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Being Prepared

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On the Cover:

A house inside of the Fourmile Canyon Fire near Boulder, CO, in the wildland-urban interface. The 7,000-acre fire claimed nearly 170 houses in the first days of the blaze. For several of the houses that were saved, the homeowners had properly prepared their land for the potential of wildfire, including building with fire-resistant materials, as well as preparing defensible, fuel-minimized spaces in the areas surrounding the structure. Photo by Matthew B. Slaby, National Interagency Fire Center.

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 Tom Harbour
Director, Fire and Aviation Management
Forest Service

Fire Doctrine—Where Has All the Fire Doctrine Gone?

Definition—Doctrine is the body of principles that sets the moral or ethical standard and forms the foundation of judgment, mode of action, decision, and behavior. It is authoritative but flexible, definitive enough to guide specific operation, yet adaptable enough to address diverse and varied situations. —Doctrine (<http://fsweb.wo.fs.fed.us/fire/fam/doctrine/index.htm>)

Today, I write this Anchor Point article with a heavy heart after the loss of the 19 Granite Mountain Interagency Hotshot Crew members on the Yarnell Hill Fire in Arizona—19 young men who did not return home on June 30, 2013, who will forever be missed, who paid the ultimate sacrifice in service to others. Our hearts go out to the families, friends, and co-workers of these brave men. We have and will continue to keep them in our thoughts and prayers; most importantly, we will never forget. We must learn from what happened and vow that, together, we will do everything possible to ensure an incident like this never happens again.

As we remember the Granite Mountain Interagency Hotshot Crew, I would ask each of you to reflect on the foundational doctrine that guides fire suppression in the Forest Service, beginning with the operational environment that states, "No resource or facility is worth the loss of human life; however, the wildland fire suppression environment is complex and possesses inherent hazards that can—even with reasonable mitigation—result in harm to firefighters engaged in fire suppression operations. In recognition of this fact, we are committed to the aggressive management of risk."

The original purpose of the Fire Suppression Doctrine, accepted by the agency in 2006, was to assist us in evolving operational doctrine to keep pace with change. Using the principles of a doctrine requires judgment in application, while adherence to rules does not. In combination, principles and rules guide our fundamental wildland fire suppression practices and behaviors and are mutually understood at every level of command. The agency's belief that doctrine will continue to assist us as we endeavor to work in this ever-changing, high-risk, and high-consequence wildland fire environment continues to be strong.

Today, our vision for Fire and Aviation Management has evolved to "safely and effectively extinguish fire, when needed; use fire where allowable; manage our natural resources; and as a Nation, live with wildland fire" (Wildland Fire Leadership Council 2010).

Doctrine establishes a particular way of thinking about fire suppression and our way of fire suppression, a philosophy for leading firefighters on the fireline, a mandate for professionalism, and a common language. Doctrinal development benefits from our collective experience and distills its lessons to further education and training.

Our doctrine within the Forest Service begins with the philosophy contained in our mission statement. This philosophy underlies publications that contain tactics, techniques, and procedures for specific functions. This body of thought helps form firefighters and fire suppression leaders through its implementation in education and training.

Principles of Risk Management

- Safety is the ability firefighters have to deal with risks or hazards to avoid damage or losses and yet still achieve the leader's intent.
- Risk management is a dynamic process exercised by everyone having fire suppression responsibilities or duties; it allows individuals to assess a given situation and take what they determine is the most appropriate course of action based on leaders' intent.
- The agency recognizes and accepts the inherent risks associated with fire suppression. Firefighters will depend on their doctrine, training, skilled experience, and leadership to mitigate those risks. Disregard for these recognized inherent risks and failure to practice risk management is unacceptable, regardless of whether or not it results in injury or death.
- Individuals will be held accountable for their decisions. Those decisions should be considered to be reasonable and prudent based on doctrine, training, and experience given the context of the situation.
- Mitigating the effects and managing fatigue of mind and body is a fire suppression leadership, as well as personal, responsibility.
- To promote a bias for action, firefighters are expected to maximize suppression opportunities while minimizing exposure to inherent risks.
- Organizational learning is crucial to risk management. Firefighters are students of fire and continually learn from all situations including successes, failures, agency safety investigations, and reviews. The agency fosters an atmosphere of willful communication. Therefore, it is critical that employee statements for agency safety investigations are treated as "confidential."
- Extensive formal and informal training is critical to risk management and mission accomplishment.
- Fire suppression leadership will ensure all employees with an incident qualifications card adhere to and maintain an appropriate level of physical fitness.
- Fire suppression leadership will recognize those firefighters practicing and promoting the use of risk management in the accomplishing of the agency mission.

To support this vision, five objectives have been defined and are essential for supporting the vision and will help move the agency forward in the future. They are:

- Transform our workforce into a more refined safety culture through risk management and risk reduction processes;
- Implement fire management programs to protect the ecology of National Forest System lands for multiple use;
- Enhance and improve collaboration and partnerships;
- Utilize science, research, and innovative practices to learn; and
- Empower employees in leadership, judgment, and decisionmaking.

These objectives, combined with the principles from the Fire Suppression Doctrine, help to create an organization guided by well-stated doctrinal principles that represent the reality of the work, the fire environment, and the mission.

Risk management is intrinsic to our success and to our goal that each and every firefighter returns home safely at the end of each shift. Risk management minimizes the exposure and effects of the inherent hazards in fire suppression while maximizing the opportunities to achieve mission objectives during fire suppression operations. Risk management includes communications and a process for situational awareness, hazard assessment, hazard control, decision point, and evaluation.

Reading and understanding the principles of risk management are the initial steps on the path to becoming more creative and deci-

We must learn from what happened on June 30, 2013, and vow that, together, we will do everything possible to ensure an incident like this never happens again.

What is most important is that we not forget these lessons, and we continue to strive for the day when, regardless of the hazards, each of us comes home safe and sound

sive leaders and firefighters. The primary way a firefighter becomes a fire leader is through training and education, both of which are firmly rooted in doctrine. Doctrine establishes the philosophy and practical framework for how we fight fire now and how we will fight fire into the future.

Education develops the understanding, creativity, judgment, and the background essential for effective fireline leadership.

Training follows doctrine and develops the tactical and technical proficiency that underlies all successful action. On-the-job training completes the picture by allowing individuals and groups to integrate their training and education, producing a whole that is greater than the sum of the parts. The lessons we learn from training and operational experience then modify the doctrine.

Doctrine establishes the fundamental beliefs of the Forest Service on the subject of fire suppression and how we practice our profession.

So, where has all the doctrine gone? Nowhere. It is here; it should be used every day regardless of whether your actions are taken on the fireline or in the course of your daily life.

We will undoubtedly learn lessons from the actions taken by the Granite Mountain Interagency Hotshot Crew on the evening of June 30, 2013. Learning, after all, is a major component of the doctrinal philosophy. What is most important is that we not forget these lessons, and we continue to strive for the day when, regardless of the hazards, each of us comes home safe and sound.

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Did You Know

The Forest Service has been working with USDA photographer David Kosling over the last few summers to capture videos and pictures of firefighters on the fireline. Kosling has taken hours of video on fires and has interviewed firefighters across the country. Kosling has put together a 2-minute trailer, available at <http://youtu.be/Xqk7zV6NUZ0>, for what is going to be a 5- to 8-minute video called "The Heart of a Firefighter." This short video will show the passion, drive, and dedication of the wildland firefighter. The video is expected to be out in 2014.

Fire Adapted Communities

Pam Leschak

Wildfires that threaten communities cost the Nation millions of dollars every year through suppression costs, structural losses, and economic and natural resource damage; they also put property owners and firefighters in danger.

There are no indications that development in the wildland-urban interface (WUI) will abate; in fact, trends indicate that retiring baby boomers may increase development in high wildfire-risk areas. Fire authorities must deal with that increasing development and the ever-rising cost of protecting structures. The risk from wildfire greatly decreases, however, if communities are prepared or adapted to accept fire as a natural part of the larger environmental landscape.

A fire adapted community could be defined as a knowledgeable and engaged community in which the awareness and actions of residents regarding infrastructure, buildings, landscaping, and the surrounding ecosystem lessens the need for extensive protection actions and enables the community to safely accept fire as a part of the surrounding landscape. The process is a pro-active approach that concentrates on prefire strategy and action to reduce risks, and thus costs, rather than relying on suppression activities alone to protect communities after a wildfire starts."

Pam Leschak is manager of the Forest Service's national Fire Adapted Communities Program in Washington, DC.

Fire Adapted Communities is not a new program; rather, it is a new strategy, and it represents the desired end state for communities at risk.
<http://www.fireadapted.org>

Fire Adapted Communities (FAC) is not a new program; rather, it is a new strategy, and it represents the desired end state for communities at risk. This is a holistic approach to mitigation rather than a piecemeal one; see the basic elements in the FAC graph (figure 1).

The FAC strategy combines tools available to address WUI fire issues with strong multijurisdictional collaborative partnerships. The tools make the partnerships stronger, and the partnerships make the tools more effective. These tools do not belong to one authority but rather to all jurisdictions and partners in the WUI; the tools are beneficial only if implementation is shared by all.

For example, a Firewise community may not achieve adequate risk reduction if the fuels near the community are not treated by the jurisdictions with the authority to do so. Conversely, fuels treatments on public property around at-risk communities will be of limited value if private property owners do not create defensible space or use fire-resistant building materials.

Think of the FAC approach as an umbrella under which exist the

Figure 1.—*Conceptual framework for evaluating potential cost impacts of fuel treatments.*

Fuels treatments on public property around at-risk communities will be of limited value if private property owners do not create defensible space or use fire-resistant building materials.

mitigation tools, programs, collaborative partnerships, and "elbow grease" needed to reduce wildfire risks to communities. Partners at every level join forces to use existing and new mitigation and prevention tools to create FAC—thereby reducing risk, loss, and costs. And, partners at all levels help to educate the at-risk public about the value of adapting to wildfire.

Key to spreading the FAC message and tools is the FAC Coalition, which is a group of some of the Nation's leading mitigation organizations who are dedicated to reducing wildfire risk by helping communities adapt to wildfire. FAC Coalition members are:

- International Association of Fire Chiefs,
- The Nature Conservancy,
- Insurance Institute for Business and Home Safety,
- U.S. Fire Administration,
- Forest Service,
- National Volunteer Fire Council,
- National Association of State Foresters,
- National Wildfire Coordinating Group Wildland Urban Interface Mitigation Committee,
- National Fire Protection Association, and
- The U.S. Department of the Interior.

The fire adapted communities effort grew out of the 2005 and 2009 Quadrennial Fire Reviews (QFRs) (<http://www.nifc.gov/policies/pol_ref_QFR.html>). The 2009 QFR said "As some ecosystems must adapt to a fire-prone environment in order to survive, so must human communities in the interface, if they are to survive over the long term." (QFR 2009, p. 21). The concept of adapting communities to coexist with wildfire was reinforced by the National Cohesive Wildfire Management Strategy (p. 1, para. 2), which supports creating fire adapted communities as one of the three elements of wildfire management, along with landscape restoration and response.

The articles in this issue of *Fire Management Today* illustrate how partners working collaboratively can accomplish more together than they can separately; indeed, that's one of the keys to adapting communities to wildfire—working together for the greater good. The whole is greater than the sum of its parts.

I hope you enjoy reading about the FAC approach and what we and our national, State, and local partners are doing to reduce risk. For more information, please visit <http://www.fireadapted.org>.

Forest Service-related Fire Adapted Communities logo.

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Proactive Protection: A Community-Wide Approach To Wildfire Preparedness

Molly Mowery and Cathy Prudhomme

Every year, wildfires burn across the United States; today, more and more people are living where wildfires are a real threat. An estimated 72,000 communities are located in wildfire-prone areas (See the National Association of State Foresters Communities at Risk Report, FY 2012 at <http://www.stateforesters.org/sites/default/files/publication-documents/FY2012_CAR-report.pdf>). Wildfires do not recognize property or jurisdictional boundaries, and everyone in a community is directly or indirectly affected when a wildfire strikes. Nonetheless, fire is a natural part of the environment, so when people choose to live in an area where wildfires occur, adaptations must be made in the way a community plans, designs, builds, and views its surroundings to proactively reduce the risks and protect residents.

Each member of a community can help prepare and protect against the threat of wildfire. From homeowner to land manager, business owner, and firefighter, everyone has a vital role. When communities embrace their individual roles, they increase their resiliency and become fire adapted. Taking steps well in advance of a fire can minimize damage to homes and property; increase public safety; protect infrastructure and businesses; reduce recovery costs and time; and help preserve tourism, recreational opportunities, and the local economy.

Each member of a community can help prepare and protect against the threat of wildfire.

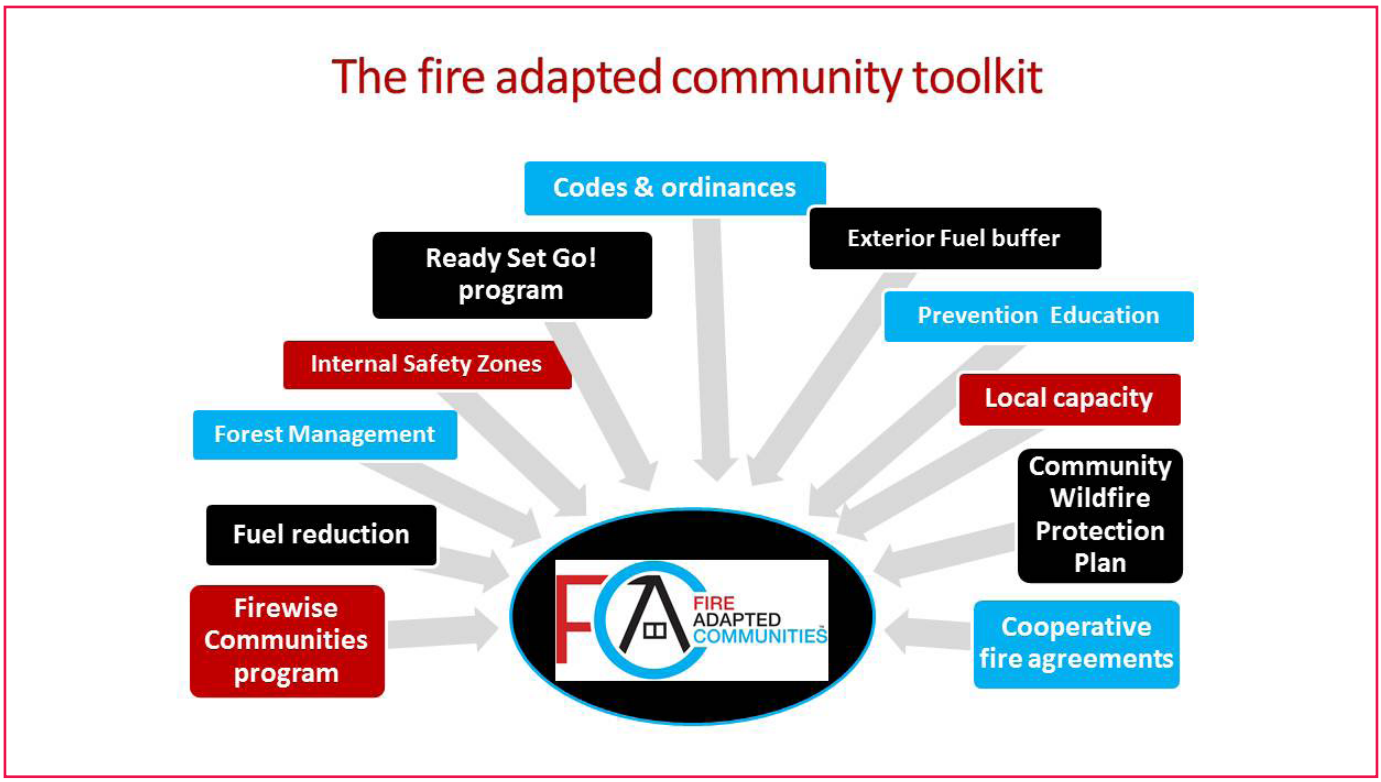
Being Fire Adapted

A fire adapted community accepts wildfire as part of the natural landscape and takes responsibility for its risk. Community members understand the risk and have proactively implemented collaborative mitigation actions to successfully survive fire. Those actions address resident and home safety, neighborhoods, businesses, infrastructure, forests, parks, open space, and other community assets. Doing so reduces risk, damage, and costs.

