

Proceedings of the Second Conference on the Human Dimensions of Wildland Fire



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Abstract

This proceedings contains articles, posters, and abstracts of presentations from the second Human Dimensions of Wildland Fire Conference held 27-29 April 2010 in San Antonio, Texas. The conference covered the social issues at the root of wildland fire management's most serious challenges. Specific topics included: firefighter and public safety; social acceptance of fuels treatments; community and homeowner fire hazard mitigation; public responses during fires and fire-related evacuations; fire communication and education; and the performance of fire management organizations—from operational efficiency to cost management and from community relations to risk management. The conference included 59 presentations, three special sessions, and nine poster presentations. Conference attendees included fire researchers and wildland fire management practitioners from the United States, Australia, Canada, Portugal, England, and The Netherlands.

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*FIRE MANAGEMENT/
ORGANIZATIONAL EFFECTIVENESS*

CAN ACCEPTABLE RISK BE DEFINED IN WILDLAND FIREFIGHTING?

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Abstract.—Risk is an ever-present challenge for fire agencies, fire managers, and firefighters, who must ensure that risks are managed at a level that is as low as reasonably practicable. This challenge provides a significant dilemma as there is no one prescriptive method for—or consensus on—defining “acceptable risk” in the field of firefighting. Risk assessment and determining what is the best course of action for dealing with risk are often weighed based on the potential benefits versus the potential costs or losses. It can be argued that it is impractical to define acceptable firefighting risks in many scenarios due to the unique and constantly changing environment. This paper discusses the factors involved in assessing wildland firefighting risks, reviews past models for defining and assessing acceptable risks, and describes a new approach to these complex topics.

1.0 INTRODUCTION: FIREFIGHTING AND RISK

Firefighting is an unquestionably dangerous activity that requires the application of skilled judgment on many levels to achieve the safest possible outcomes. Because firefighting has inherent risks, the ability to determine which risks are or are not acceptable is fundamental. As J. Adams (1995) has written, “The future is uncertain and inexplicably subjective; it does not exist except in the minds of people attempting to anticipate it” (p.30). Yet firefighters need to be able to predict the future to some degree in order to plan for current and potential risks on the fireground.

Risk in firefighting is as inevitable as the occurrence of wildfires. Indeed, if firefighters did not take risks, fires would go unchecked. Therefore knowing how

to approach risk is vital. Treasurer (2003) suggests that “knowing how to take risks should be a part of everyone’s core life curriculum” (p. 2). The implication is not that firefighting is a dangerous activity and therefore accidents will occur. Rather, risk must be understood and managed while safety incidents, poor safety practices, and injuries should be treated as the exception (Clancy and Holgate 2005).

In wildland firefighting, several methods for assessing risk go beyond a standard risk assessment template. First, formal preplans for defined areas provide an indication of risk using information about vegetation, fuel loads, and areas of threat. Second, management structures define operating guidelines, personnel roles, and the formal processes for documenting risks. Third, incident, division, or sector plans on the fire-line will detail identified risks. Finally, the firefighter on the ground plays a key role in the risk identification process. Firefighters on the fire-line will receive visual and auditory cues about risk as well as getting a “feel” for the environment.

In the firefighting environment, there is often a fine margin between success and failure when managing risk. Improper risk assessment by fire managers can reduce the effectiveness of decisions about strategies and tactics, thereby compromising safety. Improper risk assessment may occur for a range of reasons, including the immediacy of the decision’s impacts, the lack of physical impact the decision will have on the decision-maker as an individual, and the fact that the decisionmaker does not face the physical risk (Clancy 2005).

1.1 The Role of Judgment

There will always be variability in judgments when people are involved in the risk assessment process (Clancy 2005). The risks felt or perceived by an organization prior to a fire may influence how firefighters assess risks on the fireground. Those managing a wildfire will assess the risks differently

from the firefighters on the fire-line, especially in cases where the incident control center is many kilometers away from the fire-line; increased distance heightens the potential for variability in risk awareness and judgments (Clancy 2005).

At some point, all firefighters will be required to make judgment calls on risk. The trigger for this risk decision may be just a feeling that they have. This “feel” is often difficult to quantify but is based on knowledge and skills gained over time for making sense of the environment. Gut feelings, intuition, and professional judgment play a strong role in the overall risk management process when fighting wildfire. The importance of judgment calls in risk management links back to the overarching concept that risk is subjective and contextually driven (Adams 1995, Reason 1997, Clancy 2005, Sadler et al. 2007).

Gigerenzer (2007) describes how the decision-making process strongly relies on judgment, which allows cognitive shortcuts to occur. In essence the mental workload is reduced, allowing for quicker responses to immediate situations by drawing on previous experiences stored in memory. According to Gigerenzer (2007), a gut feeling is a judgment: “1. that appears quickly in consciousness, 2. whose underlying reasons we are not fully aware of, and 3. is strong enough to act upon” (p. 16). Klein (2003) describes how this process unfolds in the pattern-recognition process behind intuitive decision-making. First, there is “a situation” (for example, a wildfire) that generates “cues” that lead to recognition of “patterns” that activate “action scripts” that ultimately go on to affect the situation (p. 13). At all stages of this process, there is an opportunity to identify risk. The decision-making process is continuous so there are ongoing opportunities to decide what is or is not acceptable.

2.0 DEFINING ACCEPTABLE RISK

While defining risk is part of any decision process, the concept of *acceptable* risk differs in its construct across various disciplines. The terms “risk tolerance” and “risk appetite” are used in risk management to describe the level of risk an organization is

willing to accept. Firefighters need to be risk-averse individuals—not risk seekers—and need to be aware of their environment as risk-taking has been “closely tied to decision-making” (Treasurer, p. 15). Fischhoff et al. (1981) provide a useful starting point with their definition of “acceptable risk” as “the risk associated with the most acceptable option in a particular decision problem” (p. 3). Under this definition, it is still possible to undertake a dangerous activity since an emphasis on safe options is not specified.

In firefighting, risks and decision-making are inextricably linked. How decisions are made about whether risk is acceptable or not is a vital part of the process and is tied to understanding the true risk consequences (Treasurer 2003). The firefighting risk models used in Australia, which will be discussed below, use such phrases as “we will risk a little to save a lot” with no clear direction on what is acceptable. Fischhoff et al. (1981) describe the acceptable risk decision process as comprising five interdependent steps:

1. Specifying the objectives by which to measure the desirability of consequences;
2. Defining the possible options, which may include “do nothing”;
3. Identifying the possible consequences of each option and their likelihood of occurring should that option be adopted, including risky consequences;
4. Specifying the desirability of the various consequences; and
5. Analyzing the options and selecting the best one. (p. 2)

These five steps already occur during the development of wildland fire incident control plans. Incident management teams use the options analysis process to systematically identify and define what is acceptable for a given scenario. One of the incident management team’s first activities is to create objectives (step one)—for example, to establish a control line at a specific place, say, Smiths Track. Next, identifying the available options will provide a number of decision choices (step two). In this example, the options may be

a) to burn out an area from Smiths Track, b) to create a mineral earth break at Smiths Track, or c) to undertake a direct attack at Smiths Track. Third, as part of this process, it is vital to understand the possible consequences of selecting each option in order to make decisions about risk (step three). For example, the fire activity may be too intense for a direct attack or back burning. The fourth and fifth steps require incident managers to look at the desirability of the various options' consequences and then make a decision about the course of action based on that information. For example, based on the resources on scene, the terrain, available fuel, and weather conditions, the best option of the three mentioned above for Smiths Track may be an indirect attack using a mineral earth break.

The risk assessment process relies heavily on good intelligence from the fire-line to understand the actual risks. Since most models for determining acceptable risk “are based on probabilistic calculations of a statistical likelihood of an occupational risk occurring” (Holgate and Clancy 2007, p.1), skilled personnel must be involved in the process. Because a range of risks and possible outcomes exist in most wildland firefighting situations, a risk-rating matrix is sometimes used. These matrices include information about the likelihood that specific possible events will occur and information about the potential consequences.

As stated earlier, the concept and perception of risk are subjective. What one person perceives as a risk will not necessarily be identified as such by another person. Even when the likelihood of an incident or of a risk's coming to fruition is low, the margin for error is often slim and in firefighting the consequences can be devastating. There are many limitations and difficulties in quantifying wildfire risks given the diverse range of variables that will affect control options and help define acceptable risk. As Fischhoff et al. (1981) suggest, for firefighters and fire managers alike, acceptable risk will often be the same thing as the most acceptable option.

2.1 The “Safe Person” Model

In Australia, many fire agencies and other emergency service organizations have developed wildland fire programs based on a British model introduced in the mid-1990s. Called “Safe Person Approach and Dynamic Risk Assessment,” this model details both organizational and individual responsibilities for managing safety. It has proven to be a useful approach to addressing risk but can lead to problems when it is misapplied. The model is useful in that it defines clear expectations for an organization, such as the need to provide training, equipment, and risk information, to select appropriate personnel for particular roles, and to have safe systems of work. It also defines what is expected of individuals in the organization—for example, that they will not undertake tasks for which they are not trained and that they work as a member of a team and within accepted guidelines.

This approach has the potential to fail when an organization has all its requirements in place and something goes wrong. Failures can often be traced back to a specific human action or inaction that was not accounted for in the planning. However, just identifying human errors is not enough; the organization also must understand why the person who made the error thought that the action or inaction was acceptable. Thus, one key to understanding why firefighters behave in a particular way is having knowledge in the field of human factors. In the past decade, fire agencies have gained a stronger understanding of human performance, particularly under time-pressured constraints in situations where information can be ambiguous or incomplete. Understanding human frailties in identifying, assessing, or defining risk and the limitations of human performance in complex situations will aid in making risk decisions.

Wildfire agencies in the United States have proactively developed the field of human factors in order to better understand why failures occur and how best to train personnel. Supporting meetings have included the Wildland Firefighters Human Factors Workshop from June 12-16, 1995 and then a follow-up 10 years later

at the 2005 International Wildland Fire Safety Summit. Other areas that have been developed include the application of the human factors analysis classification system as a tool for assessing wildland fire accident investigations (Ryerson and Whitlock 2005). Research in recent years by the Bushfire Cooperative Research Centre in Australia has also increased the body of knowledge about human factors and helped the discipline to grow.

While empirical data are not available on the impact of introducing the safe person approach and dynamic risk assessment, this author believes that this approach has raised safety awareness among firefighters in Australia. The Country Fire Authority (CFA, Victoria), for example, lost 13 firefighters during the 1983 Ash Wednesday fires. Another five firefighters perished during the Linton fires of 1998 under conditions that were considered benign (Johnstone 2002). The CFA introduced the “Safe Person Approach and Dynamic Risk Assessment” program after the Linton fire tragedy. Ten years later, on Feb. 7, 2009 (which has become known as “Black Saturday”), 173 civilian fatalities occurred under the worst fire conditions in the nation’s history. Although casualties and injuries to firefighters did occur, there were no firefighter fatalities. Empirically, this outcome supports the notion that significant progress has been made in raising safety awareness among Australian firefighters over the past few decades.

2.2 Criticisms of the Dynamic Risk Assessment Model

The dynamic risk assessment model used in Australia follows the five key steps of its British predecessor:

1. Evaluate the situation or person at risk;
2. Select tactics;
3. Conduct a risk assessment of the tactics;
4. Determine whether the risks are proportional to the benefits; and
5. Decide whether additional control measures can be introduced.

At steps four and five, the decision-maker has several pathways (options), including “do not proceed,” “reassess tactics,” and “proceed with the task.” Because of the number of steps, the additional option decision points, and the inclusion of a risk assessment, it is reasonable to

anticipate that the limitations of working memory would be exceeded in complex situations (Clancy 2005). The author has observed that the application of the dynamic risk assessment varies across different jurisdictions in Australia; agencies further develop the model, in most cases to simplify the process. This approach has often failed to account for human limitations in the decision-making process as the model has been developed solely to be applied as a cognitive process.

Dynamic risk assessment has also been criticized for its lack of empirical support. Tissington and Flin (2005) state: “Perhaps the most serious area of criticism of this model – or indeed any other description of risk assessment as a clear step by step process – is that dynamic risk assessment is inextricably linked with decision making” (p. 50). Since dynamic risk assessment is a cognitive process, it is unlike the safety processes with which many people are familiar, such as filling out a form or completing a checklist. Instead, dynamic risk assessment relies solely on individuals to acquire and process information cognitively.

Tissington and Flin (2004) also criticize the dynamic risk assessment model for not being evidence-based and for being “the product of the expert view of a small number of fire officers which, given the expert nature of risk assessment, is on the face of it appropriate. However, no replicable methodology is reported for the organisation of the model nor has it (to date) been tested empirically” (p. 51).

Clancy and Holgate (2008) assert: “Any attempt to model risk assessment must take into account the limitations of human information processing and, in particular, the limitations of working memory” (p. 2). Since dynamic risk assessment is a cognitive process, this observation highlights the need to understand factors that influence our ability to process information. Working memory, theorized to be seven items plus or minus two items under ideal conditions, has the potential to impede the risk decision-making process (Miller 1956).

In fire situations, the fire ground is complex and the environment is constantly changing. There are often time pressures, and available information can be ambiguous. Therefore, it is reasonable to expect that working memory will not perform optimally. Cognitive biases also play a key role in our decision-making process and our ability to determine acceptable risk. For instance, how information is framed will determine how an individual reacts to it; this factor is an important part of providing briefings to crews prior to entering the fire ground (Sadler et al. 2007).

Procedure-based approaches, where performance relies on individuals applying entrenched methods or processes, have long been the norm in managing components of firefighter safety. These approaches include the 10 Standard Fire Orders and 18 Watch-outs that have been adopted internationally and are used to guide risk assessment in wildfires. These tools or methods greatly exceed the limits of working memory capacity (Braun et al. 2001), especially when the fire situation becomes complex. An example of this situation is the 1994 South Canyon fire in Colorado, where firefighters pursued the firefight after breaking 13 of the 18 Watch-outs and being overrun by fire (McLean 1999). Fourteen firefighters died as a result.

3.0 TOWARD A NEW DECISION MODEL

Following an extensive review of the theoretical and applied literature and research, Clancy and Holgate (2008) developed a decision model that attempts to address the lack of empirical support for existing models of dynamic risk assessment. This model was developed based on the need to simplify the complex area of cognitive psychology theories by providing solutions that can be understood by the general firefighting community. The Clancy and Holgate model consists of two components, a simplified risk-rating matrix, which limits the choices available in assessing risk, and a decision model that highlights cognitive biases.

Based on risk-rating models that agencies are currently using, for example, a four-by-four matrix provides the operator with 16 risk-level points. Clancy (2005)

applied this model to a specific wildfire scenario where participants assessed the same risk scenario and found that the assessment of risk “varied considerably and had little consistency among participants” (p. 74). In this research, 11 of the 16 potential categories were chosen by participants, highlighting the subjectiveness of the risk assessment process and demonstrating the challenges faced in obtaining accurate assessment of risk. In the Clancy and Holgate (2008) risk-rating matrix, the choices are the likelihood of the risk occurring (either likely or unlikely) and whether the consequences are minor or major. Using a simple traffic light approach, the operator can determine rapidly when the risk is high (and therefore specific actions should not proceed and alternative options should be found), medium (and therefore caution must be exercised, possibly including additional risk controls), or low (and activities can proceed but should be monitored). See Figure 1.

The dynamic cognitive risk assessment model in Figure 2 provides a snapshot of cognitive biases that can occur at each decision point. Key biases and strategies can be applied to manage the factors that affect the frailty of the human mind. The first step is to evaluate the environment to understand what is occurring. Prior assumptions about the incident are a bias that can reduce the effectiveness of the assessment and reduce the desire to undertake a full analysis of the situation. An effective strategy is to take sufficient time to evaluate the situation; this is a cognitive process and can occur very quickly.

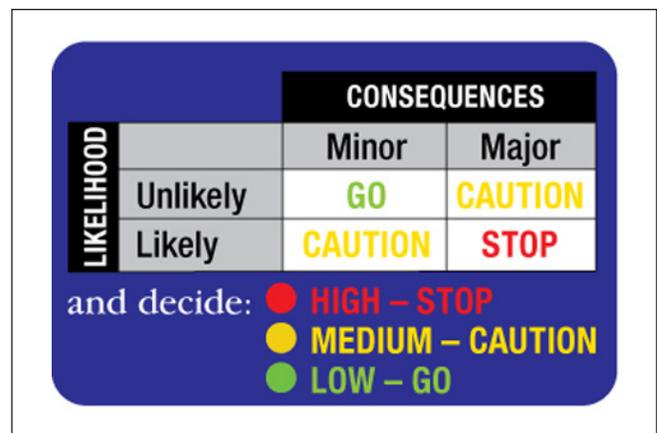


Figure 1.—Simple likelihood x consequences matrix with spotlight coding. From Clancy and Holgate (2008).

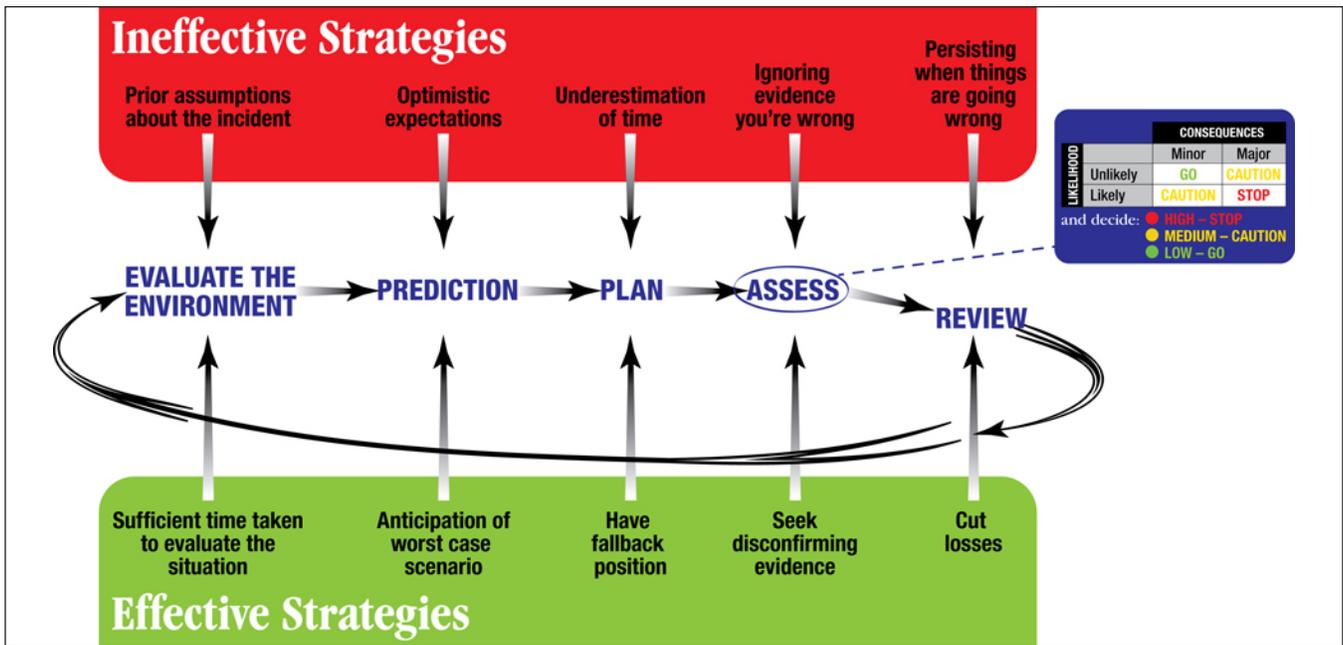


Figure 2.—Dynamic cognitive risk assessment model. From Clancy and Holgate (2008).

