

Keeley, J. E.; Fotheringham, C.J. 2001a. The historical role of fire in California shrublands. Conservation Biology. 15: 1536–1548.

Keeley, J. E.; Fotheringham, C.J. 2001b. History and management of crown-fire ecosystems: A summary and response. Conservation Biology. 15: 1561–1567. ■

Postfire greenup on the Angeles National Forest, CA. Stand-replacing fires every 20 to 40 years are typical in southern California's native shrublands. Fire triggers germination in seed-banked annuals, which return to dormancy after shrubs such as chamise, resprouting from root crowns and/or from fire-activated seeds, reestablish the canopy cover. Photo: USDA Forest Service, 1990.

Websites on Fire*

Six Minutes for Safety

The Federal Fire and Aviation Safety Team (FFAST) includes the USDI Bureau of Land Management, National Park Service, Bureau of Indian Affairs, and Fish and Wildlife Service and the USDA Forest Service. Team members have collaborated to develop the first interagency safety initiative that daily addresses the high-risk situations that historically have meant trouble for firefighters. The FFAST, in an effort to continue to find innovative ways to keep firefighters safe on the fireline, believes that the new initiative will have a tremendous positive impact.

Site visitors can either access 12 months of calendars containing "safety-of-the-day discussions" or select discussion topics from a drop-down list. The 200- to 300-word papers cover a variety of safety topics. Readers can learn about the perils of fighting fires at night, what to do when fire engines are trapped, or how to take a nap near the fireline. If you're involved in firefighting, check out the valuable, succinctly written safety information at the Six Minutes for Safety Website.

Found at <**http://www.nifc.gov/sixminutes/index_j.asp**>

*Occasionally, *Fire Management Today* describes Websites brought to our attention by the wildland fire community. Readers should not construe the description of these sites as in any way exhaustive or as an official endorsement by the USDA Forest Service. To have a Website considered for inclusion, contact the managing editor, Hutch Brown, at USDA Forest Service, Mail Stop 1111, 1400 Independence Avenue, SW, Washington, DC 20250-1111, tel. 202-205-1028, e-mail:hbrown@fs.fed.us.

Trigger Points and the Rules of Disengagement

Jason Greenlee and Dawn Greenlee

Nine decades of wildland firefighter fatalities have led to growing numbers of rules for working on wildland fires. The most common lists of firefighter safety rules include the:

- 10 Standard Firefighting Orders;
- 18 Situations That Shout Watch Out;
- Common Denominators of Fire Behavior on Tragedy Fires;
- Urban Interface Watch Out Situations;
- Downhill Fireline Construction Guidelines;
- Lookouts, Communications, Escape Routes, Safety Zones; and
- Aircraft Watch Out Situations.*

Unfortunately, because of poor situational awareness, firefighters sometimes find themselves in the wrong place at the wrong time. Most fatalities on wildland fires stem from this failure—the original plan was good, but things changed and the importance of the changes was not appreciated.

Rules of Disengagement

The Missoula, MT, smokejumpers use a simple concept to help leaders and crew members stay alert. The rules of disengagement address when a firefighter should disengage from the attack for safety reasons. The point that defines when a change is needed is called a trigger point.

Operating in a high-risk, high-consequence environment requires constantly staying alert.

A trigger point on a wildland fire is a set of preplanned, easily recognized conditions indicating that the present tactics are about to become unsafe and that it is time to disengage from the fire and move to a safety zone (see the sidebar). The lead time that a trigger point provides depends on the time needed to move the slowest resources to safety, allowing extra time for unforeseen incidents.

Smokejumper making a training jump. The Missoula smokejumpers use trigger points to help them decide when to disengage from attack. Photo: Paul Fieldhouse, USDA Forest Service, Missoula Smokejumper Base, Missoula, MT.

Jason Greenlee is the fire management officer for the USDA Forest Service, Osceola National Forest, Olustee, FL; and Dawn Greenlee is the prescribed fire specialist for the USDI U.S. Fish and Wildlife Service, Loxahatchee National Wildlife Refuge, Boynton Beach, FL.

* For additional information on firefighter safety rules, see the Fireline Handbook (NWCG Handbook 3, PMS 410–1, NFES 0065, National Wildfire Coordinating Group, Boise, ID, 1998).

Tactical Trigger Points

There are tactical, strategic, and administrative trigger points. In this article, we consider tactical trigger points, where all members of the firefighting team must be alert to changes in their environment.

When selecting a trigger point:

- Talk to local people and those who were on the last shift;
- Choose a trigger point that is relevant and can be easily monitored; and
- Decide on a trigger point that provides adequate time to move to a safety zone.

By discussing trigger points in briefings, crews are involved in environmental monitoring and receive advanced warning (see sidebar). However, each firefighter must not work independently to evaluate changes in the environment. Instead, specialists, usually the lookout(s), are assigned to monitor conditions for the whole crew or division. For example, someone with a psychrometer must monitor 1-hour fuel moisture and someone with fire behavior training must monitor the fire's rate of spread.

The location and skills of the monitor are critical to successful trigger point use. The monitor must assess the approach of a trigger point by monitoring conditions in the entire area around the fire. Qualified monitors have training in fire weather and fire behavior; they work diligently to take humidity measurements on representative sites. Credibility is a big factor. Leaders and crews must believe that the monitor is the most qualified person for the position. Then, when the monitor says that it is time to move, crew leaders respond by quickly moving everyone to one or more predetermined safety zones.

Is Your Safety Zone Really Safe?

When evacuating the crew to a safety zone, the USDA Forest Service's Fire Sciences Laboratory in Missoula, MT, advises making the zone radius four times the expected flame length (a diameter of eight times the expected flame length). Flame length is the distance from the base of the flame at ground level to the average tip of a visible flame.

The 4X rule assumes a circular safety zone without any barriers to intercept radiant heat. However, areas that are not perfect circles can be good safety zones if, because of the probable direction of fire movement, topographic variation, or natural radiation barriers, they provide the necessary 4X separation between firefighters and the source of radiant heat.

In brush and grass, the 4X standard for a safety zone is not a problem. However, in forest cover it is often

Types of Trigger Points

The following situations might be used as triggers to recognize situational changes that might require firefighters to disengage and move to a safety zone:

- Crown fire is imminent. Humidity falls and wind increases, approaching a point where crown fire is likely to threaten the perimeter, erratic or extreme fire behavior is observed, or frequent spot fires occur.
- Darkness approaches.*
- Wind exceeds a certain speed or shifts in a particular direction.
- A storm front or lightning appears in or near the operational area.
- The fire approaches a certain geographic landmark that would compromise escape routes.
- Control over the operational environment is failing. For example, radio traffic is becoming so excessive that communication is impaired; or heavy equipment is above a crew working on a rocky slope.
- Lookouts are ineffective due to features of the terrain or vegetation.
- Elements necessary to support current tactics are compromised or missing (such as water or retardant delivery and mechanized equipment).
- Adjacent units are experiencing problems requiring adjustments in tactics.
- Unforeseen difficulties and challenges, such as broken tools and equipment, are greatly slowing planned rates of fireline production.

** In the United States, disengagement usually occurs well before dark due to many incidents involving falling snags and rolling rocks.*

difficult to find or build a zone big enough. If the fire behavior prediction in a 100-foot (30-m) tree canopy is expected to produce a 200-foot (60-m) flame length at the height of the burning period, the required safety zone would be 1,600 feet (480 m) wide!