The more work a community does, the more fire adapted it becomes, since multiple activities have a greater overall impact than one single program or effort. Preparedness actions taken before a wildfire can reduce heavy reliance on fire suppression when a wildfire threatens community assets. Community preparedness examples include:

- Homeowners have homes built or retrofitted with ignition-resistant materials and landscaped using Firewise principles;
- Community members use codes and ordinances to determine where and how structures are built;
- Community members manage forests, trees, and brush to reduce hazardous fuels in surrounding landscapes;
- Local fire departments participate in the Ready, Set, Go! program;
- Neighborhoods participate in the Firewise Communities/USA Recognition Program;
- The community has an active community wildfire protection plan(s);
- Community members have taken actions to protect critical infrastructure;
- Landowners have implemented landscape-scale fuel treatments;
- Where applicable, community members have created and maintained a fire break around the community;
- Community officials have developed evacuation plans;
- Residents know and are prepared with individual emergency plans;
- Residents are informed on the community's emergency notification system, and where applicable, have registered to receive alerts; and
- The community has a safety zone for residents when safe evacuation is not a viable option.

Molly Mowery was the National Fire Protection Association's Fire Adapted Communities program manager and is now part of the Fire Adapted Communities Learning Network Coordination Team. Cathy Prudhomme is the National Fire Protection Association's Fire Adapted Communities assistant program manager.



Fire Adapted Community Toolkit. Graphic courtesy of the National Fire Protection Association.

The fire adapted community approach requires collaboration and coordination among members of a community and ensures nontraditional stakeholders are included in the process. For example, planners and developers can work to create fire adapted cities and neighborhoods; land managers and utility companies can protect public lands and infrastructures by incorporating science-based mitigation principles; and insurance companies may reduce future wildfire-related insurance claims by educating homeowners on Firewise principles and providing incentives for policy holders completing the work.

By providing education about Firewise concepts, community officials help residents take an active role in protecting their homes; furthermore, emergency responders can more efficiently and effectively defend homes and businesses that have implemented mitigation concepts. Community leaders need to support volunteer organizations involved in wildfire mitigation efforts and, when possible, dedicate material and financial resources to their mitigation efforts.

Resources for Fire Adapted Communities

For members of a community who are ready to act, a wide range of organizations and resources can assist in addressing specific mitigation needs. Since the term "fire adapted communities" was originated in the Quadrennial Fire Review (June 30, 2005, p. 26), it has evolved into a powerful national concept and outreach effort. The National Fire Protection Association (NFPA) is working with the Forest Service on implementing a Fire Adapted Communities program that provides resources for national audiences. These resources include the development and launch of a Fire Adapted Communities Web site (<http://www.fireadapted.org/>), a Fire Adapted Communities program brochure, the development of a lessons-learned video from the Colorado Springs Waldo Canyon Fire, and outreach to a variety of national audiences to promote the fire adapted community concepts.

NFPA also participates in the Fire Adapted Communities Coalition, which consists of national leaders in wildfire education, planning, and preparedness. Other coalition members are the Forest Service, the U.S. Department of the Interior, the Insurance Institute for Business and Home Safety, the International Association of Fire Chiefs, the National Association of State Foresters, the National Volunteer Fire Council, The Nature Conservancy, the U.S. Fire Administration, and the National Wildfire Coordinating Group Wildland-Urban Interface Mitigation Committee.

A fire adapted community accepts wildfire as part of the natural landscape and takes responsibility for its risk.

Each coalition member is committed to helping communities in the wildland-urban interface adapt to living with wildfire and reduce their risk for damage or loss without compromising firefighter or civilian safety. Each coalition member also plays a key role in connecting unique audiences to resources, while delivering a consistent message on wildfire preparedness. For example, the Ready, Set, Go! and Firewise Communities programs have incorporated the broader concepts of fire adapted communities within their messaging to help audiences understand the benefits of a holistic approach to community mitigation.

Other coalition efforts include the Forest Service's recent partnership with the Watershed Research and Training Center and the Fire Learning Network to establish a pilot Fire Adapted Communities Learning Network in eight hub communities—Santa Fe County, NM; Tahoe Basin NV/CA; Towns County, GA; Mid-Klamath, CA; Leavenworth, WA; Rogue Basin, OR; Ely, MN; and Woodland Park, CO. Hub organization leaders will convene and facilitate workshops and peer learning exchanges with other public and private community-based institutions and partnerships working on fire adaptation in their respective locations. They will convene national workshops, aggregate learning, and provide input and feedback that will help in adapting programs and strategies. The collaborative effort will promote collaboration among local, State, tribal, and Federal partners at the community level.

As coalition members continue to collaborate and share resources, the consistency of the fire adapted community message and concepts are magnified.

A Fire Adapted Community Example

Becoming a fire adapted community is a process that occurs over time. Each community is unique and chooses the most appropriate direction to address its risk. Some communities take a voluntary approach rather than implement codes or requirements; others prefer regulation and enforcement. Many tools and programs are available, and a community should customize and determine its own path to success.

A great example of a community that is working toward becoming more fire adapted is Rapid City, SD. Community members have been working on a "Survivable Space Initiative" since 2011 and have completed 105 fuel reduction projects located on individual properties. That geographical area covers more than 300 acres within the city, on properties valued at more than $36 million. The city is on pace to have similar accomplishments again this year. Two of its communities gained Firewise Communities/USA status last year, and two more are currently working toward the same goal. A new Firewise Demonstration Landscape was built in cooperation with South Dakota Game and Fish, Rapid City Fire, South Dakota Wildland Fire Suppression, Great Plains Fire Safe Council, and nine private business organizations.

Rapid City recently approved a new wildland-urban management plan and increased its budget to just over $300,000. The program manages fire mitigation and the mountain pine beetle on lands within the city, and it offers a 50-percent cost-share to homeowners for work on private property.

A recent Bureau of Land Management grant will fund hiring veterans for a program aimed at training for future employment. The veterans will help Rapid City with wildfire mitigation in areas that border neighborhoods at risk in the wildland-urban interface and, at the same time, they'll receive training in firefighting, forestry, Emergency Medical Service, and other public service disciplines.

Two new city ordinances are being considered that will provide guidelines for fuel management and exterior building products in the primary wildland-urban interface hazard zones.

For more examples, resources, and information, visit <http://www.fireadapted.org>.

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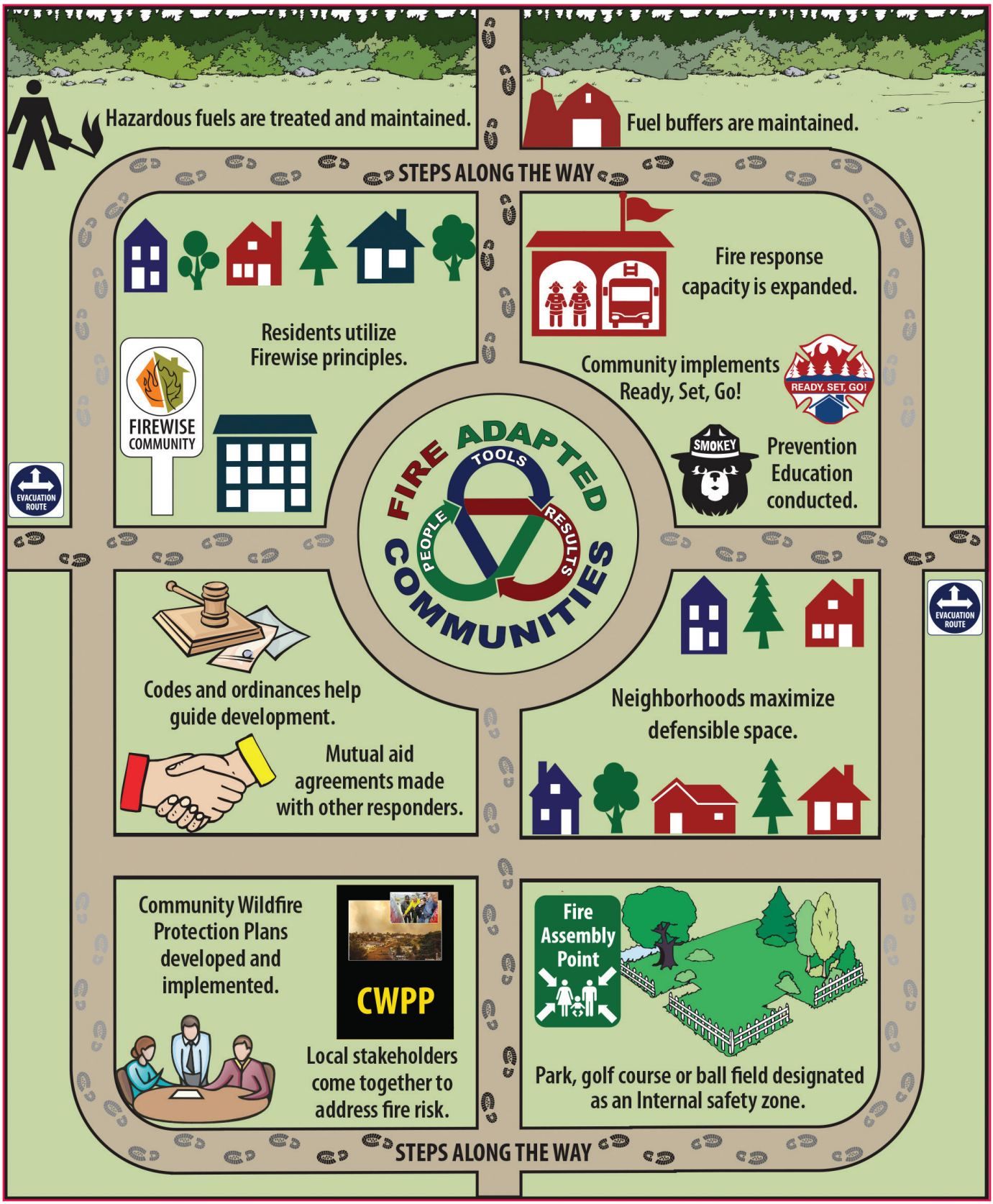

A sample "roadmap" to serve as a guide to help communities become adapted to fire.

Setting the Stage: The Role of a Fire Department in a Fire Adapted Community

Lucian Deaton

Whether you are at the town, county, or regional level, identifying and bringing together the proper players in wildland-fire preparedness can be a challenge. Each player has an important role in preparedness, and each brings both benefits and unique challenges to the local discussion.

A goal of the National Cohesive Wildland Fire Management Strategy is the creation of fire adapted communities, in which human communities are composed of informed and prepared citizens who collaboratively plan and take action to safely co-exist with wildland fire. In this vision, local fire departments play an integral role in their communities because the public's perception of response to fire is associated with their great service.

The national Ready, Set, Go! (RSG!) program, managed by the International Association of Fire Chiefs (IAFC), seeks to be a bridge to that goal. Whether fires are called wildland fires, grass fires, forest fires, outdoor fires, or brush fires, their threat to residents and resources remains the same. Engaging in a fire-preparedness dialogue is particularly important for the fire departments because national studies have shown that firefighters are uniquely respected in their communities and can project a trusted voice to the public-preparedness appeal.

The RSG! program develops and improves the dialogue on wildland fire between fire departments and the residents they serve. The program helps fire departments teach individuals who live in high-risk wildfire areas—and in the wildland-urban-interface—how to best prepare themselves and their properties against wildland fire threats. With more than 800 department members, the program works in a complementary and collaborative fashion with existing wildland fire public education efforts and amplifies their messages to individuals to better achieve the common goal of fire adapted communities. The RSG! program principles help residents be Ready with preparedness understanding, be Set with situational awareness when fire threatens, and be prepared to Go, acting early when a fire starts.

Importantly, the RSG! program also helps build partnerships between local fire departments and State forestry agencies. The program helps to frame the wildland message to the fire departments' audience and explains the role they can play in this collective effort. RSG! program fire departments serve as a link to affected residents and offer another advocate at the local level for State forestry outreach efforts.

While some fire departments are closely involved with prefire activities, other departments are facing this threat for the first time as the wildland-urban interface grows and local demographics change. If a fire adapted community is to develop, the connection between fire and forestry must be established and sustained.

Whether fires are called wildland fires, grass fires, forest fires, outdoor fires, or brush fires, their threat to residents and resources remains the same.

In helping to explain the role of a fire department in a fire adapted community, The RSG! program has fostered numerous local successes of fire departments and local outreach agency groups by engaging with residents on wildland fire preparedness and acting as the new voice for the forestry aspect of fire preparedness.

A recent example is from the Colorado State University Extension in Summit County, which has

Lucian Deaton was the International Association of Fire Chiefs Ready, Set, Go! program manager in Fairfax, VA, and is currently the senior program manager of the National Fire Protection Association in Denver, CO.

been actively involved in RSG! outreach efforts since 2011. Colorado State University Extension Natural Resources Agent and County Director Dan Schroder heads up the RSG! program and other wildland fire preparedness programs for the county.

Schroder's primary role is staff-level director of the Summit County Wildfire Council, which consists of an appointed representative of each of five towns within the county, a fire chief from each of the county's three fire districts, and four appointed citizens from each of the respective river basins.

Director Schroder has made it a point to embed the Ready, Set, Go! Campaign into local conversations. Schroder uses radio spots, newspaper ads, local media, and movie theaters to advertise citizen preparedness. In addition to fairs and events in past years, Summit County held a free RSG! workshop on June 1, 2013, to inform citizens about ember awareness, communication and evacuation considerations, and firefighter response, in hopes that community members will take steps "toward becoming a partner in the wildland fire solution."

The Town of Breckenridge, CO, recently passed an ordinance to charge consumers 10 cents per plastic bag used at retail stores. Director Schroder saw this regulation as a great opportunity to market Summit County's wildland fire preparedness and the RSG! program. In return for a completed preparedness survey, a resident will receive a free cloth bag adorned with the Summit County RSG! logo and "alert" Web site (<http://scalert.org/index.php?CCheck=1>), which urges people to register to receive emergency alerts and updates via text and email. During his various community events, Schroder also offers other promotional and educational items, such as stickers, magnets, and RSG! action guides.

Schroder has also partnered with county libraries to organize a countywide bookclub, One County One Book, which prompts people to read selections about community response to emergency, such as *The Big Burn: Teddy Roosevelt and the Fire That Saved America (Egan 2009) and Blue Revolution: Unmaking America's Water Crisis (Barnett 2012)*. He also led a Summit County Forestry field hike, which highlighted forest health and management efforts in order to expand the public's knowledge of the Forest Service's wildland fire management process.

> The Ready, Set, Go! program develops and improves the dialogue on wildland fire between fire departments and the residents they serve.

The RSG! program also sees use of its national action guide—and various localized versions—by fire departments and agencies who work to connect the issue of wildland fire preparedness with the residents they serve. Most recently, in spring 2013, the program saw departments using RSG! program resources for targeting community outreach meeting through public service announcements on local radio stations, in newspapers, and across social media; as handouts at State fire schools; as teaching tools at county fire marshal-sponsored public education events; at workshops sponsored by local law enforcement agencies and schools; and at local homeowner association and community meetings as the fire season unfolded.

Setting the stage for a fire adapted community requires essential local partnership building for success. The role of a fire department in this effort is important. The RSG! program seeks to define that role, enable fire departments to effectively promote the common message of wildland fire preparedness, and provide the tools to ensure a positive impact.

To learn more about the program, or how fire departments can help promote your wildland fire message, visit the RSG! Web site at <http://www.wildlandfireRSG.org.>

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How the Insurance Institute for Business and Home Safety Is Working With Its Partners To Advance the Creation of Fire Adapted Communities

Insurance Institute for Business and Home Safety staff

Whether conducting building science to investigate best practices, developing educational materials, or bringing together insurers and firefighters, the Insurance Institute for Business and Home Safety (IBHS) has long been committed to creating fire adapted communities.

Embracing the fire adapted communities (FAC) concept when it emerged in 2011 was a natural fit for the IBHS, which fully supported the creation of the FAC Coalition as another way to create what IBHS calls surround sound for wildfire preparedness best practices. When home and business owners hear the same message echoed by many different credible sources, they start to pay attention. Since then, IBHS has been an active partner in the FAC Coalition, in addition to lending financial and other support for specific projects such as the Ready, Set, Go! program.

Introduction to Fire Adapted Communities

One of the institute's first hands-on introductions to the concepts behind fire adapted communities came in 2007, when it conducted post-disaster wildfire research in San Diego County, CA. The research focused on the Witch Creek Wildfire, which damaged and destroyed more than 1,700 homes and resulted in the loss of $1 billion worth of insured property.

IBHS evaluated nearly 3,000 homes to determine why some survived and others did not, despite similar wildfire conditions. It also analyzed meteorological conditions, vegetation and topography, building characteristics, and social attitudes.

