Fire Management today

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Pyne: Three Fires

Protecting the Wildland–Urban Interface

Joint Fire Science Program

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On the Cover:

A P3–A Orion, the signature Forest Service large airtanker of the past, between missions in 2003. In recent years, a new generation of large airtankers has been brought into the fleet to replace the aging P3–A Orions. For the story behind the cover photo, see the article by Randall Thomas on page 5.

Photo: Randall C. Thomas, Forest Service, 2003.

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

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

Firefighter and public safety is our first priority.

Contents

Anchor Point

By Shawna A. Legarza, Psy.D.
Director, Fire and Aviation Management
USDA Forest Service

Asking the Why

The summer of 2017 marks a year since I have had the honor of becoming the Director of Fire and Aviation Management for the Forest Service. I say that with all sincerity, because like most challenges throughout my career it has given me the opportunity to learn and grow.

I have been interviewed numerous times about my new role and what I see as priorities as we move into the future. Of course, budget, aviation, risk, safety, and landscape management have always come up. But as I continue to reflect, I realize that the answer always comes back to two areas:

1. Our work environment, and
2. The mission of the agency

First, I work hard every day to influence change in our workplace environment. We work in an extremely complex system at various levels, including boots on the ground, dispatchers, aviators, and incident management teams. I am very driven to help our employees have a workplace environment that is diverse, inclusive, and free of discrimination and harassment.

Second, I believe in the Forest Service mission of sustaining the health, diversity, and productivity of the Nation's forests and grasslands to meet the needs of present and future generations. That is not just a mission statement for me. It gives me so much pride to have helped build some of our trails, perform hazardous fuels treatments, and improve habitat for diverse species. I jog those trails, and we all reap the benefits of that hard work by enjoying clean water, amazing recreation, hunting, and beautiful views. I am proud to be part of the Forest Service and contribute to those efforts.

> We must do our best to meet fire management objectives, but we can't allow responders to risk their lives attempting the improbable.

In the wildland fire community, we have all unfortunately lost peers and coworkers; therefore, we must do our best to meet fire management objectives, but we can't allow responders to risk their lives attempting the improbable. As stated in the Chief's letter of intent for the 2018 fire year, "Each of us must remain committed to '*stop, think and talk*' before 'acting' in any circumstance that may represent unnecessary exposure." This has to become our new cultural norm.

So with that, I will ask for YOUR help. Look after your fire family. If you see someone struggling, tell them they have a friend who will listen and assist them to find help. We work in an environment with a high level of exposure; it's hard work, and we need to help each other.

If someone is making a decision that you think will unnecessarily put you, them, or someone else in danger, speak up. Talk about it. Ask the why! We need everyone's vigilance, experience, and contributions to be successful.

Thank you for the work you do! ■

Redirect That Load!

Randall C. Thomas

The photo in figure 1 was taken during the 2003 fire season at the Coeur d'Alene Airtanker Base in Hayden, ID. The airtanker is T–27, a P–3A Orion operated by Aero Union.

Ed Kurowski (standing near the aircraft in an orange-and-yellow vest) is in communication with the pilot of T–27. Ed is marshaling in the airtanker.

Bernie Lionberger (standing in the foreground, visible from the rear) is talking with the copilot (on a different frequency) concerning a change in the dispatch. As he described it to me, Bernie was giving the copilot a "face-to-face briefing" with limited daylight left, redirecting air attack over a higher priority fire.

Complex Operation

This is what I would classify as a complicated and complex operation. It has the challenges of an objective with a desired outcome, along with a sudden change in mission.

Years after I took the photo, I asked Bernie if he remembered anything about it, and he told me about the change in mission, making me truly understand and appreciate the complexity of the tasks these people perform. As Bernie explained it, the T–27 had just dropped a load of retardant on a fire; the pilot was returning to base and taxiing in, expecting what's called a "load and return." Instead, the aircraft was being reassigned to a higher priority fire.

This is what I would classify as a complicated and complex operation.

The problem was this: the airtanker needed to get reloaded as quickly as possible and take off for the higher priority fire. As forest aviation officer, Bernie made the decision, in conjunction with Dispatch, that there wasn't enough time to hand the crew a new resource order.

So Ed needed to direct the pilot to properly park the airtanker for reloading with fire retardant. At the same time, Bernie needed to give the copilot a whole range of new information, including the latitude and longitude of the higher priority fire, the new frequencies that they would be using, any hazards they might face, the ground contacts they would have, the tail numbers of other aircraft working on the fire, and more. The copilot needed to program this new information while the pilot was operating the aircraft.

Figure 1—*A P3–A Orion, the signature Forest Service large airtanker of the past. Photo: Randall A. Thomas, USDA Forest Service, 2003.*

Randall Thomas is the lead fire dispatcher for the USDA Forest Service at the Coeur d'Alene Interagency Dispatch Center in Hayden, ID.

This was definitely a much more complex procedure than what a copilot and ramp person (Bernie) would normally have been doing to reload a large airtanker. If any of the new information was incorrectly relayed, it could delay the suppression of an emerging wildfire.

If any of the new information was incorrectly relayed, it could delay the suppression of an emerging wildfire.

Highly Experienced Personnel

Bernie Lionberger was involved with Fire and Aviation Management on the Idaho Panhandle National Forest from the early 1960s until his retirement in 2004. When he retired, Bernie was the fire and aviation officer for the forest, a position he had held since the early 1980s.

Ed Kurowski was involved with Fire and Aviation Management from the early 1960s until his retirement in 2006. Ed was a smokejumper out of the Coeur d'Alene Airtanker Base (which had a satellite jump base until 1988). In 1988, Ed was reassigned to the airtanker base as a mix master and ramp manager.

Both Ed and Bernie have since retired after many years of service. I had a chance to work closely with both for a few years after starting work at the Coeur d'Alene Wildland Fire Center in May 1999. Bernie and Ed both had many years of experience and training in the wildland fire aviation world; both were very good at and knowledgeable about their jobs. Bernie was the lead instructor at several aviation classes that I attended.

Background on the Photo

In spring 2003, the Northern Regional Office gave me a cash award for helping to plan and implement the Resource Ordering and Status System, a new computer system for ordering and tracking resources for wildland firefighting. I used the money to buy a Pentax film camera.

The year 2003 turned into a big fire year for the Northern Rockies as well as other areas in the West. When I could get a break, I took pictures of airtanker operations on the ramp. Bernie himself was a good photographer, and he gave me many tips.

One of the photos I took is the one shown in figure 1. The photo has always had a special effect on me, and I always wanted to share the story behind it with the wildland fire community. ■

Three Fires

Stephen J. Pyne

Modern wildland fire management effectively began in the aftermath of the Great Fires of 1910. The Big Blowup traumatized the fledgling Forest Service and its Chiefs for decades. One of the aftershocks, the 1911 Weeks Act, established the basis for a national infrastructure, with the Forest Service as the institutional matrix.

The policy of resistance failed as a universal strategy because it proved impossible to abolish fire.

Policy of Resistance

For the next 50 years, the country pursued a strategy of fire suppression, so far as possible (fig. 1). The Forest Service connected Federal agencies and States. It was a policy of resistance—that is, it sought to eliminate the fire threat by attacking every fire before it could become big, a kind of forward strategy. Part of the appeal of the policy was its administrative clarity and unblinking rules of engagement that mandated control by 10 a.m. on the morning following a fire's discovery. By 1960, the Forest Service had become a benign hegemon that controlled nearly every aspect of wildland fire and much of the rural fire scene.

Figure 1—*Suppression of a wildland fire in 1967 by Forest Service firefighters on Idaho's Kaniksu National Forest. Photo: W.E. Steuerwald, USDA Forest Service.*

This approach proved useful for rapidly building out a national system. It failed, however, as a universal strategy because it proved impossible to abolish fire. The reason was that fires that escaped initial attack became bigger. Moreover,

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Editor's note: This essay is based on testimony the author gave to the Senate Committee on Natural Resources and Energy in May 2015.

many landscapes suffered from a lack of fire; the strategy eliminated good fires as well as bad ones. It forced one agency to absorb and resolve all the tensions regarding how the national estate should be managed.

The reformation in fire management begun in the 1960s has not achieved anything like the dimensions projected or needed.

Strategy of Restoration

In the 1960s, a new strategy of restoration emerged. It sought to reinstate the good fires lost under the previous regime, it wanted a more pluralistic oversight of policy than that provided by the Forest Service, and it nurtured a civil society to counter what was becoming a de facto government monopoly. Critically, it was not enough to have a stand-alone fire protection program: fire had to be integrated with land management. Over the next 15 years, every Federal land agency had its mission redefined or rechartered. As the purpose of those lands changed, so did their requirements for fire.

The first salvos in this fire revolution came in 1962. By 1968, the National Park Service had recanted the 10 A.M. Policy in favor of restoration; in 1978, the Forest Service achieved a complete overhaul of its fire mission and its financing. The new strategy pivoted around a concept of fire by prescription. Good fires would be introduced deliberately on working landscapes, and natural fires would be granted more room to do their ecological work in wild landscapes; both kinds of fire would be conducted under a specified set of guidelines called a prescription.

Meanwhile, interagency organizations supplemented and then replaced the singular role of the Forest Service (fig. 2). Then they expanded from interagency programs to intergovernmental ones, and now they include nongovernmental organizations and the private sector as well. The collapse of the old order was remarkably swift. It was like watching the Berlin Wall fall overnight—or, less dramatically, like watching the breakup of AT&T's telephone monopoly, which happened at the same time.

Figure 2—*Prescribed fire to reduce invasive Johnson grass near Sedona, AZ. The fire was part of an interagency Wildland Fire Skills Training Day on March 27, 2017, sponsored by the Valley Verde All Hazards Training Association, with participation by six local and Federal agencies. Photo: USDA Forest Service, Coconino National Forest.*

Stalled Fire Revolution

The new strategy has now run its own 50-year course, and its problems and promises have sharpened. Prescribed burning has proved more a regional than a national project. It works as a foundational doctrine in the Southeast and parts of the Great Plains—although no one seems to get as much burning done as they believe they need—but it has not become a routine operation in the West or Alaska. The prescribed natural fire thrived in Alaska under a different set of guidelines but died nationally as a concept after the 1988 Yellowstone fires, although it continues to be reincarnated in other avatars.

The fire revolution overall stalled during the 1980s. The reasons are many, some within the purview of the American fire community, many not. Reforms renewed after the 1994 season, culminating in a common Federal wildland fire policy (1995) and the National Fire Plan (2000). The project has had its successes and showcase programs, but the sad fact remains that the reformation in fire management has not achieved anything like the dimensions

projected or needed. Most observers consider that the threats are outpacing responses. Moreover, the institutional scene has been overwhelmed by competing purposes and new organizations, including volunteer fire departments; a gamut of nongovernmental organizations, from The Nature Conservancy to the National Coalition of Prescribed Fire Councils; and private companies that have grown on such a scale that critics now speak of a fire-industrial complex.

> Burnouts under a resilience strategy may well be the future of prescribed fire in the West.

Which leads to a consideration of what the next 50 years might hold. A new strategy seems to be congealing in the West that we might label resilience. It accepts that we aren't going to get ahead of the problem overall, that too many variables are in motion, and that the fire community controls too few of those causes to intervene in fundamental ways. It seeks to make the best of the hand we are being dealt, even if, paradoxically, American society is the dealer.

Three Strategies

These three historical eras underwrite the three general strategies in play today.

Resistance. There remains an Old Guard from the 1960s who would like a return to the former order, and there are more contemporary thinkers who want to transform wildland fire organizations into an all-hazards emergency service, effectively urban fire departments in the woods—or, at a national level, a kind of Coast Guard for the interior.