This dilemma has caused compromises in the size of the safety zones to reduce costs, increase expediency, or protect the environment in areas with potentially high flame lengths. Consequently, many incident action plans on large fires have poor safety zones. Many safety zones are only deployment zones and some are not even adequate as deployment zones.*

Reevaluating Safety Zones

Because safety zone size depends on weather-related fire behavior, each safety zone should be reevaluated before each shift begins. If long flame lengths are not expected during a shift, a smaller safety zone is adequate for that shift. However, if weather conditions are expected to worsen in the same area on the next shift, today's safety zone might not be tomorrow's safety zone.

In this case, firefighters should either adjust the trigger points needed to reach a better safety zone, improve the marginal safety zone, or not work on that part of the line on that shift. If snags or other hazards related to visibility are not a problem, firefighters should consider night operations, when flame lengths are likely to be lower. It might be possible to use predictable and consistent diurnal flows or marine flows during part of the burning period.

A trigger point defines when an immediate change is needed in tactics and / or strategies.

If trigger points are used to mitigate a safety zone that does not meet the 4X standard, fire behavior trends will need to be closely watched. Time of day may not be a good trigger point. Often, it is better to select a trigger point that is sensitive to the parameter that will trigger unacceptable conditions (see the sidebar).

View from a safety zone. From the Salmon Mountain lookout, smokejumpers were able to safely observe a smoke column from the Lonely Fire on the Bitterroot Wilderness Complex in 2000. Photo: Dawn Greenlee, U.S. Fish and Wildlife Service, Loxahatchee National Wildlife Refuge, West Palm, FL, 2000.

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* Misjudging a safety zone can have tragic results. See, for example, Hutch Brown, "Thirtymile Fire: Fire Behavior and Management Response," *Fire Management Today* 62(3) [Summer 2002]: 23–30.

Trigger points must be chosen to provide enough time to use the designated escape route and to get to the safety zone.

Successful Trigger Point Use

On July 23, 2000, 16 smokejumpers were sent to the 5-acre (2-ha) Smoke Creek Fire on the Bitterroot National Forest in Missoula, MT. Smokejumper Todd Onken was in charge. The morning forecast gave a Red Flag Warning for gusty winds and low relative humidity.

A jumper designated by Onken requested a spot weather forecast when she hit the ground, and this spot forecast confirmed the morning forecast. The fire was burning in a mixture of lodgepole pine and subalpine fir with moderate 1,000-hour fuel loading. Thousand-hour fuel moistures, which the crew had discussed at morning briefings, were between 15 and 20 percent throughout much of the Salmon River area. Live fuel moistures were at record lows.

From their jump spot, the crew could see the nearby Cougar Peak Fire develop a smoke column and could speak with the jumpers on that fire as it transitioned into a large fire. Onken held a briefing at the jump spot. The crew did not expect crown fire activity until the humidity reached 20 percent. However, because the safety zone was about 2 miles (3 k) away, the jumpers gave themselves extra time by setting the trigger points as follows:

- Relative humidity = 25 percent;
- Windspeed = 12 miles per hour (5.4 m/s) at 20 feet (6 m); and
- Spot fires not easily contained.

If the established parameters were met, the jumpers would disengage from the fire until it was declared safe to return to work.

During the first afternoon shift, jumpers reached their trigger point; they spent the afternoon in the safety zone. During the second afternoon, trigger point conditions were not reached and fireline work continued through the shift. The crew contained the fire and completed half of the mopup after 48 hours, when the fire was handed over to two hotshot crews.

The smokejumpers worked safely by using trigger points to remove themselves from the fire during the few hours on the first shift when conditions were potentially dangerous.

Safety zones must be reachable by the slowest resource well within the timeframe of the warning system. In planning escape routes, firefighters should consider all possible delays, such as communications, slope, fatigue, visibility, and detection errors. Although this article focuses on crew resource management, firefighters should remember to plan for pulling out other resources as well. Sometimes, bogged-down heavy equipment slows evacuations or compromises escape routes. Enough time should be planned to evacuate the slowest, most cumbersome resources.

Plan Ahead

Advance planning and good selection of trigger points, escape routes, and safety zones can save lives, especially when adhering to the 4X standard for safety zones is not possible. Firefighters should remember to select appropriate trigger points; pack, sling out, or stash unneeded gear; preassign evacuation duties; flag and scout escape routes; obtain and use accurate maps; provide the needed support resources, such as prepositioned buses; and drill personnel in disengagement maneuvers. Do these things, remember your lunch, and have a safe day.

Acknowledgments

The authors thank Paul Chamberlin, Paul Fieldhouse, Risa Lange-Navarro, Todd Onken, Jim Steele, and Edmund Ward, Forest Service, Aerial Fire Depot, Missoula, MT; Brett Butler, Forest Service, Fire Sciences Laboratory, Missoula, MT; and John Caffin, Forest Service, Southern Region, Atlanta, GA, for their comments and encouragement. ■

A Cooperative Fire Prevention Adventure

Sara Patterson

Two days of physical toil and mental challenge, combined with lots of laughter and camaraderie, provided State and Federal foresters and Science Museum of Western Virginia employees with the satisfaction of a job well done. A banner 12 feet (3.6 m) long announced the collaborative effort, "FIRE Cooperation into the Future: Virginia Department of Forestry and USDA Forest Service." Soon, the doors would open to thrill and educate the 30,000 visitors expected over the next 3 months.

Thanks to the National Fire Plan, local schoolchildren got in free to visit educational fire exhibits at the Science Museum of Western Virginia.

A Vision Realized

Two years ago, Chris Thomsen, supervisory forester at the Virginia Department of Forestry, saw the movie *Wildfire: Feel the Heat*, released in 1999 by Discovery Pictures, a division of Discovery Communications, Inc.* He realized the relevance of the film for the wildland/urban interface (W/UI) communities nestled in the beautiful Blue Ridge and Appalachian Mountains.

Thomsen's vision was to present the film, which shows fires in varying topography and population settings, at the Science Museum of Western Virginia, which serves Roanoke and surrounding communities. The movie dramatically surrounds the audience with sights and sounds, recognizing the heroic work of the women and men who conduct ground and air firefighting operations.

A long-time museum member and supporter, Thomsen strongly supports the Division of Forestry's fire prevention and fire use outreach efforts. Undeterred by the repeated reply "No available funds," Thomsen continued searching for the funding to bring the movie to people living in the W/UI areas of western Virginia. Through his perseverance, the right contacts were made and the right buttons pushed.

After successfully tapping into the fire education and prevention portions of the National Fire Plan (NFP), Thomsen was able to fund the movie print costs and royalties. Additional NFP funds—$72,000—subsidized museum and movie admission for local schoolchildren.

The museum, having suffered recent budgetary cutbacks, was delighted with the support provided by its new cooperators—the Virginia Department of Forestry and the George Washington and Jefferson National Forests. As the fire resource assistant for the national forest, I was the primary Federal cooperator.

Smokey with friends Benjamin (youngest) and Matthew McCrickard. Thanks to funding through the National Fire Plan, schoolchildren were able to visit with Smokey at the Science Museum of Western Virginia and view the museum's exhibits on wildland fire management. Photo: Sara Patterson, USDA Forest Service, George Washington and Jefferson National Forests, Roanoke, VA, 2001.

Sara Patterson is the fire resource assistant for the USDA Forest Service on the George Washington and Jefferson National Forests in Roanoke, VA.

* For a film review, see Hutch Brown, "Fire on the Really Big Screen: A Documentary With a Difference," *Fire Management Today* 60(1) [Winter 2000]: 17–18.

Gathering Momentum

The project snowballed! The museum contacted Thomsen, wondering if the cooperators could fill 2,800 square feet (260 m^2) of exhibit space that would soon be empty.

Thomsen, Glen Stapleton, fire staff officer for the George Washington and Jefferson National Forests, and I brainstormed ways to fill the vast area. We collaborated with Fred Turck, forest protection coordinator for the State of Virginia, and solicited ideas from Bill Sweet, exhibits manager for the Forest Service's Southern Region.