The IBHS published *Mega Fires: The Case for Mitigation* in 2008 (<http://www.disastersafety.org/wp-content/uploads/wildfire_mega-fires_full.pdf>). The report took a hard look at the factors that contributed to the Witch Creek Wildfire damage and, specifically, at how the fire affected six southern California communities.

The performance of homes in three traditionally built communities and that of three master planned communities, employing the concept known as "shelter-in-place," was examined. The shelter-in-place communities performed much better with significantly fewer home losses.

Nearly 6 years after the Witch Creek Wildfire, many of the concepts used in the shelter-in-place communities and most of the IBHS recommendations that are outlined in the report are considered best practices as part of the FAC initiative.

IBHS' involvement with the Witch Creek Wildfire was just the beginning of its commitment to the concept of building fire adapted communities. In 2008, the institute hosted the first of three summits, bringing together representatives of property and casualty insurers and wildfire organizations, including the National Fire Protection Association (NFPA), the International Association of

The performance of homes in three traditionally built communities and that of three master planned communities, employing the concept known as "shelter-in-place," was examined. The shelter-in-place communities performed much better with significantly fewer home losses.

Fire Chiefs (IAFC), and the Forest Service, as well as fire marshals, fire chiefs, and wildfire researchers. The primary goal of the first gathering was to identify gaps in wildfire research that could be addressed at the IBHS Research Center in South Carolina. The second summit was focused on developing strategies to address the wildfire hazard; the third, which was co-hosted by IBHS and IAFC, focused on improving collaborative efforts between insurers and wildfire organizations to help residents and businesses in wildfire prone areas learn what they can do to better withstand wildfires.

Information offered by FAC includes nine regional wildfire retrofit guides developed by IBHS that provide geographically specific strategies and instructions for home and business owners to make their property more resistant to wildfire. The retrofit guides are supplemented by an IBHS wildfire risk assessment tool and wildfire checklists with a cost estimator to help home and business owners prioritize projects.

Advancing Fire Adapted Communities Concepts

In 2011, IBHS researchers and Federal partners at the Forest Service; U.S. Department of Homeland Security; and U.S. Department of Energy, Savannah River National Laboratory took a huge step forward in wildfire research. Together, they created the world's first indoor, full-scale ember storm at the IBHS' Research Center.

Dr. Stephen Quarles, IBHS senior scientist and wildfire expert, designed the 2011 research project to provide lessons on how easily some commonly used materials and combustible items near or on houses can ignite from embers, and what homeowners can do to better protect their homes from the threat of ember showers. More wildfire related research focusing on ember intrusion via vents and other key mitigation issues began at the IBHS lab in fall 2013.

In July 2012, IBHS was presented with another opportunity to study the effects of wildfire in the field as part of the FAC Coalition.

The *IBHS Guide to Creating a Fire Adapted Home*, which was created for the Colorado public workshops, has since been made available to the public at <http://www.disastersafety.org/wildfire>.

Through an invitation from the Forest Service, IBHS joined several other FAC Coalition partners in Colorado Springs after the Waldo Canyon Wildfire. By the time the Waldo Canyon blaze was 100 percent contained on July 10, 2012, it had destroyed nearly 350 homes, scorched more than 18,000 acres of land, and displaced some 30,000 people.

The post-fire environment presented the first opportunity for FAC partners to collectively evaluate the performance of mitigation practices and to compare the results to the mitigation strategy recommended by the FAC program.

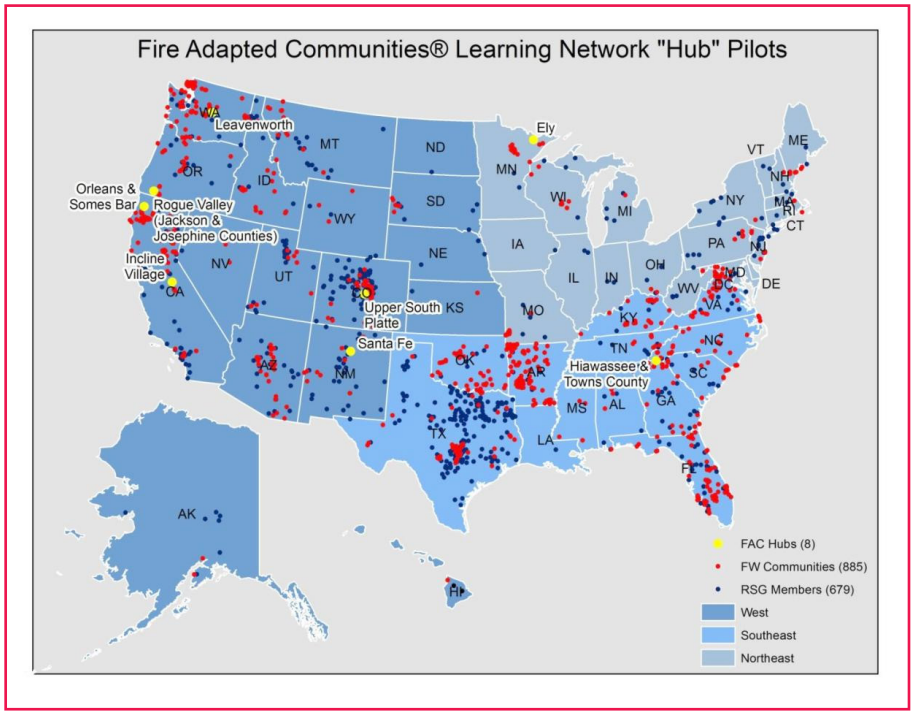
Colorado Rebuilds: Fire Adapted Communities

In September 2012, IBHS launched Colorado Rebuilds: Fire Adapted Communities in partnership with Lowes Home Improvement stores, the IAFC, Colorado State Fire Chiefs, NFPA, Forest Service, Colorado State Forest Service, Colorado Division of Fire Prevention and Control, and dozens of other national, local, and State partners. The united effort was intended to help the State recover, rebuild, and repair after the Waldo Canyon and High Park Fires, which were considered the worst in Colorado history.

The project included community wildfire preparedness workshops at Lowes Home Improvement stores over the course of 3 days in three strategic locations that had recently experienced wildfire: Fort Collins, Littleton, and Colorado Springs.

The workshops were hands-on events where residents could get fire-risk reduction tools (such as information about effective building material choices) and learn how to prepare for wildfire season. Dr. Quarles spoke at the workshops, along with fire landscape specialist Keith Worley. The events included displays showing risks posed by roofs, windows, siding, decks, and landscaping, as well as instruction for reducing these risks.

In response to demand for more workshops, IBHS partnered with the IAFC and the Colorado State Fire Chiefs to conduct training for Colorado firefighters in February 2013. The training addressed the most vulnerable parts of a home



"The Nature Conservancy (TNC), The Watershed Training Center (TWTC), the National Fire Protection Association (NFPA) and the International Association of Fire Chiefs (IAFC) (all members of the Fire Adapted Communities Coalition) work with the U.S. Forest Service through cooperative agreements to support projects on the ground that help residents and communities adapt to wildfire by reducing risk. This map shows the locations of current FAC Learning Network pilots (driven by TNC and TWTC); Firewise Communities (a program of NFPA) and Ready, Set, Go! Fire Departments (an IAFC program ."

during a wildfire and presented mitigation solutions. The session was videotaped and a five-module training series is in production by the Fire and Aviation Management Staff of the Forest Service in Boulder, CO. The training modules will be housed on the Ready, Set, Go! Web site and made available to firefighters at no cost.

The goal is to give firefighters information that they could share with homeowners during a visit to a home or if a resident came to the fire station.

The response has been positive, and IBHS has worked with several Colorado fire departments since the initial training session to support their local workshops, including producing public service announcements that are airing in local movie theaters using video from the ember storm testing at IBHS' Research Center.

In March 2013, the FAC Coalition released the findings of the Waldo Canyon post-disaster field assessment in the report, *Lessons from Waldo Canyon* <http://www.fireadapted.org/~/media/Fire%20Adapted/Images/News%20Images/Waldo-Canyon-Rpt-FINAL-shrunk%203.pdf>. A companion video produced by NFPA also was released, *Creating Fire Adapted Communities: A Case Study from Colorado Springs and the Waldo Canyon Fire* (<http://www.youtube.com/watch?v=4p9VYKoq3qE&feature=youtu.be>), which focuses on the successful loss prevention efforts in Colorado Springs that could help other wildfire-prone communities reduce their risks.

Like the findings in the Witch Creek Wildfire report, the Waldo Canyon research provides a blueprint for helping to create more fire adapted communities. One of the key findings from the Waldo Canyon research is that a community-wide approach to wildfire mitigation is very effective in reducing property damage. This is true for most natural disasters, but particularly for wildfire. How one homeowner mitigates and maintains his or her property directly affects his or her neighbor. By working together, neighbors can create a more fire adapted community.

The Colorado Springs fire marshal has been helping residents and businesses implement wildfire mitigation measures for the past 10 years, which researchers agree greatly reduced the number of damaged and destroyed buildings in that community. Many of those mitigation tools are the same practices recommended by the FAC program, and Colorado Springs is an excellent example of FAC principles at work.

IBHS is committed to continuing its active participation in the FAC Coalition and advancing the fire adapted community principles to help home and business owners create stronger, safer, more wildfire-resistant communities. ■

Fire Prevention—Who Ya Gonna' Call?

Helene Cleveland

There are different types of wildland fire management experts to call when fire severity increases. One type—the wildland Fire Prevention and Education Team (FPET)—is designed to focus on reducing the number of human-caused wildfires, educating communities to reduce their risk from wildfires, and working on special fire-related events.

The primary role of an FPET is to supplement and support the wildfire prevention efforts of local personnel and agencies. FPETs can assist a single unit or statewide interagency efforts. Teams provide interagency expertise in wildfire prevention, public relations and outreach, fire safety, the role of fire, and developing Firewise/fire adapted communities.

These interagency teams are highly successful at reducing the occurrence of unwanted human-caused wildfires by using trained specialists and state-of-the-art communication and education techniques. FPETs are available to support any geographic area preceding, during, or after periods of high fire danger or fire activity. In the Forest Service, severity funds may be provided to Forest Service units experiencing short-term needs related to weather conditions that are creating, or have potential to create, abnormal wildfire protection workloads or unexpected social events that increase the potential for human-caused wildfires. The requesting unit may use severity dollars in support of a team, or the team can be mobilized using Federal funds that are provided for the wildfire incident to cover all costs of the wildfire.

The primary role of a fire prevention and education team is to supplement and support the wildfire prevention efforts of local personnel and agencies.

In May 2013, national wildland FPETs helped implement the California interagency statewide fire prevention campaign, "One less spark–one less wildfire," which focuses on vehicle- and equipment-caused fires. In June 2013, Colorado teams worked with regional personnel to develop a social media campaign revolving around the Fourth of July holiday to help people re-think their use of fire during hot and dry weather.

Wildfire prevention education activities can reduce the number of human-caused wildfires and, thus, fire-related costs. A 2009 study on wildfire prevention education programs in Florida found that the benefit-to-cost ratio could be as much as 35:1—that is, for every additional dollar spent, it would have reduced wildfire-related

A single ember from a wildfire can travel over a mile to your home or community.

Learn how to reduce wildfire damage by spotting potential hazards at <http://www.fireadapted.org>.

Helene Cleveland is the former national fire prevention program manager for the Forest Service in Washington, DC.

From the AD Council, for more safety tips, visit <http://www.SmokeyBear.com>.

A reminder, "only you can prevent wildfires."

losses (such as home and timber losses) and suppression costs by $35 (Prestemon, Butry, Abt, and Sutphen 2010). A current study on tribal lands found that fire prevention education is highly effective; the number of human-caused fires on one tribal unit was reduced by 93 percent (Prestemon 2012).

National FPETs consist of a prevention education team leader, a prevention education team member, and a type 2 information officer. Additional resources can be added to the team as needed. Requests for firefighters, equipment, and resources for wildland firefighting and other incidents are placed through established ordering channels in the resource ordering and status system using an overhead group request and configured according to the National Mobilization Guide (chapter 60).

To find out more about the teams, contact the Forest Service fire prevention coordinator for your region/area, or your agency prevention coordinator <http://www.fs.fed.us/fire/prev_ed/smokeybearawards/cffp-coordinators.pdf>.

Fire prevention and education teams are available to support any geographic area preceding, during, or after periods of high fire danger or fire activity.

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Note:

Prevention study information can be found at <http://www.interfacesouth.org/products/fact_sheets/economic-benefits/the-economic-benefits-of-wildfire-prevention-education> and <http://www.firescience.gov/projects/09-1-09-2/project/09-1-09-2_final_report.pdf>. ■

Adopting a Learning Network Approach for Growing Fire Adapted Communities

Nick Goulette, Lynn Decker, Michelle Medley-Daniel, and Bruce Evan Goldstein

Portions of this article are adapted from *The Fire Learning Network: A Promising Conservation Strategy for Forestry* (Goldstein et al. 2010) and used with permission.

Introduction

The Forest Service's Fire Adapted Communities (FAC) program invests in a wide range of partnerships and programs to promote the mitigation of wildfire threats and impacts to communities. FAC supports Firewise Communities/USA; Ready, Set, Go!; and community wildfire protection plans. FAC staff also leads the national Fire Adapted Communities Coalition, among other efforts. Both prior to and in concert with the development of the National Cohesive Wildfire Management Strategy , FAC program leaders have sought to prioritize effective and innovative ways to accelerate the adoption of best practices in the movement toward fire adapted communities across the Nation.

The Forest Service recognized that supporting in-person and interactive forms of communication and learning provides one of the most efficient and effective means of accelerating program adoption and transferring best practices and innovations across geographies. The Fire Learning Network (FLN), a project led by The Nature Conservancy (TNC) in partnership with the Forest Service and the U.S. Department of the Interior, has demonstrated the value of the learning network model for advancing the restoration of fire adapted ecosystems across the United States over the past decade (Goldstein et al. 2010).

The complexity of contemporary resource management challenges, including community adaptation to wildland fire, requires strategies that promote adaptive management (Norton 2005); facilitate networking and collaboration within and across disciplinary, institutional, and property boundaries; and build

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FIRE ADAPTED COMMUNITIES
LEARNING NETWORK

The Fire Adapted Communities (FAC) initiative and the FAC Learning Network (FAC Network) are helping homeowners, communities, and land managers in fire-prone areas prepare for inevitable fires—to "live with fire" safely. The FAC Network encourages the development and sharing of best practices and innovations in order to accelerate the adoption of fire adapted community concepts nationwide. The FAC Network supports selected hub organizations and communities that have committed to implementing, assessing, and sharing the work that they are doing to increase their communities' resilience to wildfire. Funding is provided by the Forest Service's FAC Program (and participants' matching funds), and the FAC Network is managed by the Watershed Research and Training Center and The Nature Conservancy. More information is available at <http://facnetwork.org/>.

Learning networks draw lessons from experience, instill sound decisionmaking processes, and identify barriers and solutions to effective practice.

a community of practice (Wenger 1998). Managers must be able to continually adapt, learn, and respond to the unique characteristics of each landscape and community in which they work. They must also be able to collaborate and coordinate as a unified group to address policy and regulatory barriers.

The Forest Service is working in partnership with the Watershed Research and Training Center (WRTC) and the FLN to establish a nationwide FAC Learning Network pilot project. Project partners share information and use the FLN model, in coordination with the existing FAC Coalition and others, to accelerate the growth and development of fire adapted communities nationwide.

Conservation Learning Networks

Learning networks in general, and conservation learning networks (CLNs) in particular, have three core components: a domain, a community, and a practice (Wenger 1998).

A *domain* is the core issue on which the network focuses (for example, adapting to wildfire). A network is much more likely to be sustainable if organized around a single problem or issue rather than a broad spectrum of interests.

The *community* is composed of participants who operate in the domain and who share common objectives to enhance a particular practice (for example, fire specialists). Strong communities are grounded in mutual trust and reciprocity that sustain an atmosphere of openness and the ability to admit mistakes and learn from them, as well as the capacity and willingness to contribute skills, access, and resources toward the group's shared ends. Participants must see the network as contributing to this community, as well as their own work priorities, in a mutually reinforcing way as members share understanding and experiential knowledge about their successes and failures. Close, direct, and sustained engagement is critical to support the relationships that allow each participant to contribute his or her own experience and learn from others (Brown and Duguid 2001).

Finally, learning networks are about a *practice*—the expertise, skills, methods, and techniques used to solve problems (for example, identifying ecologically appropriate, institutionally sanctioned, socially acceptable, and fiscally responsible fire management practices).