The second step is to attempt to predict what may occur; for this step, it is vitally important to have as much information as possible to make a value judgment on what actions should be taken. Optimistic bias is an impediment to effective prediction here. Optimistic bias occurs when people are overconfident of their skills and abilities or underestimate the challenges they face, whereas good risk assessors will always exercise caution and review the situation, thinking of the worst-case scenario. By anticipating the worst-case scenario, people are positioned to deal with changes as they occur and are aware of risks in the environment.

The third step is to develop a plan of action. A key bias that will reduce the effectiveness of the action plan is underestimating the time it will take to put the plan into action; for example, individuals may underestimate the time it will take to get resources into place to implement the plan. To counter this bias, fire managers must always have a fallback position. If the situation changes, they must be ready to act based on the changed situation rather than having to develop new plans on the run.

The fourth step is the assessment of the action plan, including understanding what can go wrong, the likelihood that specific things will go wrong, and the consequences of specific things going wrong. There is some risk here of ignoring evidence that the plan is not working and some risk that confirmation bias will interfere with assessing the plan. Confirmation bias occurs when everything that happens seems to confirm that the plan is working and therefore gaps or flaws in the plan go unrecognized. The skilled fire manager will continually look for evidence that things are not going according to plan to ensure that gaps in the process are identified and acted on promptly.

The fifth and final step is part of the continuous process of reviewing how the plan is working. The greatest risk here is persisting with a plan when things are going wrong; as more time and effort are put into a flawed plan, it becomes harder and harder to change direction. The best way to manage a change in the circumstances when the plan is not going as anticipated is by cutting losses, which can be difficult to do. Again, because this is a cognitive process, it occurs very rapidly and in some cases may involve little conscious thought.

4.0 CONCLUSIONS

Fire personnel can use a combination of documented and cognitive models to follow structured processes in determining acceptable risk. Defining what is acceptable has to take into account the variability of the situation and the limitations in human information processing in the complex environment of wildland firefighting.

Many factors affect both the process of defining acceptable risk and the interdependencies of various aspects of the process. In many cases, something going wrong answers the question of whether the risk was acceptable or not.

In firefighting, there needs to be strong emphasis on the risk-assessment process and on risk assessment as a key competency. Training should also include information about the limitations of human information processing since every individual is prone to cognitive biases and will experience these biases while in firefighting roles. Tools such as dynamic risk assessment raise the profile of risk assessment, but further evidence-based research is needed to determine the validity of these tools and to identify opportunities for improving them.

Defining acceptable risk in firefighting is not an easy task; as Fischhoff et al. (1981) suggest, acceptable risk is often closely related to “the most acceptable option” (p. 3) for a given scenario. In some cases, the most acceptable option may be deciding not to undertake an aggressive attack on a fire. Fischhoff et al. (1981) also provide us with an answer to the dilemma of defining acceptable risk: it is unlikely that “acceptable risk” can be determined when fighting wildfire. The reality is that fire personnel will often be forced to choose the least risky option among many.

Tools are available to help in making risk decisions; in many cases, a combination of tools can assist in effective decision-making. Future research should aim to increase risk awareness and reduce variability in the assessment of risk. Importantly, any risk-assessment model must account for human limitations and the variability of a person’s perception of risk in order to improve the risk decision process.

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The content of this paper reflects the views of the author(s), who are responsible for the facts and accuracy of the information presented herein.

WILDLAND FIREFIGHTERS AND ATTENTION DEFICIT HYPERACTIVITY DISORDER (ADHD)

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Abstract.—Attention Deficit Hyperactivity Disorder (ADHD) is one of the most common disorders of childhood, affecting 3 to 7 percent of the population (American Psychiatric Association 2000). Research has indicated that the prevalence rate of ADHD in adult populations is approximately 4.4 percent and that the majority of those cases go untreated (Kessler et al. 2006). To date, no known research has investigated the rate of ADHD in wildland firefighters, or the implications it may have for this population. For this study, 302 wildland firefighters representing a diverse array of firefighting resource types took the Adult ADHD Self-Report Scale (ASRS v1.1). Almost one in five respondents (19.5 percent) had scores that suggested the presence of ADHD and associated symptoms. Additional studies are needed to investigate ADHD within the wildland firefighting community.

1.0 INTRODUCTION

Attention Deficit Hyperactivity Disorder (ADHD) affects between 3 and 7 percent of the American child population, making it one of the most common disorders of childhood (American Psychiatric Association 2000). Variations in this percentage are partly attributable to the different sources and assessment devices that health professionals use when diagnosing it (Committee on Quality Improvement 2000). If the higher percentages of prevalence rates are correct, nearly 10 million Americans have the disorder.

The hallmark criteria of ADHD are inattention, impulsiveness, and hyperactivity, some or all of which might be present in a diagnosed individual. According to the Diagnostic and Statistical Manual-IV (DSM-IV) of the American Psychiatric Association, ADHD is categorized in one of three ways: ADHD Combined Type (features both inattention and hyperactivity-impulsivity components), ADHD Predominantly Inattentive Type, or ADHD Predominantly Hyperactive Type.

The recommended diagnostic evaluation for children (and adults) suspected to have ADHD entails completion of a psychiatric interview, rating scales from multiple informants, and individually tailored psychological testing (Schweitzer et al. 2001). However, the Adult Self-Report Scale version 1.1 (ASRS v1.1) screening assessment, which was used in this research, has been shown to be an effective instrument in identifying individuals at high risk for ADHD (Adler et al. 2010).

Boys are diagnosed with ADHD more frequently than are girls, with the ratio varying from 2:1 to 9:1 depending on the categorized DSM-IV type (American Psychiatric Association 2000). Over the course of their lifetimes, children with ADHD are at increased risk for academic failure, behavioral problems, substance

abuse, accidents, divorce, and other mental disorders (Barkley 2006).

To date, research has not definitively answered the question of how many adults are affected by ADHD. Schweitzer et al. (2001) estimated that about one-third of children with ADHD continue to have significant symptoms into adulthood. Other research has indicated that while the prevalence rate of ADHD in adult populations is approximately 4.4 percent, the majority of those cases go untreated (Kessler et al. 2006).

The profile of an adult with ADHD typically varies from that of a child. For most, pure hyperactive behavior usually diminishes with maturity, but adults with ADHD continue to have problems with time management, self-control, planning, and being able to persevere toward goals (Harvard Health Letter 2010). Those with ADHD are also at a heightened risk for co-morbidity, or the development of other psychiatric conditions. Learning disabilities (Mayes et al. 2000), depression (Spencer 2001), bipolar disorder (Wozniak 2001), and substance abuse (Biederman et al. 1998,

Wilens et al. 1997) have all been linked with ADHD. ADHD has also been shown to impact workplace performance. In one study, adult workers with ADHD missed significantly more workdays than non-ADHD employees and had a significantly higher number of days with reduced work quality (de Graf et al. 2008).

Goldstein (2002) theorized that adults with ADHD may do better in occupations that are fast-paced, involve risk-taking, and have an outgoing style of communication. Wildland firefighting involves all of these job descriptors. However, no known research has investigated the rate of ADHD in wildland firefighters, or what impacts it might have on this population in terms of job performance and/or daily living.

2.0 METHODS

Three hundred and two wildland firefighters representing a variety of resource types (Fig. 1) took the Adult ADHD Self-Report Scale (ASRS v1.1). Subjects were recruited via word of mouth and through informational flyers posted in various firecamps during

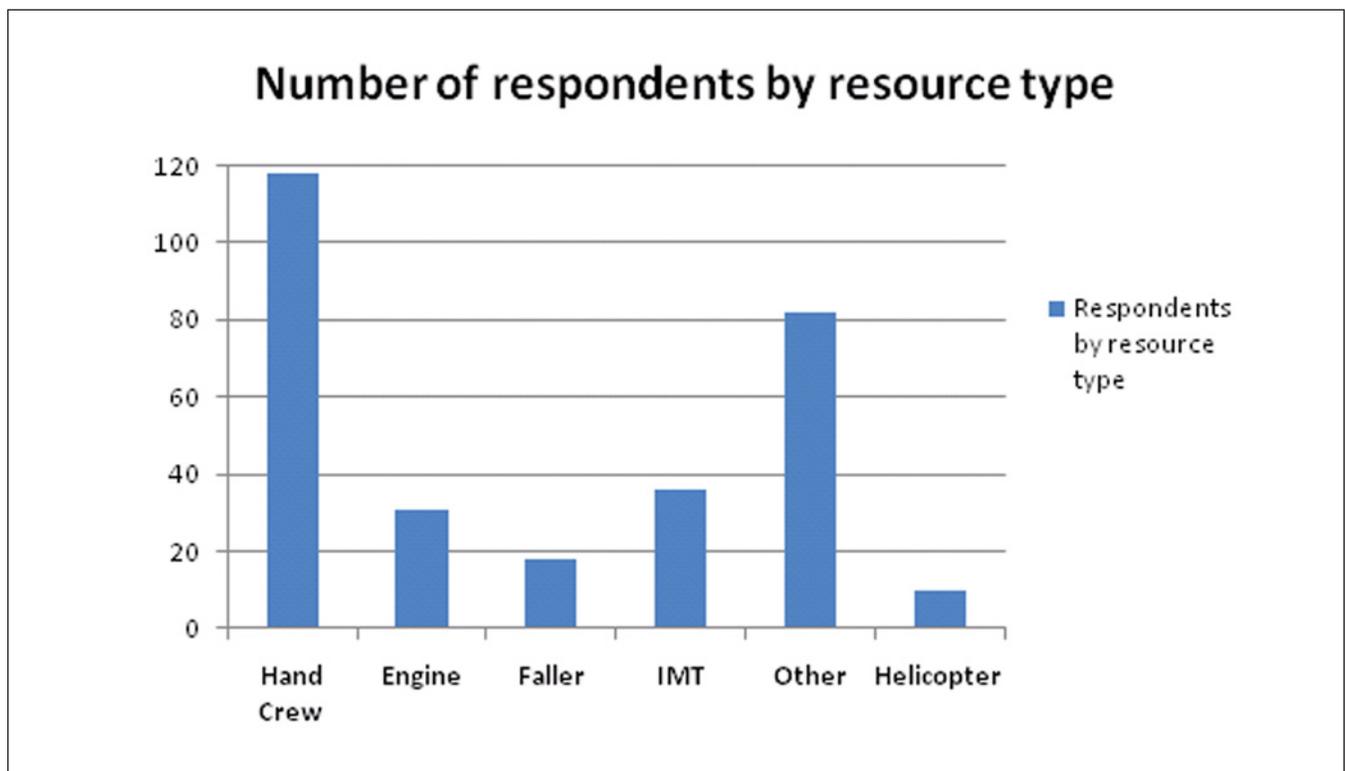


Figure 1.—Respondent breakdown by firefighting resource type.

three separate wildfire incidents in the western United States during the 2009 fire season: a Type II incident in Oregon, a Type II incident in Washington, and a Type I incident in California. Subjects completed surveys in firecamp as their schedules permitted.

The ASRS v1.1 has been demonstrated to be a reliable and valid scale for evaluating ADHD in adult populations, with high internal consistency reliability (0.63-0.72) and test-retest reliability (0.58-0.77) (Adler et al. 2006, Kessler et al. 2007). The ASRS consists of 18 questions in Likert format, with the following responses: never, rarely, sometimes, often, or very often. If the summed responses meet or exceed a minimum cutoff score, the presence of ADHD and its associated symptoms is suggested. The brevity of the ASRS v1.1 and its ability to discriminate ADHD cases from non-cases make it an attractive instrument for both community epidemiological surveys and clinical outreach and case-finding initiatives (Kessler et al. 2007).

3.0 RESULTS

Nearly one-fifth (19.54 percent) of the 302 respondents who completed the ASRS v1.1 attained a score that met or exceeded the established clinically significant cutoff score. Therefore, nearly one-fifth of those surveyed displayed symptoms consistent with an ADHD diagnosis.

4.0 DISCUSSION AND CONCLUSIONS

In this study, firefighters had more than four times the prevalence rate of ADHD that has been identified in the general adult population in previous research. However, we may not be able to generalize these results to the whole population of wildland firefighters since the subjects were not randomly selected. Further studies are needed to investigate the wider prevalence rates of ADHD within the wildland firefighting community and to assess what impacts, if any, ADHD has upon those who contend with the disorder. In addition, if the current research is an accurate reflection of just how common ADHD is in wildland firefighters, future studies could identify why those with ADHD seem to be drawn in higher numbers to the profession.

Emerging research has suggested that ADHD might actually be beneficial for certain occupational populations (Eisenberg et al. 2008) and firefighting may fall into this category. Those with ADHD are often behaviorally active individuals who are comfortable with physical movement (National Institute of Mental Health 2010) and many fire-related activities call for individuals to be physically dynamic. As noted earlier, fire operations are often fast-paced and entail risk, traits which may appeal to those with ADHD.

Results from this research have important ramifications in many areas, including training, communication, situational awareness, leadership, human error, and group dynamics. Those with ADHD are prone to distractibility and inattentiveness, and learning disabilities have been shown to be a common co-morbid condition in those with ADHD. With these considerations in mind, the current methods of training (e. g., S-classes), which rely heavily on a traditional lecture format, might not be the most effective way of educating firefighters. More experiential, hands-on types of learning might lead to better educational outcomes. Inattentiveness and distractibility might also lead to challenges in building and maintaining situational awareness, which is key to making effective decisions and ensuring safer operations in firefighting.

Impulsivity, another common trait in ADHD, could also affect decisionmaking. Impulsive individuals tend to initiate actions without thinking about possible ramifications—potentially leading to numerous negative outcomes in the wildland firefighter's operational environment. Due to the characteristics of ADHD, those with the disorder often experience interpersonal difficulties with the people around them. These individuals therefore may face challenges working in a team environment. Effective team functioning is essential in wildland firefighting since the bulk of its operations takes place in a team setting (e.g., Incident Management Team, hotshot crew, smokejumper squad, engine crew, and burning module).

Those who have been diagnosed with ADHD are also prone to being affected by other psychiatric conditions, such as a learning disability, depression, or substance abuse. Future research efforts could identify whether wildland firefighters with ADHD are more likely to experience specific co-morbid disorders.

In conclusion, nearly 20 percent of the wildland firefighting community sampled in this research appear to be experiencing ADHD, which is more than four times the prevalence rate found in adult populations. If this is indeed the case, it has far-reaching ramifications in a wide variety of areas. More research is needed to further clarify the findings presented here.

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The content of this paper reflects the views of the author(s), who are responsible for the facts and accuracy of the information presented herein.

CHANGE AS A FACTOR IN ADVANCING FIRE-MANAGEMENT DECISIONMAKING AND PROGRAM EFFECTIVENESS

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Abstract.—Wildland fire management—as evidenced by its nature, historical growth, and development—can be characterized as a program of constant change. To become better able to meet changing conditions and complexity, fire management must be agile, flexible, and able to embrace change. But many challenges and limitations to acceptance continue to hamper moving fire management advances into practice. Recent innovations in science and technology present opportunities to improve the organizational performance and effectiveness of fire management. The Wildland Fire Decision Support System application is one example of an effort to increase flexibility and agility and improve fire-management decisionmaking and program effectiveness.

1.0 INTRODUCTION

Since the start of the 20th century, fire management's very nature, historical growth, and development have been subject to change. In fact, fire management has involved such continual change that it has been described as a "change-centric" program. DeBruin (1974) linked the shift from fire control to fire management with the constant nature of change, stating that "fire management is change" (p. 11).

Factors driving continual change in fire management are directly related to program scope and magnitude. As the fire environment, social and political expectations and requirements, economic concerns, and physical capabilities change, challenges and

risks regarding wildland fire management increase in both complexity and extent. Temporal ranges of fire activity, spatial extent of burned areas, and threats from wildland fires grow each year as long-term effects of land use and fire management dominate natural vegetation communities. In addition, current land-use practices allow the building of structures with ever-escalating property values, which compound fire management concerns and, at times, limit management options.

Williams (2010) addressed the increasing complexity of wildland fire management and the need for change during a fire conference presentation. He stated that the environmental, economic, social, and physical factors affecting fire management today and into the future are shifting the calculus of fire protection in the United States and worldwide. The trajectory of these factors suggests that challenges facing wildland fire management require changed business processes and improved organizational effectiveness to keep pace. The case for change has also been reinforced by projections of strategic burned area and costs made in the Quadrennial Fire Review (National Wildfire Coordinating Group 2009a).

1.1 What is Change?

Change represents a movement from areas of experience, comfort, and practice into areas with different rules, direction, and procedures, and even strategic thinking and philosophical views that are uncommon or cause discomfort. However, change does not imply elimination of positive program experience, accomplishments, or strategic thinking that has led to success. Successful change is based on logic that adapts to development of new practices, incorporates new science and technology, and builds on lessons learned to promote organizational growth, advanced capability, and organizational efficiency. In most situations, change is seldom well embraced or easily implemented.

Change can be difficult to effect, especially when common knowledge and behaviors that feel comfortable become culture. Once a culture is established, processes to change it can be long and arduous (Schein 2004). The new overall goal and what it will take to achieve it tend to come as a shock to the planned audience (Collins and Porras 1998).