Commitments rolled in for exhibits that we could borrow—a risk calculator to help homeowners determine their degree of fire risk and a rollicking coin-operated Smokey Bear jeep ride with sirens. We also developed new ideas. A timeline showed major fire events and fire uses from prehistoric to present time, with associated tools, gear, and artifacts. For the younger crowd, we offered blank "magic" paper that, when rubbed with crayons, revealed the image of Smokey and the message "Only You Can Prevent Forest Fires."

When the effort began in early January 2001, we did not imagine that during the next 9 months we would make hundreds of phone calls, order 10,000 *True Story of Smokey Bear* comic books, secure additional Conservation Education and Urban Forestry grants for followup educational outreach, and master the assembly of 17 erector-set displays!

Opening Night

The public outreach efforts of 15 Forest Service and 15 State employees helped to make the kickoff event a huge success. On display in the pedestrian area of the museum's entry were four pieces of heavy firefighting equipment—a humvee, dozer, regular engine, and antique Forest Service engine—eliciting many "oohs" and "ahs" from the strolling crowds. A spiffy Smokey Bear, courtesy of the Forest Service's Southern Regional Office, sauntered the premises greeting visitors and thrilling children. Hundreds of helium-filled balloons floated overhead, adding to the festive atmosphere.

After the movie premier, State Forester Jim Garner hosted an elegant reception, assisted by Bettina Ring, Deputy State Forester. In attendance were many Forest Service managers, including Elizabeth Estill, Regional Forester, Southern Region; Tom Harbour, Deputy Director of Fire and Aviation Management (F&AM), Washington Office; Ron Coats, Director of F&AM, Southern Region; and Bill Damon and Alice Carlton, respectively forest supervisor and deputy forest supervisor, George Washington and Jefferson National Forests.

Firewise exhibit at the Science Museum of Western Virginia. The exhibits were effective tools for learning about fire use, firefighting, and other aspects of wildland fire management. The visitor count for the exhibits was 26,049. Photo: Sara Patterson, USDA Forest Service, George Washington and Jefferson National Forests, Roanoke, VA, 2001.

Rave Reviews

School field trips have brought many young guests to the museum to view *Wildfire: Feel the Heat* and the educational fire exhibits. In addition to experiencing the movie and exhibits, college students from Virginia Tech enjoyed a question-and-answer session about seasonal and full-time careers in fire.

Every visiting school group has benefited from a fire prevention and fire education talk provided by either a Forest Service or State employee. Many Forest Service employees have also viewed the film. Type 1 crews from the Western United States and a lead plane pilot appreciated the show, which celebrates America's heroic smokejumpers, helicopter rappellers, and hotshot crews. ■

Dome Peak Fire: Witnessing the Extreme

Mike Cornwall

Dome Peak lies on the edge of the Wenatchee National Forest, about 30 miles west of Yakima, WA. At 6,530 feet (2,070 m), the peak towers above surrounding ridges covered by dense forests of lodgepole pine, western larch, and subalpine fir. By August 2001, after months of regional drought in the Pacific Northwest, the forests were unusually dry.

On August 12, a dry-lightning strike ignited the Spruce Creek Fire just south of Rimrock Lake. With temperatures exceeding 90 °F (32 °C) and a relative humidity of only 20 percent, the fire had spread to 300 acres (120 ha) in steep and rugged canyons just a few miles west of Dome Peak.

Fire Start

The next day, as the sun came up over central Washington, it found the sky full of "popcorn" clouds. These clouds, as any seasoned wildland firefighter knows, can signal a thunderstorm. A small storm cell soon developed over Dome Peak and adjacent Stroback Mountain. The cell delivered two bolts of lightning. One struck harmlessly in a rock slide, but the other ignited a stand of heavily diseased timber on the south side of Dome Peak. By the afternoon, a smoke column was building.

At 2:30 p.m., my radio crackled. It was the Central Washington Interagency Communication Center (CWICC) in Wenatchee, WA, asking me to organize the initial attack. I immediately ordered a strike team of engines working in the Yakima area. I also requested assistance from a Washington Department of Natural Resources (DNR) helicopter that was working on the Spruce Creek Fire. When I checked on the availability of other aerial resources, CWICC told me that all airtankers were committed to other incidents.

Mike Cornwall is a fire management forester (retired) for the Alpine District, Washington Department of Natural Resources, Roslyn, WA.

It was the first time I had ever heard a DNR pilot state that nothing could be done about a fire.

Twenty minutes after the initial report, the DNR helicopter was over the fire. The pilot's report gave me a start: It was the first time I had ever heard a DNR pilot state that nothing could be done about a fire.

The first resources soon arrived in the vicinity of the fire. The first overhead officer to arrive reported that the fire had spread to 40 acres (16 ha) and was crowning and running in heavy timber. I arrived on the fire about an hour later. No roads led into the immediate area of the fire; we took a dead-end logging spur to reach a point across a canyon from the fire. We turned the engines around to be ready for a quick exit, if needed. I

Dome Peak Fire during initial attack. A strike team awaits orders while standing on a dead-end road across a canyon from the fire. Photo: Mike Cornwall, Three Rivers Imaging, Fruitland, ID, 2001.

> The fire behavior was some of the most extreme that I have seen in my 30 years with the DNR. Huge patches of timber literally exploded.

then posted lookouts to warn me immediately if they saw a spot fire on our side of the canyon. At that point, we would evacuate the area.

Extreme Fire Behavior

The fire behavior was some of the most extreme that I have seen in my 30 years with the DNR. Huge patches of timber literally exploded. Spot fires became raging infernos within minutes. Radiant heat from the main fire ignited treetops 300 to 400 feet (90–120 m) away. Walls of flame reached 250 to 300 feet (75–90 m) into the sky, dwarfing subalpine firs that were 100 to 120 feet (30–35 m) tall.

At first, I felt fairly secure where we were. A slight east wind was pushing the fire away from our vantage point and towards a cliff overlooking the Rimrock Lake basin. But I knew the wind would switch in late afternoon, strengthening and coming from the west; it worried me. There were many miles of unbroken heavy timber between the fire and the next natural firebreak. There were also many homes and summer cabins hidden in the timber.

When the wind began to change, I saw something I had never seen before except on television. In video clips taken by "storm chasers" in the Midwest, I had seen the entire cloud formation start to rotate just before a tornado formed. I saw something similar happen on the Dome Peak Fire. As the wind shifted, the huge column of smoke began not only to change direction, but also to rotate. We were soon pelted by ash, needles (both burned and green), toasted leaves, and small twigs. I felt very uncomfortable on that dead-end road with an angry fire looking over my shoulder!

Extreme fire behavior on the Dome Peak Fire. Photo: Mike Cornwall, Three Rivers Imaging, Fruitland, ID, 2001.

I immediately had the engine leaders make sure they had radio contact with me and could account for the whereabouts of every crewmember. Then, because initial attack could not accomplish much, I requested that the local engines and the strike team move back towards Yakima and become available for initial attack on other fires. I also asked CWICC to notify the local fire department of the possible danger to structures. I monitored the fire through the night; if it made a big run toward the area with homes and cabins, I would contact CWICC, which in turn would notify the fire protection district. To keep the public out of harm's way, I requested that all roads into the Cowiche Canyon and North Fork Ahtanum Creek drainages be closed by the Yakima County sheriff's office.