CLNs are distinct from other learning strategies such as formal curriculum, technology transfer, and experiential education. CLNs promote learning both from and by practitioners and professionals, fostering the spread of best practices and emerging concepts within and throughout the field (Daniels and Walker 2001). Learning networks draw lessons from experience, instill sound decisionmaking processes, and identify barriers and solutions to effective practice. They are more participatory and less hierarchical than traditional learning strategies such as academic degree programs and agency training workshops. They create

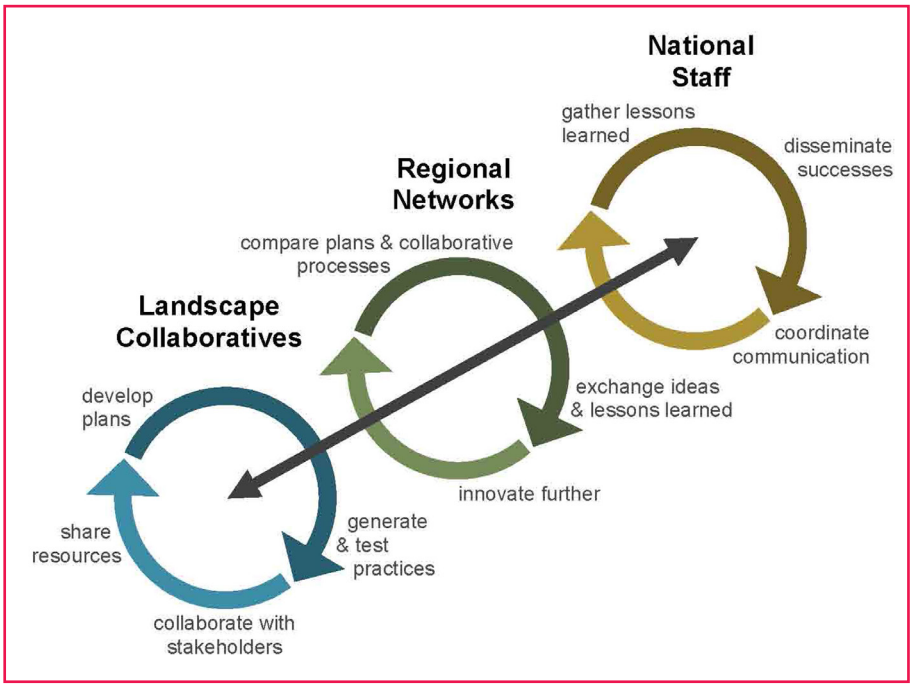

Figure 1.—*Fire Learning Network cross-scalar relationships: landscapes, regions, and the Nation.*

more opportunity for reflection and open and free exchange than is possible in a workplace setting that is typically focused on reactive problemsolving. Learning networks encourage autonomy, adaptability, and self-coordination so that relationships can emerge that reflect mutual work and shared everyday concerns (Goldstein and Butler 2010).

Learning networks can support a variety of services and activities, such as field projects, planning activities, exchange visits, field trips, information clearinghouses, publicity, and the creation and maintenance of a central contact list. Less tangibly, networks support an increased capacity to solve problems across organizational and procedural boundaries, to connect and share insights, and to use common analytic strategies. These abilities allow individuals to stay current in their profession, save time otherwise spent hunting for answers, and prioritize information.

In addition to helping experienced practitioners pass on professional "know-how" to others, networks can provide a safe and engaging space to question the status quo and develop new perspectives, operational procedures, and action strategies (Argyris and Schon 1996). The network model fosters innovation by building trusting relationships and shared purpose. Individuals are more inclined to assist others and take risks if they know they will be encouraged and supported and that their contributions will be reciprocated (Bryan 2004). Network ideas can have influence beyond their members. By sharing their learning more broadly, networks can jumpstart initiatives that might lead to more fundamental change.

The Fire Learning Network

Learning network principles, coupled with nearly a decade of experience with the FLN, has provided evidence for the application of learning networks in advancing complex fire management objectives.

The Fire Learning Network has successfully enabled participants to collaborate across organizational and administrative boundaries to develop and implement ecological restoration plans for fire-adapted ecosystems.

As noted earlier, CLNs improve practice by creating and rewarding innovation and reaching across institutional, professional, and disciplinary barriers to focus on the needs of practitioners. The FLN shows how this works in action. Its success has fostered restoration of fire-adapted ecosystems and exposed an ever-widening group of professionals and practitioners to the best practices of ecological fire restoration.

The enhanced collaborative capacity built by these networks has enabled fire managers and stakeholders to operate in partnerships, share resources, avoid redundancy, and capture synergies. By developing better plans and policies, strengthening collaborations, and establishing a shared store of actions that lead to desired results, the FLN has helped collaboratives shift priorities and practices toward more ecologically sound fire management (Butler and Goldstein 2010). The FLN demonstrates how a multiscalar collaborative learning network may help to overcome rigidity within natural resource management and promote adaptation and resilience (figure 1).

The FLN has successfully enabled participants to collaborate across organizational and administrative boundaries to develop and implement ecological restoration plans for fire-adapted ecosystems. In the decade since its founding, the FLN has included some 750 organizations distributed across more than 163 collaboratives, on landscapes ranging from 100,000 to 11 million acres. These landscapes are organized into regional networks, where they exchange information, learn new techniques, and give and receive feedback (a map of the active and historical FLN landscapes is shown in figure 2).

Together, these landscapes encompass 162 million acres that have been affected by improved collaborative planning and management. Partners in these landscape collaborations have leveraged more than $27 million in additional funding for planning and restoration, and they have planned and conducted more than 490,000 acres of treatments.

Prioritizing a Fire Adapted Communities Learning Network

Recent prioritization of the learning network approach to advancing

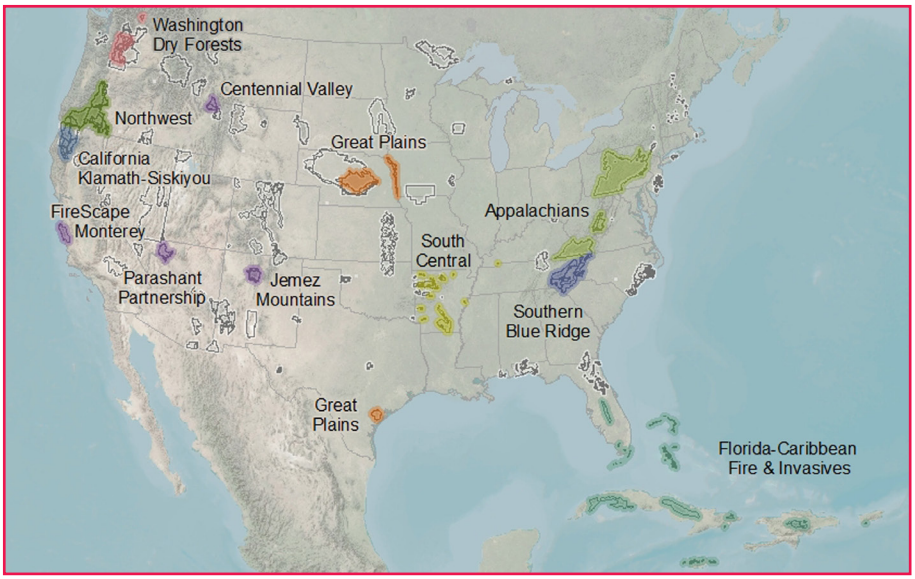

Figure 2.—*Fire Learning Network landscapes encompass 162 million acres that have been affected by improved collaborative planning and management. The Fire Learning Network spans the country with landscapes in 39 States (plus Puerto Rico) from coast to coast and 6 countries in the Caribbean.*

fire adapted communities emerged both from the Western Region Cohesive Strategy's assessment (<http://www.forestsandrangelands.gov/strategy/>) of the state of community-focused fire management strategies, and from the prioritization of "hub-and-spoke" networks for achieving FAC goals in the regional strategies.

In 2012, the Western Region Cohesive Strategy's communications working group engaged the WRTC to develop and implement an assessment titled, *Living with Wildfire: The State of Practice in Western Communities (Goulette 2012)*. More than 500 participants from across the West, representing the full diversity of stakeholders engaged in fire management, provided their insights. The final report provided a number of recommendations intended to inform the Western Region Cohesive Strategy and other national fire management strategies, policies, and programs.

The resulting findings supported a recent fire social science research synthesis (McCaffrey and Olsen 2012) and specifically indicated that "in both the provision of technical information and assistance, and in learning about new developments in support of fire management, respondents strongly favored various forms of in-person and interactive communications (peer networks, personal contacts, workshops, field tours, etc.) as the most effective tools" (Goulette 2012).

Along with indications of practitioner and stakeholder preferences evidenced by social science and assessment findings, stakeholders collaborating in the development of regional cohesive strategies provided further prioritization for the learning network approach. In setting out their FAC strategies, the three regions suggested the development of a hub-and-spoke FAC network as an element of their regional action plans. The prioritization of the FAC Network concept by the Western Regional Cohesive Strategy further supports the decision by Forest Service leaders to initiate the FAC Learning Network pilot project.

Local Fire Adapted Communities' success will be built upon a collaborative approach to connect all those who play a role in wildfire education, planning, and action with comprehensive resources to help reduce risk.

FAC Learning Network Goals, Structure, and Function

Working under the administration of Forest Service FAC program leaders, the WRTC and TNC serve as the pilot project managers for the FAC Learning Network. Representatives from the Fire Adapted Communities Coalition are working with the WRTC and TNC to coordinate and steer the project. Together, the WRTC and TNC have jointly designed and will administer the project working with pilot community leaders and subregional network hub leaders.

Network leaders and participants have defined the following goals for the network:

- Support pilot community leaders in facilitating FAC local coordinating groups and prioritized FAC activities.
- Work with hub leaders and partners to facilitate the development of subregional peer learning networks.
- Use regional peer learning networks as venues to accelerate the adoption, innovation, and diffusion of best practices associated

with FAC programs across communities and geographies.
- Share learning and innovation across the three goals of the National Cohesive Wildland Fire Strategy: resilient landscapes, fire adapted communities, and response to wildfire, supporting their purposeful integration to build truly fire adapted communities.
- Provide a meaningful and efficient feedback loop to the FAC Coalition and Federal program leaders to more efficiently and effectively support fire adapted communities.

Eight FAC pilot communities have been selected to participate in 2013–14. Beginning in spring 2013, local leaders, working in partnership with hub organization leaders in the pilot communities, organized local coordinating groups to integrate relevant fire management efforts including assessment, planning, communications, implementation, response, and recovery in support of collectively prioritized fire adapted community goals. Local FAC success will be built upon a collaborative approach to connect all those who play a role in wildfire education, planning, and action with comprehensive resources to help reduce risk. Pilot communities will demonstrate and synthesize local learning about this collaborative approach.

Over time, the regionally based hub organizations will work with other regional and State-level partners (State forestry agencies, resource conservation districts, etc.) to convene and facilitate workshops and peer learning exchanges between pilot communities and other local coordinating groups in their respective geographies.

At the national level, WRTC and TNC will convene network-wide workshops, aggregate learning, and share across regions and with Forest Service program leaders, FAC Coalition members, and other partners to help adapt programs and strategies over time. Together, these collective efforts will promote collaboration and adoption of best practices among local, State, tribal, and Federal partners, as well as facilitate multiscalar learning to accelerate the growth of fire adapted communities in the United States.

FAC Learning Network leaders will work with the Forest Service and other stakeholders to evaluate the learning emerging from the pilot project and its efficacy as a strategy to advance the overall goals and objectives of the FAC program and allied efforts.

Look for more detailed information about the FAC Learning Network pilot project and the participating communities at <http://www.fireadapted.org/region/fac-learning-network.aspx>. You can also contact Nick Goulette, director of the Watershed Center, at <nickg@hayfork.net>, (530) 628 4206 or Lynn Decker, director of the Fire Learning Network, at <ldecker@tnc.org>.

For more information on the Fire Adapted Communities program, visit <http://www.fireadapted.org> or contact Pam Leschak, Forest Service Fire Adapted Communities program manager, at <pleschak@fs.fed.us>; or Tim Melchert, Forest Service cooperative fire specialist, at <tmelchert@fs.fed.us>.

Acknowledgements

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Firewise: Empowering Wildland-Urban Interface Residents To Take Responsibility for Their Wildfire Risk

Michele Steinberg

The Firewise Communities program of the National Fire Protection Association (NFPA) is a key element of the holistic fire adapted communities strategy to involve all stakeholders in the use of valuable mitigation tools to reduce risk from wildfire.

Firewise Communities teaches residents living in wildland-urban interface (WUI) areas about the hazards of wildfire and how people can implement simple concepts around the home to prepare for and reduce the risk of damage from wildfires.

The program stresses the importance of neighbors' working in collaboration to maximize the benefits of mitigation beyond individual property boundaries and striving toward becoming a recognized Firewise community under the Firewise Communities/USARecognition Program.

Firewise Communities offers free materials and resources to enhance outreach and education. It's often through the guidance and mentoring of stakeholders and neighborhood champions that communities learn about and embrace the mitigation concepts that ultimately lead them to official recognition as a Firewise community.

Throughout 40 States, more than 900 communities are actively participating in the Firewise Communities program, and the number of participants was expected to reach at least 1,000 by the end of 2013. Interest in the program continues to grow among WUI neighborhoods; homeowner/property owner groups; individual WUI residents; and a wide range of local, State, and Federal stakeholders—all seeking a way to create interest and participation in wildfire mitigation activities at the homeowner's parcel level.

NFPA's Firewise Communities program is co-sponsored by the Forest Service, the U.S. Department of the Interior, and the National Association of State Foresters. Its continued mission is WUI fire education and outreach through the Firewise Web site, community recognition program, and a plethora of informational resources.

Who Does the Program Target?

Firewise Communities is a proactive voluntary program designed to protect people and property from the risk of wildfire by reducing a structure's potential for ignitability and modifying the vegetation that will influence the fire's behavior. The approach involves individual homeowners in collaboration with their neighbors and local community, tribes, and State and Federal agencies. Residents are empowered to take ownership and responsibility of their wildfire risk and play a role in protecting their homes and property long before a fire starts. When homes are close enough in proximity (within 100 feet) to ignite one another, neighbors are encouraged to work together to modify overlapping "home ignition zones."

> Fuel reduction within the home ignition zone decreases the ignitability of the structure and increases the chances that the home will survive an approaching wildfire.

Since 2003, communities have invested more than $130 million in Firewise-related work through the $2 per capita investment requirement (see the Becoming a Recognized Firewise Community section). More than 1.4 million people live in recognized Firewise communities.

Michele Steinberg is the National Fire Protection Association Firewise program manager in Quincy, MA.

Firewise Principles

The Firewise Communities program provides homeowners with easy-to-understand information that can be implemented at both the structure and landscape levels and that can reduce a home's risk from wildfire when accompanied by annual maintenance. Based on fire science research from leading experts, program principles include landscaping and home construction components and materials within the home ignition zone.

The home ignition zone principally determines a home's ignition potential during an intense wildfire—it includes both the structure and its immediate surroundings. This area is typically under the control of a private owner. As a result, the authority to implement wildfire mitigation actions lies with the homeowner, rather than governmental agencies or fire departments. Fuel reduction within the home ignition zone decreases the ignitability of the structure and increases the chances that the home will survive an approaching wildfire.

Defined Home Ignition Zone

The five areas within the defined home ignition zone include the following:

- **Home zone:** This zone includes the structural components—roofs, siding, windows, eaves, soffits, vents, and all related attachments (fencing, decks, porches, etc.). Within this zone, all flammables, including plants and mulch, should be kept out of the 5-foot area directly adjacent to the home's perimeter. Decks, porches, gutters, and roofs should be cleared of pine needles, dead leaves, and other ground litter materials; and loose or missing roof shingles or tiles should be replaced or repaired. Areas below patios and decks, along with roof and attic vents, should be screened using metal wire mesh no larger than 1/8-inch to prevent ember entry. Tree branches that overhang the structure need to be trimmed back, and firewood should be moved to zone 2. All flammable items stored under decks or porches should be removed. Door mats, patio furniture cushions, umbrellas, etc., should be moved indoors when an area is threatened by a wildfire.
- **Zone 1:** The area beyond the home zone should be a well-irrigated area that encircles the structure for at least 30 feet on all sides and includes all attachments to the structure. Plants should be limited to carefully spaced, low-flammability species; nonflammable mulch products are recommended. Lawns should be well hydrated and mowed to a height of less than 4 inches.
- **Zone 2:** The next area encircles 30 to 100 feet from the home. Low flammability plant choices should be used in this area; plants should be low-growing and have an irrigation system. Shrubs and trees should be limbed up and spaced to prevent the crowns of trees from touching.
- **Zone 3:** Within this zone, 100 to 200 feet from the home, low-growing plants and well-spaced trees can be used.
- **Zone 4**: This is the farthest zone from the structure (more than 200 feet); here, all plants should be selectively pruned and thinned, and highly flammable vegetation should be removed.