Kotter (1998) presents a set of steps common to all successful change or transformation efforts (Table 1). These eight steps must be implemented over time; moving too fast, giving too little attention to each, or skipping steps can derail the entire change effort.

Table 1.—Eight steps to effect change or organizational transformation (Kotter 1998) and descriptions of the steps.

Steps	Description, Actions
Establishing a sense of urgency	Organizational realities and efficiencies must be assessed and evaluated to determine whether the vision and goals are still on track or whether organizational alterations are needed to maintain the desired trajectory.
Forming a powerful guiding coalition	Once the need for change is identified, the group must be assembled with sufficient power to lead the effort and overcome barriers.
Creating a vision	A vision must be created that will frame and guide the change effort. If the vision is followed, strategies for achieving that vision will eventually be developed. Kotter (1998) emphasizes that failed transformations are characterized by an abundance of plans and programs, but no clear and achievable vision.
Communicating the vision	All existing communication delivery methods must be used to disseminate the vision.
Empowering others to act on the vision	Gaining support for the vision and encouraging people to act on it requires removal of obstacles, changing incompatible systems or structures, taking risks, and utilizing non-traditional ideas, procedures, and activities. Empowerment means giving people permission and, more importantly, the ability to do something differently.
Planning for and creating short-term wins	The change process cannot only start and end; it must be a planned, progressive action. Visible performance improvements and advances in organizational efficiency must be designed and included in plans. Short-term goals must be built into the process and periodically achieved.
Consolidating improvements and producing more changes	Once successes begin to be realized, they must be capitalized on and used to support continued changes in systems, structures, and procedures. Short-term successes build credibility and can be used to launch efforts to change other and bigger problems.
Institutionalizing new approaches	Institutionalizing change is a prerequisite to long-term success. The connection between altered practices, procedures, and policies and success, organizational efficiency, and increased performance must be direct and verifiable. As Kotter (1998) explains, “In the final analysis, change sticks when it becomes ‘the way we do things...’” (p. 18)

Within most organizations, the dynamics of management and of change are very similar. As organizational efficiency is lost, the multiple phases associated with change processes become very involved and not easily accomplished. When any organization, especially wildland fire management, steadily incorporates new scientific information and emerging technology, matches changing policy, and bases its foundation on the best available knowledge, it can sustain a high level of organizational efficiency. If the organization does not maintain dynamic growth, however, it can lose efficiency quickly. Figure 1 shows that efficiency is eroded through one of two pathways: either a chronic degradation or an acute disruption. Progressing through a chronic degradation leads the organization to situation blindness and

passive awareness, and eventually to active awareness. Situation blindness occurs when the organization has significant problems but does not know it has problems. Passive awareness develops when an organization realizes it has problems but either does not know what to do about them or refuses to acknowledge them. Eventually, as the phase of active awareness is reached, the organization recognizes its problems and develops solutions to them.

An acute disruption occurs when a significant single event drives the organization to passive or active awareness, usually the latter. Something has happened that clearly illustrates that the current state of organizational efficiency is no longer acceptable.

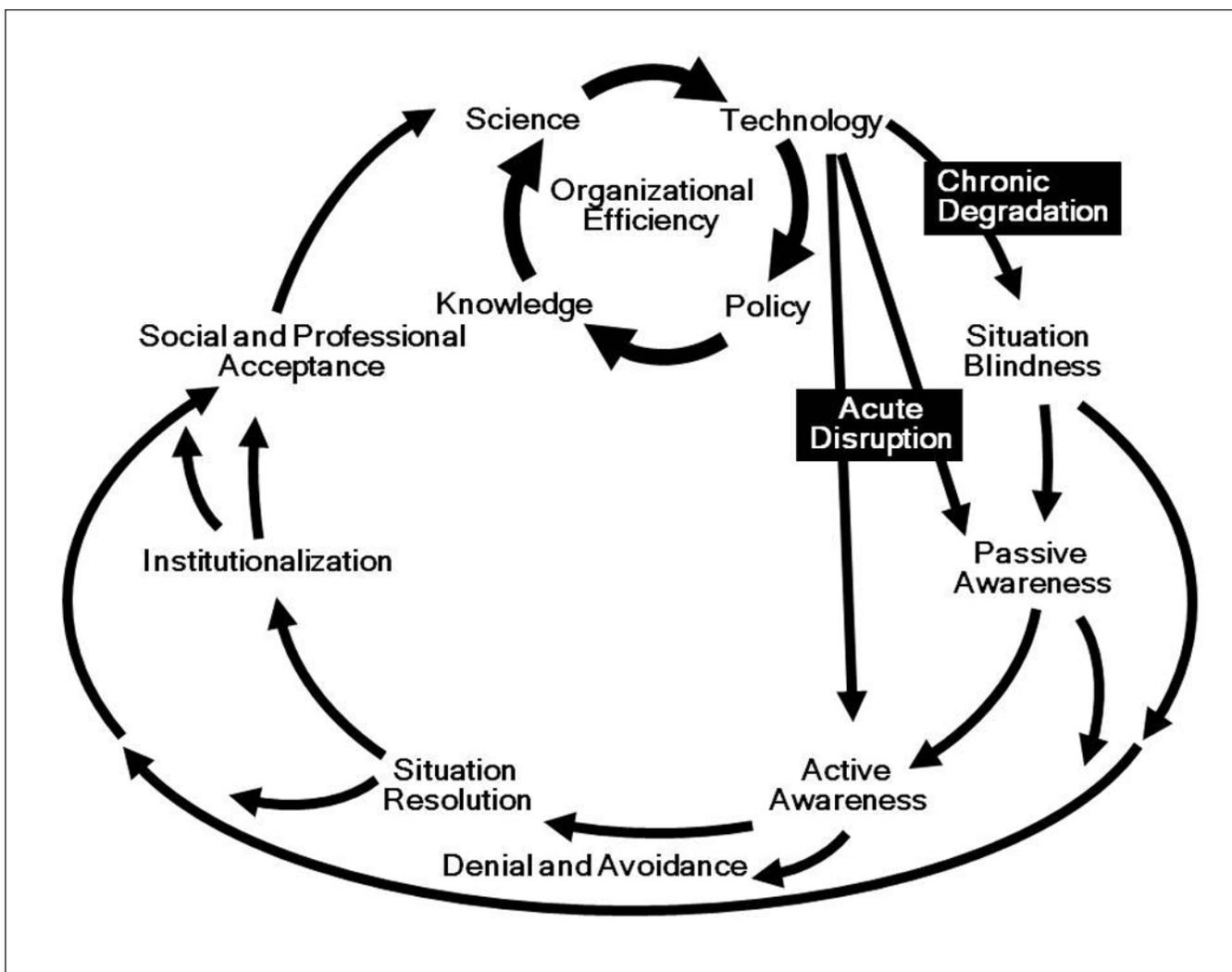


Figure 1.—Generalized change dynamics model.

Once active awareness is reached, the organization develops methods to correct the problems. Problem resolution procedures, practices, and methods are developed and implemented. The process then advances to the institutionalization stage, where new practices, procedures, and changed policy are documented in guiding principles, directives, or policies and become mandated business rules. From this point, the process moves toward professional and social acceptance, where endorsement is acquired from organization personnel; external groups including the public, media, and political groups; and prior organization employees, either retired or otherwise separated from the current organization. Although the new direction has been institutionalized, this stage is particularly important because without full endorsement, change implementation can stall, languish, and fail to support re-establishment of full organizational efficiency.

Once social and professional acceptance is achieved, the organization moves back into the desired high level of organizational effectiveness. An important point is that at every stage in the process, denial and avoidance can (and usually does) occur, delaying or blocking implementation and progression back to full effectiveness. Denial and avoidance lose energy and dissipate once social and professional acceptance is achieved.

The change dynamics model in Figure 1 encompasses a wide range of steps in the change process. Kotter's (1998) eight steps do not enter the model until the active awareness phase. It is desirable to keep the organization in the highest organizational efficiency level—but if that is not possible, it is important to pass through problem recognition and definition quickly so as to reach the active awareness stage. Until the problem is fully recognized, there is no sense of urgency. Communication is vital to all efforts and once a vision is created and action steps are developed, communication must occur throughout the process; it is especially important to professional and social acceptance.

2.0 WILDLAND FIRE MANAGEMENT – A CENTURY OF CHANGE

2.1 Program Development

Wildland fire is a fundamental program element within the larger field of natural resources management. In contrast with wildland fire management, companies in the private sector respond to change by remaking themselves in order to maintain competitiveness in highly dynamic market environments. But in wildland fire management, market share and competition are not relevant and change is not forced by constant pressure to grow, expand, and gain greater efficiency. Instead, there is a basic need to update management strategies to respond to an increasingly complex and challenging program environment.

Since the inception of organized fire suppression in the early 1900s, wildland fire management has progressed from a one-dimensional program focusing on fire control and immediate extinguishment to a multi-dimension program that uses the full spectrum of management responses to accomplish both protection and ecological objectives. The constant growth of wildland fire management is illustrated conceptually in Figure 2.

Early on, fire management focused on resource protection. As fire management matured, fire suppression methods became more organized and refined and the expansion of capabilities began to take precedence. Prescribed fire, the intentional application of fire to achieve beneficial objectives, began as an important program component but remained subordinate to fire suppression for some time. Gradually, however, use of prescribed fire in resource management gained importance and acceptance as it increased knowledge about fire effects and the role of non-anthropogenic fire. Prescribed fire and fire suppression eventually converged into a single fire management program with a focus on organizational efficiency and decisionmaking (Fig. 2). This convergence occurred from 1968 to 1974, when federal wildland fire management agencies moved from fire control to fire management to better reflect

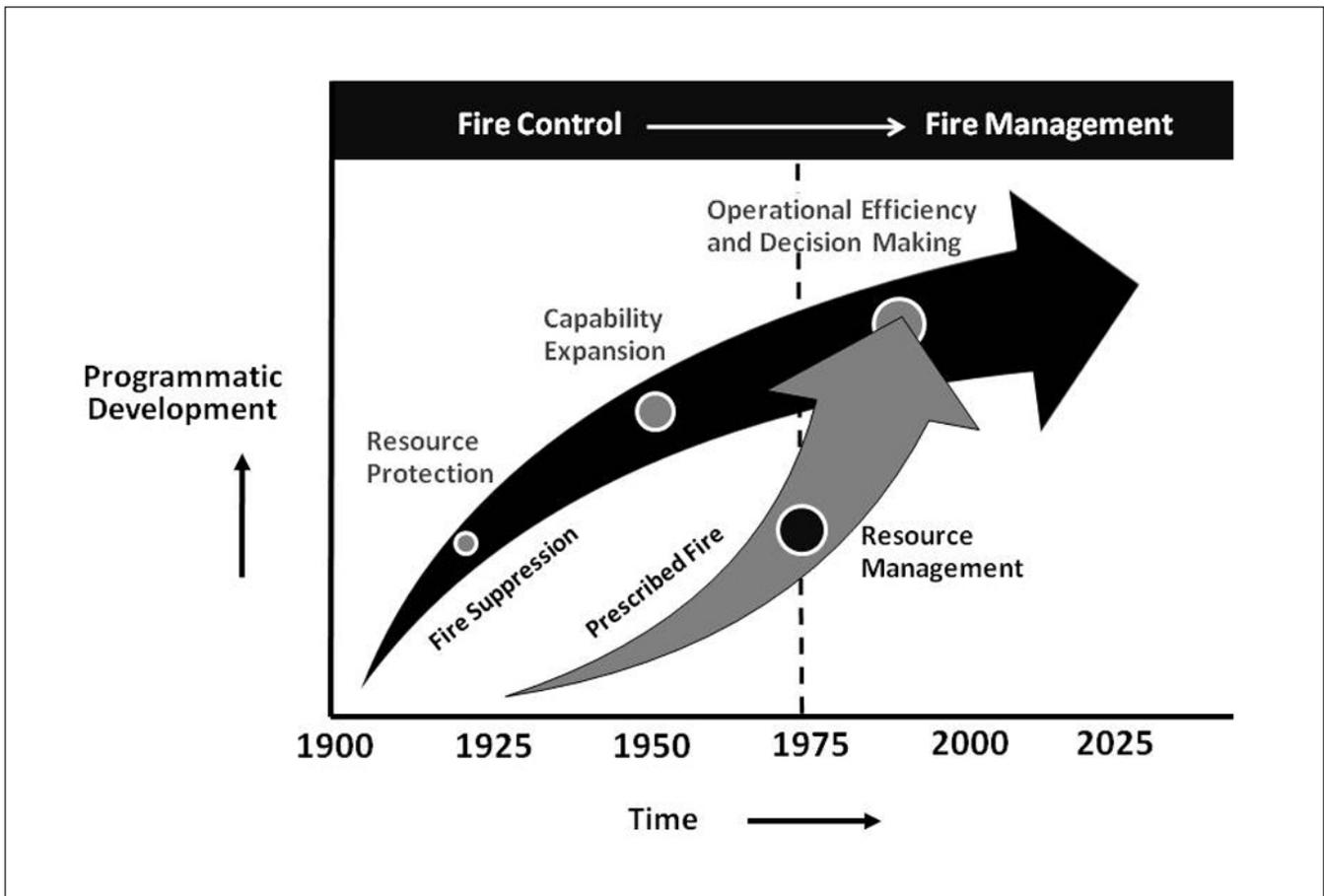


Figure 2.—Programmatic development of the wildland fire management program.

the range of management activities and objectives (DeBruin 1974, Gunzel 1974, van Wagtenonk 2007).

As fire management moves into the future, it will need to focus on improving program efficiency while still accomplishing protection and other resource management objectives. Improved decisionmaking capability will be of particular importance and can be gained by: adding new knowledge and capability from fire research; incorporating ecological, economic, and social considerations into decision analysis; creating new tools to aid situational analysis and risk assessment; and connecting decisions to land and resource management. Cleaves (2010) states that despite significant milestones since 1910, future wildland fire management research must change and take new directions. In support of land and resource management, Williams (2010) says that “the next century of fire management needs to have a commitment to a more mature, more sophisticated land management strategy in fire dependent ecosystems.”

2.2 Factors Driving Change in Fire Management

Multiple factors have become increasingly important over time in forcing changes in fire management. The changing temporal and spatial extent of fires; increasing operational complexity; decreasing management capability; growing ecological significance of fire effects; escalating seriousness of potential fire consequences; rising social, economic, and political concerns; evolving policy; innovations in science and technology; climate change impacts; and organizational learning have all changed fire management. Organizational learning—the aggregation of experiences; acquisition of new information; analysis of activities; application of knowledge, processes, technology, and proven practices; and archiving of overall processes and results—is of particular relevance (Zimmerman and Sexton 2010).

2.3 Barriers to Change

Change in fire management, while commonplace, is not easy or quick and is associated with numerous challenges and limitations to acceptance. These limitations present barriers, delay progress, or block movement and are generally a function of “reinvention tension.”

Most of the factors that constrain change result from an inability to cope with risk, uncertainty, and movement outside a zone of comfort and security. Many are related to human nature and human dimensions and show ties to Kotter’s (1998) eight steps. Common barriers to change include:

- Uncertainty – Individuals may be uncertain about what the outcome of change will be and how they and their organization will be affected.
 - o Movement outside comfort zone – It is extremely difficult to move people out of their comfort zones. Cultural traditions and biases can lead to divisiveness. Schein (2004) says that when substantial change comes up against significant culture, culture always wins.
 - o Lack of vision – The absence of a sensible vision fuels uncertainty, and efforts to implement change can dissolve into a list of confusing and incompatible projects that take programs in the wrong direction or nowhere at all.
 - o Experience – Discomfort and lack of support often occur when change involves moving outside the parameters of past experience. Change should involve creating a new possibility for a powerful future, which can often mean a future that experience and predictions indicate is impossible.
 - o Predictability – Predictability tends to offer a sense of security and even a degree of control. Without stated intentions, ground rules, clear direction, identified procedures, and timeframes, people cannot predict and anticipate the future, which promotes discomfort and reluctance to continue.
- Trust – Without trust, involved individuals will not believe that goals can be achieved.
- Lack of communication – Without active communication, the vision and urgency of the case for change cannot be understood, and the process will quickly degrade and likely be unsuccessful.
- Human nature – The limitations of human nature influence individuals’ responses to change and an organization’s ability to effect change. Specific limitations include the following (adapted from Los Alamos National Laboratory [2006]):
 - o Limited working memories – Memories are keyed to information in terms of key words, phrases, and pictures, which can lead to oversimplified views of processes, procedures, and practices and cause change processes to lose momentum.
 - o Limited attention – The ability (or inability) to focus on multiple issues varies among individuals, can be hindered by stress, and may cause people to miss or overlook information.
 - o Limited perspective – Usually only some parts of an issue or problem receive attention. This limited perspective, leads to the formulation of inaccurate mental pictures or models, which are preclude support of change efforts.
 - o Susceptibility to emotion – Anger, embarrassment, social anxiety, pride, insecurity, and motivation to succeed and accomplish goals are all important elements that cannot be overlooked during change efforts. Individuals faced with change will be highly susceptible to emotional responses, and failure to recognize and respond to emotions will promote discord and limit group progress.
- Organizational Learning – Organizational learning is based on the integration of program analysis and documentation of both successes and failures in order to build better practices and improve program effectiveness. Organizations’ failure to learn and respond can limit perspective, retain cultural traditions or biases, and severely impede change efforts.

- Leadership – Traditional fire management leadership and governance models of command-and-control conflict with newer goals of transparency, shared decisionmaking and acceptance of risk, and collaborative leadership.

3.0 WILDLAND FIRE DECISION SUPPORT SYSTEM (WFDSS)

Federal agency policy has required documentation and analysis of wildland fire suppression decisions for nearly 30 years. The Wildland Fire Situation Analysis (WFSA), which required managers to evaluate different suppression strategies, previously met this requirement. The WFSA was a complex decision-analysis tool based on decision-science principles that were fundamental to suppression efforts. Unfortunately, use of the WFSA frequently occurred at times of highest uncertainty, time sensitivity, workload escalation, and associated elevated stress levels. Additional processes emerged over time for documenting and analyzing alternatives for managing wildland fire for resource benefits—the Wildland Fire Implementation Plan (WFIP)—and for long-duration wildland fires—the Long-Term Implementation Plan (LTIP).

Utilizing three distinct fire decision-analysis processes resulted in process redundancy, excess work, and a lack of continual inclusion of emerging and improving technology, fire modeling, and geospatial analysis. WFDSS was created as a single system to replace all previous processes and is intended to streamline and improve wildland fire decisionmaking for line officers, fire managers, and analysts.