This is happening globally, motivated by desires to protect structures and lives. Evidence to date suggests that such a revival or a repurposing can help serve a threatened public, but it has not shown that it can manage fire because it breaks the bond between fire management and land management. While a resistance strategy retains the strengths of fire suppression, it also retains its formidable weaknesses as a singular strategy.

Restoration. Restoration remains an inspirational goal for many practitioners, either to return to a Golden Age in the past or to advance toward one in the future. Its motivation is a near-universal unhappiness with the existing scene. But restoration, too, has upgraded its mission to include complex collaborations, ways to supplement prescribed fire with other treatments, and a determination to get ahead of the problem—to gather and apply the best science in order to restructure the national estate in such a way that we can control bad fires and reintroduce good fires more easily, cheaply, and safely.

There are many projects actively underway. Yet if the restoration vision still shines brightly, so, too, its problems continue to darken. It has proved costly, not only in money but in political and social capital. Research, reviews, protocols under the National Environmental Policy Act, endless conversations among stakeholders—these are a necessary exercise in democracy but can take years. Moreover, the actual area involved is small relative to the size of the challenge. The threats are growing bigger and faster than our responses. We need flexibility to operate on landscape scales, not only geographically but also institutionally. We need to move beyond single projects and events. There is little reason to believe that the country will muster the will to rehabilitate at the rate required the 39–58 million acres believed to be out of whack.

Resilience. In the West, a strategy is emerging that accepts, in fact if not in doctrine, that we cannot get ahead of the problems coming at us. Instead, it allows for the management of wildland fires to shift from attempts at direct control to more indirect reliance on confining and containing outbreaks (fig. 3). Of course, there are fires that simply bolt away from the moment of ignition or that need immediate suppression. But many fires offer opportunities to back off and burn out. It is hoped that this strategy will prove more cost-effective and safer for fire crews while introducing some degree of semicontrolled ecological burning.

These are not let-burns. Rather, fire officers concentrate their efforts at point protection where assets are most valuable, such as communities, municipal watersheds, or sequoia groves. Elsewhere, they will try to pick places—draw boxes—from which they can hold with minimum costs, risks, and damages. A given fire might see aggressive firefighting on one flank or on one day and a more removed burning out on another flank or at another time.

These are hybrid fires—half suppression, half prescribed burn. The strategy is compatible with Federal policy and in many respects

Figure 3—*Firefighters on the 2014 Happy Camp Complex Fire, Klamath National Forest, northern California. The lightning-ignited fire complex, managed with a resilience strategy (partly suppressed wildfire, partly prescribed burn/monitored-and-managed wildfire), ultimately scorched more than 135,000 acres (54,000 ha). Photo: Kari Greer, USDA Forest Service (September 17, 2014).*

> All three strategies remain in play, and all three are needed.

moves in directions long urged by critics and even by the Government Accountability Office, although it can look like a mashup and the outcomes will be mixed. Some patches will burn more severely than we would like and some will barely burn at all, but the rest will likely burn within a range of tolerance. Such burnouts may well be the future of prescribed fire in the West. If so, we need to do them better, and we need to understand how to build future landscapes out of the patchy aftermath of the megafires that define the current regime.

Equally, we need a reordering of the institutional scene. In political terms, we are witnessing the American fire community's Euro moment. We either truly integrate, we break up, or we tolerate endless bailouts. The National Cohesive Wildland Fire Management Strategy could become the start of a kind of fire constitution that redefines for our Federal system the roles, rights, and responsibilities of the many, many players in the American way of fire. It could do for the future what the Weeks Act did after the Big Blowup in 1910.

A Mix of Strategies

So, three strategies. It's worth pointing out that all fire strategies suffer failures and at roughly the same rate. Some 2–3 percent of wildfires escape initial attack. Probably a comparable number of prescribed fires escape or fail to do the ecological work expected. And we can expect similar rates of breakdowns with managed wildfires.

Without wishing to sound flip or push an analogy too far, we might call the resistance strategy a rock, the restoration strategy a scissors, and the resilience strategy a paper. At any one time and place, one trumps another and is in turn trumped. All three remain in play, and all three are needed. We need rocks around our prize assets and communities when they are threatened by active fires. We need scissors to buffer against bad burns and nudge toward good ones as part of managing healthy land. And we need resilience because the ideal can be the enemy of the good, and a mixed strategy that includes boxing-and-burning may be the best we can hope for. ■

The Effectiveness of Community Wildfire Protection Plans: Comments from the Field

James D. Absher, Jerry J. Vaske, and Courtney L. Peterson

Community wildfire protection plans (CWPPs) have been promoted as key to mitigating losses from wildfire and addressing the challenges of living in the wildland–urban interface (WUI). Candid responses from professionals and residents involved in CWPP development and implementation in Colorado supplement prior quantitative results that highlighted the complex social nature of CWPPs (Vaske and others 2016). We evaluated both successes and challenges in the ongoing efforts to formulate and carry out CWPPs. These voices from the field will hopefully assist others as they focus on gaining local community support for CWPP planning and implementation.

Colorado State Forest Service Volunteer Day, Colorado State University Mountain Campus. Keeping the forest properly thinned and pruned in a defensible space will reduce the chances of a home burning during a wildfire. Photo: Colorado State Forest Service (2012).

CWPPs in General

CWPPs were authorized and defined by the Healthy Forests Restoration Act (HFRA 2003). They emphasize community planning for a variety of benefits to communities from a wildfire protection plan. A CWPP represents an opportunity for a community to rise to the challenges of the WUI by incorporating comprehensive and locally supported solutions, bringing together diverse local interests, and offering a positive, solution-oriented environment. CWPPs address challenges such as local firefighting capability and the need for defensible space around homes and subdivisions. They set priorities for land management on both Federal and non-Federal land. The involvement of local citizens in community wildfire preparedness also exposes wildland fire managers and community planners to public opinions beyond expert knowledge and scientific inquiry. Because local knowledge is a crucial component of a community, social capital is an important element of CWPPs.

> There are no "cookie cutter" approaches for communities faced with wildfire risk.

The National Cohesive Wildland Fire Management Strategy has made fire-adapted communities a goal for all fire-affected communities (Jewell and Vilsack 2014). CWPPs can be an integral part of fire-adapted communities because the plans bring together diverse agencies, community leaders, and residents into a cohesive whole that develops collaborative plans and sustainable programs through concerted effort

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at all levels, including counties, fire protection districts, and owners associations (Booz Allen Hamilton 2014; CWPP Task Force 2008; Hawkins and others 2004; Jakes and others 2012).

There are no "cookie cutter" approaches for communities faced with wildfire risk (see, for example, Cooke and others 2016; and Toman and others 2013). Ellison and others (2015) suggest that preparedness actions tend to emphasize county-level rather than more localized community settings. Other work points to the importance of understanding and incorporating the social dynamics within a group of actors (Brummel and others 2010; Jakes and Sturtevant 2013) or a community's specific needs and capacities (Everett and Fuller 2011). Studies of CWPPs suggest that "social learning" is important (Jakes and Sturtevant 2013), as are framing, scale, and building sustainable capacity (Williams and others 2012). Abrams and others (2014) show that there is considerable variation in the plans' content, despite detailed writing guidelines.

Most plans tend to share a common emphasis on a relatively small range of activities centered on fuels reduction. Residential surveys in Colorado (Absher and others 2009) reveal that many "easy" defensible-space activities were commonly reported but that more expensive or technically complex activities were not reported. Community participation in planning efforts was less likely to occur than any other individual homeowner defensible space action. The Forest Stewards Guild of CWPPs in New Mexico (Evans and others 2015) found that for effective mitigation to occur, people are the key. The CWPP process needs to be inclusive from the development stage. The study also found that CWPPs need a clear prioritization of implementable projects.

Most plans tend to share a common emphasis on a relatively small range of activities centered on fuels reduction.

CWPPs in Colorado

The Colorado State Forest Service has established minimum standards for the development of CWPPs in Colorado and has promoted the development and implementation of CWPPs as a tool to help build fire-adapted communities. Colorado requires counties to complete a CWPP for identified fire hazard areas within unincorporated areas of the county. Of Colorado's 62 counties with unincorporated areas, 49 counties have completed a countywide CWPP. (Denver and Broomfield Counties are completely incorporated and are therefore excluded.) A template for writing CWPPs is available on the Colorado Wildfire Risk Assessment Portal website (CSFS 2012). A list of completed CWPPs can be found on the Colorado State Forest Service website (CSFS 2017).

With over 200 CWPPs now in existence in Colorado, it is essential to assess the effectiveness of these efforts and identify barriers to participation and implementation. In Colorado, the CWPP process must include local government, the local fire authority, local Colorado State Forest Service personnel, and representatives of relevant Federal land management agencies as well as other appropriate nongovernmental partners (CSFS 2012).

Demonstration site for a community wildfire protection plan, East Canyon, CO. Demonstration sites within the community can be great tools for motivating neighbors to engage in wildfire mitigation practices. Photo: Colorado State Forest Service (2014).

There are, however, significant differences among the Colorado CWPPs, beginning with who writes the document. A CWPP can apply to any level of "community," from an owners association or mountain town, to a fire protection district, to a metropolitan city or county. County-level plans can be used as an umbrella for smaller scale plans but should not be considered a substitute, because county-level plans will not provide the detail needed for project planning at the level of a fire protection district or an owners association.

Study Design

This article emerged from a larger study of CWPPs in Colorado (Vaske and others 2016) focusing on communications among team members, success in funding and implementing their plans, progress toward CWPP goals, fuels treatments implemented, barriers to implementation, and CWPP outreach and education efforts. In this article, we build on the main results in the project reports and bring to light the comments from managers and team members who were closely involved in the plans and their implementation.

We obtained data from a survey mailed to all 212 CWPPs in Colorado in spring 2014; we received 133 responses, for a response rate of 63 percent. The survey asked open-ended questions about CWPP development and implementation. From August 2014 to January 2015, we obtained additional information through 18 indepth, semistructured interviews with key participants involved in Colorado's CWPP process. Survey and interview participants represented a variety of levels of CWPPs, ranging from countywide, to fire protection districts, to subdivisions or owners associations. Interview participants were selected based on geographic variability, plan level, and the year of CWPP development.

Key Findings and Voices of CWPP Team Members

The quantitative part of this study (Vaske and others 2016) showed that a CWPP should not be static. It functions best as a living document that is based on a coalescence of interests, as framed in the plan's guidelines and subsequently implemented and modified over time. As such, CWPPs will have inherent strengths and weaknesses, some of which stem from the values and viewpoints of the CWPP team.

> Plans function best as living documents based on a coalescence of interests, implemented and modified over time.

In particular, the quantitative survey results suggested that:

- The flexibility of CWPPs, though an advantage, can be a barrier for owners associations that have limited expertise on their planning teams.
- Communities report funding and time as the main barriers to CWPP implementation.
- Other challenges to CWPP implementation focus on resident participation, notably community involvement, communication among community members, and full communitywide participation.
- Some plans would benefit from greater focus on preparedness and evacuation planning; other plans would benefit from paying more attention to postfire issues such as erosion and debris removal.
- CWPPs can quickly become outdated due to changes in community structure. They may need updating to refocus and reenergize implementation efforts.

Based on the open-ended comments and interview responses, six key themes emerged (Vaske and others 2016):

1. Recommendations for CWPP planning,
2. Recommendations for CWPP implementation,
3. Challenges to community involvement,
4. Recommendations for successful community involvement,
5. Suggestions for focusing beyond fuels mitigation, and
6. Suggestions for updating plans.

This article summarizes the written and interview comments that support these themes.

Recommendations for CWPP Planning

Both the Healthy Forests Restoration Act and the CWPPs are flexible, but their flexibility can sometimes be a barrier for more localized plans (such as for subdivisions or owners associations) where leaders have less expertise. Getting started with the CWPP process can often be difficult. One landowner, for example, said that "interest cannot be from some official saying you have to do this." Generating community interest in the CWPP process must come from the community itself. Positive and forward-thinking sparkplugs from within the community can give the CWPP development process traction.