Becoming a Recognized Firewise Community

By working with neighbors, individual residents can make their own property and the larger neighborhood much safer from the flames and embers of a wildfire. The Firewise Communities/USA Recognition Program provides a series of five steps that pave the path to becoming a recognized community for homeowner/property owner associations, neighborhoods, and small communities. Those steps include:

- Obtain a neighborhood- or community-wide wildfire risk assessment as a written document from the State forestry agency, local fire department, or other designated and capable entity.
- Form a board or committee and create an action plan based on the community risk assessment. Share the plan with the Firewise State liaison.
- Conduct a Firewise Day event or activity as a component of the plan's implementation.
- Invest a minimum of $2 per capita in local Firewise actions for the year. This can include volunteer hours, in-kind services, donations, contributions, and grants.
- Submit an application to the State Firewise Communities liaison.

> Firewise is a proactive voluntary program designed to protect people and property from the risk of wildfire.

To maintain active status, participating communities must continue their annual Firewise Day events, document their local $2 per capita investment, and submit a renewal application each year.

Resources

Firewise resources cover a myriad of areas. The Firewise Communities Web site, <http://www.firewise.org>, has a plethora of wildfire safety resources and an online catalog of Firewise products that are provided at no cost. Complimentary ground shipping of materials is available to U.S. addresses. Many of the materials are also available as electronic files.

In addition to hard-copy materials and other promotional items, free online courses and other resources are available for the media and public information officers, including the *Communicators Resource Guide*, video footage, and public service announcements.

NFPA's Firewise Communities program is a partner in the Fire Adapted Communities Coalition—a group of partners committed to helping people and communities in the WUI adapt to living with wildfire and reduce their risk for damage without compromising firefighter or civilian safety. As part of the fire adapted approach, Firewise helps community residents protect their homes from wildfire. ■

Ready, Set, Go! Florida Wildfire Program

Ronda Sutphen

Fire season is a year-round reality in Florida, requiring firefighters and residents to be on heightened alert for the threat of wildfire throughout the year. Unlike wildfires in other parts of the country where residents may have more time to prepare and evacuate, wildfires in Florida often start and spread quickly, leaving little time to evacuate, much less time to prepare.

More than 80 percent of all wildfires in Florida occur within 1 mile of wildland-urban interface (WUI) areas. Fires in WUI areas often present challenges for fire response, suppression, and public safety, in part because wildfire suppression may involve multiple landowners as well as Federal, State, and local fire, law enforcement, and emergency response agencies.

Working Together

Ready, Set, Go! (RSG!) (<http://www.wildlandfireRSG.org>) allows fire departments, law enforcement officials, emergency response agencies, and homeowners the opportunity to work together to prepare for wildfires. The program teaches homeowners how to be part of the solution by taking responsibility to prepare their homes and family for the threat of wildfire.

Ronda Sutphen is the wildfire mitigation coordinator for the State of Florida Forest Service. She is using mitigation tools such as Firewise and Ready, Set, Go! to help communities adapt to wildfire.

Wildfires in Florida often start and spread quickly, leaving little time to evacuate, much less time to prepare.

Core principles are:

- **Ready—Take personal responsibility** and prepare long before the threat of a wildfire, so that your home is ready in case of a fire. Create defensible space by clearing brush away from your home. Use fire-resistant landscaping near your home and building materials that are less susceptible to wildfires. Assemble emergency supplies and belongings in a safe spot. Establish an action plan that includes escape routes. Make sure all residents residing within the home are familiar with and can follow the plan.
- **Set—Act immediately.** Pack your vehicle with your emergency items. Stay abreast of the latest news, reported by both news crews and your local fire department, for updated information on the fire.
- **Go—Leave early!** Following your action plan makes you prepared at this step of the process. Firefighters are now able to best maneuver the wildfire, ensuring your family's and your safety.

RSG! was developed and is managed by the International Association of Fire Chiefs (IAFC) with support from the Forest Service and the Insurance Institute for Business and Home Safety (IBHS). Although RSG! is a fire department program, the Florida Forest Service (FFS) decided to take the lead in coordinating the wildfire and mitigation portions for fire agencies and residents because Firewise and other mitigation measures, such as mowing (mastication), chopping, and prescribed burning, are major responsibilities of the FFS. The FFS also has mitigation specialists located in the 15 field units throughout the State; these specialists provide public education and outreach programs that cover every county in Florida and are able to assist fire departments and homeowners in coordinating wildfire mitigation and prevention efforts.

Florida Takes It From the Top

Florida has taken a unique top-down approach with the RSG! program by getting buy-in from top officials and creating a steering partnership to ensure that the program will be supported on all levels and be successful when implemented at the ground level in all of Florida's 67 counties. The statewide steering partnership is made up of FFS, Florida Fire Chiefs' Association, Florida Sheriffs Association, American Red Cross, Florida Division of Emergency Management, national forests in Florida, U.S. Department of the Interior, Federal Alliance for Safe Homes, and IBHS.

Each partner has taken actions to help promote the RSG! program by writing news releases, publishing articles in quarterly publications, posting information on Web sites, and educating internal audiences about the program. Every partner serves different audiences, which helps in getting the message to people who need it. Education of internal audiences has played an important role in gaining understanding and support from supervisory personnel, which has contributed to the success of the program.

The steering partnership developed a "personal wildfire action plan" specifically for Florida residents to be used in presentations for homeowners and at community meetings. Lucian Deaton with the IAFC provided 10,000 copies of personal wildfire action plans for these presentations.

The Florida steering partnership is also fortunate to have the IBHS as a partner. IBHS is an association of property insurance companies that conducts objective, scientific research to identify and promote effective actions that strengthen homes, businesses, and communities against natural disasters and other causes of loss. IBHS' scientific research on vulnerabilities of buildings to wildfire exposure has helped the firefighting community better understand the risk of wildfires and reinforced the notion that embers pose more of a threat than direct flame contact and radiant heat. The ember intrusion video developed in the IBHS lab in South Carolina gives us a better understanding of how homes burn when exposed to embers and can help firefighters, as well as homeowners, better understand the risk and the actions needed to mitigate that risk. This video is a key component of the Florida RSG! program and is part of the RSG! kit provided to emergency response agencies and homeowners participating in the program.

A Campaign for Community Preparedness

The FFS received a redesign grant from the Forest Service to create a public service campaign for the RSG! program, with the theme "Wildfire Is Coming, Do You Have a Plan?" The FFS has created billboards and placed them along major roadways throughout Florida, as well as developed and distributed educational materials to cooperating agencies and homeowners. The FFS designed kits for fire departments and other emergency response agencies to use in RSG! presentations to homeowners and in community meetings. The kits include a flash drive with information on the RSG! program as well as information on Firewise and other mitigation programs, personal wildfire action plans, note pad and pen, and a bag to store emergency supplies or personal documents.

FFS mitigation specialists have set up meetings with fire departments and emergency response agencies to go over the materials in the kit and answer any questions. They are also available to assist with RSG! programs. The response so far has been very positive, and all agencies have pledged to work together to deliver the RSG! message to their own agencies and provide support in educating homeowners about the program. Presenting a united front to homeowners and the public will help to reinforce the importance of the program.

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Photos: *Before and after photos of the Lehigh Acres Fire in Collier County, near Fort Myers, FL. Photos courtesy of the Fort Myers News-Press.*

Wildfire, Wildlands, and People: Homeowners in the Wildland-Urban Interface

Susan M. Stein, James Menakis, Mary A. Carr, Sara J. Comas, Susan I. Stewart, Helene Cleveland, Lincoln Bramwell, Volker C. Radeloff

Preamble

This article is excerpted from a previously published general technical report, *Wildfire, Wildlands, and People: Understanding and Preparing for Wildfire in the Wildland-Urban Interface—A Forests on the Edge Report* (Stein et al. 2013). This excerpt focuses on research about homeowner attitudes and characteristics that affect participation in and commitment to actions to reduce the risk of damage from wildfire. The report in its entirety is available from the Forest Service Open Space Web site: <http://www.fs.fed.us/openspace/fote/>.

Introduction

Fire historically has played a fundamental ecological role in many of America's wildland areas. However, the increasing number of homes in the wildland-urban interface (WUI), associated impacts on lives and property from wildfire, and escalating costs of wildfire management have led to an urgent need for communities to become "fire-adapted."

Some 32 percent of U.S. housing units and one-tenth of all land with housing are situated in the wildland-urban interface (Radeloff and others 2005), and WUI growth is expected to continue (Hammer and others 2009). While the degree of risk may vary from one place to another, given the right conditions, wildfire can affect people and their homes in almost any location where wildland vegetation is found.

The creation of a fire-adapted community is a proactive process that produces a community-wide prefire strategy, as well as actions, to reduce risks and thus costs (Leschak 2010). In this way, communities do not rely solely on suppression activities for protection after a wildfire starts, but rather become less at risk for damage to property and lives in the first place. To be successful, efforts to create and maintain a fire adapted community must involve the entire community—including residents, government agencies, emergency responders, businesses, land managers, and others.

The presence of networks within communities, as well as between communities and various government agencies, can help motivate homeowners to adopt wildfire mitigation practices. Photo by National Fire Protection Association Firewise Communities program.

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Homeowners in the Wildland-Urban Interface

In recent years, a wealth of research on attitudes and behaviors of homeowners in the WUI, based on surveys of individual communities, provides useful insights to their varying levels of participation in and commitment to actions to reduce the risk of damage from wildfire, which can be due to a number of reasons related to motivation, means, and opportunity (Kent and others 2003, Reams and others 2005, Kocher 2011). Some findings include:

- **Homeowner involvement varies.** Awareness of wildfire risk has been an important factor in the decision of many homeowners to reduce wildfire risk on their properties (McCaffrey and others 2011), and most homeowners in areas of high wildfire risk have undertaken some type of defensible space activity (McCaffrey 2009). However, the level and nature of effort ranges widely, from small-scale actions to fireproof homes to extensive fuels treatment actions (Brenkert and others 2006). Ninety-one percent of WUI residents interviewed in California, where defensible space ordinances are in place, have lowered fire risk by removing flammable vegetation from their property, while less than 50 percent of residents in Florida and Michigan had done this action (Vogt and others 2005).
- **Individual motivations vary.** According to one survey, motivating factors for some individuals included friends and family, regulation, and the desire to clear property for building; for others, these factors were less important than agency outreach, influence of community leaders and homeowner associations, and government programs (McCaffrey and others 2011). Most homeowners do think that managing vegetation on their property to create defensible space is their personal responsibility (McCaffrey and others 2011, Winter and others 2009). The presence of social networks within communities, as well as between communities and various government agencies, seems to increase the likelihood that a community will adopt wildfire mitigation actions (Jakes and others 2007, as cited in McCaffrey 2011).
- **Perceptions of risk vary.** Some homeowners tend to estimate the risk of wildfire damage to their own homes and property as being lower than the estimated wildfire risk elsewhere in their immediate area, in part because they may have taken at least some mitigation actions (McCaffrey 2008). A survey of WUI residents in Colorado, for example, indicated that although wildfire risk was acknowledged as an important issue and some safety measures had been adopted, most people had not engaged in fuels treatment activities. The reason was, in part, because they saw no need to take that level of action until actually faced with a wildfire (Brenkert and others 2006).
- **Time, resources, and knowledge can be limited.** Some of the greatest barriers to action include the lack of time, money, assistance, and technical knowledge, as well as homeowner perceptions of costs and labor requirements (Hodgson 1995). Additionally, many homeowners have difficulty disposing of vegetation cleared to create defensible space (Winter and others 2009). To address such

A wealth of research provides useful insights to their varying levels of participation in and commitment to actions to reduce the risk of damage from wildfire, which can be due to a number of reasons related to motivation, means, and opportunity.

Homeowners in the WUI vary in their levels of participation in and commitment to actions to reduce the risk of damage from wildfire. Photo by Kari Greer, contractor for the Forest Service.

A key ingredient for effective community action is the sharing of knowledge and resources among neighbors. Photo by Larry Kohrnak, Interface South.

limitations, some communities provide free home inspections and free or cost-shared clearing, chipping, and disposal of debris (Reams and others 2005).

- **Feelings towards regulations are mixed.** Most homeowners prefer not to have mandatory regulations, although some see a role for government and insurance companies in requiring vegetation management to reduce the risk of wildfire damage, particularly when other policies and approaches have not been successful (Winter and others 2009). Homeowners are most likely to comply with risk-reduction guidelines and other rules if they see the guidelines as fair, if they trust the sources (Vogt and others 2005), and if they see their actions as part of a larger efforts involving fire-safe building codes and zoning/planning practices that discourage development in high-risk areas (Winter and others 2009, Monroe and others 2004).
- **Aesthetic preferences can help or hinder.** Although some homeowners enjoy the look of wildfire-resistant landscaping (such as minimal trees or selection of certain types of shrubs and other vegetation) (Winter and others 2009), others reject such actions for aesthetic and privacy reasons (Daniel and others 2003, Kent and others 2003, Nelson and others 2003, Brenkert and others 2006, Winter and others 2009). Studies have noted that some homeowners would rather make structural changes to their homes than make landscape changes they find unattractive (Brenkert and others 2006).
- **Conflicts with best management practices.** In areas where vegetation removal can lead to increased erosion, creating safer home ignition zones can be problematic because they sometimes conflict with local "best management practices" (BMPs) for soil and water protection. For example, residents of one community indicated that their State department of environmental quality guidelines prohibited the removal of vegetation over a certain size (Winter and others 2009).
- **Conflicts with homeowner association restrictions.** In the past, some homeowner associations restricted tree removal, dictated that roofs have wood shingles, or mandated certain kinds of vegetation for aesthetics, despite the potential fire hazard. Much progress has been made in this area, however, and most homeowner associations no longer have such clauses; some now require vegetation management to reduce fire risk (McCaffrey 2011). In one case, the State of Colorado passed a law to forbid homeowner associations from interfering with the rights of homeowners to create defensible space or install nonflammable roofing (General Assembly of the State of Colorado 2005).

Conclusion

Although wildfire has been and will continue to be fundamental to the ecological health of many wildland areas, wildfires can harm people and their homes, especially when weather, vegetation, and terrain create extreme conditions and when communities are unprepared. Numerous opportunities are available for planners, developers, and others to help WUI communities adapt to wildfire through education, planning, and mitigation activities that can help limit the number of ignitions, reduce flammable vegetation, create Firewise homes, and thereby establish fire-adapted communities.

About Forests on the Edge

Forests on the Edge is a project of the Forest Service, State and Private Forestry, Cooperative Forestry Staff, in conjunction with Forest Service, Research and Development and National Forest System areas and universities and other partners. The project aims to increase public understanding of the contributions of and pressures on America's forests and to create new tools for strategic planning. For further information, visit the Forests on the Edge Web site at <http://www.fs.fed.us/openspace/fote>.

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Forest Service Response to Nonfire Emergencies

Gordy Sachs

Wildland fire agencies respond to more types of emergencies than only wildland fire, and structural fire departments respond to more than structure fires. In addition to day-to-day emergencies of all types within their areas of protection, these emergency responders also deal with incidents related to hurricanes, tornadoes, floods, earthquakes, and terrorist attacks. Any type of natural or human-caused disaster or emergency could result in a request to the Federal Government for wildland or structural fire resources.

Coordination of resources can be complicated during a Presidential declaration of emergency or major disaster; however, a process exists to guide such multiagency interactions. In these cases, the response is coordinated under the National Response Framework (NRF), which identifies the roles and structures of Federal agencies to provide support to States or other agencies through emergency support functions (ESFs).

Emergency Support Function #4: Providing a Link

The NRF identifies ESF #4 as being the *coordinating mechanism for wildland, rural, urban, and suburban firefighting support*; the Forest Service serves as the primary agency for ESF #4. During all types of disasters and major emergencies, ESF #4 is the primary link between the Federal wildland and structural fire communities and the Federal Emergency Management Agency (FEMA). The Forest Service coordinates and staffs ESF #4 with the support of the U.S. Department of the Interior (DOI), Office of Wildland Fire and the U.S. Fire Administration and serves as the face of wildland and structural firefighting resources to FEMA and other involved agencies.