Fire Complex

The fire behaved itself through the first night. It spotted across a large meadow and burned slightly towards the north and east, away from my position across the canyon. At about 3 a.m., an inversion set in over the lower two-thirds of the fire, the portion burning inside the canyon. As the sun came up just before 6 a.m., a 5-acre (2-ha) patch of timber just above the inversion exploded. The ensuing mushroom cloud sucked the inversion out of the canyon in a matter of minutes. The fire awoke from a night's sleep, ready to get on with the day's work.

During the night, the Spruce Creek Fire and the Dome Peak Fire became the the Spruce–Dome Fire Complex. CWICC told me that I would be re-lieved at 8 a.m. by a type 1 incident management team. I was to brief the team upon arrival.

My initial-attack resource order had included the initial-attack dozer for the DNR's Alpine District and two contract dozers. The district dozer and its operator arrived on the fire at about 6:30 a.m. We studied the burn and decided that if we could get the dozer across the creek at the bottom of the canyon, we could start direct attack on the lower part of the fire, which had burned into meadows. We pinpointed areas of cooling black as our escape routes and safety zone. The dozer started work at 8 a.m. on the fire's southwestern flank. Anchoring to the creek, the dozer built a tight trail uphill to the west, toward the cliffs that overlook Rimrock Lake.

At about 9 a.m., the two contract dozers arrived. They started a flanking action anchored to the creek in a southeasterly direction. Our plan was to get around the fire's east flank and tie the fireline from the creek to the rocky ridgetop before the usual afternoon winds arrived, blowing stronger and from the west.

The type 1 team relieved me as incident commander at about 1 p.m. I briefed the incoming incident commander on my plan. He told me that if it worked, I would be a hero; the fire behavior specialist had predicted that the Spruce–Dome Fire Complex would grow to 10,000 acres (4,000 ha). It was now at 400 acres (160 ha).

Seeds of a New Forest

I headed home for some much-needed rest. On the following day, the fire blew out of its lines and made a huge run. All told, about 2,500 acres (1,000 ha) burned. Mother Nature must have had

When the wind began to change, I saw something I had never seen before except on television. The smoke column started twisting like a tornado.

enough, because on the fourth or fifth day of the fire, about half an inch (13 mm) of rain fell and the crews were able to get a dozer trail around the head of the fire to stop it. On Labor Day weekend (September 1–3, 2001), responsibility for the fire was reassigned to the DNR's Alpine District. I reassumed the role of IC, taking charge of mopup and rehabilitation.

As I walked through some of the heaviest burned areas, I was amazed to find lodgepole pine cones where there was not a lodgepole pine in sight. The cones were lying in the ash, popped open and with the seeds falling out. I realized that the cones were transported there by the awesome forces unleashed by the fire. A new forest would be growing soon. ■

Dome Peak Fire during mopup. A crewmember flakes one of many pieces of hose as mopup winds down. Photo: Mike Cornwall, Three Rivers Imaging, Fruitland, ID, 2001.

Big Ed Pulaski and the Big Blowup

Gerald W. Williams

> "Some men went berserk, clamoring over the prostrate bodies, choking, gasping. Others praying. Others laughing."
>
> –*William Chance, survivor in the Pulaski mine*

There are many stories about the Big Blowup of August 20–21, 1910, when a massive million-acre firestorm charred vast areas of national forest and remote towns in western Montana and northern Idaho. More than 85 lives were lost. The Montana towns of DeBorgia, Grand Forks, Haugan, Henderson, and Taft were completely destroyed.

In Idaho, the flames swept around the frontier town of Wallace, destroying many homes and buildings. Wallace sits in Silver Valley, a peaceful valley 40 miles (64 k) long, east of Coeur d'Alene and west of Lookout Pass. The community was very small in 1910; even today, there are less than a thousand residents.

Wallace was home to Ed Pulaski, whose tale is the most enduring story associated with the Big Blowup. In the summer of 1910, Pulaski was 42 years old. A native of Ohio, he had wandered west at age 16 to work in the mills and mines of Montana and Idaho. In 1910, he was barely 2 years into his Forest Service career as the district ranger on the Wallace Ranger District, Coeur d'Alene National Forest.

"Big Ed" was a physically imposing man. Like others in the USDA Forest Service, Pulaski was leading a crew of firefighters against the Great Fires of 1910, which hit the Northern Rockies beginning in July. "By August 19," wrote Charles K. McHarg (1931), "Pulaski had about 120 men on the St. Joe/Coeur d'Alene divide working on fires in the two Big Creeks." The stage was set for an encounter between a massive, uncontrollable forest fire and the fortitude and determination of a small group of firefighters trying to save their lives.

From the Horse's Mouth

In 1923, the journal *American Forests and Forest Life* held an essay contest asking subscribers to write about their most exciting experience as a forest ranger. Pulaski submitted his story "Surrounded by Forest Fires," which was printed in the journal's August issue (see the sidebar). After that, he "never wrote another word about the Great Fires or, for that matter, spoke of them further in any formal way," noted the fire historian Stephen J. Pyne (2001).

Pulaski told a simple story. On August 20, there was "a terrific hurricane" that was "so strong it almost lifted men out of their saddles."* The winds carried fire for miles, joining the fires, which "swept with the roar of a thousand freight trains." The intense smoke and heat made it difficult to breathe.

Fear became a factor. Men packing in supplies to the firefighters simply dumped their loads and fled back to town. With "the whole world" seemingly ablaze, many firefighters "thought that it really was the end of the world." Pulaski abandoned all hope of fighting the fires and simply tried to get his crew to safety.

He managed to gather 45 men. Barely making himself heard "above

Pulaski's Story

Editor's note: Ed Pulaski formally told his story only once, in the August 1923 edition of American Forests and Forest Life. *The following excerpt illustrates his simple, straightforward style.*

On August 20 a terrific hurricane broke over the mountains. It picked up fires and carried them for miles. The wind was so strong it almost lifted men out of their saddles, and the canyons seemed to act as chimneys, through which the wind and fires swept with the roar of a thousand freight trains. The smoke and heat became so intense that it was difficult to breathe. The men who were packing in supplies refused to go to their destinations, dumped their loads, and fled back to Wallace. …

Jerry Williams is the national historian for the USDA Forest Service in Washington, D.C.

* Early fire crews often used horses and mules to reach remote fires and resupply firefighters in the back-country.

the noise of the fire and wind," he directed the men to take blankets and follow him. "Trees were falling all about" and it was "almost impossible to see through the smoky darkness," but Pulaski was familiar with the backcountry trails. He led his crew to an old mine tunnel, reaching it just in time before the fire closed in behind them.

Pulaski ordered the men to lie face down to keep from suffocating, "for the tunnel was filling with fire gas and smoke." One man panicked and tried to rush into the firestorm, but Pulaski stopped him at gunpoint. "The first man who tries to leave this tunnel I will shoot," he said.

When the mine timbers caught fire, Pulaski hung wet blankets over the entrance. Filling his hat with water from the mine floor, he doused the burning timbers. "The men were in a panic of fear, some crying, some praying." Many passed out from the heat, smoke, and fumes. Pulaski battled the blaze at the mine entrance until he, too, lost consciousness.

Pulaski remained unconscious for hours. Then he heard someone say, "Come outside, boys, the boss is dead." "Like hell he is," he replied. It was 5 a.m. on August 21, and the men were becoming conscious. Dragging themselves outside to a creek, they found the water still too warm to drink. Five men never regained consciousness. The rest staggered back toward Wallace. Rescuers met them on the way.

The survivors were "in a terrible condition, all of us hurt or burned." Pulaski himself was temporarily blinded, with terrible burns on his hands. He spent nearly two months in the hospital, recovering from blindness and pneumonia. His experience left him with "poor eyes, weak lungs, and throat; but, thank God, I am not now blind."