One of the CWPP contractors noted that it is important to "try

to make the CWPP process as easy as possible; don't make it overly regulatory because it scares people away. [You] need people to do it in the first place. Things will happen from there." Providing guidance that is accessible to people at all levels of CWPP expertise can help to make the plan more usable and achievable. One landowner suggested that the Colorado State Forest Service "provide a template for writing a CWPP as this makes the process less daunting, and allows a focus on specific projects." More outreach must be done to communicate the location of the CWPP template on the Colorado State Forest Service website (CSFS 2012).

Recommendations for CWPP Implementation

Minimum requirements of the CWPP process include identifying fuels treatment priorities and methods and developing an implementation plan. Based on our survey (Vaske and others 2016), CWPP representatives faced challenges to implementing projects, such as lack of funding, time, community involvement, and political support. A key message from the interview participants was that communities cannot depend on grants and other funds to get work on the ground done. One landowner emphasized the need to "sell people on the concept that it's important to do the work outlined in the CWPP, whether we have outside funding or not." Another landowner, a member of an owners association, called for "a commitment that we have in our budget money to self-fund work." That way, even without access to grant funds, the community can continue to accomplish the fuels treatments outlined in its CWPP.

Specific projects should be written into the CWPP. One fire chief said that the "CWPP was probably too general in terms of not specifying enough particular projects that needed to be done." Detailing specific projects, such as fuelbreaks along main access and egress roads or thinning projects in open spaces within communities, can help serve as an implementation roadmap. The right level of detail can also help with grant applications. One emergency manager suggested "building answers to grant application questions into your plans." The more detail put into the CWPP from the beginning, the easier it will be to apply for grants and prioritize implementation projects. Finally, the time to carry out projects outlined within a community's CWPP is when wildfires are in the news and smoke is in the air. One contractor urged the community to "build on momentum—take advantage of time after wildfires to get the public involved." When wildfires are in the news, community interest is peaking, and that is the time to really push to get projects done.

Community engagement in the process is a key goal—but one of the hardest to achieve.

Challenges to Community Involvement

One of the main goals of CWPPs is to engage the community in wildfire mitigation planning and implementation. Community engagement, however, is one of the hardest goals to achieve. Our interviewees mentioned a number of challenges to community involvement, the first being knowledge that the CWPP is available as a tool to use. One fire chief said "there wasn't much involvement in the planning side of it. In fact, I would say almost nobody in the community even knows it's out there with the exception of a couple specific neighborhoods that we have discussed the CWPP with." It is also important to communicate the relevance of the CWPP to community members so that they can determine how best to use the CWPP to accomplish the community's wildfire risk reduction objectives.

Several interview participants claimed that very few community members attended meetings. For example, one contractor stated that "when we had the interested party meeting, the only people that showed up were CSFS [Colorado State Forest Service], a couple county commissioners, the sheriff, the fire chief and a couple of his buddies, and myself and that was it." Members of the community that the countywide CWPP was being written for were not present. Communities must find incentives to bring all stakeholders to the table; combining meetings with food is often helpful in achieving that goal.

Another challenge to community involvement in the CWPP process is a lack of engagement by secondary homeowners and absentee landowners, which can be extremely frustrating for full-time residents and property managers within communities. One landowner said that "it's very hard to make an impression on somebody if you only get to have a short time, maybe a few weeks for them to understand what their property does and how it affects their neighbors." To overcome this challenge, one landowner suggested "encouraging owners to protect their investment by taking mitigation actions." If absentee landowners don't seem interested in doing

Houses in the red zone in Colorado's wildland–urban interface (WUI). Over 2 million people live in Colorado's WUI, making it more important than ever for communities to engage in wildfire risk reduction through community wildfire protection plans. Photo: Colorado State Forest Service (2015).

> "The most effective way of educating and informing the community about the plan was using my own property as an example," said one landowner.

mitigation work, they can be told of the investment they would lose if their property burns in a wildfire.

The final challenge to community involvement throughout the CWPP process was a lack of involvement by younger generations. "It's definitely mostly retirement age. I'm saying anywhere from 50 to 75," said one mitigation specialist when describing the community members directly involved in the work. Younger generations will be the future forest landowners in communities with wildfire risk, so it is imperative to get them engaged in wildfire risk reduction efforts now. Specifically involving youth groups or younger residents to do mitigation work helps out elderly community members, who might find the work more challenging. As a volunteer firefighter put it, "[G]et younger landowners involved in mitigation work by helping their neighbors do work on their land … if they've actually donated an hour or a couple of hours of their time … they are probably willing to stay invested in the project over the long term."

Recommendations for Successful Community Involvement

Despite the challenges to community involvement throughout the CWPP process, interviewees had many recommendations for better engaging communities, an important component of CWPP success. Some suggested using the CWPP as an educational tool. One fire chief said that "developing the CWPP was a great way to learn more about the area we protect." CWPPs can inform local emergency service personnel about the community values at risk, and emergency workers can in turn use the CWPP to educate newcomers to the WUI about wildfire risk in the area. "Copies of the evacuation plan are available for new residents. One family has made multiple copies for cabin guests," said one landowner.

Another successful practice was to highlight properties where work had been properly done and was being maintained. "The most effective way of educating and informing the community about the plan was using my own property as an example," said one landowner. Having community members tour their neighbors' firesafe properties can help overcome misconceptions about what wildfire mitigation actually means and looks like on the ground.

CWPPs should also be used to create a sense of community and place. As one landowner said, "[W]e build a community, and when you're trying to establish either a wildfire protection plan or a Firewise community, community is the key word. People need to know each other and care about each other and talk to each other." A best practice is to encourage everyone in the community to join in developing the CWPP plan so that everyone feels responsible for the community. That

makes it easier to get neighbors to take action to protect the place they call home.

Another successful approach is to use existing community groups and resources to better involve the community throughout the CWPP process. A contractor suggested "utiliz[ing] organized groups, events, community gathering places (e.g., fire station)." The momentum of people already engaged in making their community a better place can instill interest in CWPP implementation as well. The recommendations that communities decide to follow should be listed in an action plan for community involvement as a component of the CWPP.

Suggestions for Focusing Beyond Fuels Mitigation

Although agency funding and programs correctly emphasize fuel issues, such issues should not be the sole focus of the CWPP. Comments from the CWPP surveys and interviewees emphasized the need for more focus on preparedness and evacuation planning. One emergency manager said that "if anything needed to be changed, it would be that the CWPPs need to incorporate an evacuation and preparedness piece much more than [an] implementation piece." The evacuation piece is a minimum requirement in Colorado for CWPPs. Each plan needs to include information on the community's preparedness to respond to a wildfire and describe steps to take when a wildfire occurs.

There should also be a focus on postfire issues related to wildfire. Often, postfire issues are not included in CWPPs, but several interviewees noted that it's important to start thinking about those things ahead of time. Erosion is a major issue after wildfires, but the topic is typically not discussed in CWPPs. Before a large wildfire occurs, a community should compile a list of things to have ready (such as dumpsters for all the debris that accumulates during a wildfire).

Some interviewees noted that postfire issues might be more practical to include in an update than in the first draft of a CWPP. If you are trying to get a first CWPP completed, it might be better to focus on preparedness actions. As one interviewee noted, "If you're trying to get traction and get a first CWPP done … it might almost be counterproductive to worry people about … the aftermath. We're trying to get people to be positive and forward thinking." However, if communities are truly going to be prepared for a wildfire, they need to consider the postfire effects as a part of their CWPPs.

Suggestions for Updating Plans

As plans are carried out, the people involved and the yearly activities will change. A 10-year planning cycle might not be adequate. Several interviewees noted that updates were necessary because plans were outdated.

One fire chief, for example, noted that "the CWPP is being updated because 80 percent of the area has experienced fires and flooding." Other interviewees, however, argued that most plans have already addressed the low-hanging fruit and that more difficult projects are not as likely to get done. Other suggested reasons to update or revise a CWPP include:

- Community turnover—the plans are driven by people, and as the community changes, so too should the CWPP team;
- Changes in community structure, especially as new houses or other infrastructure are added;
- Changes in risk due to shifting seasons or the occurrence of drought or fires that affect the CWPP area; and
- Improvements in firefighting, prevention, and mitigation techniques.

Making CWPPs More Effective

The six themes summarized in this article do not comprise a comprehensive review of all the issues facing CWPPs. However, the

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experiences of those involved in Colorado's WUI are informative and give practical direction for those in similar situations elsewhere.

In general, we encourage those involved with CWPPs to think of the plans as ongoing and emerging. A broad set of actors and actions should be represented in CWPP planning guidelines, especially with respect to communication and collaboration. Our findings are consistent with other work done in Colorado and elsewhere on related topics, such as community preparedness and fire-adapted communities (see, for example, Leschak 2014; Stein and others 2014; and Mowery and Prudhomme 2014).

Given that CWPPs were authorized more than a decade ago under the Healthy Forests Restoration Act, it is important to take stock of their impacts at various levels. County plans tend to focus on the landscape and cross-boundary projects. Plans led by fire protection districts often focus on tactical operational issues that are important if a fire approaches. Plans at the level of owners associations focus more on local needs and projects (such as signage and fuelbreaks). This article gives insight about the extent to which the goals identified by CWPPs are being carried out and offers some recommendations as communities continue to develop and update their CWPPs so that the plans might better become a key component of fire-adapted communities. ■

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Social Factors in Wildland Fire Risk Management and Planning

David Martín Gallego, Eduard Plana Bach, and Domingo Molina Terrén

The socio-environmental dimension in wildland fire management is critical for moving towards a baseline of firewise planning. Wildland fire risk planning is a land use planning tool that should be able to keep pace with rapid rates of social and environmental change. Changes in land use and climate bring alterations in fire regimes, aggravating and diversifying the range of associated impacts and leaving a vulnerable society unprepared to take on a magnitude of risk. Extreme fire behavior is appearing even in areas not historically affected by severe wildfires. Success in adapting to increased risk can depend on social factors such as fire risk perceptions, social capacity to accept risk, and identification of social actors (decision makers, urban planners, firefighters, researchers, and the like) who can rise to the challenge of land management planning as a crucial aspect of wildland fire risk management. Moreover, societal and institutional involvement in management decisions is required for participatory risk governance. The vulnerability of urban settlements and infrastructure at risk can be attenuated by developing hazard mitigation strategies to create more resilient landscapes and communities. For example, a combination of agroforestry and livestock activities will yield a landscape mosaic. This, along with the social capacity to take protective measures in wildfire prevention as well as in emergency situations, will contribute to reducing overall community vulnerability (fig. 1).

Successful wildfire risk management requires good governance and societal and institutional involvement in management decisions.

What are the key social factors at play in developing sound hazard mitigation strategies?