In addition to the primary ESF #4 mission of firefighting, the Forest Service and DOI are also identified as support agencies for the other 13 ESFs. The Forest Service and DOI may be subtasked by the primary agencies of these ESFs to provide resources for missions identified in the NRF. For example, under these support missions, the Forest Service may be asked to provide:

- Saw-capable personnel for emergency road clearing;
- Command and control assets—single resource or incident management teams (IMTs);
- Transportation assets, such as aircraft;
- Radio communications systems and support personnel;
- Engineering, contracting, and procurement personnel and equipment to assist in emergency removal of debris;
- Resources and supplies for evacuation shelters;
- Staff for establishing logistics facilities, such as incident support bases or Federal staging areas;
- Personnel, equipment, and supplies to support Federal health and medical teams;
- Cache equipment and supplies to support Federal urban search and rescue task forces;
- Technical assistance and logistical support at oil and hazardous materials spills; and
- Law enforcement and investigation personnel.

ESF #4 activations do not always result in mobilization of response assets such as IMTs or crews. In fact, most activations require the Forest Service to staff the ESF #4 desk at a FEMA Regional Response Coordination Center (RRCC) or the National Response Coordination Center (NRCC) at FEMA Headquarters with one or two liaisons for a few days—nothing more. However, for some incidents, dozens of ESF #4 staff and hundreds of responders have been mobilized; examples include Hurricanes Katrina, Rita,

Any type of natural or human-caused disaster or emergency could result in a request to the Federal Government for wildland or structural fire resources.

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and Wilma in 2005; the California fire sieges in 2007 and 2008; Hurricane Irene in 2011; and Hurricane Sandy in 2012.

Hurricane Sandy: Diverse Missions

The 2012 hurricane season tied with 4 other years (1887, 1995, 2010, and 2011) as the third most active Atlantic season on record. Hurricane Sandy was the second largest Atlantic storm on record, affecting the East Coast from Florida to Maine, and States as far west as Indiana. Making landfall as a post-tropical cyclone in southern New Jersey on October 29, Sandy battered the densely populated New York and New Jersey region with heavy rains, strong winds, and record storm surges. On the western side of the storm, blizzard conditions paralyzed parts of the central Appalachians, including much of West Virginia.

The storm's effects were extensive, resulting in a massive Federal response. Through ESF #4, the Forest Service coordinated the mobilization of 4 national incident management organizations, 2 type 1 IMTs, 9 type 2 IMTs, 43 crews (from 17 States), and various other resources. Missions included emergency road clearing, managing mobilization centers and staging areas, coordinating emergency response, supporting local emergency operations centers, and assisting with emergency response planning. In addition, qualified Forest Service ESF #4 and support personnel worked directly with FEMA at the NRCC, three RRCCs, two joint field offices, and two State emergency operations centers.

Rachel Smith (2nd from right) and Mike Shipley (right) perform ESF #4 duties at the FEMA Region I Regional Response Coordination Center in Maynard, MA, during the response to Hurricane Sandy. Others in the photo are from other ESFs, representing other Federal agencies.

At the height of the response, approximately 1,200 responders had been deployed through ESF #4, including more than 1,000 firefighters assigned to clear downed trees from roadways in Connecticut, New York, New Jersey, and West Virginia to provide access for emergency responders and power crews. More than 900 miles of road were cleared of fallen trees by these firefighters in the days following the storm.

IMTs mobilized to Hurricane Sandy had diverse missions. For example, one of the assigned national incident management organizations was part of the Debris Recovery Task Force set up by the New York City Office of Emergency Management. The task force's primary job was to find, bring in, track, and push out hundreds of pieces of heavy equipment to help New York clear debris from roadways and sidewalks after the storm. By November 10, the task force had mobilized more than 2,700 pieces of public, private, and military

Members of a wildland fire crew mobilized through ESF #4 work to clear a tree blown across a roadway in Connecticut to provide access for local emergency responders and power crews after Hurricane Sandy went through the area in October 2012. Over 1,000 firefighters were mobilized to clear trees from roadways in Connecticut, New York, New Jersey, and West Virginia. Photo courtesy Forest Service.

equipment onto the streets of New York City to help in the clean-up. Grapplers, dump trucks, front-end loaders, roll on–roll off container trucks, large dumpsters, skid steers, backhoes, self-loaders, long-haul trucks, railroad cars, and barges were all part of the huge push of heavy equipment thrust onto the streets of New York City to get all five boroughs cleaned up.

Other IMT missions related to Hurricane Sandy included managing mobilization centers, staging areas, and points-of-distribution; coordinating local emergency response; supporting local and State emergency operations centers; and assisting in the development of emergency response plans for areas affected by the storm.

Summary

As stated in the *Forest Service Foundational Doctrine for All-Hazard Response* (USDA Forest Service 2011), the Forest Service "is a land management agency with a unique combination of people, skills, and resources that add significant value to our national emergency response capability. The agency accepts this all-hazard role as complementary to its overall land management mission." Wildland fire agencies continue to demonstrate that they are prepared and organized to support all hazard responses—wildfire and nonfire—by providing trained personnel to use their inherent skills, capabilities, and assets to protect human life, property, and at-risk lands and resources.

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New and Revised Fire Effects Tools for Fire Management

Robert E. Keane, Greg Dillon, Stacy Drury, Robin Innes, Penny Morgan, Duncan Lutes, Susan J. Prichard, Jane Smith, Eva Strand

Introduction

Announcing the release of new software packages for application in wildland fire science and management, two fields that are already fully saturated with computer technology, may seem a bit too much to many managers. However, there have been some recent releases of new computer programs and revisions of existing software and information tools that deserve mention because they constitute a suite of technology that can be used to effectively integrate fire ecology into fire management.

Computer tools that synthesize fire effects research into a software application or data structure are important to all phases of fire management. In planning, fire effects tools can be used to design fuel treatments, develop burn prescriptions, allocate available fire management resources, predict future fire effects, and prioritize areas for treatment. In real-time operational settings, these tools can be used to quantify adverse fire effects, evaluate the benefits of wildfire, determine smoke emissions, and determine values at risk. After a fire has passed, the tools can be used to predict secondary effects, evaluate regeneration potential, and prioritize rehabilitation efforts. Indeed, most fire management applications should include evaluations of fire effects to fulfill all management objectives.

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Information Technology

Fire Effects Information System: FEIS-Spatial

The Fire Effects Information System (FEIS), now in its 27th year, continues to provide managers with online syntheses of scientific knowledge about plants and animals and their relationships with fire. FEIS now contains reviews of more than 1,100 species, including extensive recent reviews of invasive plants. FEIS reviews offer a wealth of information for resource management, restoration, rehabilitation, and fire management. The system is heavily used—nearly half a million visitors from throughout the United States and more than 90 other countries visited the FEIS Web site in 2012.

In summer 2012, FEIS introduced a new, spatially searchable user interface, which is currently being tested at <http://www.feis-crs.org/beta> (figure 1). FEIS-Spatial offers users many new features, including the ability to search for species reviews and fire studies by (1) State, province, or country; (2) plant community; (3) national park, forest, refuge, reservation, or other Federal land; (4) plant, animal, lichen, or fungus; and (5) invasiveness and nativity.

The newest product available in FEIS is a collection of fire regime syntheses, which describe historical fire regimes and current changes in fuels and fire regimes for groups of plant communities described by LANDFIRE (figure 2). The first two of these syntheses, covering the Alaskan tundra and all of Hawaii, were published in early 2013. More will be published as they are completed and reviewed. Go to <http://www.fs.fed.us/database/feis/fire_regime_table/BpS_fire_regime_table.html> for a list of fire regime syntheses completed and underway.

Computer tools that synthesize fire effects research into a software application or data structure are important to all phases of fire management.

Severe Fire Potential Map (SFPM)

Digital maps of burn severity are widely used to describe the spatial distribution and magnitude of fire effects on vegetation and soils in recently burned areas. Examples include the Burned Area Reflectance Classification data produced to support Burned Area Emergency Rehabilitation efforts (Clark and McKinley 2011), the Rapid Assessment of Vegetation Conditions products to assess overstory vegetation loss immediately post-fire (Guay 2011), and the Monitoring Trends in Burn Severity (MTBS) (<http://www.mtbs.gov>) products that have provided a fire atlas of large fires and their severity since 1984. Among other uses, these types of post-fire severity assessments help to identify when and where to mitigate adverse fire effects, plan post-fire fuel management activities, and describe landscape-scale ecological conditions. What these products don't provide, however, are predictions of those areas most likely to experience severe fire effects in future fire events. To fill this void, the Severe Fire Potential Map (SFPM) was produced.

The SFPM is a comprehensive 30-meter-resolution raster dataset covering the conterminous Western United States (figure 3). It depicts the potential for fires to result in high-severity effects if they should occur on a 0 to 100 scale. This dataset is intended to be an online resource that managers can download and use to evaluate the potential ecological effects associated with new and potential fire events. It can also be used to aid strategic fire management planning, including prioritization and placement of fuels treatments across large landscapes.

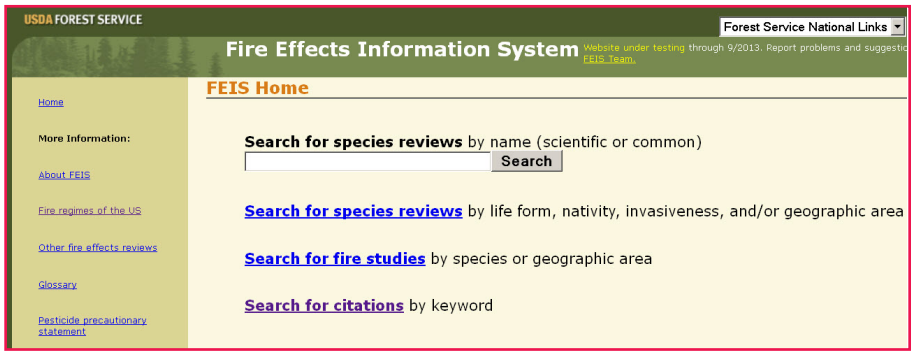

Figure 1.—*The new front page of the Fire Effects Information System (FEIS).*

Fire regimes of the United States

Under construction. More vegetation communities will be added as syntheses are completed.

Syntheses of fire regime information on biophysical vegetation communities throughout the United States. Select the fire regime synthesis name for information on historical fire regimes based on a systematic literature search. Numbers in the table are derived from LANDFIRE succession modeling of Biophysical Settings (BpSs), which is based on literature, local data, and/or expert estimates.

Region	FEIS syntheses		Results from LANDFIRE models										
	Fire regime syntheses	Relevant species reviews	Fire interval[1] (years)	Fire severity[2] (% of fires)			Number of BpS groups in each fire regime group						Summary data for component BpSs
				Replacement	Mixed	Low	I	II	III	IV	V	NA[3]	
Alaska	Alaskan tundra	+	175-1,023	98-100	0-2	0	0	0	0	2	7	15	+
Alaska	Black spruce	+											+
Alaska	Sitka spruce	+											+
Hawaii	Hawai'i	+	12-4,975	0-50	50-100	0-100	3	0	4	0	7	8	+

[1]Average historical fire-return interval derived from LANDFIRE succession modeling (labeled "MFRI" in LANDFIRE).
[2]Percentage of fires in 3 fire severity classes, derived from LANDFIRE succession modeling. Replacement-severity fires cause >75% kill or top-kill of the upper canopy layer; mixed-severity fires cause 26%-75%; low-severity fires cause <26%.
[3]NA (not applicable) refers to BpS models representing vegetation types that did not burn during simulations or had extremely low probabilities of ignition.

Figure 2.—*An example of output from the Fire Regime Synthesis product in Fire Effects Information System.*

The SFPM builds on satellite-derived observations of burn severity from MTBS for more than 7,000 fires that burned between 1984 and 2007. Random Forest statistical models were built relating severe fire occurrence to a set of environmental conditions for forested and nonforested settings in each of 17 mapping regions by sampling locations that have experienced high-severity fire, as well as those that did not. Environmental variables considered in the Random Forest models included a suite of topographic descriptors including elevation and maximum potential solar radiation, 1,000-hour fuel moisture percentile at the time of each fire, and density of pre-fire green vegetation as expressed by the Normalized Difference Vegetation Index (NDVI). Classification accuracies for individual models ranged from 65 percent to 83 percent for forest models, and 69 percent to 82 percent for nonforest models. Elevation, 1,000-hour fuel moisture, and NDVI were always among the five best predictor variables, often with some combination of slope, broad-scale topographic position, and solar radiation.

To map severe fire potential across the landscape, the statistical models were used to predict how likely severe fire effects would be for each 30-meter pixel, conditional on that pixel's experiencing fire at a particular percentile level of 1,000-hour fuel moisture. It is important to note that the 1,000-hour fuel moisture percentiles were inverted so that higher percentiles reflect drier conditions, consistent with the way fire managers are accustomed to referring to other fire weather indices such as the Energy Release Component.

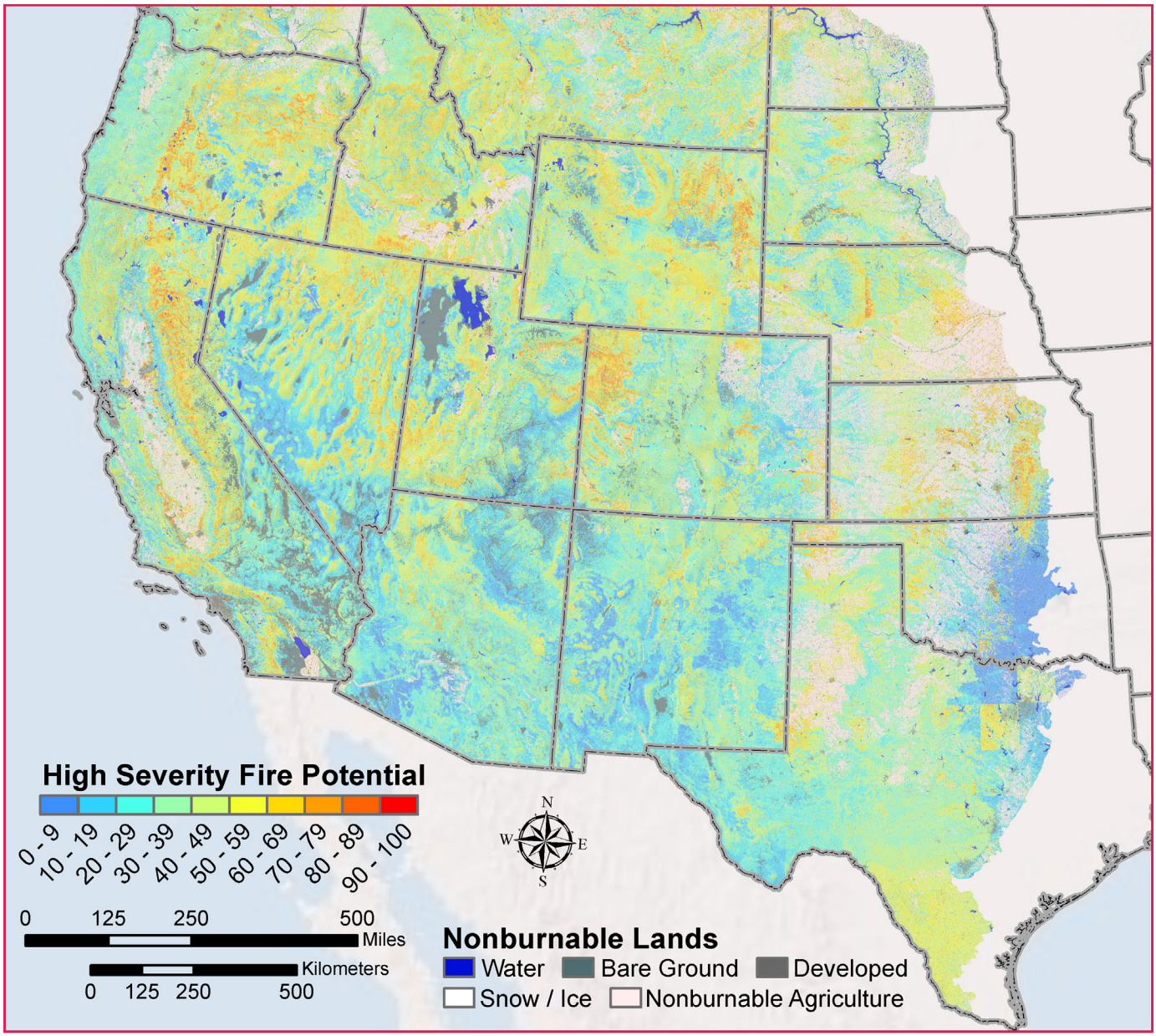

Figure 3.—*The Severe Fire Potential Map product.*

For our spatial predictions, the 1,000-hour fuel moistures were set as constant across the entire landscape. The SFPM was initially built using the 90th percentile (i.e., very dry) fuel moisture conditions, but it could easily be generated for other fuel moisture conditions as well. Our SFPM also used NDVI calculated from 2011 Moderate Resolution Imaging Spectroradiometer (MODIS) satellite imagery to reflect current vegetation condition. Again, updated versions of the SFPM could be easily generated in the future by using newer MODIS NDVI mosaics. Mosaics of the 90th percentile SFPM by our 17 mapping regions and by forest and woodland versus nonforest settings are available online at the FRAMES Web site (<http://www.frames.gov/firesev>).