WFDSS is a Web-based system for documenting decisions, supporting analysis, and completing operational plans. This system utilizes fire behavior modeling, fire weather information, economic principles, and information technology to support effective wildland fire decisions consistent with Land and Resource Management Plans and Fire Management Plans for all wildland fires. WFDSS greatly reduces text input requirements by using spatially oriented and graphically displayed information. The system incorporates a progressive

decision documentation and analysis process that can be scaled and adapted to match situational changes. Through WFDSS, information is assembled, consolidated, and processed for decision-makers in a way that fosters collaboration and, ultimately, provides opportunities to improve large wildland fire strategic decisionmaking.

WFDSS has many attributes that make it different from other decision systems previously used in wildland fire management. These differences, along with implementation swiftness, represent a significant change in fire management practices. Fire managers initially reacted to the introduction of the WFDSS with uncertainty, consternation, avoidance, and reluctance to support. Because of these early reactions, WFDSS represents a prime example of a process and policy change in action and is a useful illustration of how change is successfully being implemented.

4.0 MEASURING SUCCESS

Success of WFDSS development can be assessed in several ways. First, in relation to Figure 1, the WFDSS development steps can be easily equated to the generalized change dynamics stages. Development of WFDSS progressed through these steps, moving decision analysis and documentation toward levels of higher organizational efficiency. As historic decision analysis methods evolved into multiple processes, limitations regarding the processes and understanding and implementation of them led to chronic degradation. The situation blindness and passive awareness stages were relatively short-lived as it became quickly apparent that the old (pre-WFDSS) processes were not meeting managers' needs. In the active awareness stage, fire-management leaders clearly identified the issues and the need for change. In the situation resolution stage, the vision for a new process was clarified, assignments were made for development, and WFDSS was developed and delivered to managers for use. Federal fire-management policy modifications eventually identified WFDSS as the single process for decision analysis and documentation for all wildland fires (National Wildfire Coordinating Group 2009b, USDA Forest Service-U.S.Department of Interior 2009), which,

in combination with amended agency manuals and directives, represented the institutionalization necessary for full implementation. The amount of accelerated training, application during active fire situations, and outside interest gives an indication of professional and social acceptance.

Since the initial release, training for WFDSS has been provided through a variety of delivery methods, including webinars, face-to-face regional and national training courses, instruction in other courses, and presentations at agency and interagency meetings. Through these sessions, more than 5,000 individuals have been trained to date. Use of WFDSS has increased substantially. From 2007 to 2010, the number of incidents recorded annually in WFDSS has grown from 218 to 12,433. An additional indicator of professional acceptance is provided by the number of fire-related managers and other professionals with an authorized WFDSS logon (users). Currently, there are nearly 7,000 authorized WFDSS users.

Some denial and avoidance occurred during this process, but they were minimal because of strong support, a clear vision, and fire management agencies' inability to delay acceptance as other cooperators moved forward. All five federal wildland fire management units have now endorsed WFDSS and accepted it as their standard for decision analysis and documentation.

Describing WFDSS development and implementation in relation to Kotter's (1998) eight steps to transformation also provides a measure for WFDSS's success to date (Table 2). A sense of urgency was developed at the beginning of the process and the initial managing agency responsible for WFDSS development actually accelerated the initial delivery date by 1 year. A powerful coalition was established through the interagency community and its level of support for WFDSS was evident in subsequent fire policy directives (National Wildfire Coordinating Group 2009b, USDA Forest Service-U.S. Department of Interior 2009). A clear vision was established and communicated to all affected agencies and users. The nature of an analytic-deliberative system and the

need for a network of users and support personnel empowered a large number of others to learn, act on, and use WFDSS. Short-term wins have not been well planned for and created but did occur during the development process. Although agencies initially sought to slow implementation of WFDSS and take a phased-in approach, fire season realities pushed accelerated use by field units, resulting in increased support for use and more rapid movement to acceptance. Consolidating improvements and producing more changes are ongoing activities and the large network of users provides a consistent, reliable, and dynamic feedback process for identifying needed system improvements. Institutionalization of WFDSS has been occurring and will continue as agencies refine interagency and agency policy and directives regarding decision analysis and documentation.

5.0 SUMMARY

Change is fundamental to improving organizational effectiveness. Within wildland fire management, change is relentless and has been a part of the development of this program since its inception. As the program has matured, many variables combined to increase complexity, and efficient decisionmaking has become increasingly important. Managers need to be able to acquire as much information as possible as quickly as possible to support their analysis and deliberation during decisionmaking. A progressive and swift decision documentation and analysis process that allows immediate responses to changing situations or scales was determined to be necessary to improve fire management decisionmaking.

The Wildland Fire Decision Support System was developed to meet this need as a single system applicable for all wildland fires. The development and application of WFDSS is an example of a basic change process in fire management. It represents a significant shift from traditional methods and is part of fire management's attempt to improve performance and meet increasingly complex challenges. WFDSS has changed the fire management process, the kind and amount of information available, and the speed with which data can be acquired, analyzed, and utilized.

Table 2.—WFDSS implementation actions and measures of success associated with Kotter’s (1998) eight steps to transformation.

Steps	WFDSS Implementation Actions and Measures of Success
Establishing a sense of urgency	Fire managers from all federal agencies reached a consensus that the three independent decision documentation processes in wildland fire management were inadequate and needed to be consolidated into a single process, applicable to all wildland fires as soon as possible. The associated sense of urgency was cause to charter a group to lead development of a new system—the Wildland Fire Decision Support System.
Forming a powerful guiding coalition	A powerful guiding coalition was formed when senior wildland fire-management managers agreed to support development of a new system. At that time, the National Aviation and Executive Board and senior managers from all federal wildland fire management agencies pledged support.
Creating a vision	A vision was created stating that the new process would be linear, progressive, scalable, consistent, flexible, inclusive of fire-behavior and economic-analysis models, geospatially based, less reliant on text inputs, and hosted on the Web.
Communicating the vision	The vision was communicated to all agencies through numerous presentations, workshops, agency directives and information bulletins, and eventually through established on-line training, information sharing, and presentations at national and international symposiums, national and regional federal and state training courses, and agency and interagency meetings. Communication will remain an ongoing activity for the duration of system development.
Empowering others to act on the vision	Because WFDSS has numerous authorized user roles, the likelihood that thousands of users will understand their specific roles and use parts of the system is high. It is important that many individuals act on the vision, develop varying levels of proficiency, and disseminate information to others about the system. A network of individuals, currently exceeding 7,000 registered users, cascades from the national level down to local units and is serving to advance system understanding.
Planning for and creating short-term wins	Short-term wins have occurred through endorsement by all agencies; some agencies issued direction in 2009 to utilize WFDSS on all fires and eliminate previous processes. Other agencies took a more phased-in approach and implemented WFDSS over longer periods. The ability to use old systems was curtailed by their phase-out. Other short-term wins included the volume of use by all agencies (over 7,700 wildland fires during the first calendar year of implementation; use by all five federal agencies, 17 states, and some private entities such as Alaska Native Corporations; and use on over 12,000 wildland fires during the second year of implementation) and endorsement by senior level managers in all agencies and national budget oversight organizations.
Consolidating improvements and producing more changes	During WFDSS implementation, suggestions about enhancement and modification have continuously been received. These suggestions range from minor modifications to user interface appearances and function to movement beyond a post-ignition decision documentation system. The system will continue to develop and expand beyond the original vision.
Institutionalizing new approaches	The institutionalization of WFDSS has been occurring and will continue as agencies document its required use through directives, manuals, and policies. WFDSS is currently on the way to characterization as “the way we do business here.”

WFDSS development has progressed rapidly, has mirrored change dynamic stages and accepted transformation steps, and represents a much-improved system that serves to modernize situational analysis, risk assessment, and complex decisionmaking.

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EXAMINING CHANGES IN WILDFIRE POLICY AND GOVERNANCE IN THE UNITED STATES THROUGH THREE ANALYTICAL LENSES

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Abstract.—U.S. wildfire policy and governance increasingly emphasize collaboration among levels of government and between government and non-governmental entities, expanding the roles and duties of nonfederal and nongovernmental organizations, and instituting performance-based measures to improve accountability and control costs. While many changes have been enacted, others have yet to be realized. This paper’s purpose is to examine changes in U.S. wildfire governance through three analytical lenses: collaborative public management (CPM), adaptive governance (AG), and historic institutionalism (HI). CPM focuses attention on: structures of interdependence; strategies for pooling resources, monitoring, and accountability; and capacity to attain desired outcomes. AG draws attention to structures that facilitate social learning, successive modifications, and continued improvement across different scales. HI suggests that the institutions of governance resist change so that even new ideas—such as collaborative public management and adaptive governance—may fail to become institutionalized, even when widely supported. If they do become institutionalized, it may be in a context in which older institutions continue to coexist, creating a complex and sometimes contradictory management context. Each lens offers a framework of understanding and explains certain aspects of wildfire policy and governance; collectively, the lenses provide analytical power beyond what any single lens could provide.

1.0 INTRODUCTION

In this paper, we examine the pathways and factors associated with changing wildland fire policy and governance in the United States that have spurred the growth of collaborative, network-based governance approaches from the local to national levels (Steelman and Burke 2007). These multi-scalar governance approaches lend themselves to analysis using Kiser and Ostrom’s (1982) “three worlds of action” framework for analyzing governance institutions, which specifies three levels of governance rules: operational, collective-choice, and constitutional-choice. *Operational* rules articulate decisions about how to appropriate and manage resources, provide information, monitor actions, and enforce rules. *Collective-choice* rules define what and how decisions are made, thereby enabling or constraining operational-level governance. *Constitutional-choice* governance refers to who gets to participate in decisionmaking, the powers and authorities with which participants are vested, and how participants are structured and organized. This framework provides a means by which to examine where governance changes are occurring, what factors enable or constrain changes at each level, why these factors arise and persist, and the prospects for durable change given conditions across the three governance levels. Our research follows the work of Imperial (2005), who examines the performance of collaborative watershed management across the three governance levels.

To further the critical nature of the examination and add depth to answering the “why” question, we apply three interpretive lenses to our wildfire management governance cases: CPM, AG, and HI. When brought together, the lenses shed light on how and why pathways and mechanisms of governance change manifest the way they do, and how changes—or lack of changes—at the operational, collective-choice, and constitutional-choice levels interact. Further, applying

the three lenses collectively can target barriers to specific pathways and mechanisms to more durable governance change and inform more systematic, intentional transformations in wildfire governance.

2.0 STATUS OF WILDFIRE GOVERNANCE

Since 2000, federal and state policy-makers have enacted a series of policy initiatives to transform wildfire governance: the National Fire Plan (NFP), the Western Governors Association’s Ten-Year Implementation Strategy (TYIS), the Wildland Fire Leadership Council (WFLC), and the Healthy Forest Restoration Act (HFRA) (Table 1). NFP is a set of collective-choice governance rules directing federal agencies to invest technical, financial, and organizational resources to support wildfire management across jurisdictions and land ownerships.

Similarly, the TYIS is a collective-choice mechanism specifying a framework for intergovernmental, interagency, and government/nongovernmental organizational collaboration, and a system of performance-based measures. The WFLC was created by the Secretaries of Agriculture and Interior as a constitutional-level arrangement to oversee wildfire policy. WFLC is an intergovernmental committee of federal, state, tribal, county, and municipal government officials that provides oversight and coordination of the National Fire Plan and Federal Wildland Fire Management Policy. As a constitutive policy, HFRA authorized communities to collaborate with government agencies to create Community Wildfire Protection Plans (CWPPs). CWPPs specify priority areas for hazardous-fuels reduction, recommended treatment prescriptions for those priorities, and measures to reduce “structural ignitability.”

Table 1.—Recent U.S. wildfire management policies.

Policy	Governance Level	Description
National Fire Plan	Collective-Action	Directs the Departments of Agriculture and Interior to take steps to achieve goals of increased firefighting capacity, post-fire rehabilitation, hazardous fuel reduction, and assistance to communities to reduce catastrophic wildfire risk.
Ten-Year Implementation Strategy	Collective-Action	Establishes a collaborative, performance-based framework across federal, Tribal, state, and local governments to achieve goals of improving fire prevention and suppression, reducing hazardous fuel reduction, restoring fire-adapted ecosystems, and promoting assistance to communities to reduce catastrophic wildfire risk. The collaborative framework spans three organizational levels: local, state/regional and Tribal, and national.
Wildland Fire Leadership Council	Constitutional	Establishes duties and responsibilities for an intergovernmental committee of federal, state, Tribal, county, and municipal governments to work in concert to address large-scale policy, programmatic resource allocation, prioritization, and budget issues.
Healthy Forest Restoration Act of 2003	Constitutional, collective-action, and operational	Directs the Secretaries of Agriculture and the Interior to conduct hazardous fuels reduction projects on National Forest System lands and Bureau of Land Management lands aimed at protecting communities, watersheds, and certain other at-risk lands from catastrophic wildfire, and to enhance efforts to protect watersheds and address threats to forest and rangeland health, including catastrophic wildfire, across the landscape. Authorizes the role of communities to work collaboratively with federal, state, and local governments to develop Community Wildfire Protection Plans to complement plans and priorities of federal agencies to reduce wildfire risk to communities.

For more details on each policy, see further: <http://www.forestsandrangelands.gov/index.shtml>

What has been the progress of these governance changes? At the constitutive level, the WFLC has carried out its duties to meet on a regular basis to discuss policy, resource allocation, prioritization, and budgeting.¹ However, WFLC recommendations have not translated into changes at the collective-choice or operational levels. The General Accounting Office (GAO) has consistently discovered that agencies have failed to develop and implement a comprehensive, cohesive wildland management strategy as specified by the NFP, TYIS, and HFRA (GAO 2006, 2007b, 2008, 2009a). With regard to the TYIS' recommendation to develop a coordinated system of accounting and performance measures, GAO and others have found that federal agencies have fallen short in developing information systems to prioritize and measure effectiveness of treatments, and in developing budgeting tools to allocate funds to achieve national wildfire management goals (GAO 2007a, 2009b; U.S. Department of Agriculture-Office of the Inspector General 2006).

Information and research on local CWPP development and implementation suggest that the expansion of communities' roles and duties has made halting progress. CWPPs alter collective-choice rules for how communities, non-governmental stakeholders, and federal, state, Tribal, and local governments interact to address wildfire management goals and priorities. A recent update reported that more than 4,600 CWPPs have been developed (U.S. Department of Interior and U.S. Department of Agriculture 2009). A comparative case study of 13 CWPP processes across eight states indicates varying types and levels of collaboration in CWPPs (Jakes et al. 2007). One key finding is that the collaborative process to develop CWPPs does result in social benefits beyond hazardous-fuels reduction, such as: enhanced social networks within the community and between community members and government entities; the development of learning communities; and the development of community capacity to self-organize to address wildfire risks and hazards beyond the CWPP process (Jakes et al. 2007).

¹Information on WFLC meetings can be accessed at URL: <http://www.forestsandrangelands.gov/leadership/meetings/index.shtml>

On the other hand, an assessment of CWPP processes in Colorado sponsored by a consortium of conservation organizations (the Southern Rockies Conservation Alliance) found that many CWPPs lacked specific fuels reduction recommendations, had inconsistent involvement from government agencies, and lacked clear planning objectives to continue updating and revising CWPPs in the face of new information (Chapman 2009).

In looking forward, the Quadrennial Fire Review 2009 final report (WFLC Fire Executive Council and National Association of State Foresters 2009) defines a "strategy calling for reaffirming fire governance, essentially building a new national intergovernmental wildfire policy framework" (p. v) to clarify and realign roles, responsibilities, and authorities for the various wildfire management agencies. The report further outlines needed capacities to achieve these strategic elements, including workforce capacity and capital assets.

3.0 ANALYSIS AND INTERPRETATION

Despite significant reforms at the constitutional-choice, collective-choice, and operational levels of wildfire policy and governance, such change has generally fallen short of expectations. In this section, we apply three interpretive lenses to analyze where and why change has progressed or stalled out: collaborative public management, adaptive governance and management, and historical institutionalism.

3.1 Collaborative Public Management

The primary analytical foci of CPM are the structures, processes, conditions, and capacities that advance interdependent goals among diverse organizations. When the CPM lens is applied to the three levels of wildfire governance, the analytical challenge is to examine the pathways and mechanisms through which new collaborative arrangements are interacting, transforming existing wildfire management institutions, and creating enduring governance changes.

At the operational level, research by Jakes et al. (2007) suggests that collaboration among government, non-government, and community organizations is inconsistent. In some cases there was intensive collaborative engagement throughout CWPP development, while other communities relied solely on government agencies or private contractors to develop CWPPs. Due to uncertainty (or, in some cases, unwillingness) on the part of public agency wildfire managers regarding their role in collaborative CWPP processes, public wildfire managers still address the new challenge of community-based wildfire management largely through existing hierarchical processes (Jakes et al. 2007).

An overriding consideration for agency managers is that HFRA stipulates that 50 percent of hazardous-fuels reduction treatments must be completed in the wildland-urban interface, providing an incentive to identify geographic areas to which to apply those funds. In the competition for scarce funds, agency managers may be motivated to develop as many CWPPs as quickly as possible. Since collaboration takes time, agency managers are confronted with the choice of either positioning themselves to garner funding or embarking on what might be an onerous collaborative process, thereby possibly jeopardizing funding.

In the case of the WFLC, there is evidence of more cooperation among agencies, among levels of government, and between government and non-governmental organizations. However, WFLC has no authority to alter the collective-choice or operational rules of any organization or collection of organizations. Fire suppression still commands a large proportion of federal government agency budgets, while state and local government, non-governmental entities, and community organizations have insufficient funds to carry out non-suppression wildfire management activities.

At the collective-choice level, while HFRA expanded the roles and duties of entities in wildfire management, specifically communities, HFRA was vague or silent

on who is supposed to be in charge and who has authority and responsibility for carrying out CWPPs. Empirical research and anecdotal evidence suggest that collaborative governance in CWPPs has been highly variable, possibly due in part to the lack of specified authority and responsibility. Additionally, there are no standards for what constitutes “collaboration” under HFRA.

At the constitutional-choice level, TYIS and HFRA clearly set out new expectations for roles and responsibilities over wildfire management, but federal and state fire managers are held politically and legally liable and accountable for wildfires and suppression. As such, government managers—especially federal wildfire managers—are highly exposed to negative consequences while their partners may not be. Collaborative governance inherently requires shared risks, but the existing set of liability rules does not yet redistribute those risks beyond government managers.