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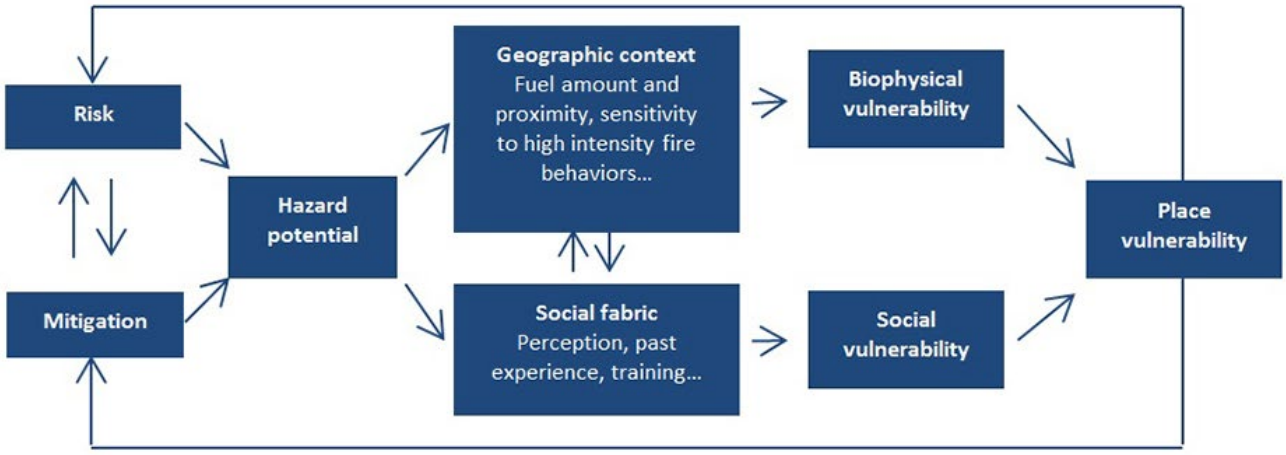

Figure 1—*Hazards-of-place model of vulnerability. Hazard potential is affected by a geographic context leading to biophysical vulnerability (site and situation of the place) and a social fabric leading to social vulnerability (the population at risk). The combination of both results in the overall place vulnerability, a dynamic factor influenced by the level of risk, the implemented mitigation strategies, and the hazard potential. Source: Adapted from Cutter (1996).*

Risk Management in the Wildland–Urban Interface

Because large wildfires are rare, wildland fire professionals should focus on the latent risk over long timespans, making sure that both citizens and policymakers remain aware of the risk. Fire is often excluded in the wildland–urban interface (WUI), with little or no thought given to the role of fire as a natural component of the ecosystem. In rural settings, the traditional use of fires is maintained to some extent but also increasingly excluded due to the rising risk of wildfire spread. The WUI is one of the most controversial and challenging issues for wildfire suppression and emergency services. People living in WUI areas need to assume some responsibility for protecting their property but usually remain unaware of how fire behaves and what mitigation actions are available (Blanchard and Ryan 2007).

Learning to live with fire appears to be the most effective strategy all across the world. Designers, developers, and builders working with structures in WUI areas have the opportunity to offer residents a home designed and constructed with firewise features (fig. 2). Firewise planning is a valuable service that landscape architects and designers can offer to homeowners, addressing needs in two areas: the structure (thinking about homes as fuels) and the area around it (offering a defensible space). Building and forestry technical codes for future developed areas should take into account:

Learning to live with fire appears to be the most effective strategy all across the world.

- The radiant heat of an approaching wildfire, prescribing an adequate distance between vegetation and buildings; and
- The potential for spot fires near houses and infrastructure.

Planning for wildland fire protection in the WUI should also incorporate suitable access for suppression services as well as for the safe evacuation of residents. Public officials with authority to approve planning documents can review the technical instructions in order to convert them into mandatory technical regulations.

Factors Affecting Attitudes Towards Risk Mitigation

Psychological variables related to public beliefs and attitudes affect public support for wildland fire management strategies (Absher and Vaske 2007). Martin and others (2007) summarized the main factors as follows:

- The perceived effectiveness of actions to reduce the risk,
- Confidence in the capacity to correctly carry out actions,
- The perceived responsibility for fire risk management, and
- Trust in and the credibility of the institution that is calling for action.

Better public understanding of the role of fire in ecosystems will foster long-term cross-sectoral strategies based upon fuel management at a landscape level. Better knowledge of risk exposure will promote a public desire for self-protection and shared responsibility. Social factors, such as people's perceptions, beliefs, and attitudes toward fire impacts, play a decisive part in the success or failure of fire management programs.

Studies have found that those who have experienced wildfire in the past have an increased awareness of

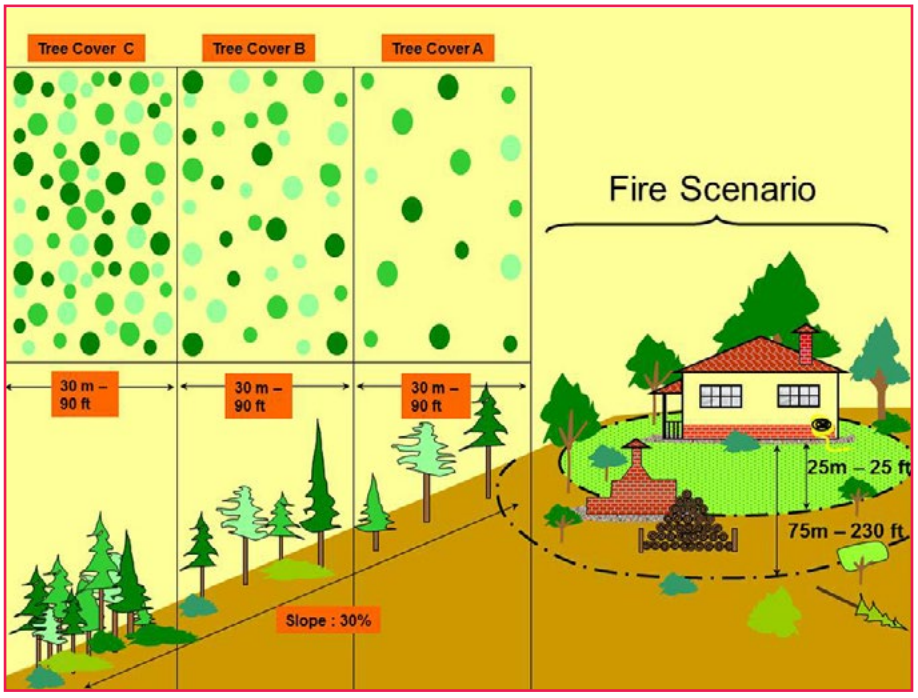

Figure 2—*Firewise planning: model of defensible space around a house. Firewise planning entails fire mitigation measures in and around areas in the wildland–urban interface. Reducing fuel loads in the nearby forest lowers the rates of radiant heat from an approaching fire. Buffer strips within homeowner property limits are necessary due to firebrands blowing across fuelbreaks and starting spot fires near homes.*

risk. However, past experiences with wildfire do not automatically motivate people to undertake fire management practices (Blanchard and Ryan 2007). According to Sims and Bauman (1983), experiencing wildfire increases risk awareness only for a relatively short period. Therefore, mitigation measures and statutory change are most likely to succeed immediately following an event.

A central question is this: Who owns the risk? Is it really individual homeowners? After all, homeowners pay taxes to public authorities, who give permits to build houses in wildlands. Moreover, the main risk factor does not come from fires starting on a homeowner's property but rather from heat transfer coming from fuel loads in wildlands. And the wildlands typically belong to a State or Federal government, to a municipality, or to other private landowners (fig. 3).

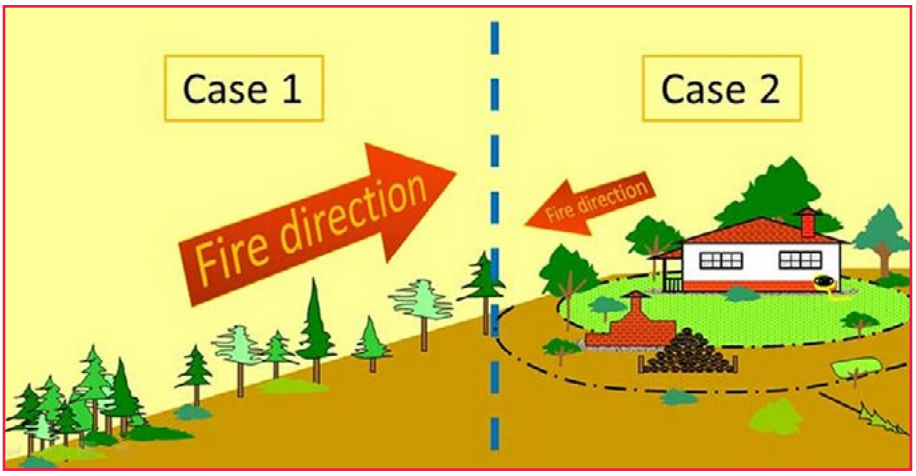

Figure 3—*Risk ownership in a wildland–urban interface area. The blue dashed line indicates the limit of the homeowner's lot. The arrows indicate the level of intensity of a fire originating in a forest (case 1: responsibility of the forest owner) versus the level of intensity of a fire originating on the lot of a private homeowner (case 2: responsibility of the homeowner). From a legal point of view, risk ownership is a controversial question that is difficult to sort out.*

Cross-Sectoral Risk Planning and Societal Involvement

Figure 4 shows the risk cycle, including the interrelationships between its components: The more a community prepares in the context of these interrelationships, the fewer efforts are necessary to protect it from wildfire. All public and private actors should be involved in the causal chain, from territorial to forest and home management scales across multiple sectors (a cross-sectoral approach is where forests, agriculture, livestock, and urban and spatial planning policies meet). Making a political arrangement creates a framework for operational cooperation and coordination among private stakeholders and public agencies.

It is important to reduce uncertainty and give strength and legal status to wildfire risk planning. Reducing uncertainty makes decision making more consistent. Costa and others (2009) described new systematic approaches to determining the most likely fire spread patterns as a function of physical geographic criteria and local synoptic situations. Such approaches create an opportunity to incorporate wildfire risk into land management planning (Plana and others 2015). Likewise, economic arguments can build support for wildfire mitigation

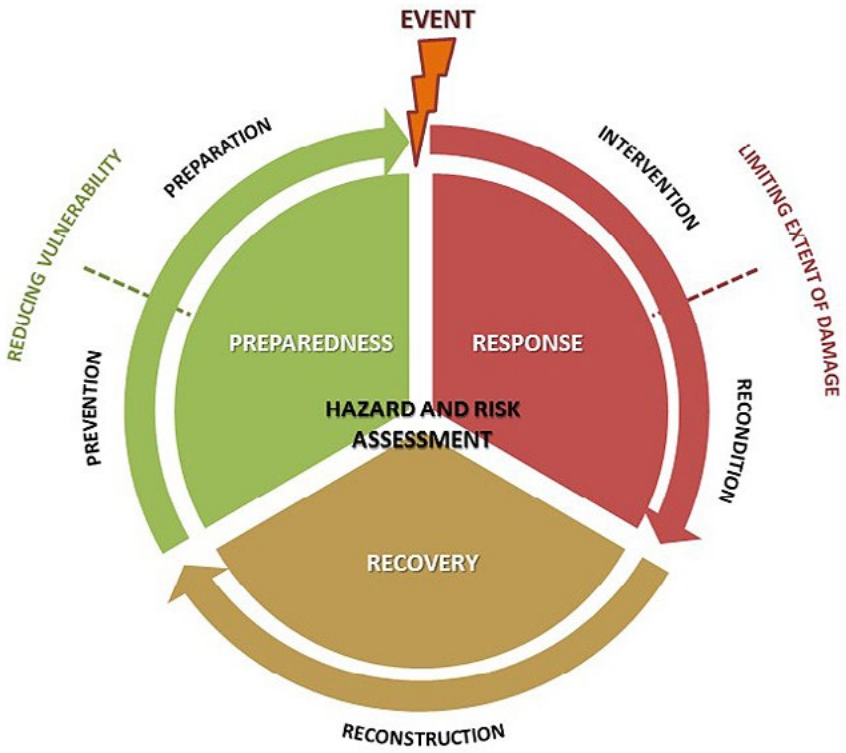

Figure 4—*Components of the risk cycle. Various actors can work together at each stage in the cycle to mitigate risk. Source: Adapted from PLANAT (2011).*

measures as cost-effective. In any case, risk assessment should take into account the physical criteria for fire spread patterns, which are highly influenced by topography, weather, and fuel load distribution. Risk assessment should adapt such criteria to the spatial scope of municipal prevention plans.

Municipalities and other local governments can play a key role in wildfire risk planning as intermediaries between homeowners and planners at higher levels of government. Local planning processes can promote stakeholder awareness and establish responsibilities among homeowners while building trust and credibility. A new and enhanced risk culture should emerge for the WUI.