Inventory and Monitoring

FEAT-FIREMON Integration

Inventory and monitoring tools are needed for many diverse purposes such as quantifying fuels inputs to fire behavior and effects simulation models, monitoring changes in fuels and ecological characteristics after treatment or wildfire, and calculating fuels tools in fire management. Most current classification applications have inherent constraints that limit their scope. Standardized protocols and methods for measuring ecological characteristics, especially fuels attributes, are essential for successful fire management.

In 2005, Lutes et al. (2006) released the first version of the FIRE MONitoring and inventory system (FIREMON), an integrated database and computation system that contained standardized methods for collecting a suite of ecological characteristics, including fuel data, which were linked to a set of ACCESS databases for the entry of those data. It also contained a set of computation queries linked to the databases that calculated numerous other ecological characteristics, such as fuel loading.

Many people have adopted FIREMON protocols for their agencies and organizations. However, the National Park Service had already been using a set of protocols and tools called FEAT (Fire Effects Assessment Technology) for the same applications, so it became evident that any new revision of FEAT or FIREMON should integrate the two tools into one, and this integration was creatively called FEAT-FIREMON Integration (FFI) (Lutes et al. 2009). Recently, FFI was upgraded to create version 3.1 (figure 4).

FFI is an interagency, science-based, ecological monitoring software application that is designed to help managers meet mandated monitoring requirements. It is used by the Forest Service; the U.S. Department of the Interior's National Park Service, Bureau of Land Management, U.S. Fish and Wildlife Service, U.S. Geological Survey, and Bureau of Indian Affairs; tribes; State and local governments; nongovernmental organizations; and universities. FFI is a robust vegetation and fuels monitoring tool used to consistently describe ecological systems and monitor change over time. It incorporates the components necessary to conduct a successful monitoring program, including an integral database, analysis and reporting tools, and modular Geographic Information Systems component.

In July 2012, the FFI development team released FFI v1.04.02, which added customizable tree data reports and a save-data queries ability, bug fixes, and other user-requested updates. Additionally, work is underway on "FFI-lite," which is a more compact installation of FFI to be used on field computers and by users who do not need the full functionality of a Structured Query Language (SQL) server. FFI information and software are available at <http://www.frames.gov/ffi>.

> Digital maps of burn severity are widely used to describe the spatial distribution and magnitude of fire effects on vegetation and soils in recently burned areas.

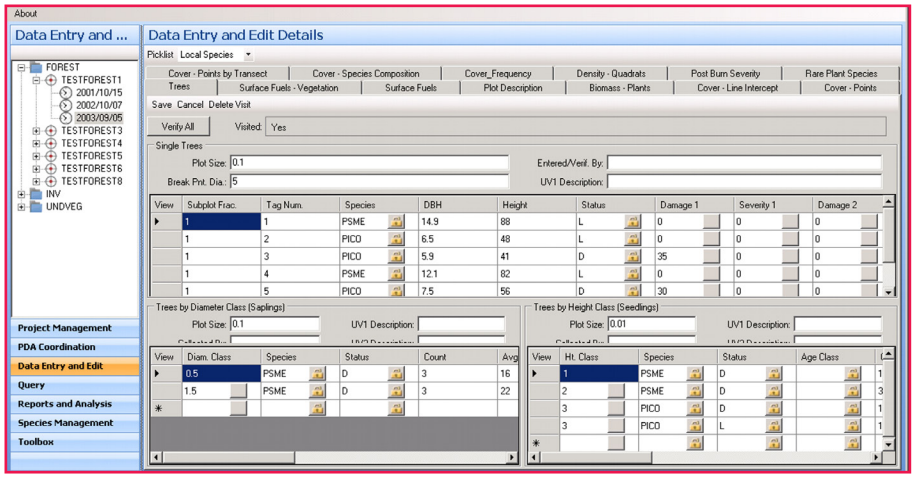

Figure 4.—*The newest version of the FEAT FIREMON Integration package.*

Fuel Treatments and Ecological Restoration

First Order Fire Effects Model

Version 6.0 of the First Order Fire Effects Model (FOFEM) has just been released and is now available to compute the direct or immediate consequences of fire (figure 5). Currently, FOFEM provides quantitative fire effects information for tree mortality, fuel consumption, mineral soil exposure, smoke, and soil heating.

FOFEM is national in scope and uses four geographical regions: Pacific West, Interior West, Northeast, and Southeast. Forest cover types provide an additional level of resolution within each region. Geographic regions and cover types are used both as part of the algorithm selection key and as a key to default input values.

FOFEM is a computer program that was developed to meet the needs of resource managers, planners, and analysts in predicting and planning for fire effects (Reinhardt and Keane 1998). Quantitative predictions of fire effects are needed for planning prescribed fires that best accomplish resource needs, for

impact assessment, and for long-range planning and policy development.

Most fire effects research has tended to be empirical, and thus limited in applicability to situations similar to those under which the research was conducted. Additionally, fire effects research results have not previously been assembled in a common format that is easily accessed and used, but rather have been scattered in a variety of journals and publications.

In developing FOFEM, a comprehensive search of the fire effects literature was conducted to obtain all useful predictive algorithms. These algorithms have been screened to evaluate their predictions over a range of conditions. Thus, a major internal component of FOFEM is a decision key that selects the best available algorithm for the conditions specified by a user. The algorithms are incorporated into FOFEM in an easy-to-use computer program. Realistic default values, documented in detail in the "Help" section of the program, have been provided for many inputs, minimizing the data required. These defaults were derived from a variety of research studies. Any of these default values can be overridden by the user, allowing the use of this program at different levels of resolution and knowledge.

FOFEMv6 replaces its two predecessors—FOFEMv4, an IBM-PC DOS version developed in the early 1990s (Reinhardt et al. 1997), and FOFEMv5, an IBM-PC Windows version developed circa 2000. FOFEMv6 is functionally equal to FOFEMv5 but has a much improved user interface, graphical output, and a few other internal changes, including the following:

- Tree species codes are changed to standardized vegetation cover type codes,
- New Fuel Characteristics Classification System (FCCS) cover types and related foliage and branch fuels have been added,
- FFI tree data can now be imported directly into FOFEMv6 to compute mortality,
- The soil heating model has been refined, and
- A new tree mortality model for longleaf pine has been included.

FOFEM will be useful in a variety of situations including: (1) setting acceptable upper and lower fuel moistures for conducting prescribed burns, (2) determining the number of acres that may be burned on a given day without exceeding particulate emission limits, (3) assessing effects of wildfire and developing timber salvage guidelines following wildfire, and (4) comparing expected outcomes of alternative prescribed and wildfire management actions.

Consume

Consume is a decisionmaking tool designed to assist in prescribed burn and wildfire planning and assessment by using realistic fuels data. Consume predicts fuel consumption by combustion phase, pollutant emissions, and heat release based on input fuel characteristics, lighting patterns, fuel moistures, and other environmental variables.

Because Consume captures the inherent complexity of wildland fuels through a close interface with the FCCS (<http://www.fs.fed.us/pnw/fera/fccs>), specific fuel strata and categories can be targeted for prescription or noted as a potential source of pollutant emissions depending on the burn scenario. For example, a fuelbed with a developed organic soil layer (termed duff in Consume) may create a significant emissions source if burned under low duff moisture conditions. By evaluating a range of potential

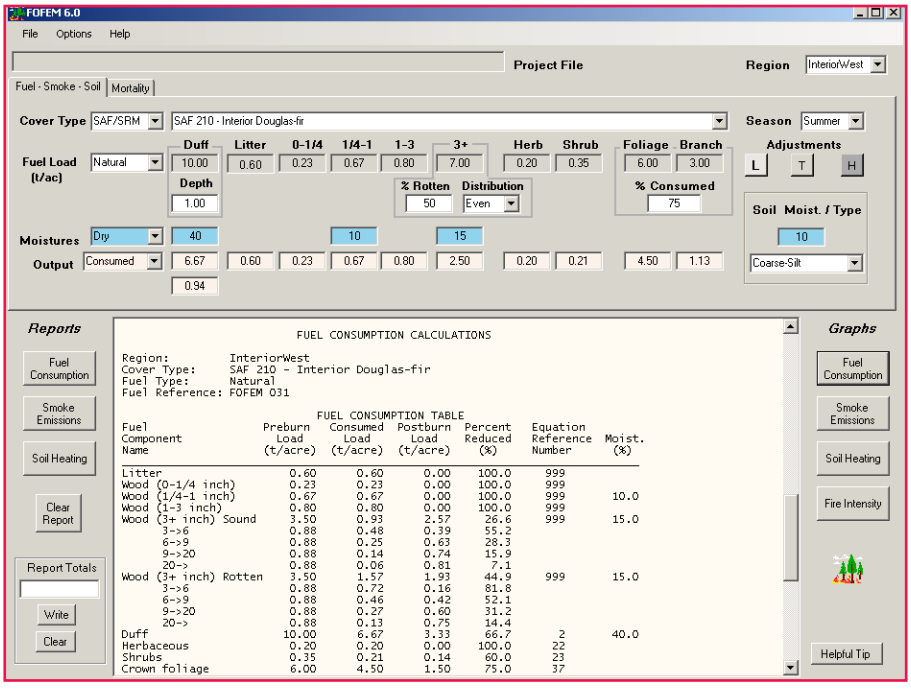

Figure 5.—*The new version 6.0 of the First Order Fire Effects Model.*

The Interagency Fuels Treatment Decision Support System provides a single, consistent user interface to access more than 50 fire effects and fire behavior tools.

burn scenarios, Consume users can target a suitable prescription window. With Consume, users can determine when and where to conduct a prescribed burn or plan for a wildland fire to achieve desired objectives, while reducing the impact on other resources.

Consume 1.0 included a set of consumption algorithms formulated from data collected at operational broadcast burns in logging slash. During the 1990s, the Fire and Environmental Research Application (FERA) team began developing models of fuel consumption by combustion stage for other fuel types beyond the Pacific Northwest and considering different configurations of fuels.

In addition, FERA began developing the new FCCS system, which allowed managers to select different fuel loadings for input into Consume. Consume 2.1 included calculations for activity-piled, activity-nonpiled, and natural fuels. Emission factors were also added to Consume 2.1, allowing estimation of emissions. Consume 3.0 included new consumption algorithms based on recent research on the flaming, smoldering, and residual combustion phases of western pine, southern pine, and boreal forests. The FCCS fuelbed input design was incorporated into Consume 3.0 to make use of the national fuelbed database of fuelbed loadings. Fuel loading values can be either imported from the FCCS or directly input by Consume users.

In 2002, FERA received funding from the Joint Fire Science Program (JFSP) to enhance Consume by predicting fuel consumption and smoke emissions in all wildland fuelbeds in the United States. Consume 3.0 included new consumption algorithms based on recent research on the flaming, smoldering, and residual combustion phases of western pine, southern pine, and boreal forests. The FCCS fuelbed input design was incorporated into Consume 3.0 to make use of the national fuelbed database of fuelbed loadings. FCCS contains a fuelbed reference library and calculates a wide range of fuel characteristics. Fuel loading values can be either imported from the FCCS or directly input by Consume users. In both software applications, fuelbeds are organized into six strata from canopy fuels to ground fuels.

The latest version of Consume (v. 4.1) was written in Python© and is being incorporated into the Wildland Fire Emissions Inventory System <http://wfeis.mtri.org> and the Interagency Fuels Treatment Decision Support System (IFTDSS) (figure 6) (see the Online Fire Effects and Fire Behavior Framework section later in this article). It will also be available as a stand-alone application. Consume 4.1 contains updated natural fuel consumption algorithms and emissions factors based on the latest available fuel consumption and emissions datasets.

FuelCalc

What has always been missing in the planning and design of fuel and ecological restoration treatments has been an easy and seamless link from plot data entered in data inventory databases to software that computes ground, surface, and canopy fuel characteristics from the plot data, and then to a simulation model that simulates the effect of a treatment on the entire fuel complex and subsequent fire behavior.

Figure 6.—*The newest version 3.1 of the Consume model.*

The Forest Vegetation System (FVS) currently performs these functions using the Fire and Fuel Extension (FFE), but it takes quite a bit of training to use FVS-FFE. Further, there are few graphic outputs for interpreting results, and it is not easy to contrast and compare treatment modifications. Moreover, most fire managers are not trained to run FVS-FFE; it is a tool for silviculturalists.

Enter FuelCalc (Fuel Calculation tool) (figure 6). This new software package allows for the direct import of surface and canopy fuel field data to calculate initial fuel conditions—such as surface fuel loadings (down dead woody, shrub, herb, duff, and litter), canopy bulk density, and canopy loading—and a variety of associated silvicultural characteristics such as timber volume and basal area. These data are interactively displayed to the user, who can then easily simulate the effects of harvest, thinning, pruning, piling, and broadcast burning on ground, surface, and canopy fuel characteristics.

FuelCalc was originally designed as a batch command line program to compute canopy fuel characteristics for mapping in the LANDFIRE prototype project (Keane et al. 2006). The JFSP program then decided to fund an expansion of FuelCalc to cover the computation of surface fuel loadings from FFI databases and the simulation of a wide variety of fuel treatments. The FOFEM, Burnup (Albini et al. 1995), and Nexus (Scott 1999) simulation models are embedded in FuelCalc to compute fuel consumption and crown fire behavior.

In general, FuelCalc is a software system for assisting local and regional fuel management planners

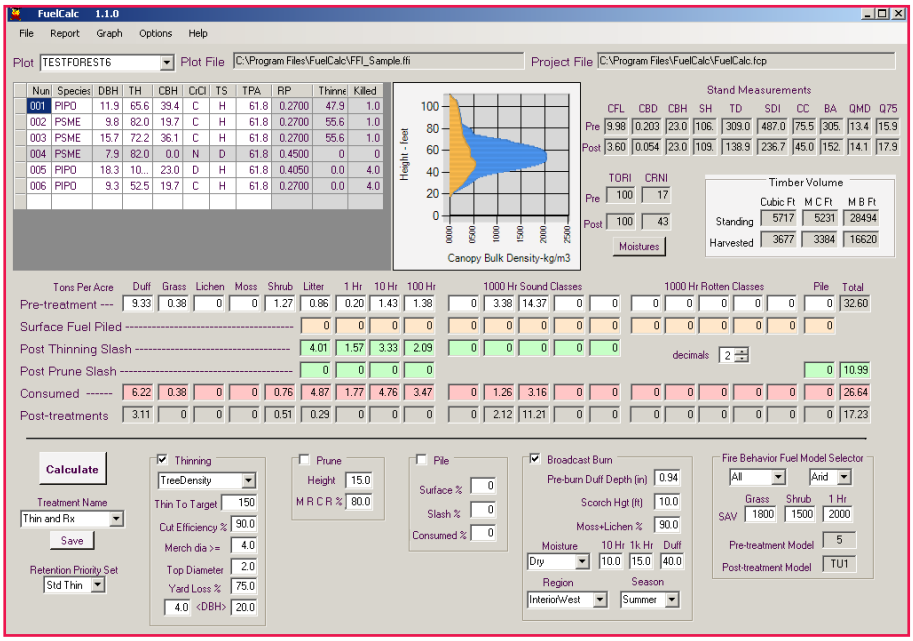

Figure 7.—*The first version 1.0 of the FuelCalc model.*

and related resource specialists in designing and implementing fuel treatments in forest stands (figure 7). The inherent spatial scale of FuelCalc is the plot or sample point (small group of integrated plots). FuelCalc has two primary applications.

First, FuelCalc is a tool to calculate current, or initial, canopy fuel characteristics at an inventory plot using a "treelist" (a listing of the characteristics of trees measured on a forest inventory plot) as input. The required tree characteristics for use in FuelCalc include tree species, diameter at breast height (dbh), tree height, crown base height, crown class (crown position), tree status, and the number of trees per acre represented by each tree in the treelist.