3.2 Adaptive Governance

According to Brunner and Steelman (2005), AG re-imagines how multiple participants with diverse interests learn together to establish and modify policies and actions that serve the common interest. However, evidence suggests that the process of developing CWPPs has been more like scientific management—achieving the target of a completed plan without necessarily creating a sustainable governance structure that can follow through on implementation, evaluation, and adaptive change (Chapman 2009). Collaboration has taken place in some locales while in others contractors took on the task of organizing the plans.

The AG literature suggests that harmonizing actions across scales is important for policy effectiveness (Cash et al. 2006). Cross-scale *support* has not been a constraint for CWPPs, but cross-scale *interaction* has been. In the case of CWPPs, HFRA defines constitutive-level rules to support operational-level action. However, feedback mechanisms to the collective and the constitutional levels are missing. It is not clear whether there is horizontal interplay or vertical interplay in terms of learning. When CWPPs

fail to live up to their potential, feedback to the collective level or back to the constitutive level is not offered.

At the operational level, the question we would like to be able to answer is: Have CWPPs made a difference in the way we manage fire? From an adaptive management perspective, we would want some empirically-based evidence to demonstrate how direction in CWPPs (prioritizing fuel reduction projects, identifying important values at risk, and specifying forest and fire management strategies) made a difference in how fires were managed. However, we do not know the answer to this question because we do not have a system in place to collect information that addresses such questions.

At the collective and constitutive levels, the WFLC oversees the implementation of NFP through the TYIS, but it is not clear that the feedback mechanisms work. The disjuncture between the collective and constitutive levels is troubling because great effort has been expended to effect change at these levels. Individuals find it increasingly hard to effect change as they move up in the hierarchy and it is frustrating not to realize the benefits (Goodin 1996).

We do not see evidence of adaptive management at the operational level, nor do we see evidence of structures in place at the collective or constitutive levels that could promote the integration of knowledge and social learning that typify adaptive governance. We do have governance structures in place that are mutually supportive (e.g., HFRA supports CWPPs), but there is no feedback at any level within the system to promote learning. To create a more adaptive management/governance regime would require linking the information derived from the operational processes to decision-makers at the operational, collective, and constitutive levels and then taking action based on what was learned.

3.3 Historic Institutionalism

Historic Institutionalism (HI) is a school of political science focused on understanding how institutions—rules, habits, cultures, and history—structure political action (Steinmo et al. 1992, Thelen 1999). Ideas institutionalized in earlier periods of political development continue to influence current politics even after ideas have changed about how we should govern—a concept known as “path-dependence” (Skocpol 2002).

At the operational level, Jakes et al.’s (2007) research demonstrates how past cooperative efforts to address wildfire or other natural resource-related issues, and the history of conflict over natural resource issues, affect collaboration in CWPP development. Similarly, the historic pattern of federal land management agencies’ failing to invest in response monitoring has limited the development of adaptive collaborative arrangements at the operational level of CWPPs. Until recently, federal and state wildfire agencies did not maintain any sort of monitoring database for wildfire management activities. While the NFP and TYIS emphasized performance-based measures to gauge progress towards broad policy goals, the main mechanism, National Fire Plan Operating and Reporting System (NFPORS) has been criticized for not gauging whether fuel reduction treatments are achieving desired objectives (Cochrane et al. 2006, Stephens and Ruth 2005).

The limitations to collaboration and adaptive learning at the operational level have their source in part at the collective-choice level. Federal land management agencies were originally set up to be populated by scientifically trained technical experts and insulated from public and political pressure (Kaufmann 1960). The insular nature of these agencies eroded with laws requiring public participation in decision-making, such as the Administrative Procedures Act and the National Environmental Policy Act. However, resistance within the U.S. Forest Service to these changes, coupled with growing public distrust and displeasure over federal land management, resulted in a divisive, “us vs. them”

posture (Wondolleck 1988). Since the 1910s, wildfire management in particular has been characterized by a militaristic organizational structure given near autonomy and authority to garner resources and implement action with little need to collaborate outside the wildfire institutional structure (Busenberg 2004, Pyne 1997). New governance structures, monitoring of performance measures, accountability, and collaboration run headlong into these long-standing wildfire management institutional structures.

HI suggests that once something is deeply institutionalized, it is not easily changed. How can change occur? Historical institutionalists have long pointed to crises as critical junctures (Kingdon 1984, Skowronek 1982). This has certainly been the case with wildfire management. Over the past century, years with massive fires have led to major policy change and, ironically, an increase in the suppression capacity of the federal land management agencies. Despite the National Fire Plan's intent to reduce costs, reduce wildfire risk, restore fire-adapted ecosystems, and reintroduce wildfire as a natural process, much of what has actually happened both at the collective-choice and operational levels has re-enforced and further strengthened the suppression institutions. Rather than reducing costs and engagement in fire suppression, the institutional momentum of fire management combined with the political crisis of the large wildfires in the late 1990s and early 2000s served to reinforce and strengthen old institutions instead of dramatically changing them.

The HI perspective also sheds light on the reality that new policies may come into conflict with long-standing, institutionalized policies at any level. Beyond the reinforcement of wildfire suppression institutions, another major institutional dynamic has been in play in the area of hazardous-fuels reduction. The combination of pressure from Office of Management and Budget to lower costs plus the culture of measuring success have led the U.S. Forest Service to focus hazardous-fuels reduction efforts on maximizing the number of acres treated.

4.0 DISCUSSION

We acknowledge that selecting these three lenses for this analysis necessarily excludes other lenses that explain change, such as individual behavior, institutional incentives, and political risk-taking. Additionally, we rely primarily on secondary sources of information to draw conclusions about change in wildfire governance. Our analysis may also be limited by the time-span since policy reforms were enacted.

Nonetheless, we believe that our analysis raises critical issues relating to changing wildfire policy and governance. The CPM lens helps explain how existing vertical organizational practices and budget structures prevent fully implementing collaborative, adaptive wildfire management. At the operational level, collaboration is only inconsistently occurring among stakeholders; government agencies often push through CWPPs in order to get as many completed as possible to garner financial resources. Additionally, collaborative groups—either at the CWPP or the national WFLC level—lack any enforcement authority to assure that agreements and recommendations are, in fact, carried out. As a result, the U.S. Forest Service and other government agencies can act independently of any collaborative effort and seek to achieve their own goals and objectives. At the same time, federal agencies are held accountable to achieve acres-treated targets associated with their budget allocations. When facing a choice between achieving acres-treated targets and entering into numerous small-scale CWPP processes, Forest Service managers may be forced to forego the collective-choice rules spelled out in HFRA and other collaboration mandates.

The AG lens focuses primarily on how institutions foster social learning in order to integrate diverse forms of knowledge and information when designing, monitoring, and evaluating action. Harmonizing actions across scales is important for overall policy effectiveness. Adaptive management is not occurring at the operational level, nor do we see evidence of structures in place that could promote the integration of knowledge and social learning that typifies adaptive governance. Multi-level governance structures are in place that are mutually supportive (e.g., HFRA

supports CWPPs), but there is no formal feedback at any level within the system to promote learning. Moving to a more adaptive governance regime would require linking the information derived from the operational processes to decision-makers at the operational, collective, and constitutive levels and then taking action based on what was learned.

The HI lens sheds light on the role of historical context and motivations in creating stable institutional structures that are designed to endure through changing ideas about governance. HI suggests that change occurs incrementally, as new governance arrangements must be dovetailed with existing governance institutions and practices. The supremacy of fire suppression as de facto policy and practice for the U.S. Forest Service and other responsible agencies represents a daunting institutional issue for new wildfire governance strategies. The recent changes at the constitutional- and collective-choice policy levels to increase interagency coordination and community collaboration have actually strengthened fire suppression institutional structures. Policies intended to increase hazardous-fuels treatments to restore fire-adapted ecosystems, increase community safety, and reduce suppression costs have not been realized as a result. Instead, due to internal agency incentives to maximize the geographic area treated while minimizing cost per unit of treatment, hazardous-fuels treatments are being conducted in places with low per-unit costs rather than places where they would do the most to reduce community risks or lower suppression costs.

When these lenses are combined, three primary barriers to collaborative, adaptive wildfire governance come into focus. First, there are organizational, operational, and budget structures, and long-standing values, attitudes, and behaviors rooted in history. Looking specifically at the U.S. Forest Service, we note that wildfire management has long been associated with fire suppression. The newer goals of restoring fire-adapted ecosystems and community protection do not yet have organizational infrastructure around them. Budgets for wildfire management have been and continue to be directed primarily

to suppression; frequently, funds for restoration are drawn from non-wildfire programs, which historically have much lower budgets. Furthermore, the historic organizational norms associated with wildfire management stem from a highly militaristic, hierarchical structure unaccustomed to collaboration.

Second, there is a lack of institutional structures and performance measures that foster feedback and learning across governance and jurisdictional levels. While NFP and the TYIS in particular mandate performance-based measures to facilitate adaptive management, the measures themselves lack adequate feedback relative to the inter-linked goals of fire suppression, post-fire rehabilitation, restoration of fire-adapted ecosystems, and community protection. The last two goals lack performance measures that, when monitored, would indicate movement towards goal accomplishment. Where such measures are being monitored, there is a paucity of mechanisms by which to aggregate and integrate these measures across governance and jurisdictional levels. Without the ability to aggregate treatment effectiveness measures at higher levels, it is not possible to know where to continue to invest scarce resources or to adapt management practices.

Last, the emphasis on “acres treated” targets and the institutional pressure to minimize per-unit treatment costs suggest that the current institutional incentives do not align with new wildfire policy goals. Performance targets are an historical artifact for public natural resource agencies, whether they relate to timber outputs, livestock grazing production, water yields, or wildlife target populations. Such single-objective targets are ill-suited to the integrated goals of new wildfire policies. By focusing on the number of acres treated at the lowest possible cost, government agencies are often motivated to achieve those targets at the expense of the recommended priorities of collaborative arrangements. Without incentives and rewards associated with performance measures that show progress towards multiple wildfire management goals, agency managers are motivated to achieve single-objective targets only—and are held accountable only for those single objectives.

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THE CHANGING ROLES OF NATURAL RESOURCE PROFESSIONALS: PROVIDING TOOLS TO STUDENTS TO TEACH THE PUBLIC ABOUT FIRE

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Abstract.—The Arthur Temple College of Forestry and Agriculture (ATCOFA) at Stephen F. Austin State University is taking a proactive stance toward preparing forestry students to work closely with the public on fire planning in wildland-urban interface areas. ATCOFA’s incorporation of the “Changing Roles” curriculum provides lessons on how natural resource managers’ roles are (1) different than they used to be, and (2) ever-evolving. The undergraduate Forestry Field Station summer program at the University’s Piney Woods Conservation Center now emphasizes the importance and challenges of working with the public. The program brings practicing professionals from the Texas Forest Service to describe the real-world challenges they face in communicating and working effectively with the public in their jobs. The goal is that the ATCOFA students, no matter where they are eventually employed, will understand

the importance of taking a proactive role in working with the public on interface-fire planning and will have knowledge and information that makes them more sensitive to the complicated underlying issues in natural resource and wildfire management.

1.0 INTRODUCTION

A rapidly changing landscape of urban development, expanding communities, and people living “off the grid” has increased the potential for wildfires to cause losses of property and life in wildland-urban interface (WUI) areas. While numerous programs to address WUI fire risks have been—and continue to be—developed across the country, each region has a unique combination of ecological, cultural, social and political perspectives and a single “one size fits all” approach will not work everywhere.

2.0 TRAINING NATURAL RESOURCE MANAGERS TO COMMUNICATE WITH THE PUBLIC

It has become increasingly important—and challenging—for natural resource managers to communicate with a diverse public about WUI fire issues and wildfire planning. Two training programs have attempted to address this for current and future natural resource managers. First, discussions with agency leaders and the findings of a U.S. Forest Service report, “Human Influences on Forest Ecosystems: Southern Wildland-Urban Interface Assessment” (Macie and Hermansen 2002) prompted the creation of a new training curriculum, “Changing Roles: WUI Professional Development Program.” The program is a collaborative effort of the Southern Group of State Foresters, the U.S. Forest Service, Interface South, the University of Florida’s School of Forest Resources and Conservation, and the U.S. Fish and Wildlife Service. The goal is to prepare professionals working in WUI communities to be more

engaged with the public and to assist WUI residents in taking responsibility for wildfire mitigation around their homes and communities. The “Changing Roles” curriculum has four modules:

Module 1: Interface Issues and Connections introduces participants to key WUI issues.

Module 2: Managing Interface Forests provides tools and knowledge for effectively managing fragmented forests in the WUI, including management practices appropriate for the interface; equipment and systems for small forests; managing for wildlife, fire, water, and visual and recreational amenities; enterprise opportunities for landowners; and forest cooperatives.

Module 3: Land Use Planning and Policy explains land use decision-making tools and explores how natural resource professionals can get involved in local decision-making and land use planning processes.

Module 4: Communicating with Interface Residents and Leaders discusses key tips for effective communication with WUI residents and community leaders.

Subsequently, the Arthur Temple College of Forestry and Agriculture (ATCOFA) at Stephen F. Austin State University changed its natural resource management curriculum to provide students with public involvement training similar to what the professionals were receiving. It is a long-standing tradition that, at the end of their junior year, ATCOFA forestry students attend a 6-week field station experience at the University’s Piney Woods Conservation Center (PWCC). The program consists of six separate courses: silviculture, forest measurement, surveying, wildlife, harvesting & utilization, and nontimber management. In 2009, the faculty decided that the “Changing Roles” curriculum would be a valuable addition to the nontimber management course. Integrating the curriculum in the summer field experience also provides opportunities for direct observation as the PWCC is Firewise-certified and located adjacent to Powelltown, TX, a small, rural Firewise community on the Sam Rayburn Reservoir (Figs. 1 and 2).

“Changing Roles” lessons were introduced in the summer of 2009 and continued in 2010 as part of a course on the Firewise program (which helps WUI communities plan for and carry out fire hazard mitigation work). Texas Forest Service staff, consultants, and community leaders gave presentations on Changing Roles, Firewise, and Community Cooperation, and faculty directed the students in developing conflict prevention and resolution skills. The Powelltown fire chief also spoke with students about working with communities and described his town’s experience with Firewise (Figs. 3-5).

By integrating the “Changing Roles” curriculum into the classroom and field station experience, ATCOFA provides the opportunity for students to develop the skills needed for public involvement and interaction prior to professional employment. After the course, a few students decided to do an independent study course on the development of Firewise community plans for areas where they lived, providing an indication of the impact of the training. These students, and those that follow, will be tracked after graduation for the first 5 years of their professional careers to assess the impact of the interactive “Changing Roles” lessons—and to see if the students are putting the lessons to work in their professional lives. This will be accomplished via the college’s online alumni survey instrument, where questions will correlate the concepts of “Changing Roles” with perceived preparedness for jobs that require those skills.

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Figure 1.—Texas Forest Service staff works with students in the field on Firewise forest assessments.



Figure 2.—Community cooperation for Firewise model.



Figure 3.—Karen Stafford, Texas Forest Service, presenting to the students.



Figure 4.—Powelltown Fire Chief talking with students about working with the community.



Figure 5.—Students learning about conflict management and resolution.

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SECURING THE HUMAN PERIMETER: BEYOND OPERATIONAL APPROACHES TO DEVELOPING COMMUNITY CAPACITY TO LIVE WITH FIRE. TWO EXAMPLES FROM VICTORIA, AUSTRALIA

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Abstract.—This paper explores the parallels that frequently exist in fire management organizations between operational approaches to fire and engagement approaches in the community. We observe that community issues are often treated in the same way as a fire incident—“controlled” and “contained” through education and “direct attack” messaging. The aim of these approaches is to reduce uncertainty and ambiguity so that people ultimately will better understand fire risk and change their behavior. However, we argue that building community capacity to live in fire-prone landscapes should not be approached or judged in the same fashion as operational or communications activities that take place during actual emergencies. Indeed, taking a command-and-control mindset into non-hierarchical social groupings, e.g., communities when there is no emergency, can reinforce community distrust, antagonism, dependence, and complacency. We also describe two case studies that go beyond relating to communities via command and control and demonstrate effective strategies for dealing with fire-prone communities.

1.0 INTRODUCTION: THE PAST

In the past decade, the Land and Fire Management division of the Department of Sustainability and Environment (DSE) in Victoria, Australia, has begun to widen its emphasis from pursuing excellence in fire suppression to developing its expertise in long-

term strategic planning, ecological understanding, and recovery. It has done so by increasing its capability in fire ecology, fire and fuel behavior analysis, spatial technologies, and rapid recovery responses. In this sense, the organization is broadening its operational toolbox to ensure that it is as competent at Planning, Preparedness, and Recovery as it is at Response.

We argue that the operational emphasis on responsiveness in the past has also influenced the way the organization relates to communities. In the attempt to care for and protect people, DSE has attempted to “control” and “contain” engagements with people and remedy flare-ups of misunderstanding through messaging. Although these “responsive” and “reactive” ways of caring for people are still necessary *during actual incidents*, research suggests that care for people needs to be expressed differently across the Planning, Preparedness, Response, Recovery spectrum (see, for example, Sharp et al. 2009).

Hence, just as the organization looks to understand fire more holistically in an operational sense, DSE is beginning to recognize the need to more fully appreciate how people’s responses to fire are not simply about short-term bursts of attention, fear, or anger but are socially, politically, and economically constituted over the long-term. In this paper, we describe how, by broadening its emphasis on the Planning, Preparedness, and Recovery phases of the spectrum, the organization is beginning to re-conceive how it relates to the community and in the process is gaining a level of comfort with the complexity of everyday human relationships.

The authors are relatively new to working within DSE (and fire operations for that matter)—making us what you might call “privileged outsiders” (Bahktin 1993). We are privileged to be able to participate in the organization but are still new enough to be

able to reflect on, and be somewhat objective about, the changes in organizational culture that we are observing. Our paper and its framing argument draw together our own observations as outsider-participants at a time of immense change in the organization that began before the fires of February 7, 2009 and before our arrival in early 2008.

1.1 The Problems

The very nature of emergency management has traditionally dictated a strong command-and-control structure. This approach seems to suit when responding to emergencies. However, research and experience have suggested that emergency management should be viewed more broadly than response alone. Planning, Preparedness, Response, and Recovery (PPRR) form the four pillars of contemporary emergency-management approaches.