Homestead in the Northern Rockies on the eve of the Big Blowup. Homesteaders fled the flames to local towns, which were often evacuated by train. Photo: B.L. Wheeler, USDA Forest Service, Boise National Forest, ID, 1909.

A Survivor's Story

Sherry Devlin (2000), a staff writer for the newspaper *The Missoulian*, recounted a letter from William Chance, a member of Pulaski's crew, about the heroism of Big Ed. Chance was new to firefighting, barely a day on the fireline when the Big Blowup came.

"Fire came at us rapidly," wrote Chance. The blaze was unimaginably ferocious. Pulaski told his men to follow him back to town. However, the people of Wallace had ignited a backfire, trapping Pulaski and his men between two converging walls of flame. The crew took refuge in an old adit.

The firefighters were skeptical about their chances of surviving inside the tunnel. But Pulaski "emphasized his point with his six-shooters." "Inside, the tunnel was a mad house," Chance wrote. "Some men went berserk, clamoring over the prostrate bodies, choking, gasping. Others praying. Others laughing. I'll never forget one man lustily singing, 'The Pride of the House is Mama's Baby.'"

Chance passed out. Awakening, he crawled toward the mine entrance and found Pulaski there, badly burned after trying to extinguish burning timbers with his hands. Chance helped Pulaski and others crawl down the mountainside to Wallace. In town, Pulaski took the hungry to a restaurant and the rest to a hospital, then went home to his wife and 7-year-old daughter.

Pyne's Story

Stephen J. Pyne (2001) offers a comprehensive account of the Pulaski story in his masterful book *Year of the Fires* (see the sidebar). On August 20, Pulaski and others were riding up the West Fork when the fire began burning behind them. Perhaps these new fires were backfires started by residents of Wallace to save their town.

Pulaski began to lead the crew to safety, but the fire threatened them

> "The first man who tries to leave this tunnel I will shoot."
>
> –*Ed Pulaski*

from all sides. "They advanced but haltingly, as Pulaski would dash ahead to scout the way and then return to lead the terrified group to the next spot." The terrified men stuck with Pulaski only because they did not know the trail.

Pulaski, "with a wet gunnysack over his head," located the Nicholson Mine and determined it was safe. Then he led the men toward it. "The final dash was a horror," with one man lagging behind and dying. Finally, Pulaski urged the remaining 44 men into "a shaft 75 to 80 feet deep, barely the height of a man, with a trickle of water running through it."

The crew retreated as far as possible into the mine. "[T]he men packed the narrow passage like oats in a feedbag, while Pulaski tried to beat out the flames at the entrance with a horse blanket and a hat full of water." Others might have tried to help. With "their fresh air shrinking and their fears swelling," the men began to panic. At least one man tried to push his way out, but at the entrance "he met Big Ed Pulaski, pistol in hand, who said that he would shoot the first man who tried to leave."

Pulaski finally passed out at the entrance to the mine. When he regained consciousness, "[h]is lungs were a mess, his eyes almost useless." Those inside the mine "were a little better off," and the men dragged themselves out of the mine. They called roll and realized that some men were missing. Five were found dead inside the tunnel. Two horses had also survived inside the mine "but in such wretched condition that they were shot on the spot."

Folk Hero

Big Ed carried the scars of the Big Blowup, especially on his hands and face, for the remainder of his life. For years, he was the only person who regularly tended the graves of the fallen firefighters. Pulaski worked on the Wallace Ranger District for another 20 years, retiring in 1930. He died in 1931 from injuries associated with an auto accident. For a nation suffering through the Great Depression, Ed Pulaski became, according to Pyne (1982), "a celebrity, a symbol of a strenuous life spent bravely battling the reckless waste of natural resources. … For firefighters he became a folk hero."

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Pyne Tells the Pulaski Story

Editor's note: Stephen J. Pyne, the leading fire historian in the United States, conducted exhaustive research on the Big Blowup for his book Year of the Fires *(2001). The following excerpts illustrate Pyne's masterful account of Ed Pulaski's story.*

The final dash was a horror. Only the fact that they were trailing the creek, tucked into the ravine, while the flames raced with the wind along the upper contours of the slopes, likely spared them from being instantly incinerated. By now the fire was around them, and the winds bellowing like thunder, and the embers thick as snowflakes. The tortured winds snapped off giant cedars and hurled them across the hills. …

The crew became almost senseless. They could neither hear nor speak nor see nor taste nor barely feel. They clung to one another and ran and stumbled along the trail, only because that took less thought than anything else they might do. Richard Wood lagged and died, possibly crushed by a flaming tree. Along the way a bear joined the cavalcade. …

INVENTING THE PULASKI

Gerald W. Williams

Most firefighters know that the pulaski firefighting tool was named for Ed Pulaski, the hero of the Big Blowup of 1910. Pulaski, a jack-of-all-trades, is often credited with inventing the tool in the years following the Big Blowup. However, stories abound about the tool's invention, and not every account is the same.

> Early firefighting usually involved "knocking down" or beating out the flames, because water was generally not available.

Early Tools

James B. Davis (1986), a research forester for the USDA Forest Service, noted that the Collins Tool Company developed a tool as early as 1876 that was designed to clear land. This farm tool, still on display at the Smithsonian Museum of Arts and Industry, looked and functioned essentially like today's pulaski. It is not clear why the Collins land grubbing tool was not used either to put out fires or as a model for a practical firefighting tool.

As Davis (1986) points out, early fire tools were whatever firefighters happened to have available. Early firefighting usually involved "knocking down" or beating out the flames, because water was generally not available. Beating out was usually done with a coat, a slicker, a wet sack, or even a saddle blanket. "A commonly used tool," notes Davis (1986), "was a pine bough cut on arrival at the fire edge." Farming and logging tools came into use, including the shovel, ax, hoe, and rake. "[L]ittle thought was given to size, weight, and balance," notes Davis (1986).

For many years, "ranger inventors" toyed with the idea of building one tool that could do several jobs and be carried on a horse or pack mule and by a firefighter or tree planter. Many variations of such tools were tried and discarded. Several did rise to the top, including the Macleod tool, invented in 1905 by Ranger Malcolm Macleod on the Sierra National Forest in California. This sturdy combination rake-and-hoe or ax-and-mattock has withstood the test of time, although it never gained the popularity of the pulaski.

Pulaski Origins

Davis (1986) describes the pulaski's disputed origins. Earle P. Dudly claimed to have invented a pulaski-like tool by having a local blacksmith modify a lightweight mining pick. He said he used the tool for firefighting in the Forest Service's Northern Region in 1907.

William G. Weigle, supervisor of the Coeur d'Alene National Forest, also took credit for inventing a pulaski-like tool, though not for firefighting. Weigle wanted a new tool to replace the mattock for planting and other forestry work. In late 1910 or 1911, Weigle sent Rangers Joe Halm and Ed Holcomb to Ranger Ed Pulaski's home blacksmith shop to turn out a combination ax, mattock, and shovel.

Firefighters with pulaskis in Oregon in 1939. By the 1920s, pulaskis were a standard firefighting tool throughout much of the United States. Photo: Ray M. Filloon, USDA Forest Service, Umatilla National Forest, OR, 1939.

Jerry Williams is the national historian for the USDA Forest Service in Washington, D.C.

The device proved to be too awkward for use as a planting tool. But Pulaski kept using and improving it. He abandoned the shovel part and reshaped the ax and mattock blades. By 1913, he had a well-balanced tool with a sharp ax on one side and a grubbing blade on the other.

By 1920, the Forest Service's Northern Region had "adopted the tool as its own," according to the fire historian Stephen J. Pyne (2001). The Forest Service asked for commercial production in quantity, and the pulaski and shovel soon became "the dominant, defining tools of fire control" (Pyne 2001).