Psychological variables related to public beliefs and attitudes affect public support for wildland fire management strategies.

At the community level, even a partial perception of risk can build local capacity for cooperation in prevention and self-protection. Fire education and outreach programs should be designed to change people's attitudes, behavior, and level of knowledge. But program delivery should be effective enough to build local engagement and commitment.

Creating debate about levels of vulnerability and about alternatives for mitigating risk offers citizens a chance to interact with fire agencies in making management decisions. Community participation in decision making promotes democratic development and implementation of management actions. When proposals come from homeowners, social acceptability is higher, as are social commitment and sustainable activism on behalf of firewise management.

Furthermore, the conjunction of local and scientific/management perceptions contributes to a broader understanding of natural/social systems and processes by giving rise to an interactive and two-way learning process among participants (Paveglio and others 2009). Participation programs foster contacts among neighbors, helping to form a sense of community (McDaniel 2014). People come to understand that wildfire hazards affect everyone and that cooperation is required to tackle the common challenge.

To help communication processes succeed, messages should be tailored to different groups and specific social contexts. Some authors have proposed tailoring educational programs to specific groups, such as property owners, year-round residents, chambers of commerce, local realtors, and schools (MacGregor and others 2008; McDaniel 2014).

MacGregor and others (2008) explained that the goal of the message should be not only to make people aware of risk but also to

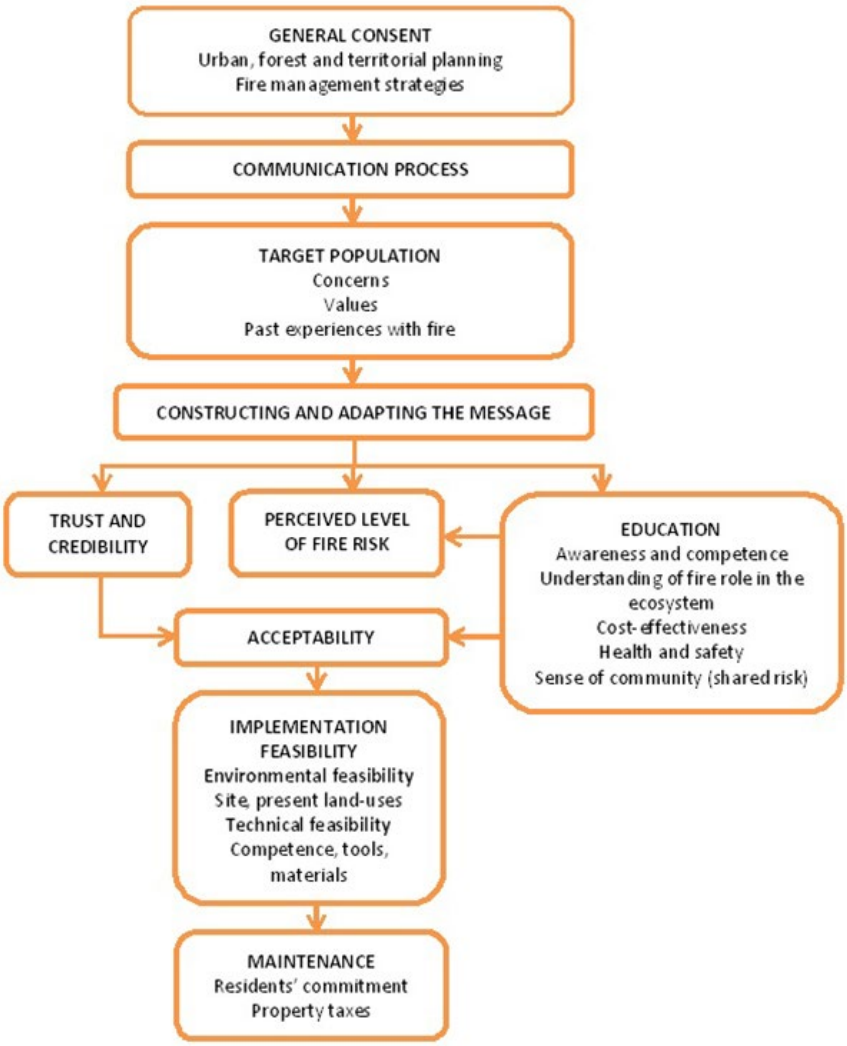

Figure 5—*Sequence of stages in the process of communication and factors that influence public acceptance of wildland fire management. Source: Plana and others (2015).*

get them to understand the severe consequences they could suffer and, most importantly, the effectiveness of their efforts to manage and reduce risk. Furthermore, the aim of communication processes should be to give communities the appropriate capability and tools (such as guidelines offered by fire management authorities) to take effective fire prevention actions.

Pedagogical strategies are also instrumental in the communication process. As a core premise, communication should not cause fear or discomfort within the community. The general misperception of reality (including a reluctance to cut trees and a false sense of safety) teaches the importance of educating while communicating. The goal is to give people a better approach to actual wildfire hazard and risk prevention planning.

A lack of trust and credibility constitutes the main barrier to effective risk communication (Steelman and McCaffrey 2013). According to McDaniel (2014), personal contact through interactive events such as workshops, field trips, and demonstration sites can show openness, giving experts the chance to substantiate and clarify their actions while giving the public the opportunity to ask questions and express concerns. Moreover, the credibility of the information provider and the clarity of the message will influence the acceptability of the message and increase the likelihood that people will practice wildfire mitigation.

Reducing community vulnerability means integrating the social dimension into risk management planning, thereby building trust and credibility while properly assigning risk ownership responsibilities to private and public actors (fig. 5).

Taking Social Factors Into Account

Wildfire risk assessment and wildland fire management analysis, especially in the current global change context, need to include room for interpretations from the social sciences. Such interpretations should include the new forms of interaction between wildland fire and society, particularly the impacts of fire on expanding WUI communities.

The synergistic effect of working in partnership might encourage learning and the exchange of knowledge, which should be robust, homogeneous, harmonic, and transferable. Knowledge exchanges in group settings can systematically improve approaches to wildfire risk planning.

Communication processes should be targeted at the local level to engage homeowners in planning processes. Effective communication is designed to increase local understanding of the need to take responsibility for creating and maintaining defensible spaces around homes. ■

Acknowledgments

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The Joint Fire Science Program: An Effective Knowledge Broker

Rebecca Smith and Martha E. Lee

A knowledge broker is an organization or individual that translates and disseminates research findings to working professionals (Konijnendijk 2004). Knowledge brokers participate in a variety of activities, including translating, spreading and commissioning research, and packaging science to meet the preferences of their readers (Cheng and others 2008; Ward and others 2009). The goal of knowledge brokering is to help individuals acquire new information and suggest ways of using new information in their decision making and practices (Michaels 2009). The Joint Fire Science Program (JFSP) is a knowledge broker that distributes current, credible, and useful information to fire professionals.

The JFSP is a knowledge broker that distributes current, credible, and useful information to fire professionals.

Mission and Structure

Congress established the JFSP in 1998 to provide a scientific basis and rationale for fire and fuels management activities. The mission of the program has four parts:

1. To provide credible research that is relevant to the needs of fire and fuels managers;
2. To listen to the needs of managers and then respond to those needs;
3. To solicit proposals from scientists; and
4. As research is completed, to deliver research through a variety of channels so that managers are aware of, understand, and use the information in management decisions.

The channels of communication used by the JFSP include Twitter, Facebook, email, print, blogs, and the program's website. Through these channels, the JFSP notifies individuals of funding opportunities for projects related to fuel treatment effectiveness, the effects of smoke, the fire social sciences, and the compatibility of fire and fuel treatments with wildlife (JFSP 2014).

There are 14 Knowledge Exchange Consortia within the JFSP (fig. 1). The consortia help connect managers, practitioners, and scientists working in a specific geographic area. The consortia sponsor conferences, webinars, and workshops, and they describe and list relevant research on their websites. Each consortium uses a variety of methods to disseminate information about new publications, webinars, and upcoming events.

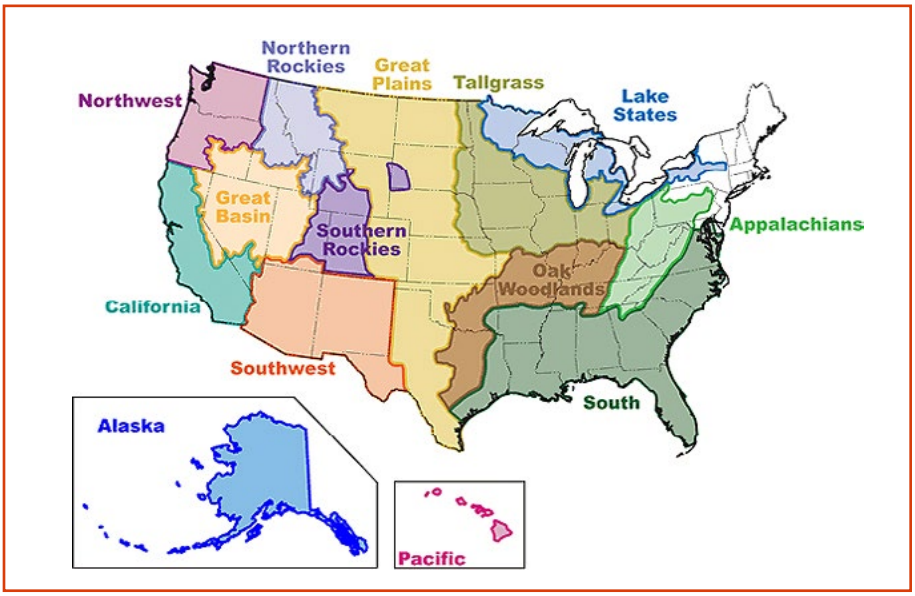

Figure 1—*The 14 Joint Fire Science Program Knowledge Exchange Consortia. Source: JFSP (2017).*

Rebecca Smith worked as a graduate research assistant at the School of Forestry, Northern Arizona University, Flagstaff, AZ; and Martha Lee is a professor in the School of Forestry, Northern Arizona University, Flagstaff, AZ.

The JFSP is effective as a knowledge broker because most survey respondents found its publications to be trustworthy, useful, easily accessible, and understandable.

Delivery methods include email, Twitter, blogs, Facebook, YouTube, and Vimeo.

The JFSP currently publishes the Fire Science Digest, eNews, and Synthesis of Knowledge. The Fire Science Digest, written by science writers, summarizes research on particular topics. The Digest has covered topics such as smoke, climate change, knowledge exchange, and new tools for planning. It is published several times a year and is available in print, online, and as an electronic publication for e-readers/tablets.

eNews is a biweekly newsletter that is emailed to subscribers and is available on the JFSP website. eNews notifies subscribers of new JFSP publications, funding opportunities, and current research.

The Synthesis of Knowledge covers one broad topic per issue, with chapters that contain information on specific subtopics. It is published periodically and is available online. Past topics have included fuels management, fire management, the wildland–urban interface, fire effects, and postfire treatments.

The JFSP no longer publishes Fire Science Brief, but past issues are available on the JFSP website. Fire Science Brief is a news story written by science writers who summarize research on a single topic. Each issue is about six pages long and highlights one to three scientists' research.