Until recent times, Land and Fire Management at DSE has had a strong operational focus. An unintended result has been a way of relating to community that displays strong parallels with operational ways of working. These operational approaches of “control” and “containment”, although appearing to be less risky in the short term, may build dependence, reduce trust, and ultimately degrade existing resilience. It is important to note that these tendencies are not limited to emergency management organizations or fire agencies; most Western approaches to governance of human or environmental systems attempt to address networked systems as if they were ordered (Holling and Meffe 1996).

2.0 DISCUSSION: GAINING CONTROL AND CONTAINING THE SITUATION

So let us now, in turn, take two conventional approaches to responding to fire and illustrate how the approaches have parallels with community engagement strategies intended to bring about behavior change.

2.1 Parallel 1 – Gaining Control

The first parallel highlights fire managers’ desire for control of an uncertain situation. In the same way that

variables and uncertainties on the fire-ground must be controlled if suppression is to be successful, members of the public, and the questions that they raise, are often viewed as flare-ups that need to be “managed” through “information saturation.”

The information-deficit approach was validated by early risk-communication research, which suggested that only people who are suitably informed about risks and options for precautionary measures are able to make appropriate decisions (Smith 2001). This approach led to the belief that by providing people with appropriate information, risk managers could bypass apparently irrational responses and induce ‘informed judgments’ or behaviors. In other words, there was an assumption that if the information was good enough, then fire agencies could increase the predictability and uniformity of people’s responses to emergencies. In-depth research has shown, however, that despite having a basic awareness (Strahan Research 2007), individuals are rarely able to achieve adequate understanding to cope with fires or the complexities of land management (Tibbits et al. 2008, Toman et al. 2006). These findings indicate a need for an additional approach to transform awareness into behavior change.

Current research suggests that even if a hazard is well understood by members of the public, the link between this understanding and levels of preparedness is tenuous (Horlick-Jones et al. 2003, Toman et al. 2006). Therefore, treating community safety as an information-deficit problem alone:

- underestimates human capacity to respond creatively and appropriately to “system surprises”;
- fails to appreciate how social values, experience, social background, and pre-existing relationships to the information-provider lead to highly variable interpretations of information and “messaging”;
- fails to account for the multiplicity of scenarios that individuals are faced with in an emergency.

2.2 Parallel 2 – Containing the Situation

Another example relates to a desire to “contain.” Just as we desire to contain a fire’s spread, we often attempt to contain individual interpretation, discussion within a community, and discussion between community and fire agencies. This reaction reflects a concern that discussion might lead to emotional flare-ups, people “knowing the wrong thing,” or losing control of messages. Containment actions have typically included “direct attack” approaches such as bombarding people with messages through public meetings, pamphlets, refrigerator magnets, and advertising, among other things.

Again, contemporary disaster research, communication theory, and social learning theory all argue that new knowledge must undergo a transformation process before it can be incorporated into people’s lives (Ballentyne et al. 2000, Daniels and Walker 1996, Lave 1993, Paton 2003, Wenger 1998). For interpretation and assimilation to occur, people must ask “What does this mean for me?” That is, people must filter these messages and information through their current mental models of the world, grapple with them, discuss them, and negotiate their meaning with others before finally incorporating the “message” into a new mental model. Only through this interplay of internalization and externalization can anonymous, de-contextualized, and un-contextualized messages or texts be personalized and localized.

In addition, research has shown that during emergencies, people draw on relationships characterized by trust rather than authority (Chia 2010, Taylor et al. 2009, Ulmer 2001). When fire agencies try to contain discussion within communities and between communities and organizations, they also contain the development of the relationships that people will draw on during emergencies. In command-and-control structures, care for community is expressed as a desire to take care of everything and to attempt to think for people. This way of relating to people during planning, preparedness, and recovery can inhibit the formation of trusting relationships and can create dependency or result in disengagement during an emergency.

In the past, we have considered our job done at the delivery stage of awareness-raising actions or materials, yet it is at this point that interpretation of messages, information, and engagement material begins. As the foregoing discussion highlights, it is also important to “accompany” people through this interpretive process because this is where meaning, understanding, and potential behavior change are produced. To accompany a person or a community through the interpretive process requires a new way of working.

3.0 DISCUSSION: TWO EXAMPLES OF DOING THINGS DIFFERENTLY

Two projects, commenced by DSE’s Land and Fire Management division, are beginning to re-envision the relationship between the division and the Victorian community. These processes are as much about organizational change as they are about building community capacity to live with fire. The first describes research to improve the Fire Operations Planning (FOP) process. The second describes the development of a Fire Learning Network across the state of Victoria.

3.1 A New Way of Conducting Community Engagement for Fire Management Planning

In the past 10 years, several post-fire incident reports and inquiries highlighted DSE’s failure to adequately engage in public consultation during fire suppression activities and in preparing strategic fire-management plans. The FOP process—a listing of proposed planned burns and fuel reduction works that requires a 6-week period to actively seek public comment—was selected as the means for engaging the Victorian community about fire management on public land. “Community meetings” were decided on as the method of engagement and consultation.

Recently, DSE commissioned social research (led by one author) to explore the effectiveness of the FOP process. The research (Ipsos-Eureka 2010) highlighted that while DSE staff’s efforts in conducting the FOP engagement were often successful, there remained a need to improve the overall design and scope of this

vitaly important collaborative planning tool. Research identified a lack of direction and guidance around engagement goals and approaches that had resulted in staff members' falling back on traditional ways of working—command-and-control style approaches that applied “information-deficit” models to a collaborative planning tool. The authors' observations of interactions between staff and community, comments from community members, and comments from DSE staff suggest that many people consequently perceived the organization as unapproachable.

In some cases, efforts have been made to foster relationships with interest groups and stakeholders. A lack of guidance, experience, and value placed on skills for facilitating such relationships, however, caused negative experiences, frequently leading staff to resume a position of authority. This outcome shifted the balance of power and trust and closed the door to truly collaborative management.

This research also showed that because of the prevailing information deficit approach, much of the informal relationship building work that staff do in their local communities—such as chatting with people in the forest, at the post office, on the way to the depot, or at a BBQ—is not recognized and as such cannot be measured within current frameworks. For this reason, much of the good work that occurs remains unknown to the organization.

The research highlighted the need to expand the scope of engagement activities used by land and fire managers to take into account the diversity of “community” needs and redress the balance of power and trust. DSE senior managers now recognize the important role that good engagement can play and they are keen to facilitate changes in staff members' attitudes and skill sets. The recognition that the organization, too, must change is evidence that DSE is beginning to go beyond the command-and-control paradigm in planning, preparedness, and recovery modes of fire management.

3.2 A New Approach to Relationships and Knowledge-Sharing: A “Fire Learning Network”

Since 2008, the division has also been developing a state-wide Fire Learning Network. Though the need for this approach was inspired by the Nature Conservancy's network of the same name in the United States, the DSE network has many differences.

The DSE Fire Learning Network is composed of multiple localized community groups that, at times, are connected at a state level. The groups are not formalized, but they are characterized by a process of open, facilitated conversations guided by strategic questioning. Importantly, the concept of “a strategic conversation about fire” is holistic and accommodates what the group cares to talk about at that time. As such, fire is the entry point to a whole range of associated community concerns, hopes, and values (Blair et al. 2010, Campbell et al. 2010).

“Community” is defined as *anyone*. Therefore, a conversation may include fire agency staff and volunteers, local residents, or interest groups. It is important to note that at Fire Learning Network conversations, we meet as people first but also acknowledge that our experience, relationships, and roles may provide us specific knowledge of the issue. This realization ensures that new skills and knowledge (especially specialized knowledge) can enter the conversation in a non-patronizing fashion, underscoring the learning network's principle that *we all have something to learn and something to share*.

A strategic conversation is intended to increase social resilience by building relationships within the group and at the same time elucidate, value, and share knowledge that emerges from the group. Conversations take place intermittently through the year (at times and locations determined by the membership). In this way, learning from others is cumulative and, as relationships develop, information is negotiated, tested, and incorporated into participants' lives. This approach emphasizes the capacity that we all have to learn, care, and contribute.

This approach to learning and knowledge transfer is quite different from the knowledge-deficit model, where the organization predetermines what the community should learn and controls the interpretation of information by eliminating space for ambiguity, discussion, and varied interpretation. By contrast, the learning and relationship “outcomes” of connected strategic conversations and the learning network they form, are emergent—they cannot be predetermined and will depend on the group’s unique strengths, interests, and experiences.

Three authors of this paper lead this project and act as the principle facilitation team—facilitating both conversations and the network of relationships that support them. One community we work with was initially very keen to put together a “community fire plan”—a document that informed people of what they should do in the event of a threatening fire, given the local context. Instead of trying overtly to control this concept or withdrawing from dialogue about it, fire agency staff explored the idea in facilitated conversation, with different staff members as equal participants. The group began by talking about the need for government to deliver various types of new infrastructure—for example, mobile phone towers and community fire shelters. After two conversations over 3 months, however, the group began to question its own logic, asking reflexive questions such as, “Who is in this community and what do they know?” and “Is it realistic to expect new infrastructure for next fire season?”

Group members began to think that in order to create a community fire plan, it was important to know their own community and to understand the complex environment of those for whom they were creating this plan. The concept of “producing a community survey” emerged, with some in the group feeling that even just completing the survey would build fire awareness in their community. A smaller number of people volunteered to collect the surveys personally so that in the process they could connect with others and engage respondents in a personal conversation about fire preparedness, concerns, and hopes.

The conversation in this location is ongoing, but as a result of the process so far, clear and meaningful outcomes include:

- the formation of community “working bees” to help elderly residents prepare their blocks;
- the initiation of three community Fireguard groups;
- the development of a community fire newsletter;
- locally organized dialogue as a response to a planned burn that broke containment lines or “spotted over”;
- comments about the positive social interactions stemming from these conversations. Perhaps more important than the preceding outcomes is the development of relationships that emerge from the meetings. People reported to us that—to paraphrase— “these conversations have such a good feeling that for the first time I feel like I’m really connected to other people,” “I met my neighbour tonight and we’ve discussed our fire plans together,” and “Mum and I have been thinking a lot about what to do and now we’ve decided that on any catastrophic days we’ll be booking a room at a hotel.”

As social scientists and fire agency employees, we could have directed people to undertake a community survey, rather than waiting for the idea to emerge at its own pace. This attempt at control may have resulted in a better-designed and -implemented survey, but it would have led to a process that no longer had any meaning for the community.

Recently, a planned burn broke containment lines in this community. Hours later a community meeting was held to discuss what was happening. Remarkably, this meeting was co-facilitated by a community member involved in the strategic conversations. DSE staff members later described how constructive and easy the discussion was. They felt that understanding and trust were high enough to be able to talk about what had happened—whereas, in the past, relationships between the community and organization (particularly in relation to burning) had been very difficult.

Recent conversations have turned from personal safety to matters of fire ecology—how the forest recovers from fire. This development and maturation of knowledge and discussion illustrates how a non-controlling process can develop people’s understanding of complex phenomena at a natural pace. In addition, the self-reported development of intra-community relationships shows how taking a non-hierarchical or network approach into a social setting that is itself non-hierarchical facilitates the strengthening of relationships in a familiar way.

4.0 DISCUSSION: WHAT IS UNIQUE ABOUT THESE NEW WAYS OF WORKING?

While on the surface these activities may continue to be described as community engagement, much of their uniqueness lies in the deliberate and authentic repositioning of ourselves (i.e., fire agency staff) from people who deliver a project with defined and expected outcomes to people who:

- accept that benefits are emergent, and cannot be strictly predetermined;
- are affected by the process;
- learn from and adapt according to local action and experience;
- believe in the capacity of others to respond to the life issues they face; and
- trust others in the face of ambiguity.

In most situations where change is desired, an intervention is introduced and it is hoped that the desired change occurs. The most significant element of individual, family, and community change is the formation of meaning—answering the question, “Why is this important to me/us?” It is in the process of answering questions like this that information is given meaning and existing information and experience become knowledge. Most community engagement initiatives do not prompt people to reflect on this question, nor do they accompany people through the process by which information becomes understanding. The two example projects intentionally reposition interactions between DSE staff and community as

reciprocal. In addition, the learning network provides a deliberate space where the processing of making meaning can take place through strategic conversation.

5.0 CONCLUSIONS

By relinquishing much of the control that is traditionally exerted by fire agencies, and frequently anticipated by the public, the approaches described reorganize the rules of engagement by positing land management agencies as learners within communities rather than as deliverers of information or arbiters in consultation processes.

The practice and experience of developing a Fire Learning Network and the findings of DSE’s community engagement research lead to a similar conclusion: that changing how “we” as an organization and “we” as a community relate will need time, support, and mentoring. An organization cannot simply charge staff with using new engagement methodologies or communication tools and expect behaviors and ways of relating to change. Similarly, organizations cannot simply give booklets or lectures to a community and expect the profound changes in behavior that are hoped for.

Land and fire management is moving beyond traditional response strategies of relating to people. Going beyond operational approaches will mean that fire managers must shift their behavior, language, and reactions to uncertainty as they alternate between PPRR contexts. A move beyond an operational approach to working with people toward one of true capacity development requires us to trust the capacity of others, and learn how to value less tangible outcomes such as relationships and understanding. It will mean that managers must become more willing to trust communities, allowing them to solve problems at a natural pace and sometimes make mistakes, and to change the ways we measure success. In this way, people can truly own an understanding of fire and integrate this understanding into their lives.

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WILDFIRE IN THE UNITED KINGDOM: STATUS AND KEY ISSUES

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Abstract.—This paper reviews the status of wildfire risk in the United Kingdom and examines some of the key issues in U.K. wildfire management. Wildfires challenge the resources of U.K. Fire and Rescue Services (FRSs), especially in dry years, yet FRSs are poorly equipped and trained to deal with wildfire. A brief geography of U.K. wildfires is presented using fire statistics from the Department of Communities and Local Government (CLG) and the MODIS (Moderate Resolution Imaging Spectroradiometer) active fire database. Citizens' awareness of U.K. wildfires is reviewed using Community Risk Registers and CLG reports. Residents have little awareness because wildfire reporting is of poor quality, severe wildfires occur sporadically, they do not result in loss of life, and "property" is defined narrowly so that environmental assets are not adequately considered. In addition, this paper examines how government policy on habitat management in moorlands does not adequately address wildfire risk management. Moorland managers express fear that conservation restrictions, especially on prescribed burning, are increasing fuel loads and hence the risk of severe wildfire. In the United Kingdom, management for multiple land uses requires wildfire-aware management of ecosystem services and ecosystem service-aware management of wildfire.

1.0 INTRODUCTION

1.1 Aims and Data Sources

To review the status of wildfire risk in the United Kingdom and examine some key issues in U.K. wildfire management, this paper draws on three

sources. First, fire statistics published by the Department of Communities and Local Government (CLG) and the MODIS (Moderate Resolution Imaging Spectroradiometer) active fire database are used to demonstrate the frequency and timing of U.K. wildfires and to show deficiencies in the evidence base. Second, Community Risk Registers and CLG reports are used to demonstrate the level of awareness of wildfire risk. Finally, findings from the 2007-2009 Fire and Ecosystem Services (FIRES n.d.) seminar series on fire and climate change in U.K. moorland and heaths are used to examine the relationships among wildfire, prescribed burning, and ecosystem services in moorlands and heathlands in the context of climate change and changes in the rural economy.

1.2 Wildfire, Moorlands, and Ecosystem Services in the United Kingdom

"Wildfire" is the de facto term in the United Kingdom for uncontrolled vegetation fires that are large by U.K. standards. The term "wildland fire" is rarely used since the United Kingdom has few wildlands in the North American sense of the word. Most U.K. land is not far from settlements.

Moorlands (Fig. 1) are arguably the United Kingdom's closest equivalent to wildlands. Moorlands are open landscapes of dwarf shrubs, notably heather (especially *Calluna vulgaris*), cotton grass (*Eriophorum vaginatum*), and acid grasslands. The United Kingdom contains most of the world's remaining heather, which is protected under European Union (E.U.) Biodiversity Action Plans. Much of the moorland in the north and west of the United Kingdom is blanket bog on deep peat. This moorland is the U.K.'s most important carbon store, containing the equivalent of 20 years of its CO₂ emissions (Worrall and Evans 2009).

It is important to recognize that even remote moorlands are only semi-natural ecosystems, altered by centuries of burning and grazing (Davies et al. 2008). Many of the largest wildfires in the United

Kingdom occur in moorlands because firefighters have trouble reaching them and because peat fires are especially dangerous and inherently difficult to control.

An ecosystem services approach has been adopted as a unifying framework by government agencies managing the British countryside (Defra 2007b). Moorlands are important for a range of ecosystem services (Bonn et al. 2009). Supporting services include biodiversity and nutrient cycling, both of which depend on maintaining the peat substrate. Provisioning services include timber, wool from sheep, and food from grazing animals and game. Water supply, carbon cycle regulation, and flood protection are examples of regulating services. Cultural services include game-shooting and informal recreation.

Heather moorland is a fire-adapted ecosystem maintained by rotational prescribed burning for habitat management, especially for that of the game

bird, red grouse (*Lagopus lagopus scotica*) (Fig. 1). Like heather moorland, lowland heath is another fire-adapted ecosystem where severe wildfires are a problem. Heather and gorse are fire-adapted ecosystems because fire assists regeneration by, for instance, encouraging seed germination and preventing succession to scrubland (Davies et al. 2008). Lowland heath, made up of heather and gorse on sandy soils, is found in such areas as Dorset, the southwest of England, and East Anglia. These are important habitats for rare species such as the ladybird spider (*Eresus cinnaberinus*) and the Dartford warbler (*Sylvia undata*).

The 14 National Parks in Great Britain (England, Wales, and Scotland, excluding Northern Ireland) are not in public ownership (Quinn et al. 2010). They are cultural landscapes where people live, work, and go for recreation; management for multiple land uses is the norm (Bonn et al. 2009). Wildfire management in the National Parks and other moorland habitat



Figure 1.—Prescribed burning for grouse moor management, North Pennine moors, England.

areas faces the challenge of being superimposed on a framework of complex land ownership and diverse land uses.

Wildfires also occur in peri-urban grasslands and agricultural land, even though stubble burning is now banned. One problem in analyzing U.K. wildfire count data is that pre-2009 CLG figures lumped everything from small grassland fires and intentional stubble burning to major moorland, heathland, and forest fires into one class—referred to hereafter by the normal CLG shorthand of “grassland fires”.