Pulaski Legend

Ed Pulaski might not have invented the tool that bears his name, but he certainly helped to develop, improve, and popularize it (Davis 1986). Today, many thousands of pulaskis are ordered every year by the Federal Government, as well as by State and county firefighting organizations. Forestry supply catalogs always seem to have a category for pulaski fire tools.

For more than 75 years, firefighting has been defined by the tool named for Ed Pulaski. Pyne (2001) calls it "the supreme fire tool," noting that it "embedded the legend of 1910 more firmly than any agency stunt, congressional memorial, or recovered memory." Every time a firefighter reaches for a pulaski, he or she figuratively retells "the story of Big Ed and the Big Blowup, the saga of the Great Fires and the year that tried to contain them" (Pyne 2001).*

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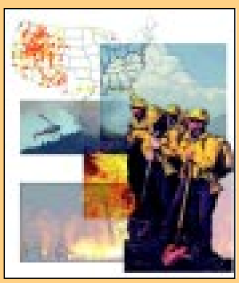
* For the story of Ed Pulaski, see the article by Jerry Williams on page 19 of this issue.



Your National Fire Plan at Work*

Assessing Postfire Emergency Rehabilitation Conditions

Funded by the National Fire Plan (NFP), scientists at the USDA Forest Service's Southwest Forest Science Complex (SFSC) in Flagstaff, AZ, are providing land managers with postfire data from predictive models to help prevent erosion and catastrophic flooding. The models are also used to research the effects of erosion on wildland fire, vegetation treatments, hydrology, and geomorphology.

Similar SFSC research efforts using NFP monies include collaboration with the Joint Fire Sciences Program (JFSP) to link a study about the effectiveness of contour-felled logs in retaining soil in high-severity burned areas to research about postfire watershed responses.

Other efforts by SFSC scientists using NFP funds include:

- Signing agreements to collaborate with other research institutions in updating a model that identifies time trends in watershed response and monitors water yield responses to wildland fire and fuels reduction treatments in the Southwest;
- Researching soil chemical or physical properties after a fire or after fuel treatments, in partnership with a JFSP study on the microbiological effects of fire in ponderosa pine ecosystems;
- Restoring a gauging station in the Workman Creek watershed, Sierra Ancha Experimental Forest, to continue to monitor water and sediment yields from the Coon Creek Fire in Arizona;
- Remeasuring riparian geomorphic and vegetation transects on four streams in and adjacent to the 1991 Dude Fire in Arizona's Tonto National Forest; and
- Preparing a manuscript for publication in 2002 on the processing of archived hydrologic data used to assess the effects of wildland fire on postfire snowmelt hydrology. ■

Occasionally, Fire Management Today *tells a success story or describes an exemplary project under the National Fire Plan. Readers can find many more such accounts on the Website for the National Fire Plan at <http://www.fireplan.gov>.*

Photo Contest 2001

Hutch Brown

We had some excellent submissions for our 2001 photo contest. We solicited photos in six categories:

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

We evaluated photos submitted in three steps. First, we looked for technical flaws, such as soft focus. For print publication, photos must have the highest technical quality. We automatically eliminated submissions with technical flaws, even though many were otherwise outstanding.

Next, we judged the remaining photos based on traditional photography criteria. We asked such questions as:

- Is the composition skillful and dynamic?
- Are colors and patterns effective?
- Does the photo tell a story?

Finally, we made the awards, based partly on absolute merit. For example, if we decided that there was only one excellent photo in a category, then we would make only one award in that category—First, Second, or Third Place, depending on how outstanding we thought the photo was. Winning photos are reprinted here.

Hutch Brown is the managing editor of Fire Management Today*, USDA Forest Service, Washington Office, Washington, DC.*

Do you have a photo that tells a story about wildland fire management? Would you like the thrill of seeing your photo in print? If so, turn to page 39 for instructions on how to enter our 2001 photo contest. ■

First Place, Wildland Fire. *Firewhirl in a crown fire burning in fir and pine on the Hash Rock Fire, Ochoco National Forest, OR. Photo: Thomas Iraci, USDA Forest Service, Pacific Northwest Region, Portland, OR, 2000.*

Second Place, Wildland Fire. *Lone snag silhouetted against a crown fire burning in down and standing lodgepole pine on the Hash Rock Fire, Ochoco National Forest, OR. Photo: Thomas Iraci, USDA Forest Service, Pacific Northwest Region, Portland, OR, 2000.*

Third Place, Wildland Fire. *A fast-moving firestorm sweeps upslope through pine on the Hash Rock Fire, Ochoco National Forest, OR. Photo: Thomas Iraci, USDA Forest Service, Pacific Northwest Region, Portland, OR, 2000.*

First Place, Aerial Resources. *A Sikorsky S–64 Skycrane delivers retardant on the 1996 Clark Peak Fire, Coronado National Forest, AZ. Photo: Marvin Carpenter, USDA Forest Service, Helena National Forest, Helena Ranger District, Helena, MT, 1996.*

Second Place, Aerial Resources. *A Canadian CL–415 loads water on the Fraser River in British Columbia, Canada. Photo: Allen Farnsworth, Coconino National Forest, Peaks Ranger District, Flagstaff, AZ, 1997.*

Third Place, Aerial Resources. *View from the cockpit during aerial monitoring of lightning-caused wildland fires in North Cascades National Park, WA. Photo: Allen Farnsworth, Coconino National Forest, Peaks Ranger District, Flagstaff, AZ, 1997.*

First Place, Wildland/Urban Interface. *Melted newspaper boxes bear testimony to the heat of the Skeleton Fire in the Sundance subdivision of Bend, OR, near the Deschutes National Forest. In the background are brush rigs from the Bend Fire Department. Photo: Thomas Iraci, USDA Forest Service, Pacific Northwest Region, Portland, OR, 1996.*

Second Place, Wildland/Urban Interface. *A Buddha watches over a home that failed to survive the Skeleton Fire in the Sundance subdivision of Bend, OR, near the Deschutes National Forest. Photo: Thomas Iraci, USDA Forest Service, Pacific Northwest Region, Portland, OR, 1996.*