Survey of Fire Professionals and Researchers

We conducted a survey among fire professionals and researchers who belong to the 14 JFSP Knowledge Exchange Consortia to determine the effectiveness of the JFSP in distributing current and useful information. The consortia gave us contact information for fire professionals and researchers to be surveyed. In 2013, we used SurveyMonkey to conduct an online survey created and distributed in collaboration with the JFSP. The approximately 15-minute survey included multiple-choice questions and open-ended questions. We designed the survey to determine:

- Trust in each JFSP publication as a source of information: Respondents were asked to rate each publication on a scale ranging from –2 to 2, with –2 being "totally mistrust it" and 2 being "totally trust it."
- Usefulness of each publication: Did respondents learn anything new? Did the publication enhance their understanding of fire ecology and/or fire management? Was it relevant to their job? Did respondents use the information in day-to-day management decisions? The scale used ranged from 0 to 2, with 0 being "never" and 2 being "always."
- Understandability of the information presented in each publication: Respondents were asked to rate the technicality of the writing on a scale ranging from –2 to 2, with –2 being "too elementary" and 2 being "too technical."
- The ease of access to each publication: Respondents were asked to rate ease of access on a scale ranging from –2 to 2, with –2 being "very difficult to obtain" and 2 being "very easy to obtain."
- Comments about each publication: Respondents were asked to say what they found appealing and what they would change.

A web link to the survey was given to nine of the consortia to distribute through their list-serves. Three consortia provided us with email lists to send the web link to survey participants. Three consortia did not participate in the distribution of the survey web link. The survey link was sent to about 8,433 individuals. Individuals on multiple list-serves might have received more than one invitation to survey. The web link to the survey was also posted on the JFSP's Facebook page, blog, and Twitter account. We do not know how many people saw the invitation to take the survey in addition to the participants contacted, so we cannot calculate an overall response rate. A total of 494 respondents completed the survey.

Respondents represented a variety of age groups. Thirty-five percent of the 494 respondents were between the ages of 50 and 59 years of age, and 26 percent were between 40 and 49. Four percent of respondents were between 18 and 29 years of age.

Respondents were well educated, with a lot of experience as fire professionals or in fire science. About 52 percent held a graduate degree, 58 percent held a 4-year degree, and 10 percent held a degree of less than 4 years. About 65 percent had 11 or more years

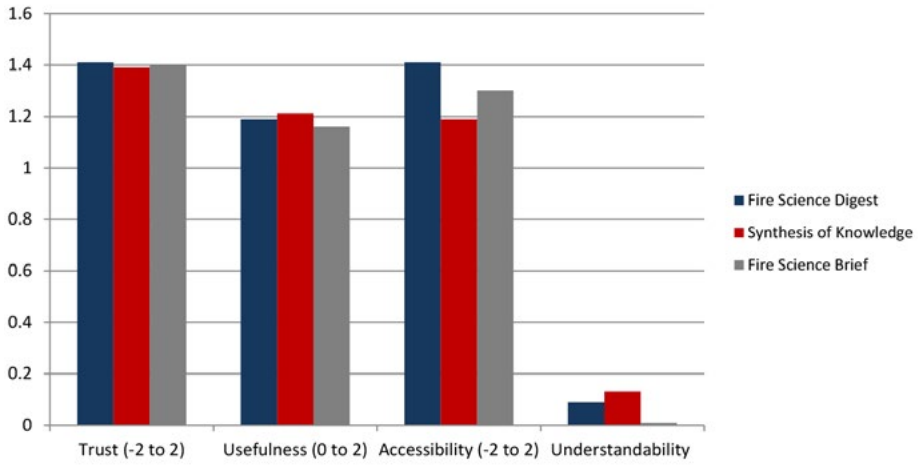

Figure 2—*Survey responses regarding the trustworthiness, accessibility, and understandability of Joint Fire Science Program publications were on a scale of –2 to 2. Survey responses for usefulness were on a scale of 0 to 2. For understandability, the mean score of almost 0 signified that the writing was just right (neither too elementary nor too technical).*

of experience in fire science or as a fire professional. Researchers made up the largest job category (24 percent), followed by fire managers (14 percent), staff and line officers (11 percent), and fuels planners/fuels managers (8 percent). The "other" category (35 percent) included silviculturists, wildlife biologists, field technicians, and foresters.

Survey Results

JFSP Publications as Information Sources

Participants indicated that all three JFSP publications contained trustworthy information. The mean trust level for all three publications was about the same (fig. 2). Most respondents said that they used the information some of the time but not all of the time. The Synthesis of Knowledge was considered to be slightly more useful than the Fire Science Digest and Fire Science Brief.

Participants found all three publications to be easily accessible, with the Fire Science Digest the easiest to obtain. The information presented in each publication was written at the right level; the information was neither too elementary nor too technical (fig. 2). The JFSP is effective as a knowledge broker because most survey respondents found its publications to be trustworthy, useful, easily accessible, and understandable.

What Respondents Liked

We asked respondents what one thing appealed to them about Fire Science Digest, Synthesis of Knowledge, and Fire Science Brief. Responses were similar. Respondents liked the fact that both Fire Science Digest and Fire Science Brief were short—quick and easy to read. They also liked the topics and information. The two publications have a similar purpose: to give brief summaries of research on a single topic.

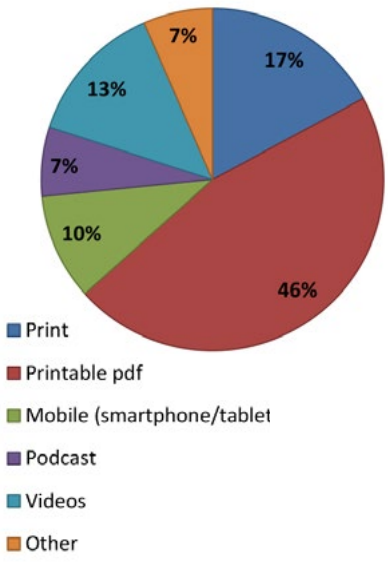

Figure 3—*Formats preferred by survey respondents for getting information on fire ecology and fire management.*

What most appealed to respondents about Synthesis of Knowledge was that it brings together a lot of information and resources into one place, is comprehensive, has relevant information, and contains current research and information. Synthesis of Knowledge appealed to respondents because its purpose is to provide indepth and comprehensive information about a single topic.

What Respondents Would Change

We asked respondents what one thing they would change about each JFSP publication. Three suggestions emerged:

1. Make it easier to find and access JFSP publications on the Internet,
2. Improve distribution to the field because it might be difficult for some employees to obtain a copy of a particular publication, and
3. Advertise a publication before it is made available to make individuals aware of an upcoming issue or topic that might be of interest.

Recommendations for Improving Information Dissemination

The JFSP uses a variety of methods to make its publications accessible, including the JFSP website and links on social media and emails. Our survey results suggested ways to improve and expand information dissemination to fire professionals.

The program might consider using the formats preferred by most survey respondents (fig. 3)—printable pdfs, print publications, and videos.

Survey respondents also preferred the more traditional delivery methods—such as print, email, and the JFSP website—to social media (fig. 4).

The JFSP could advertise an upcoming topic and/or publication on its website or through email and social media so that individuals know when and where to look it for it. The JFSP could also encourage those who receive notifications of new publications to let others know. In addition, publishing new publications in a consistent manner would make it easier to advertise them because readers would know when to expect them.

It is important for the JFSP to regularly evaluate whether readers still find its publications to be useful, trustworthy, easily accessible, and understandable and to know the preferred delivery methods and formats. As demographics and technology change, attitudes and preferences might change as well. The JFSP needs regular updates to assess its effectiveness as a knowledge broker and to find areas that need improvement. ■

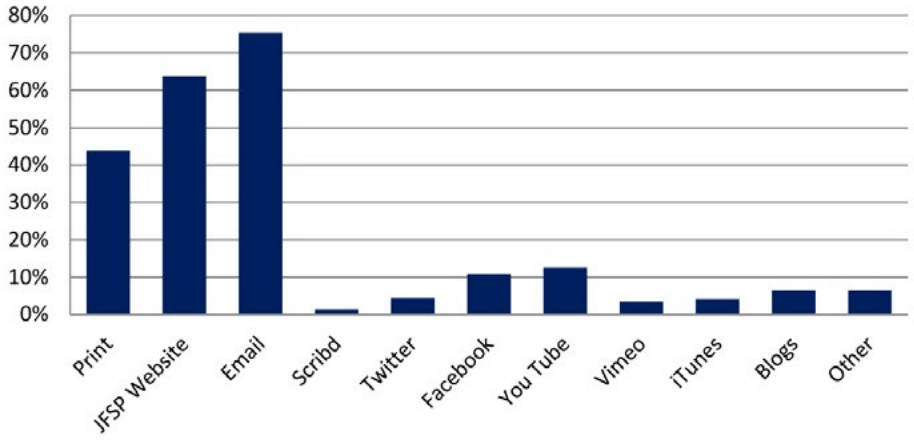

Figure 4—*Delivery methods preferred by survey respondents for getting information on fire management and fire ecology.*

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Grant Funding for Fire Districts Helps Start Their Engines

Greg Johnson

As the first responders to wildfires, local fire districts and departments need to be ready to battle fires with good equipment that helps protect lives and property in rural areas. One example is Stevens County Fire District #5.

This small fire district in Addy, WA, serves about 5,000 people over 75 square miles. The district runs five stations, all staffed by volunteers, with a structure engine, a brush truck, and a fire tender. About 40 percent of the district's calls are for wildfires.

Fire Tender Acquisition

The State of Washington's Firefighter Property Program gives fire districts like Stevens County Fire District #5 a cost-effective way of acquiring vehicles that can be converted into wildland firefighting equipment. With assistance from the Washington State Department of Natural Resources (DNR), Stevens County Fire District #5 was able to obtain a "new" fire tender through the Firefighter Property Program. A fire tender is an important piece of equipment used to transport water to a fire scene. Tenders can also draft water from a stream, lake, or hydrant.

Stevens County Fire District #5 was able to obtain a "new" fire tender through the Firefighter Property program.

This fire tender started out as a 1997 M–1090 military dumptruck. With a mileage of only 5,166 miles (8,266 km), it was picked up from Ft. Lewis Army Base by Stevens County Fire District #5. The dumptruck was converted into a wildfire tender with the help of fire district volunteers, a local auto parts and repair business, and a $49,800 fire district assistance grant from the DNR. A converted tender costs significantly less than a similarly built new tender.

Within days of completion, the tender was called into action. On August 26, 2016, it was used to help suppress a wildfire caused by a motor vehicle accident.

Fire District Assistance

The DNR's Fire District Assistance Program is the conduit for Washington fire districts and departments to participate in the Forest Service's Firefighter Property and Volunteer Fire Assistance Programs for grants as well as in State-funded fire district assistance

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An M–1090 military dumptruck (left) acquired by Stevens County Fire District #5 through the Washington State Department of Natural Resources Firefighter Property Program and converted into a water tender for wildland firefighting (right). Photo: Washington State Department of Natural Resources.

grants. These programs can reduce costs for taxpayers and improve local and State agencies' response to wildfires. Local fire districts and departments are able to obtain used excess military equipment and receive financial assistance to pay for its conversion to wildland fire use. Eligible fire districts can apply to DNR for assistance from these programs.

In 2016 alone, through the Firefighter Property Program, DNR obtained 25 vehicles for districts and departments across the State to help them get ready for firefighting. At a substantial cost savings, the vehicles were converted into engines and tenders for wildland fire use.

Fire districts that receive the vehicles are required to convert them and place them into service within 1 year. After the vehicle is in service for 1 year, the fire district takes ownership with full title. With this in mind, many fire districts in the State of Washington are using the Firefighter Property Program to convert their fleets from Federal Excess Personal Property equipment to Firefighter Property equipment.

Local fire districts and departments are able to obtain used excess military equipment and receive financial assistance to pay for its conversion to wildland fire use.

Two more funding opportunities are also available to fire districts. The federally funded Volunteer Fire Assistance grants and the State-funded fire district assistance grants provide critical funding for retrofitting firefighter property and other equipment, acquiring personal protective and general fire equipment, and assisting with fire prevention and fire training. These grants are open to all Washington fire districts and departments that deliver wildland fire protection to private, State, or Federal landowners; serve communities with less than 10,000 residents; and have a current agreement with the DNR.