2.0 A BRIEF GEOGRAPHY OF U.K. WILDFIRES

2.1 Does the United Kingdom have Wildfires?

The United Kingdom has a temperate climate that is not usually associated with wildfire, yet wildfires occur annually. Severe fires by U.K. standards can occur in any year but became a significant hazard in drought years such as 1976, 1995, and 2003. One peat fire in the Peak District (Fig. 2) in April 2003 burned 3 square miles of moorland, including areas under statutory conservation protection. Smoke closed major roads and disrupted air traffic at Manchester Airport; £2 million was ultimately required for restoration. Another Peak District fire in July 2006 required 30 days of firefighting at a cost to taxpayers of approximately £1 million. A wildfire on the North York Moors in May 2010 resulted in the evacuation of more than 250 people from a campsite. Although these fires did not cause fatalities and are not on the same scale as those that occur in North America, Australia, or the Mediterranean countries, they had negative impacts on ecosystem services in the short term, and represented a significant challenge to Fire and Rescue Services (FRS) resource resilience and service delivery.

2.2 Wildfire as a Challenge to FRS Resilience

Fire suppression is organized regionally in the United Kingdom and is free at the point of delivery. There are 43 FRSs in England and Wales, six in Scotland, and

one in Northern Ireland. Each is governed and funded by a Fire Authority. The United Kingdom has no agency with specific responsibility to manage wildfire. Instead, wildfire management falls within the scope of many agencies, and statutory responsibility rests with FRSs under the Fire and Rescue Services Act 2004 (or its equivalent for the devolved administrations of Scotland and Northern Ireland).

FRSs do not have separate forces for fighting fires in wildlands as opposed to structures and equipment and training favor preparation for structural fires. This bias reflects the partial funding of Fire Authorities from local taxation, the majority of which comes from urban areas. Even though three-quarters of the fires attended by FRSs between 1995 and 2007 were outdoor fires and 38 percent of these were “grassland fires,” FRSs are primarily equipped and trained to deal with structural fires in urban settings. Few have access to all-terrain vehicles or wildland fighting equipment. Partnerships between rural land managers and agencies within a local fire group are helping to overcome this limitation.

The United Kingdom has a fire-averse attitude to wildfire, regardless of intensity and duration. In this respect, U.K. policy is similar to the United States’ pre-1971 no-burn policy and “fire out by 10 a.m.” objective (U.S. Fire Administration 2001). For the safety of fire ground personnel, however, fires are not normally fought at night in the United Kingdom. Zero-tolerance of wildfires is not surprising in a small country with a high population density and a history of multiple land uses. Much of England, especially in the southeast, is the equivalent of a wildland-urban interface. The Local Authority-based planning system regulates where houses are built, but wildfire risk is not normally a factor in housing decisions. Dorset (Fig. 2) is an exception because gorse fires on heaths are a significant problem. No building is allowed within 0.25 miles of Natura heaths (an E.U. conservation designation). A mitigation fee of £1719 is charged for permission to build a house within 0.25 to 3 miles of Natura heaths, and this fee finances an innovative wildfire management program as part of the

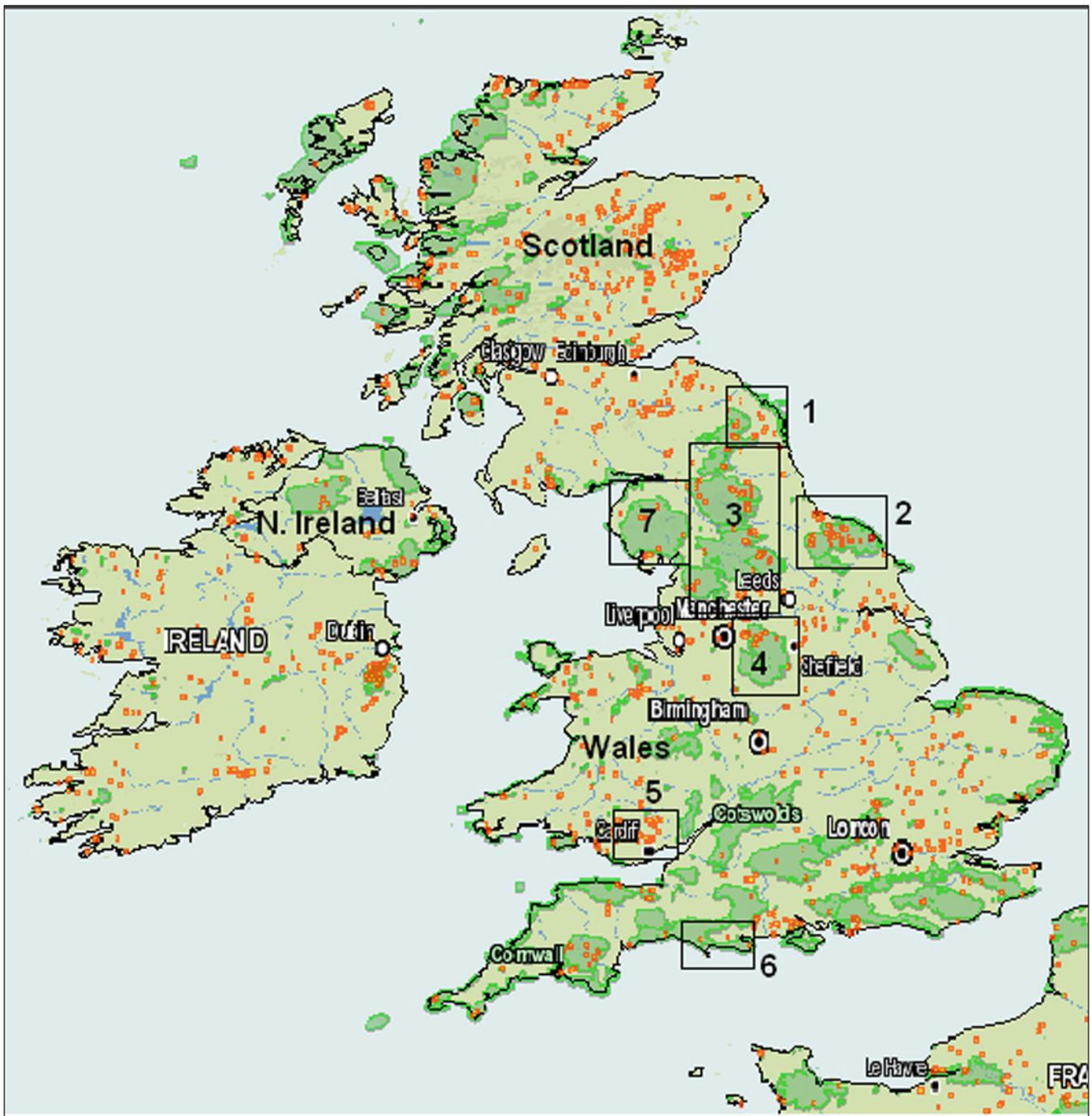


Figure 2.—MODIS Hotspot/Active Fire Detections for the U.K., excluding Shetland Islands, 1 Jan 2003 – 29 March 2010. Green shading represents National Parks and other protected areas (NASA/University of Maryland 2002). Locations referred to in text: 1, Northumberland; 2, North York Moors; 3, Pennines; 4, Peak District; 5, South Wales; 6, Dorset; 7, Cumbria.

Dorset Urban Heaths LIFE Project (Dorset Fire and Rescue Service n.d.).

FRS resilience is challenged by the number and timing of smaller wildfires. When resources are deployed in fighting wildfires, especially in remote moorlands, they are not available for urban incidents. Between 1995 and 2007, FRSs responded to an average of 84,000 “grassland fires” per year (CLG 2008a). These “grassland fires” represented 20 percent of all outdoor fires and 17 percent of all attended fires. In the drought year of 2003, almost 153,000 grassland fires occurred across the United Kingdom, representing 30 percent of all outdoor fires and 25 percent of all attended fires that year. The incidence of grassland fires was concentrated in key months; in April 2003, there were more than 1,000 grassland fires a day, compared with 40 per day in January. Climate change is likely to lead to longer, drier summers with larger, more frequent fires (Albertson et al. 2009, CLG 2006). This expected change will increase the costs of providing fire cover, shift focus from response to prevention, and increase demand for better risk assessment tools (CLG 2008c).

FRSs are required to define risks to communities within their Integrated Risk Management Plans (CLG 2008b), but many have failed to recognize wildfire as a risk. A recent survey, however, suggests that Category 1 and 2 responders recognize the need to improve wildfire risk assessments (CLG 2008c). Among the reasons cited for improved wildfire risk assessments are: a perception that more remote locations need better protection because personnel and vehicles currently have difficulty arriving in time to put out fires; recognition that wildfires can have a significant economic impact on farming and on transportation when roads are closed; and concern about firefighter safety. One senior FRS officer stated: “Wildfire is, and will remain, a national problem until the majority of fire services with a wildfire risk recognize that they may not have appropriate skills, knowledge or tactical ability... required to effectively manage this type of incident” (Hedley 2010, p. 34).

One response has been the formation of two stakeholder advocacy groups, the Scottish Wildfire

Forum and the England and Wales Wildfire Forum. Another is the rapidly growing local fire group movement, pioneered by the Peak District National Park Fire Operations Group, where FRSs work alongside agencies and landowners from the rural sector to share equipment and training, and develop burning plans together. There are now at least six such local fire groups in the United Kingdom, and the partnership approach is considered an effective way to manage wildfire (FIRES n.d., Ayles 2009).

2.3 Causes of Wildfires

U.K. wildfires may be caused by arson, escaped prescribed burns, discarded cigarettes, and barbecues, and by sparks from power lines, vehicles, or ordnance in military training areas. However, reliable evidence on causes is sparse, fire causes are rarely confirmed by forensic investigation, and very few prosecutions are brought for arson. This situation is unlikely to change until the interpretation of property extends beyond structures to include all environmental assets and until these assets can be adequately valued. The online Met Office Fire Severity Index (MOFSI) acknowledges the role of human ignition sources. It expresses the risk of severe fire on a 10-km grid and triggers closure of Access Land (land over which statutory right-to-roam has been negotiated with landowners under the Countryside and Rights of Way Act 2004) although public rights-of-way remain open. MOFSI also acknowledges the conflict between wildfire regulation and recreation and agricultural land use.

2.4 Implications of the Sporadic Timing of Wildfires

The United Kingdom normally has two fire seasons: spring (March to April) and summer (July to September). However, only one fire season may occur, or both may be minimal in a wet year. The number of grassland fires inversely mirrors the mean annual rainfall trend (Fig. 3). The sporadic occurrence of wildfires creates vulnerability in three ways. First, it stretches resources in dry months. Second, preparedness may be low when a severe fire does occur since most firefighters will not have experienced a major wildfire and it is difficult for FRSs to maintain

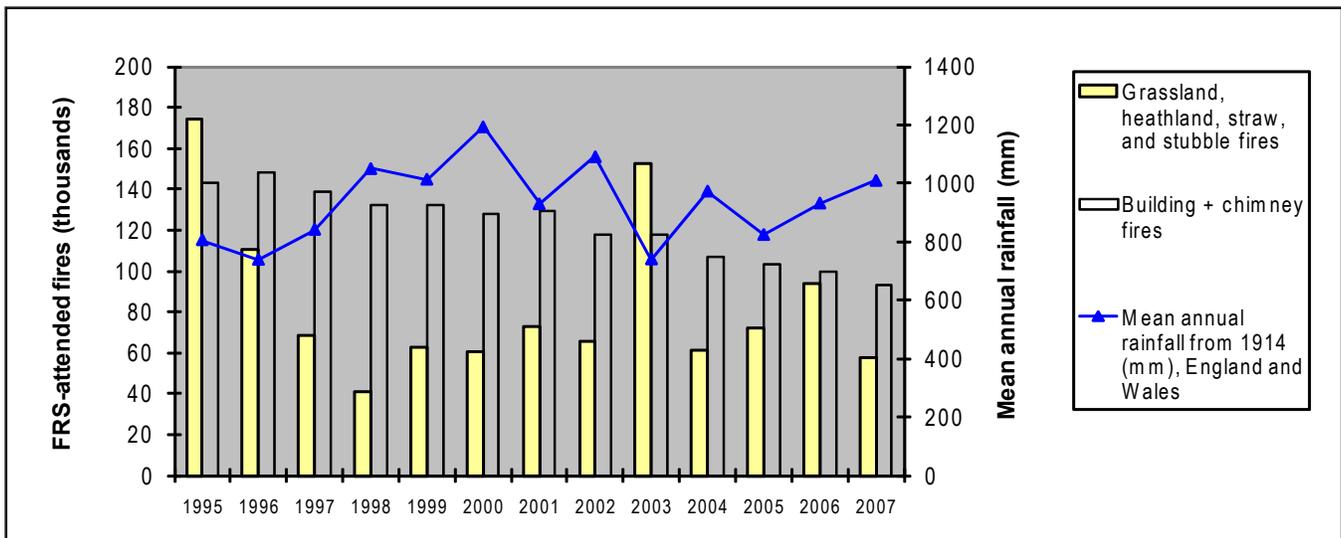


Figure 3.—Primary and secondary grassland and other outdoor fires in the U.K., 1995 - 2007. Fire data: CLG (2008a). Rainfall data: Met Office (online).

alertness and investment in wildfire fighting resources in wet years. Third, wet years allow fuel buildup, a potentially significant problem that must be considered within the context of the polarized attitudes to prescribed burning on heather moorlands and changes in the rural economy (see section 5.0 below). Unlike in the United States, most FRSs and government agencies in the United Kingdom have yet to recognize the potential consequences of over-suppression and the need for fuel management.

2.5 MODIS-detected Fires

Satellite fire databases provide insight into the geography of the largest U.K. wildfires. The majority of MODIS-detected active fires (57 percent) from November 2006 to June 2010 were on scrub, herbaceous moors, and heathland; only 5 percent were on forest land. MODIS data generally include some false positives, but many more fires are omitted because MODIS captures only the largest fires at the time of the twice-daily overpass and under clear sky conditions (National Air and Space Administration/ University of Maryland 2002). Figure 2 shows clusters of putative moorland fires in Scotland, the North York Moors, Pennine moorlands, and southwest England. The cluster in south Wales is thought to be grassland fires caused by arson. Wildfire regimes are believed to vary regionally, but this hypothesis cannot be

confirmed until spatially robust national statistics are available.

3.0 Poor Evidence Base

Poor reporting of U.K. wildfires means that little is known about their relative severity, such as area burned or assets affected. Data on attended fires are collected locally by individual FRSs, and official summary statistics and reports are sent to CLG from the FRS in whose jurisdiction a fire occurs. Inconsistency in reporting between FRSs and a generally poor reporting standard for vegetation fires make it difficult to analyze habitat type, cause, and location.

There is also inconsistency in the category assigned (stubble, grass, moorland, etc.), suspected cause, and accuracy of geocoded location. A pilot study of data for attended fires from three brigades covering the South Pennine moorlands showed that FRS-level statistics were thematically and spatially biased. The location recorded was for the callout or fire appliance and not the fire ground, thus limiting meaningful geographic information system analysis of fire location (Walker et al. 2009).

Data inconsistency is not surprising given the largely low wildfire awareness and fragmentation of data

collection. This is a particular problem for a moorland area like the Peak District National Park, which is covered by six FRSs. Fortunately, partnership collaboration in the local fire group provides a good alternative database for spatial analysis of fire risk (McMorrow et al. 2009).

A two-tiered system of reporting was used for all U.K. wildfires until April 2009. The majority of wildfires were classified as Secondary rather than Primary fires, so they were reported to a lower standard. Secondary fires were those that involved no casualties, rescue, or property loss and that were attended by fewer than five appliances (CLG 2008a). The new Web-enabled Incident Recording System (IRS) uses a consistent standard of reporting for all fires (CLG 2009). This approach should improve consistency between FRSs and provide fuller information on wildfires, including broad habitat type and area burned. It is being implemented locally, however, so concerns remain about consistency and data quality. Geolocation is still restricted to a point instead of a polygon of the burned area, but more accurate spatial reporting and analysis will be possible.

Poor reporting to the European Union and the United Nations further contributes to low international awareness of U.K. wildfires. The United Kingdom is a member of the European Forest Fire Information System (EFFIS) but no longer sends data to the European Fire database (European Forest Fire Information System n.d.).

4.0 NATIONAL AWARENESS OF WILDFIRE IN COMMUNITY RISK REGISTERS

Awareness of wildfire risk in emergency planning is low at the national level but higher at the regional level. The Civil Contingencies Act 2004 (CCA) requires that Local Resilience Forums (LRF) consisting of emergency and other services work together to assess risks to society and put necessary contingency arrangements in place. LRF risk assessments must be published and maintained online as Community Risk Registers (CRRs) (Cabinet

Office 2010). The four-step process for creating risk assessments is: (1) identifying local risks, which for wildfire would include wildfires severe by U.K. standards: a forest or moorland fire affecting up to 50 hectares, requiring evacuation of up to 100 residential or business properties and with up to 5 fatalities and 20 casualties; (2) estimating likelihood of occurrence over the next 5 years and assigning the risk to one of five probability classes; (3) assessing impacts on health and economic, social, and environmental assets; and (4) rating and prioritizing risks.

4.1 Survey of CRRs

We carried out a survey of 49 CRRs in England, Wales, and Scotland between March and June 2010. Thirty-six of the 49 CRRs (73 percent) included forest or moorland fire. Wildfire likelihood was plotted against impact in the standard risk matrix (Fig. 4). The modal wildfire risk rating across all 49 CRRs was medium (20, 41 percent), with 14 (29 percent) rating it as low, 2 (4 percent) as high, none as very high, and 13 (27 percent) not even including it (percentages are rounded to the nearest integer so they do not sum to 100 percent). Despite this recognition at the local level, wildfire is not yet included in the public version of the U.K. National Risk Register of civil emergencies.

In most CRRs, likelihood of wildfire was rated medium-low (1 in 2,000 over 5 years). Risk of a moderate fire was rated high (1 in 2) in Northumberland, South Wales, and Cumbria, which matches clusters of MODIS-detected fires (Fig. 2). Likelihood may be underestimated because the recurrence interval of events of this magnitude is probably longer than the 5-year span being considered, so recent experience and awareness would be low. The poor historic evidence base also hinders assessment. Arguably, low likelihood increases vulnerability in the long term, because preparedness may be low and the potential for fuel accumulation may be high. The matrix does not recognize the inverse long-term causal relationship between likelihood and impact, and the 5-year political cycle does not encourage long-term thinking.