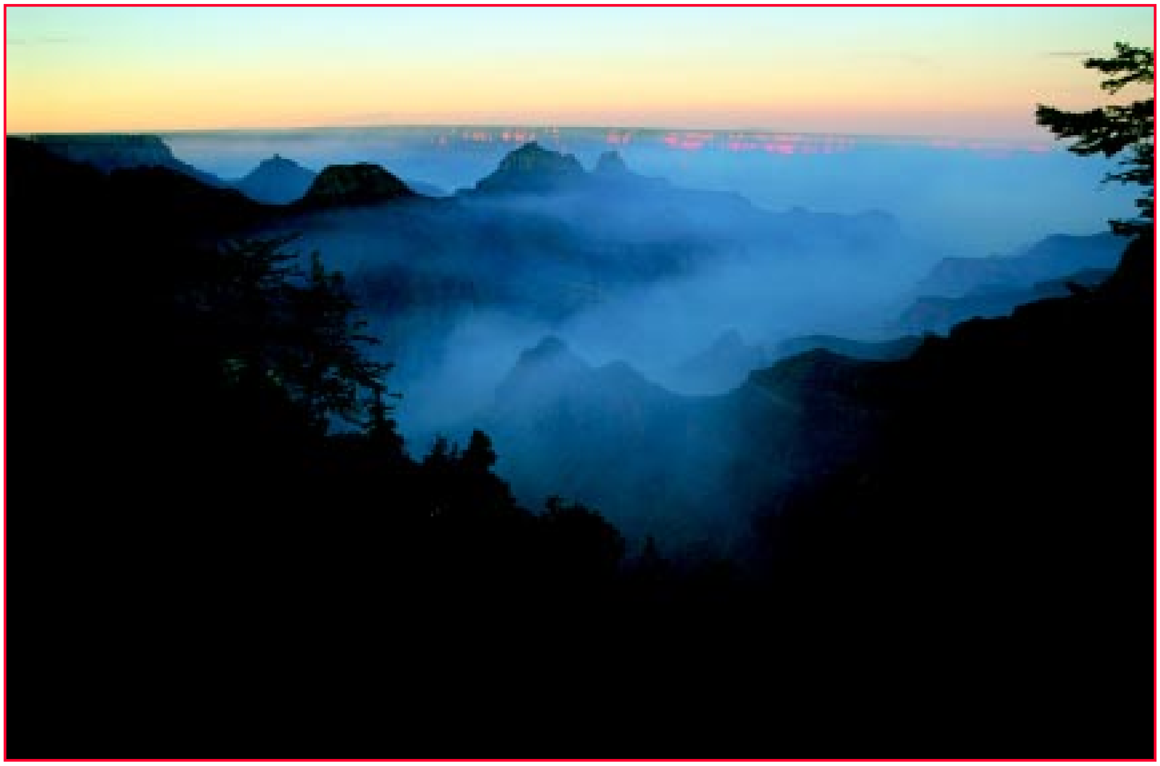
Third Place, Wildland/Urban Interface. *Remains of a home destroyed in the Shepard Mountain Fire, Custer National Forest, MT. Photo: Marvin Carpenter, USDA Forest Service, Helena National Forest, Helena Ranger District, Helena, MT.*

First Place, Prescribed Fire. *A prescribed burn for fuels management adjacent to a home under construction in Flagstaff, AZ. The Flagstaff Fire Department uses prescribed fire to manage fuels in neighborhoods throughout the city. Photo: Allen Farnsworth, Coconino National Forest, Peaks Ranger District, Flagstaff, AZ, 1996.*

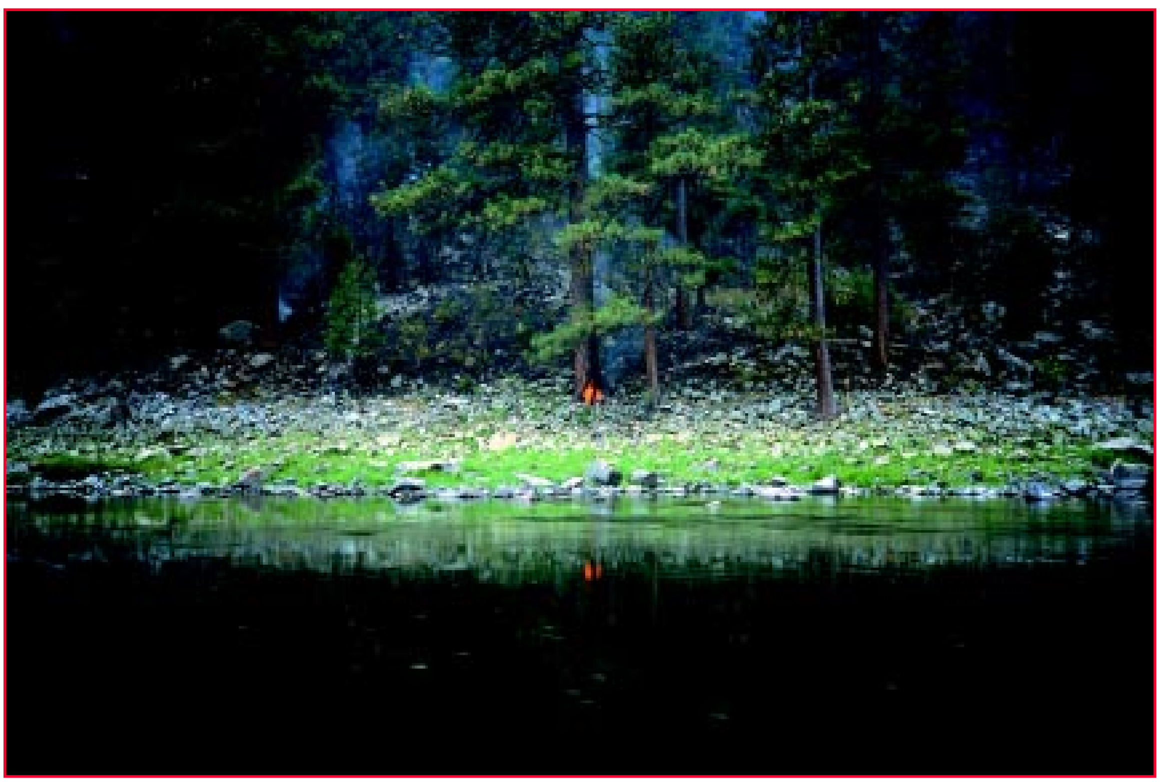
Second Place, Prescribed Fire. *State and local firefighters, supported by students from the Prescribed Fire Training Academy, use prescribed fire to reduce fuels in a neighborhood in Palm Coast, FL. Photo: Allen Farnsworth, Coconino National Forest, Peaks Ranger District, Flagstaff, AZ, 2000.*

Third Place, Prescribed Fire. *A prescribed burn for fuels management in Palm Coast, FL. Hard hit by wildland fires in 1998, many Florida communities use prescribed fire to reduce fire hazards. Photo: Allen Farnsworth, Coconino National Forest, Peaks Ranger District, Flagstaff, AZ, 2000.*

First Place, Miscellaneous. *Sunburst through smoke on a lightning-ignited fire on the Mill Creek Wilderness, Ochoco National Forest, OR. The fire was managed for wildland fire use. Photo: Thomas Iraci, USDA Forest Service, Pacific Northwest Region, Portland, OR, 1995.*



Second Place, Miscellaneous. *Sunrise over the Grand Canyon reveals smoke from the North Rim Fire Complex. The flat smoke pall suggests a temperature inversion, a common nighttime phenomenon in the deep, steep valleys and canyons of the West. Photo: Allen Farnsworth, Coconino National Forest, Peaks Ranger District, Flagstaff, AZ, 1998.*



Third Place, Miscellaneous. *The Salmon River reflects a flame at the base of a ponderosa pine on the Main Salmon Fire Complex, Salmon National Forest, ID. Photo: Allen Farnsworth, Coconino National Forest, Peaks Ranger District, Flagstaff, AZ, 1998.*

Honorable Mention, Miscellaneous. *The Moran Fire leaves a patchwork of burns below the Teton Peaks on Jackson Lake, promising future landscape diversity in Wyoming's Grand Teton National Park. Photo: Allen Farnsworth, Coconino National Forest, Peaks Ranger District, Flagstaff, AZ, 2000.*

First Place, Ground Resources. *An engine crew foams a cabin threatened by the Graves Fire, which became part of the Nine Mile Fire Complex, Lolo National Forest, MT. Photo: John M. Orton, Idaho Panhandle National Forests, St. Joe Ranger District, St. Maries, ID, 2000.*

Honorable Mention, Ground Resources. *Sunburst through smoke during a burnout operation, MHRD Fire, El Dorado National Forest, CA. Photo: Thomas Iraci, USDA Forest Service, Pacific Northwest Region, Portland, OR, 1999.*

Honorable Mention, Ground Resources. *A firefighter in Slovenia foams vegetation during a winter prescribed burn. Photo: Muhič Darko, Postojna, Slovenia, 2001.*

Honorable Mention, Miscellanous. *Foam protects a small tree during a winter prescribed burn in Slovenia. Photo: Muhič Darko, Postojna, Slovenia, 2001.*

Author Index—Volume 62

Subject Index—Volume 62

Fire Research

Fire Weather

Florida

Fuels Management

History

Incident Management

Media

Montana

National Fire Plan

New Mexico

Pacific Islands

Personnel

Pennsylvania

Planning

Policy

Prescribed Fire

Prevention

Publications

Safety

Standards

Suppression

Telecommunications

Training

United States—West

Washington

Weather Forecasting

Wildland / Urban Interface

Wyoming

“It Is Not Understood Why Forest Fires Should Get Away …”

Editor’s note: The directive excerpted here was issued by the General Land Office, the agency responsible for managing the Nation’s forest reserves from 1891 to 1905, a time when a single ranger might oversee hundreds of thousands of acres of trackless wildland. The directive is from the archives of Jerry Williams, a historical analyst for the USDA Forest Service, Washington Office, Washington, DC.