The DNR's Fire District Assistance Program can help districts through some of their most difficult times, such as when they are newly formed, when they have annexed unprotected lands, and when they have unexpectedly lost equipment. Most vehicles acquired under this program can be converted in less than 6 months and for much less than it would cost to buy a new fire engine.

You can learn more about the programs at the Washington State DNR Fire District Assistance webpage (http://www.dnr.wa.gov/FireDistrictAssistance). ■

Fire Control and the 1953 Rattlesnake Fire

Hutch Brown

The Forest Service's wildland fire journal, *Fire Management Today*, has featured the same safety slogan since 1997. You can find it on page 2: "Public and firefighter safety is our first priority."

Early issues of the journal had a very different slogan. Every issue from 1936 to 1964—the year of the Wilderness Act—called for using "the technique of fire control" to help stop "the appalling wastage by fire."

The fire control slogan disappeared when the Forest Service and other land management agencies began exploring alternatives to fire control in the 1960s. The safety slogan took its place after the 1994 fire season, when 35 wildland firefighters perished, the most during a single fire season in 84 years.

In 1995, the National Wildfire Coordinating Group adopted an interagency wildland fire management policy for the five Federal land management agencies, with safety as its first guiding principle: "Firefighter and public safety is the first priority in every fire management activity" (USDI/USDA 1995). In the decades that followed, the Forest Service strengthened its focus on firefighter and employee safety. Under Chief Tom Tidwell, for example, safety became the first of five agencywide focus areas for the Forest Service (Tidwell 2012).

Could a change in the way decisions are made to suppress a wildfire result in fewer firefighter fatalities?

Rising Firefighter Fatalities

Yet wildland firefighter fatalities have persisted; indeed, their number has grown. From the 1970s to the 2000s, the number of wildland firefighter fatalities per decade rose from 90 to 193 (NIFC 2016a), an increase of 114 percent. By contrast, the average annual number of structure firefighter fatalities fell: the number of "on-duty firefighter deaths" for structure firefighters (not counting those who died on 9/11) decreased from 174 in 1978 to 68 in 2015, a decline of 61 percent (Fahy and others 2016). According to Guenthner (2014), wildland firefighters make up only about 5 percent of all "career firefighters" in the United States, yet they accounted for about 27 percent of all career firefighter fatalities from 1994 to 2013. Wildland firefighters seem to be at much greater risk than their counterparts in structure firefighting.

Burnovers are the leading cause of Federal firefighter fatalities (NIFC 2016b). Explanations for wildland firefighter entrapments leading to burnovers tend to focus on local conditions and tactical failures, such as changing weather conditions or a failure to give firefighters clear direction (see, for example, Safety Matters 2014). However, the single greatest common denominator for wildland firefighter fatalities, no matter what the proximate cause, is the presence of firefighters on a fire.

That begs a series of questions: Why do firefighters try to control a particular fire? What values are they protecting? Are the values worth the risk?

It might be worth exploring such questions in relation to past "tragedy fires"—wildland fires with firefighter fatalities. I hope to do so, starting with this issue, for several tragedy fires selected from hundreds (NIFC 2016a). Although hindsight is always twenty-twenty, in each case the question pertains: Could a change in the way decisions are made to suppress a wildland fire result in fewer firefighter fatalities?

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The only thing worth protecting in Powder House Canyon was the lives of the firefighters themselves.

A Desolate Canyon

In 1953, at about 2:30 p.m. on a hot July afternoon, an arsonist started a fire near the eastern boundary of the Mendocino National Forest in northern California, on the western edge of the Sacramento Valley. According to the accident investigation report, the fire began at a point along Alder Springs Road (Cliff and others 1953). The road follows Powder House Creek upslope onto the forest from the mouth of Powder House Canyon at the forest boundary (fig. 1, stand 1).

The fire was burning in the dry–mesic chaparral that grows in northern California in a band of vegetation at elevations just above the Sacramento Valley floor in the rain shadow of the Coastal Range (fig. 2). Such landscapes naturally burn every 50 to 75 years in stand replacement fires (MFSL 2012). At least 42 years old at the time of the fire (and possibly much older) (Cliff and others 1953), the dense chaparral in Powder House Canyon was coming due—was perhaps already overdue—for another severe wildland fire.

Winds from the east/southeast, normal in such canyons on July afternoons (Snook 1992), blew the fire upcanyon toward the west from its point of origin near Alder Springs Road (fig. 1, stand 2; Cliff and others 1953; WFLDP, n.d.). Firefighters appeared within an hour. Under

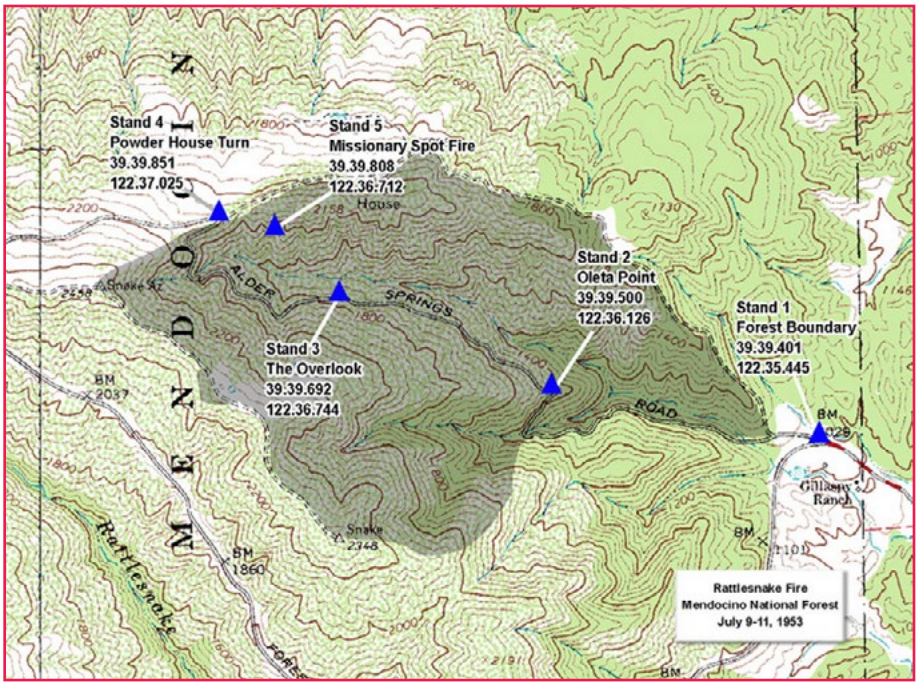

Figure 1—*Extent of the Rattlesnake Fire, July 9–11, 1953 (in gray). Triangles = five stops on the Rattlesnake Fire Staff Ride (a training exercise). Stand 1 = mouth of Powder House Canyon at the edge of the national forest; stand 2 = point of origin of the fire (Oleta Point) on Alder Springs Road; stand 3 = overlook of the fatality site; stand 4 = overlook of the area where the nighttime spot fires ignited, including the fatal one; stand 5 = approximate location of the Missionary Spot Fire. Source: Wildland Fire Leadership Development Program (n.d.).*

Figure 2—*Powder House Canyon, with dense chaparral and the Sacramento Valley in the distance. To this day, the canyon has no development other than a paved road. Source: Wildland Fire Leadership Development Program (n.d.).*

the direction of Forest Service "fire officers" (incident managers and crew bosses), the volunteer firefighters worked at first from the fire's point of origin, digging fireline along the fire's flanks. When the south flank of the fire escaped control, the fire officers gave up on direct attack and decided on an indirect approach.

Driving west up Alder Springs Road, the fire crews got well ahead of the fire and fought it indirectly by building firelines at the head of the canyon and burning out fuels downslope (fig. 1, stand 4). By about 8 p.m., they seemed to have succeeded. Fire activity had lessened, and the fire seemed to be contained within the canyon south of Alder Springs Road.

As temperatures dropped, the upcanyon winds calmed and shifted direction, as they often do on summer evenings in the area (Snook 1992). Turbulent winds drove embers from the fire upslope, starting a spot fire north of Alder Springs Road at about 8 p.m. (fig. 1, stand 5). After fire officers scouted the fire, they deployed 24 firefighters beginning at about 9 p.m. on what was dubbed the Missionary Spot Fire, which was slowly burning upslope. The firefighters soon had it under control.

> Suppressing the Rattlesnake Fire only postponed the inevitable: mature chaparral is extremely combustible, and sooner or later it will burn.

As nighttime temperatures continued to drop, the shifting winds created more turbulence. Shortly after 10 p.m., at least six more spot fires started near the head of the canyon, just below Alder Springs Road (fig. 1, stand 4). Firefighters soon suppressed most of them, but no one noticed one particular spot fire until too late (fig. 3).

At about 10:15 p.m., as the shifting nighttime winds started blowing downcanyon, the unseen spot fire, hidden in a hollow just above the road, sent a flaming front burning to the north and east toward the 24 firefighters on the Missionary Spot Fire (fig. 1, stand 5; fig. 3). A fire officer raced to their position and ordered them out. Nine firefighters escaped by retreating upslope to a firebreak at the top of the ridge (fig. 3).

The other 15 firefighters, including two fire officers, moved eastward along the slope, away from the Missionary Spot Fire (fig. 3; Cliff and others 1953; WFLDP, n.d.). They thought they were safe, not knowing that the main fire had shifted direction and was no longer burning upslope. Instead, driven by downcanyon winds, the flaming front had turned 180 degrees from its direction during the afternoon. Now it was coming straight east at the firefighters and moving much faster than they could through the dense chaparral.

The fire caught them within about 30 minutes, and all 15 firefighters perished. After the Griffith Park Fire in 1933, the Rattlesnake Fire was the worst tragedy fire in California history.

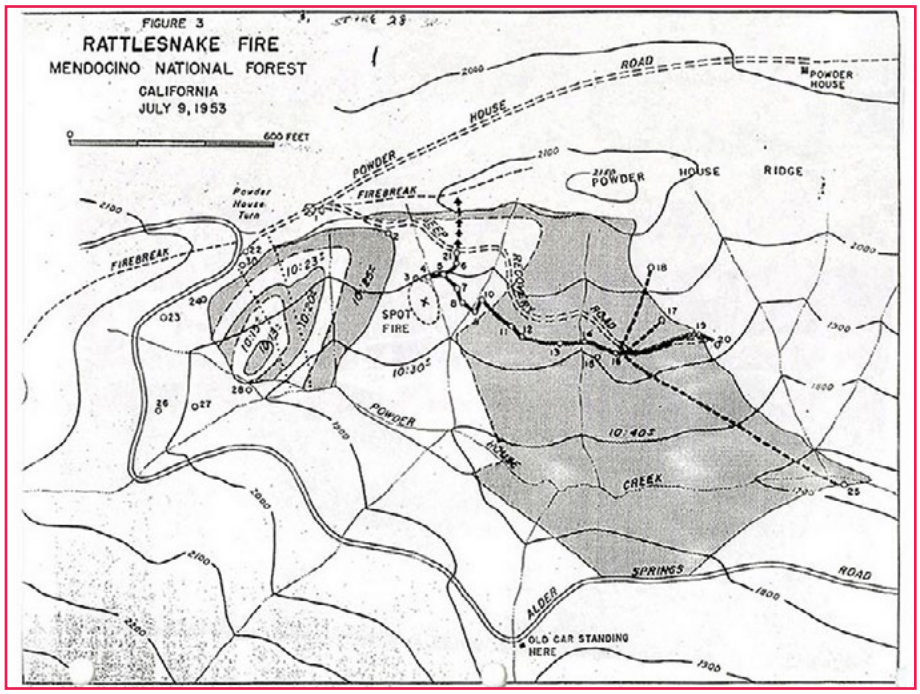

Figure 3—*Location of the Missionary Spot Fire (marked "SPOT FIRE") and the unseen fatal spot fire at about 10:13 p.m. below the sharp turn on Alder Springs Road (upper left, Powder House Turn). The fatal spot fire spread initially upslope toward the firebreak. Nine firefighters on the Missionary Spot Fire escaped uphill (line of arrows) to the firebreak. The other 15 firefighters fled east (solid black line), roughly parallel to the slope. Driven by nighttime downcanyon winds, the fire turned east to follow the firefighters, overrunning the Missionary Spot Fire by about 10:30 p.m. and catching the firefighters by about 10:40 p.m. Source: Wildland Fire Leadership Development Program (n.d.).*

The accident investigation report attributed the burnover mainly to "the action of the fire in changing its direction of travel and burning intensity," and it called on Forest Service researchers to develop "additional knowledge of fire-weather and fire-behavior" (Cliff and others 1953). Factors such as changing weather and fire behavior have appeared in subsequent studies as common denominators of tragedy fires (Safety Matters 2014; Sutton 2011; Wilson and Sorenson 1978). However, studies of common denominators often overlook the most fundamental common denominator of all: the decision to put firefighters on a particular fireground.