Second, FuelCalc is a tool for simulating the effects of a fuel treatment—thinning, pruning, pile burning, and broadcast burning—on ground, surface, and canopy fuel characteristics. In addition to the treelist inputs mentioned above, simulating the effects of a fuel treatment on canopy fuel characteristics requires a quantitative description of the treatment, including the type and intensity of thinning, the height of pruning, how much existing or activity fuel is to be piled, and the nature of a broadcast burn. Any combination of these four fuel management activities can be specified. In order to also simulate the effects of a fuel treatment on ground and surface fuel characteristics, FuelCalc requires a description of initial ground and surface fuel load, by size class.

In addition to the primary functions mentioned above, FuelCalc also has ancillary functions that may be useful to fuel management planners and silviculturists. From the initial surface fuel loads and from the loads after simulation of a fuel treatment, FuelCalc suggests a surface fire behavior fuel model that may be appropriate for the situation. If the fuel treatment simulation includes a broadcast burn, FuelCalc estimates fuel consumption and smoke production. FuelCalc also calculates several summary characteristics based

on the initial or simulated treelist that may be useful to fuel treatment planners, silviculturists, or even wildlife biologists; these characteristics include stand height, stem density, Stand Density Index, canopy cover, basal area, quadratic mean diameter, and quadratic mean diameter 75th percentile.

FuelCalc's main purpose is to design, in detail, multiple fuel treatments to achieve a desired effect. FuelCalc is useful for planning fuel treatments, as well as for estimating the effects of wildfire on surface and canopy fuel characteristics. FuelCalc works by simulating changes in ground, surface, piled, and canopy fuel loads by size class as fuel treatments add to, or subtract from, the load in each class. FuelCalc input files can be created in the FFI ecological monitoring software (<http://www.frames.gov/ffi>) or by manually creating an input file in FuelCalc's standard format.

Wildland Fire Assessment Tool (WFAT)

The Wildland Fire Assessment Tool (WFAT) is a planning tool for generating fire behavior and fire effects maps for fire management (figure 8). It is a custom toolbar in ArcMap that provides an interface between the ArcGIS Desktop software and the FlamMap and FOFEM algorithms to produce these predictive maps. Fire behavior outputs include rate of spread, flame length, fireline intensity, fire type, and scorch height; fire effects outputs include soil heating metrics, emissions of common pollutants, fuel consumption of a variety of fuel classes, and tree mortality.

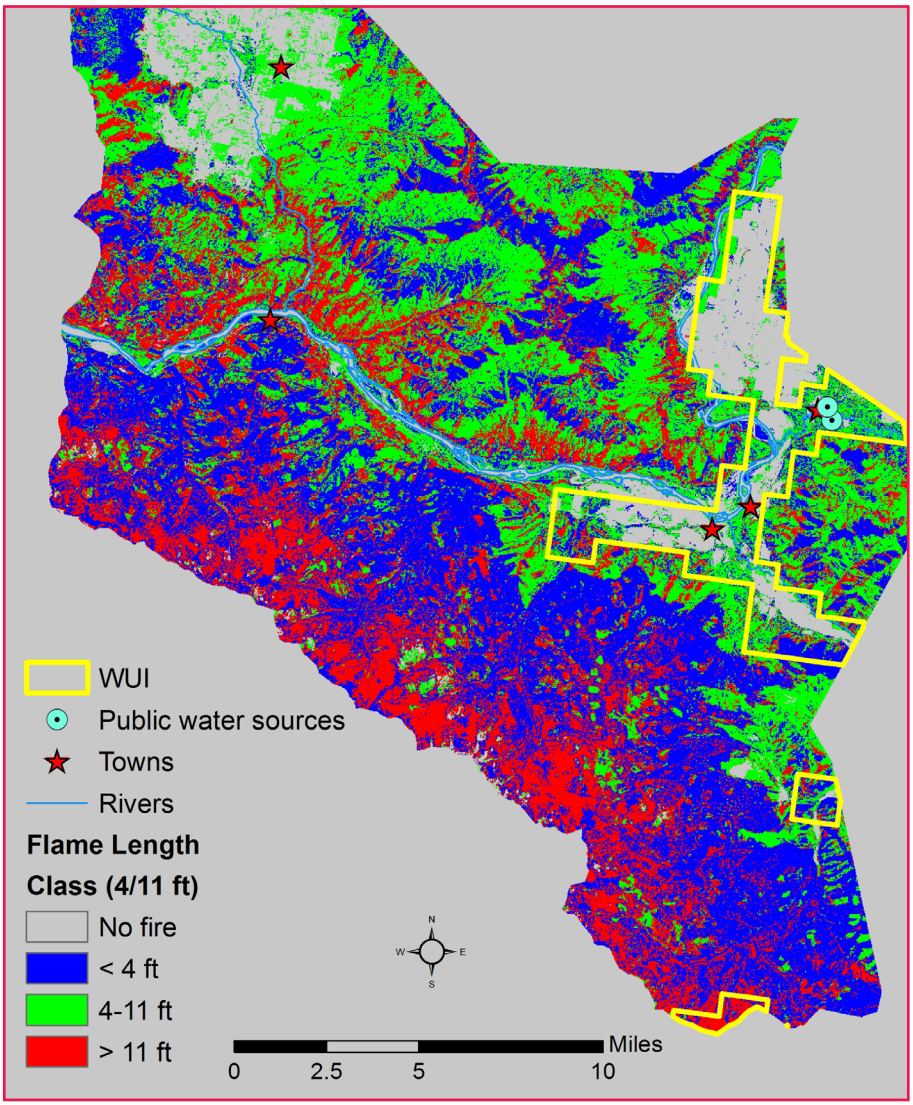

Figure 8.—*The Wildand Fire Assessment Tool Demo—ArcMap.*

The primary objectives behind the development of WFAT were to provide a tool that helps managers to prioritize fuel treatments on the basis of predicted fire behavior and effects and to assess the effectiveness of fuel treatment proposals in a geospatial context. WFAT provides decision support to land management planning by answering the question, *Where on a landscape are fire behavior and effects likely to be most problematic in regard to specific land management objectives?* Weather and fuel moisture conditions can be manipulated to simulate wildfire or prescribed burning conditions. The ArcGIS platform allows the user to integrate fire behavior and effects outputs with other spatial data, such as land ownership, areas of special concern, and digital imagery. WFAT uses spatial data in the ESRI Grid format and saves all outputs to the same format. LANDFIRE (<http://www.landfire.gov>) provides input data layers directly compatible with WFAT or local data can be used.

WFAT is the successor to the Fire Behavior Analysis Tool and the FOFEM Mapping Tool and incorporates the functionality of both tools into one convenient software application. WFAT also provides a landscape file (.lcp) generator and an import tool to convert FARSITE and FlamMap ASCII Grids

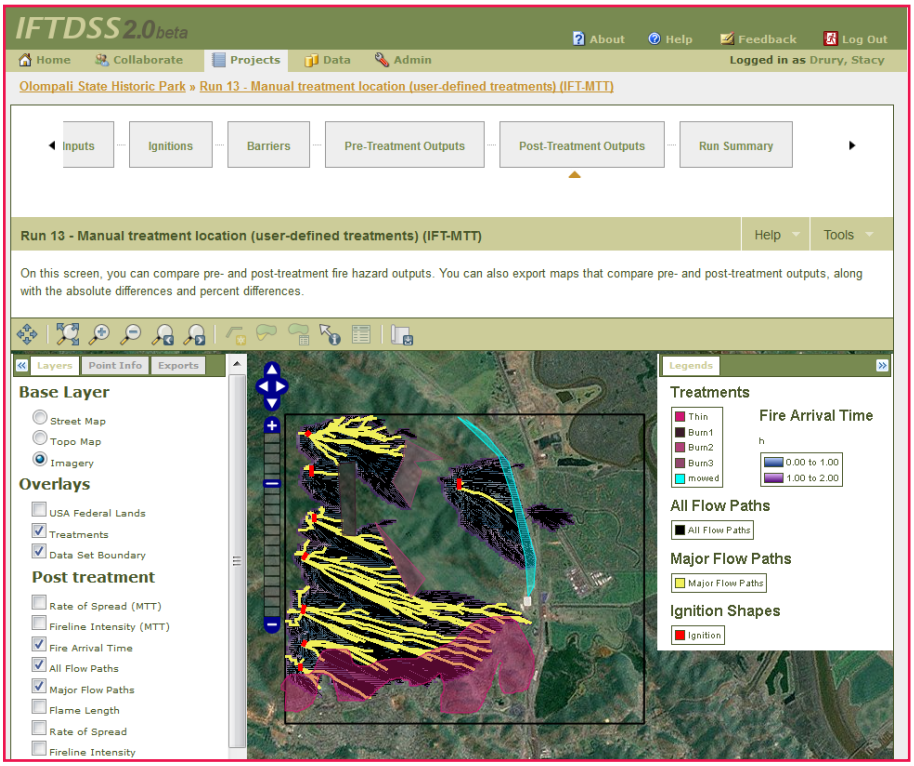

Figure 9.—*The Integrated Fuel Treatment Decision Support System integrated fire management tool.*

into ESRI Grid format for use in ArcGIS.

In summary, WFAT is a planning tool that can help fire and fuels managers to:

- Define and identify the location of hazardous fuel;
- Prioritize, design, and evaluate fuel treatment projects;
- Develop burn plans for prescribed fire;
- Predict fire behavior and effects for summary in planning and monitoring documents; and
- Calibrate fuel data layers based upon observed fire behavior.

WFAT was developed by the Fuels and Fire Ecology group within the Rocky Mountain Research Station Wildland Fire Management Research, Development and Applications (WFMRDA-FFE). The WFAT software, a user's guide, and tutorials are available for download at <http://www.frames.gov/wfmrda-ffe>. WFMRDA-FFE has also developed a short online course that introduces the theory behind WFAT and helps the user to quickly become proficient in using the tool for planning in fire and fuels management. For further information about WFAT, visit the Web site or email your questions to <help-desk@niftt.gov>.

Online Fire Effects and Fire Behavior Framework: Interagency Fuels Treatment Decision Support System

The IFTDSS is a new Web-based software and data integration framework that organizes previously existing and newly developed fire and fuels software applications to make fuels treatment planning and analysis more efficient and effective. Fire and fuels managers can access the system at <http://iftdss.sonomatech.com.>

IFTDSS provides a single, consistent user interface to access more than 50 fire effects and fire behavior tools including simulation modules found in FOFEM, Consume, Behave, Randig, and FlamMap. The single portal for accessing data and models in IFTDSS reduces the amount of time a user needs to spend learning new interfaces and transforming data, thereby freeing up time for critical analysis of the work performed.

Fire effects, fire behavior, and risk assessment simulations are conducted within the IFTDSS using a set of stepwise workflows designed to address the business needs of land managers for planning fuels treatments and prescribed burns. The workflows within the IFTDSS provide access to data, simulation modules, and analysis tools in an intuitive, stepwise pattern (figure 9). Within the workflow concept, IFTDSS users have the ability to upload custom datasets, acquire and edit LANDFIRE data to reflect local conditions, conduct fire weather statistical analysis, simulate fire effects and fire behavior, assess potential fire hazards, evaluate risk to values within a landscape, and plan a prescribed burn using an online version of the interagency prescribed burn plan template.

The IFTDSS contains four workflows: hazard analysis, risk assessment, fuels treatment, and prescribed burn planning.

The hazard analysis workflow provides tools for performing a current-condition assessment of fire hazard within an area of interest. The focus of this workflow is to identify areas that warrant further analysis because of the potential

fire hazard in those areas. High fire hazard is expressed by high potential fire behavior (e.g., flame length, rate of spread, and fireline intensity) or undesirable fire effects (e.g., tree mortality, smoke emissions, or excessive fuel consumption). Within IFTDSS, hazard analysis is viewed as the initial step in the fuels treatment and prescribed burn planning processes and is performed primarily at the landscape scale.

Risk assessment is a new and evolving process for fire management. Many fire managers have expressed a lack of direction on how risk should be assessed with respect to fuels treatment and managing harmful fire effects. In IFTDSS, risk is assessed based on expected loss or benefit due to burning. Risk is quantified using the response function concepts proposed by Calkin et al. (2010) to evaluate net value change across a landscape in the event of burning by wildfire under a set of environmental conditions. In the IFTDSS users can:

- Develop values-at-risk maps,
- Model fire behavior and burn probabilities across landscape,
- Model the expected loss of benefit for a value at risk resulting from fire, and
- Analyze potentials for applying fuels treatments to lower the potential for harm to values at risk owing to wildfire across landscapes.

Fuels treatments are designed to lower hazardous fire potentials and restore ecosystem resiliency temporally and spatially. In the IFTDSS fuels treatment planning workflow, users can evaluate potential fuels treatment options, including no-

Tool	Purpose	Type	Previous version	Changes	Web site
FEIS-Spatial	Provides syntheses of information on fire effects and fire regime characteristics	Searchable database of synthesis documents	FEIS	Syntheses searchable by multiple criteria, including geographic. New syntheses on fire regimes.	http://www.feis-crs.org/beta
SFPM	Depict the potential for severe fire to aid in evaluation of ecological effects of future fires	Landscape-level, raster geospatial data	New	There are no previous versions.	http://www.frames.gov/firesev
FFI	Application for collection, storage, analysis, reporting, and exporting ecological monitoring data	Plot-level, stand-alone program	FFI v1.04.02	Added custom tree report, added FuelCalc export, updated FVS export, updated data query tool.	http://www.frames.gov/ffi
FOFEM v6.0	Calculate fuel consumption, smoke emissions, soil heating, and tree mortality	Stand-level, stand-alone program	FOFEM v5.9	Complete redesign of GUI, new tree mortality equations, improvements in duff consumption, soil heating.	http://www.firelab.org/science-applications/fire-fuel/111-fofem
CONSUME 4.1	Predicts fuel consumption, emissions, and heat release	Stand-level, stand-alone program and batch processor	Consume 3.0	Updated natural fuel consumption and emissions factors; separated GUI from calculations to support batch processing.	http://www.fs.fed.us/pnw/fera/research/smoke/consume
FUELCALC v1.0	Design surface and canopy fuel treatments	Stand-level, stand-alone program	New	An old version of FUELCALC was a batch program that calculated canopy fuel characteristics.	http://www.firelab.org/science-applications/fire-ecology/228-fuelcalc
WFAT	Predicts fire behavior and fire effects spatially	Landscape-level extension to ArcGIS	FBAT and FOFEM Mapping Tool	Combines the functionality of FlamMap and FOFEM with display and analysis capabilities of ArcGIS.	http://www.niftt.gov
Online IFTDSS	Online system to predict fire behavior and fire effects spatially and aspatially for fuels treatment planning	Online, open source framework for plot-level and landscape-level analysis.	IFTDSS V1.2	New Web-based software and data integration framework that organizes existing and newly developed fire and fuels software applications.	http://ifdss.sonomatech.com

Table 1.—*A recently released suite of fire effects tools that are either new or revised to meet the needs of fire management.*

treatment, mechanical fuel removal and tree thinning, and prescribed burning. Additionally, users can identify where fuels treatments may have the greatest influence for mitigating wildland fire potential at the stand and landscape scales. In the IFTDSS, users can define and evaluate treatment strategies, locate treatments across landscapes, and assess the effectiveness of treatments for mitigating unwanted fire effects or fire behavior.

Prescribed burn planning and writing burn plans are critical duties for fire managers. All prescribed burns require a written plan that addresses how the burn will be conducted, the environmental conditions for burning, the expected fire effects and fire behavior, the resources needed to implement the burn plan, and plans for maintaining control of the burn.

In IFTDSS, users can simulate stand level fire effects and fire behavior potentials to develop burn prescriptions. Additional functionally is provided to conduct landscape level analysis for contingency planning and to provide maps for inclusion in the burn plan. The IFTDSS also contains an online template based on the *Interagency Prescribed Burn Planning Guide* (<http://www.nwcg.gov/pms/RxFire/rxfireguide.pdf>) and the Rx-341 prescribed burn plan writing course. This template allows users to input all data directly into the template and then generates a formatted burn plan that is compatible with Microsoft Word.

The current IFTDSS version 2.0 beta was released in October 2012. In early 2013, IFTDSS was evaluated by Carnegie Mellon's Software Engineering Institute (SEI). SEI is using a combination of nationwide instructor led workshops, virtual online workshops, inverviews, and questionnaires (Bennett et al. 2013). The SEI report concluded that IFTDSS represented an important paradigm shift in making software tools and support available to fire and fuels managers (Bennett et al. 2013). Additional information on IFTDSS can be found at <http://www.frames.gov/iftdss>.

Conclusion

This article does not present all fire ecology tools available for use in management; if interested, users should visit the FRAMES Web site (<http://www.frames.gov>). Table 1 lists fire effects tools that are either new or revised to meet the needs of fire management.

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