Department of the Interior,

GENERAL LAND OFFICE,

Washington, D.C., June 2, 1903

Forest Officers.

Gentlemen:

The season is now at hand when your special attention should be directed against forest fires, owing to the dry condition of your territory. …

During last season reports relative to forest fires received from the forest officers were very encouraging, generally speaking, but in some cases gross neglect of duty must have prevented fires from being discovered. It is not understood why forest fires should get away from the rangers, or rather why they do not find them and extinguish them more promptly. It seems reasonable that a ranger provided with a saddle horse and constantly on the move, as is his duty, should discover a fire before it gains much headway. This statement is made knowing that some of the rangers’ districts are extremely large. …

When absolutely necessary, the rangers should engage emergency help at once. … It would seem, however, that if the ranger does his duty, fires would be discovered so quickly that it would seldom be necessary for him to employ extra men. …

When reporting fires to this office you should be careful to mention in which ranger’s district said fire originated. … In the absence of a satisfactory explanation, supervisors and rangers will be held personally responsible for any fire that is allowed to escape.

Please acknowledge receipt of this letter.

Very respectfully,

J. H. Fimple
Acting Commissioner

NOTE. – Copy of this circular should be furnished to each forest ranger.

Guidelines for Contributors

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

Submission Guidelines
Submit manuscripts to either the general manager or the managing editor at:

USDA Forest Service
Attn: April J. Baily, F&AM Staff
Mail Stop 1107
1400 Independence Avenue, SW
Washington, DC 20250-1107
tel. 202-205-0891, fax 202-205-1272
e-mail: abaily@fs.fed.us

USDA Forest Service
Attn: Hutch Brown, Office of Communication
Mail Stop 1111
1400 Independence Avenue, SW
Washington, DC 20250-1111
tel. 202-205-1028, fax 202-205-0885
e-mail: hutchbrown@fs.fed.us

Mailing Disks. Do not mail disks with electronic files to the above addresses, because mail will be irradiated and the disks could be rendered inoperable. Send electronic files by e-mail or by courier service to:

USDA Forest Service
Attn: Hutch Brown, 2CEN Yates
201 14th Street, SW
Washington, DC 20024

If you have questions about a submission, please contact the managing editor, Hutch Brown.

Paper Copy. Type or word-process the manuscript on white paper (double-spaced) on one side. Include the complete name(s), title(s), affiliation(s), and address(es) of the author(s), as well as telephone and fax numbers and e-mail information. If the same or a similar manuscript is being submitted elsewhere, include that information also. Authors who are affiliated should submit a camera-ready logo for their agency, institution, or organization.

Style. Authors are responsible for using wildland fire terminology that conforms to the latest standards set by the National Wildfire Coordinating Group under the National Interagency Incident Management System. *FMT* uses the spelling, capitalization, hyphenation, and other styles recommended in the *United States Government Printing Office Style Manual*, as required by the U.S. Department of Agriculture. Authors should use the U.S. system of weight and measure, with equivalent values in the metric system. Try to keep titles concise and descriptive; subheadings and bulleted material are useful and help readability. As a general rule of clear writing, use the active voice (e.g., write, "Fire managers know…" and not, "It is known…"). Provide spellouts for all abbreviations. Consult recent issues (on the World Wide Web at <http://www.fs.fed.us/fire/planning/firenote.htm>) for placement of the author's name, title, agency affiliation, and location, as well as for style of paragraph headings and references.

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

Photos and Illustrations. Figures, illustrations, overhead transparencies (originals are preferable), and clear photographs (color slides or glossy color prints are preferable) are often essential to the understanding of articles. Clearly label all photos and illustrations (figure 1, 2, 3, etc.; photograph A, B, C, etc.). At the end of the manuscript, include clear, thorough figure and photo captions labeled in the same way as the corresponding material (figure 1, 2, 3; photograph A, B, C; etc.). Captions should make photos and illustrations understandable without reading the text. For photos, indicate the name and affiliation of the photographer and the year the photo was taken.

Electronic Files. See special mailing instructions above. Please label all disks carefully with name(s) of file(s) and system(s) used. If the manuscript is word-processed, please submit a 3-1/2 inch, IBM-compatible disk together with the paper copy (see above) as an electronic file in one of these formats: WordPerfect 5.1 for DOS; WordPerfect 7.0 or earlier for Windows 95; Microsoft Word 6.0 or earlier for Windows 95; Rich Text format; or ASCII. Digital photos may be submitted but must be at least 300 dpi and accompanied by a high-resolution (preferably laser) printout for editorial review and quality control during the printing process. Do not embed illustrations (such as maps, charts, and graphs) in the electronic file for the manuscript. Instead, submit each illustration at 1,200 dpi in a separate file using a standard interchange format such as EPS, TIFF, or JPEG, accompanied by a high-resolution (preferably laser) printout. For charts and graphs, include the data needed to reconstruct them.

Release Authorization. Non-Federal Government authors must sign a release to allow their work to be in the public domain and on the World Wide Web. In addition, all photos and illustrations require a written release by the photographer or illustrator. The author, photo, and illustration release forms are available from General Manager April Baily.

Contributors Wanted

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

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

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

Photo Contest Announcement

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

Awards

All contestants will receive a CD–ROM with all photos not eliminated from competition. Winning photos will appear in a future issue of *Fire Management Today*. In addition, winners in each category will receive:

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

Categories

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

Rules

- The contest is open to everyone. You may submit an unlimited number of entries from any place or time; but for each photo, you must indicate only one competition category. To ensure fair evaluation, we reserve the right to change the competition category for your photo.
- Each photo must be an ***original color slide*** or ***print***. We are not responsible for photos lost or damaged, and photos submitted will not be returned (so make a duplicate before submission). ***Digital photos will not be accepted*** because of difficulty reproducing them in print.
- You must own the rights to the photo, and the photo must not have been published prior to submission.
- For every photo you submit, you must give a detailed caption (including, for example, name, location, and date of the fire; names of any people and/or their job descriptions; and descriptions of any vegetation and/or wildlife).
- You must complete and sign a statement granting rights to use your photo(s) to the USDA Forest Service (see sample statement below). Include your full name, agency or institutional affiliation (if any), address, and telephone number.
- Photos are be eliminated from competition if they have date stamps; show unsafe firefighting practices (unless that is their express purpose); or are of low technical quality (for example, have soft focus or show camera movement). (Duplicates—including most overlays and other composites—have soft focus and will be eliminated.)
- Photos are judged by a photography professional whose decision is final.

Postmark Deadline

First Friday in March

Send submissions to:

Madelyn Dillon
CAT Publishing Arts
2150 Centre Avenue
Building A, Suite 361
Fort Collins, CO 80526

Sample Photo Release Statement

(You may copy and use this statement. It ***must be signed.***)

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

Signature____ Date ____________________________

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