The accident investigation report for the Rattlesnake Fire never explained the decision. In presenting the "history of the Rattlesnake Fire," the report folded "discovery and initial action" into a single section, with initial attack on the fire immediately following its first reporting and without comment—as though it were a matter of course (Cliff and others 1953). Contemporary news reports echoed the same theme. "Here's the story," began one (Gleeson 1953). "The blaze broke out alongside the road about 2:30 o'clock yesterday afternoon. By 7 o'clock about 100 men were on the scene." The "blaze broke out," and so "men were on the scene"—as though it were all a matter of course.

Yet there was nothing in Powder House Canyon to protect, not even timber (fig. 2). No people, homes, or infrastructure (other than the road) were anywhere nearby. The fire ultimately burned a total of 1,200 acres (480 ha) of fire-adapted shrublands primed for burning on natural cycles that had lasted for thousands of years.

To be sure, the fire was human caused, but humans have been causing wildland fires, accidentally or not, for millennia, contributing to the evolution of fire-adapted ecosystems across North America (Pyne 1982). On the Rattlesnake Fire, fire managers worried mainly that the fire might burn into the next drainage (WFLDP, n.d.)—not because there was anything there to protect, either, but because it was "inaccessible" (roadless). In other words, suppressing the fire was an end in itself.

How did that come to be?

The Policy of Fire Control

The Forest Service was founded in 1905 by its first Chief, Gifford Pinchot, who served until 1910. His was arguably the single greatest legacy in the history of the Forest Service (Miller 2001; Pinchot 1947; Steen 1976; Williams 2000), and it was marked during his tenure as Forest Service Chief by a single-minded determination to control all fires—to exclude wildland fire from the Nation's forests (Pyne 1982, 2001, 2015).

Pinchot wrote the first set of field directives for the Forest Service, the so-called *Use Book* (Pinchot 1905). The "greatest single benefit" from the national forests, the *Use Book* avers, is "insurance against the destruction of property, timber resources, and water supply by fire." Forest Service line officers, according to the *Use Book*, have "no duty more important than protecting the reserves from forest fires."

In 1910, in an episode known as the Big Blowup, wildland fires burned about 1 million acres in the Northern Rockies, costing at least 92 lives and burning through countless homesteads and even into towns such as Wallace, ID. Trapped by firestorms in the mountains, 78 wildland firefighters gave their lives in service to the people whose lives and homes they were trying to protect. The tragedy shocked the Nation, and Pinchot barnstormed the country on behalf of the Forest Service, claiming that the agency could have stopped the fires with enough resources (Egan 2009; Pyne 2001).

As a result, Congress appropriated more funds for firefighting, and the Nation went to war against wildland fire. The aftermath of the Big Blowup of 1910 gave the Forest Service license to lead the way in fire control, and for the next 60 years, the agency enthusiastically embraced its leadership role, setting fire policy for the Nation.

In 1935, the Forest Service adopted a policy of putting out all fires by 10 a.m. on the morning after they were first reported. The 10 A.M. Policy seemed realistic at the time because the Federal agencies—and the Forest Service in particular—could draw on the Depression-era Civilian Conservation Corps, throwing legions of firefighters into the field. The watchword for the wildland fire community became, "Put 'em out, put 'em all out, put 'em all out fast!" (Tidwell and Brown 2010).

So in 1953, in accordance with the 10 A.M. Policy, wildland fire suppression was indeed a matter of course. The decision to suppress every wildland fire was automatic, and Cliff and others (1953) wasted no time in their accident investigation report explaining what firefighters were doing in Powder House Canyon. Focused instead on the effectiveness of fire control, they concluded with satisfaction that "the general

strategy, tactics, and generalship employed on the fire were in conformance with acceptable fire suppression principles."

Still, Cliff and others (1953) were appalled by the tragedy and deeply concerned about firefighter safety, and their report made safety-related recommendations still relevant today. Indeed, one recommendation—using the Rattlesnake Fire tragedy for training—anticipated the Rattlesnake Fire Staff Ride, a later training opportunity for fire managers (WFDLS, n.d.). Other recommendations helped to change the course of wildland fire management in the United States. Together with reports from other tragedy fires from 1937 to 1956, the accident investigation report for the Rattlesnake Fire led to adoption of the 10 Standard Fire Orders, a tremendous advance in safety for wildland firefighters.

Fatal Consequences

Yet every recommendation made by Cliff and others (1953) presumed the validity of fire control and the 10 A.M. Policy. After the disastrous wildfires of 1910, putting out all fires seemed a matter of course for the good of the Nation; firefighters simply needed to get smarter and safer about it. Until the 1960s–1970s, except for prescribed fires in places such as the pineries of the South, the Forest Service presumed that all wildland fires were bad for both people and the land, with the fire-free forests of northern Europe widely regarded as a model.

Such thinking reflected widespread ignorance of fire ecology during the era of official fire control (1905–1978). Indeed, one recommendation by Cliff and others (1953) was for "brushland management," a dubious proposition for chaparral (fig. 2), which cannot viably be thinned and needs periodic severe fires to thrive (Keeley 2003). Suppressing the Rattlesnake Fire, even had it gone entirely according to plan, would have only postponed the inevitable: mature chaparral is extremely combustible, and sooner or later it will burn in a stand-replacing fire—just like it did on that fateful California afternoon in 1953.

So why postpone the inevitable and potentially make fuel conditions even worse? The only thing worth protecting in Powder House Canyon was the lives of the firefighters themselves. And a reflexive policy of fire control deliberately put firefighters in harm's way. ■

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Fire Camp Overrun by Fire*

Region 3 RLS Team

The Turkey Fire on New Mexico's Gila National Forest was reported on June 5, 2016. The fire was burning in a wilderness area, and the local ranger district had decided not to suppress fires in the area but rather to use them for resource benefits. But the Forest Service typically monitors such fires to make sure they don't threaten anything of value.

> "When I saw him [the least experienced crew member] digging line around camp, I should have helped him, not stopped him."
>
> *–Incident Commander*

Deciding Where to Camp

On June 7, a three-person crew rode horses into the area to monitor the fire's growth and plan contingency actions. At about 3 p.m., the incident commander decided where to camp based on factors such as safety, logistics, and comfort. One of the driving considerations in choosing the camp location was water for the horses.

Another consideration was the location of the Turkey Fire itself. The fire had reached the western edges of two large green meadows that did not burn (fig. 1). The incident commander thought that if they camped across the meadows, on the far side of the fire, their campsite would be safe.

The campsite was just off a National Forest System trail in a small stand of ponderosa pines. The pines gave shade, and a nearby creek had water for the horses. The camp area had a light layer of needlecast on the ground.

As the crew set up camp, the least experienced crewmember began to dig line around camp as a precautionary measure. The incident commander, who had spent 17 years on the local hotshot crew, told him

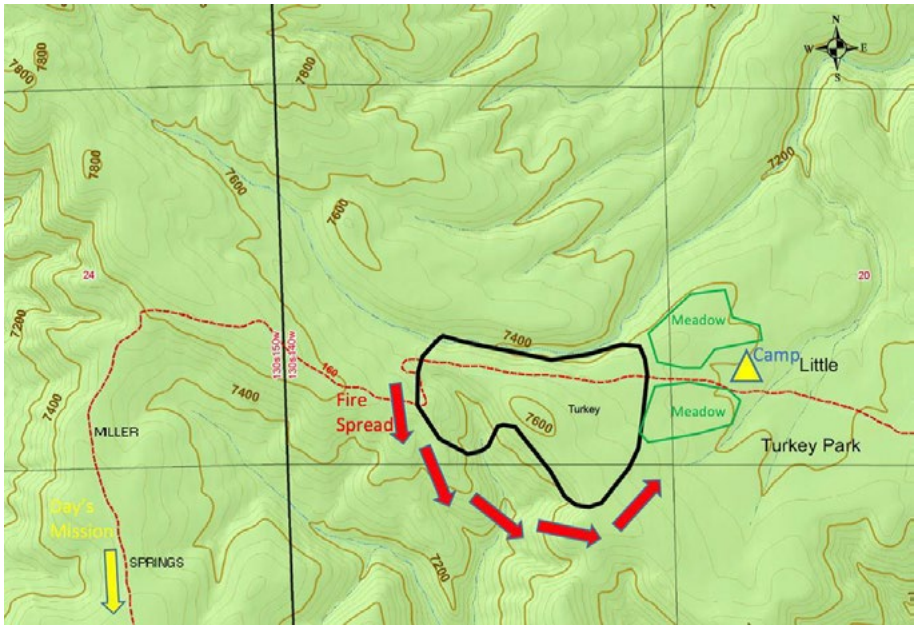

Figure 1—*Location of the Turkey Fire (inside black border), the firefighter campsite (yellow triangle), the meadow shielding it (inside green borders) and the firefighters' activity away from the fire (yellow arrow).*

The Region 3 RLS Team is a team for rapid lesson sharing in the Forest Service's Southwestern Region, Albuquerque, NM.

**The piece, published in 2016, is adapted from Rapid Lesson Sharing, a website maintained by the interagency Wildland Fire Lessons Learned Center.*

not to bother, explaining that the meadows would act as a firebreak.

On the morning of June 8, the crew mounted up and set out to size up a cabin in the area and create a protection plan in case the fire threatened it. The cabin was located along the same trail as the campsite, to the southwest.

As the crewmembers rode down the trail, they noticed that the fire had remained parked at the meadow edges (fig. 1). The only active piece of the fire was located along the fire's western edge. Therefore, the IC believed that the fire posed no threat to the camp.

Fire Pulls Off Big Surprise

The crew rode down the trail to the cabin and spent most of the day designing a detailed protection plan and compiling a list of supplies for carrying out the plan if the need arose. In midafternoon, they headed back up the trail toward camp.

As they approached the fire area, they saw that the fire's western edge had remained active and grown. The fire also appeared to have backed steadily to the south and then eastward underneath the area that had already burned (fig. 1). The incident commander was unconcerned because he had seen earlier that the meadows had stopped the fire, which he assumed had continued.

The fire had managed to find a narrow strip of needlecast that led across the green meadow grass into the camp area.

Figure 2—*The Turkey Fire spread into the firefighters' campsite under ponderosa pines. Photo: USDA Forest Service.*

But, as the group rode into camp, everyone's jaw dropped. Everything in camp had burned (fig. 2)!

The incident commander had been correct. The green meadows did not burn. But the fire had managed to find a narrow strip of needlecast maybe 6 inches (15 cm) wide. Coming from an oddly angled tree, the needlecast led across the green meadow grass into the camp area.

Lessons Learned

Put line around your camp. When choosing where to camp, consider being well away from the fire area, even if it's inconvenient. Remember how often we are surprised by what fire can do. ■

Fire Management today GUIDELINES FOR CONTRIBUTORS

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