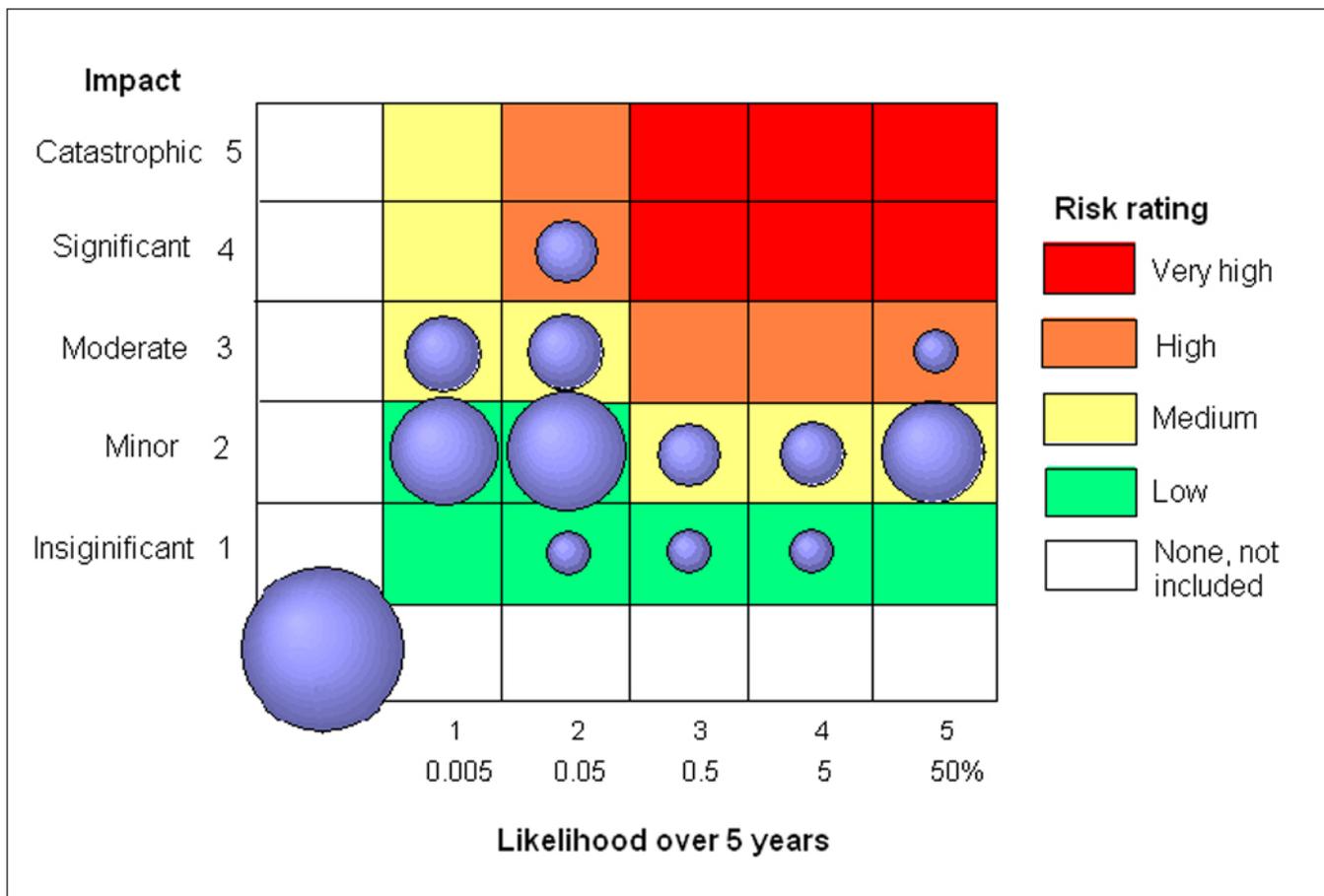


Figure 4.—Community Risk Register (CRR) ratings for likelihood and impact of forest and moorland fire in Great Britain (England, Wales, and Scotland) for 2010. Circles proportional to number of CRR entries, N = 49. Maximum impact and likelihood score used where there was more than one entry per CRR.

Most CRRs rated potential wildfire impact as minor (47 percent) or excluded it (28 percent). Fatalities from wildfires are rare and directly attributable impacts on health are difficult to prove. Anecdotally, most minor injuries to firefighters occur in moorland fire fighting because personal protective equipment and other equipment are designed for fighting structural fires, not for outdoor incidents in inaccessible areas. Damage to structural property is low relative to environmental assets such as clean water or aesthetic value, which are notoriously difficult to value. Values of £450 per hectare (approx \$294/acre) have been assigned for moorlands with sporting (shooting) interest and £40 per hectare (approx \$26/acre) for other moorland (ENTEC 2000). Forestry assets were assigned a value between £2000 (approx \$1,308/acre) and £8000 per hectare (approx \$5,235/acre).

About 42 percent of England, Wales, and Scotland was estimated to have vegetation that is combustible at certain times of the year. Bog nonetheless was not regarded as combustible (ENTEC 2000), so a reassessment is required. Carbon storage and sequestration may become a significant asset in the future (Hurteau et al. 2009), especially for moorlands, where fires can burn into the peat and cause net loss of investment in peatland restoration (Anderson et al. 2009).

5.0 PRESCRIBED BURNING IN THE UNITED KINGDOM

Some land management agencies and stakeholders disagree about the use of prescribed burning for moorland habitat management, which may in turn affect wildfire risk. There are also strong and polarized opinions about whether the target habitat should

be heather moorland, which was largely created on shooting estates by the Victorians in the late 19th century, or older, more mixed habitats (Davies et al. 2008).

The land management community, represented by organizations such as the Moorland Association, Game and Wildlife Conservation Trust, and the Heather Trust, uses prescribed burning as a vital tool in grouse moor management. Strips of heather 100- to 80-feet wide are burned on a 20-year rotation to encourage new shoots of heather on which grouse feed. Older stands provide cover for the grouse. The long-term ecological response is a patchwork of different ages of heather. Grouse game-shooting generates jobs, direct income (~£1500 per gun per day), and indirect income by maintaining a cultural landscape valued by visitors. Land managers also argue that this practice reduces wildfire risk by controlling fuel load.

Nature conservation groups have different habitat management objectives. The Department for Environment Food and Rural Affairs (Defra), Natural England (the statutory body for nature conservation in England), and nongovernmental organizations such as the Royal Society for the Protection of Birds seek to restrict burning on deep peat. Suppression burning to control a wildfire is also not allowed in areas protected by statute. The aim of burning restrictions is to protect nesting birds and habitat biodiversity and to reduce the likelihood that escaped management burns will become peat fires.

It is widely understood that fire can help maintain heather moorland and heath, but land management agencies must operate under legally binding Public Service Agreements to maintain bogs in “favorable condition” and they are subject to E.U. legislation on biodiversity and water quality. The target ecosystem is normally mixed wet blanket bog, including some heather. Private land managers are paid subsidies under agri-environment schemes to manage protected land in accordance with stated goals. This type of subsidy marks a shift from conventional production subsidies for providing ecosystem services to prioritization of supporting and regulating

ecosystem services (Hubacek et al. 2010). There are parallels between this situation and the controversy in Yellowstone National Park (located in parts of Wyoming, Montana, and Idaho) described by McBeth et al. (2005). In Yellowstone, “Old West” groups seeking to maximize economic returns with a focus on resource extraction and utilization have given way to biocentric “New West” groups that place a higher priority on conservation and recreation.

From a wildfire risk perspective, restrictions on habitat management burning and grazing should require that an alternative form of fuel load management is included in management plans to reduce the risk of severe wildfire. However, government policy on habitat management in moorlands has yet to take into account the management of wildfire risk.

Burning is regulated through a voluntary Heather and Grass Burning Code and statutory regulations (Defra 2007a). It is limited spatially and temporally to a legal winter burn season, and burning plans are required. Land managers at the 2007-2009 FIRES seminar series on fire and climate change in U.K. moorland and heaths expressed concern that restrictions on burning and lower sheep densities required by Natural England management agreements are allowing fuel loads to become dangerously high, increasing the risk of severe wildfire. This risk is compounded by a shortage of skilled labor and an expected increase in wildfire risk caused by climate change. Martínez et al. (2009) report that these factors have already contributed to an increased wildfire incidence on abandoned land in Mediterranean countries.

The frequency of MODIS-detected fires on moors and heathlands peaks at the end of the burn season. The time limit may inadvertently be encouraging more risky behavior as land managers try to complete their burning by the end of the legal season. More research and analysis are needed to examine the spatial relationships between prescribed burning and wildfire; for instance, are fewer or more wildfires found where there is prescribed burning? How many prescribed burns become wildfires? The International Union for Conservation of Nature will

soon publish (International Union for Conservation of Nature n.d.) a literature review and stakeholder consultation on burning in peatlands. When managers assess ecological response, they need to consider the combined wildfire and prescribed burning fire regime, including factors such as temperature, duration, timing, and frequency. But a more fundamental question remains about what that desired ecological response should be: Which ecosystem service(s) should have priority?

6.0 THE CASE FOR WILDFIRE REGULATION AS AN ECOSYSTEM SERVICE

Wildfire regulation is not currently recognized or prioritized as an ecosystem service. Until recently, few agencies and FRSs saw the need for wildfire management. Tensions between burning on deep peat and nature conservation have already been highlighted. But there are also potential conflicts and synergies with management for other ecosystem services such as carbon storage (Hurteau et al. 2009). Giving higher priority to certain ecosystem services can inadvertently exacerbate wildfire risk. For instance, £2 million has already been invested in the Peak District to restore eroded peatlands damaged by previous wildfires, and an additional £3 million has been allocated for this purpose (Anderson et al. 2009). Restoring degraded dry bog to wet blanket bog by reseeded and rewetted should produce a more wildfire-resistant ecosystem, but the investment is at risk if fuel load management such as grazing or cutting and removal is not included in the longer term.

In a multiple land-use situation like the United Kingdom, wildfire-aware management of ecosystem services is required. Equally importantly, ecosystem service-aware management of wildfire is needed. Wildfire regulation is an ecosystem service equivalent to flood protection; if not managed properly, wildfire can become an ecosystem disservice. The challenge is to superimpose a crosscutting issue such as wildfire regulation onto existing institutional structures and property rights (Quinn et al. 2010). Decisionmakers must try to avoid the bounded rationality and silo

mentality that contributed to the U.S. wildfire policy error of over-suppression (Busenberg 2004).

7.0 CONCLUSION

The United Kingdom has a significant wildfire problem in drought years. Awareness of the risk is low at the international and national levels but higher at the local level. Three issues have been identified as contributing factors: a poor evidence base; the sporadic nature of wildfires relative to the 5-year political cycle; and a narrow definition of property, which excludes damage to the less easily evaluated supporting, regulating, and cultural ecosystem services. Other key messages, knowledge gaps, and policy recommendations are summarized in the FIRES policy brief (FIRES n.d.).

The three factors are related; severe wildfires are infrequent and do little damage to structural property, so improving the evidence base and conducting comprehensive costing studies are not priorities. But without evidence we cannot demonstrate the problem—a Catch-22 situation. The Incident Recording System and satellite databases can begin to provide some of the evidence required and contribute to improved wildfire risk assessment tools.

So far, the link between the likelihood and impact of wildfires is poorly appreciated, both in terms of biophysical hazard and FRS preparedness. Government agencies recognize the need to control human ignition sources, but not the need for fuel management. The alleged fuel load accumulation in fire-adapted heather moorlands requires investigation. So too do spatial relationships between prescribed burning and wildfire. Peer-reviewed studies of wider economic costs are needed. Concern about fire fighter safety is growing, and calls are increasing for specialized training and equipment. Many of these practical concerns are being addressed by grassroots action—by collaborative work among partnerships in local fire groups and through the two wildfire forums. Regrettably, FRS officers express fear that wildfire will not move up on the political agenda until a fatality occurs.

8.0 ACKNOWLEDGMENTS

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The content of this paper reflects the views of the author(s), who are responsible for the facts and accuracy of the information presented herein.

PUBLIC RESPONSE

THE SOCIOLOGY OF LANDOWNER INTEREST IN RESTORING FIRE-ADAPTED, BIODIVERSE HABITATS IN THE WILDLAND-URBAN INTERFACE OF OREGON'S WILLAMETTE VALLEY ECOREGION

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Abstract.—In many parts of the world, the combined effects of wildfire, climate change, and population growth in the wildland-urban interface pose increasing risks to both people and biodiversity. These risks are exemplified in western Oregon's Willamette Valley Ecoregion, where population is projected to double by 2050 and climate change is expected to increase wildfire risk. Restoring elements of the region's historic fire-adapted prairie, savanna, and woodland habitats may help to reduce future wildfire risk and help conserve the region's threatened biodiversity. We report on a mail survey (n = 939) examining the socio-demographic factors influencing private landowners' likelihood of restoring fire-adapted habitats in the future. We found that newer landowners, landowners with a liberal political ideology, and landowners who have experienced wildfire are more likely to restore fire-adapted habitats in the future than their long-time owner, conservative, or inexperienced counterparts. However, experience with wildfire ceased to be a significant influence when we controlled for underlying landowner motivations for owning their property. Our findings can help planners and scientists

better understand and account for the effects of a dynamic human population's influence on landscape patterns, structures, and composition.

1.0 INTRODUCTION

Urbanization and altered fire regimes increase society's wildfire risks and pose a major threat to biodiversity. These threats will likely be exacerbated by global climate change (Gude et al. 2008, Running 2006, Westerling et al. 2006). Projecting the effects of future climate change on local landscapes is important in a wide array of land-use planning and policy contexts (Ahern 2001, Lempert et al. 2003). Understanding the likely impacts of human land-use and management decisions in the wildland-urban interface (WUI) is a necessary component of developing planning models and creating policies that maximize socio-ecological landscape resilience in the context of multiple uncertainties (Lempert et al. 2003). In this paper, we report on the initial results of sociological research developed to help inform a coupled natural and human systems model. That model investigates how climate change, land use, management decisions, and wildfire may interact over the next 50 years in the WUI of western Oregon's Willamette Valley Ecoregion.

Oregon's Willamette Valley Ecoregion (WVE) encompasses nearly half (the lower elevations) of the 11,500 sq. mi. Willamette River Basin, the majority of which is privately owned. WVE is home to approximately 2 million people or roughly two-thirds of Oregon's population (Baker et al. 2004). The WVE population is expected to increase to nearly 4 million people by 2050; although it is likely that most of the population increase will be incorporated in Oregon's urban areas, most projections agree that exurban and WUI areas will continue to grow as well (Hulse et al. 2002, Hulse et al. 2004, Lane Council of Governments

2006). At the same time, climate change is expected to increase wildfire risk by leading to warmer and potentially wetter winters coupled with hotter and drier summers, increasing seasonal fuels growth during an extended growing season.

The combination of increased summer temperatures and reduced snow pack with increased fuel loading would lead to extended droughts, which make fuels more burnable (Millar et al. 2007). Many forest and woodland habitats that today occupy much of the non-agricultural and non-developed areas of the WVE carry high fuel loads that contribute to increased fire risk in the region. By contrast, historic prairie, savanna, and woodland habitats of the Pacific Northwest were more resilient to wildfire. Higher-frequency, lower-intensity ground fires prevented succession to the types of conifer forests that now dominate the western Cascades and Coast Range ecoregions (Agee 1993). In 1850, those fire-adapted habitats occupied nearly half of the WVE (Hulse et al. 2002); today, more than 90 percent of these habitats have been degraded or converted to other land uses and forest types (Baker et al. 2004, Noss et al. 1995).

The loss of these habitats has made them critical conservation targets as they are home to some of the WVE's most threatened biodiversity (Oregon Department of Fish and Wildlife 2006). Restoring prairie, savanna, and woodland habitats presents an opportunity to minimize the conjoined risks of climate change and urbanization by reducing wildfire risk and enhancing key conservation targets in the WVE.

Population growth, like that expected for the WVE, is often credited with contributing to changing perceptions and attitudes about natural resource management and land use (Graber 1974, Nelson 2002, Nielsen-Pincus in press, Wilson 1997, Wulfhorst and Nielsen-Pincus 2003, Yung et al. 2003). Socio-demographic characteristics such as length of residence and political ideology are often interpreted to reflect attitudinal differences and differences in sense of place. Convention assumes that newcomers are more likely to have beliefs and attitudes associated with the values of amenities rather

than the traditional values of production activities (Green et al. 1996, Jones et al. 2003, Nielsen-Pincus et al. 2010). Competing liberal and conservative political ideologies (see Theodori and Luloff 2002, Wilson 1997) are exhibited in debates about designating wilderness areas, about forest management, and about property rights (Bassett 2009).

The associations among length of residence, political ideology, and environmental concern are well explored, but their influence on the perceptions and attitudes about natural resource management and land use is not uniform (Graber 1974, Smith and Krannich 2000, Van Liere and Dunlap 1980). More specifically, the associations of length of residence, political ideology, and private landowners' inclination to restore fire-adapted habitat have not been explicitly explored (Fisher and Bliss 2008), and it is unclear whether the environmental attitudes often associated with newcomers and liberal political ideology apply to land management activities that serve multiple goals such as reducing fire risks and conserving biodiversity.

Experience with wildfire may also be an important factor in landowner decisions to mitigate wildfire hazard or risk. Those landowners who have experienced wildfires may be more likely to see wildfire as an extreme threat to themselves and their property (Abt et al. 1990). The duration of this effect is unclear, however (Brenkert-Smith et al. 2006). Others have found a negative relationship between experience and perceptions about wildfire risk and mitigation programs (Hall and Slothower 2009, Winter and Fried 2000), potentially reflecting the influence of familiarity (i.e., resulting in lower perception of risk) or an attitude of acceptance and futility.

In this paper, we examine socio-demographic influences on landowner interest in restoring fire-adapted habitats. We report results from mail survey data of landowners in two WUI study areas of the WVE. Specifically, our objective was to determine the influence of length of residence, political ideology, and experience with wildfire on the likelihood that landowners will express interest in conducting ecological restoration to reduce fire

hazard and increase biodiversity. We examined these socio-demographic influences while controlling for underlying landowner motivations for owning their property. We discuss these landowner characteristics and identify future research that may improve coupled natural and human systems modeling in the context of wildfire hazard mitigation and ecological restoration based on better understanding of landowner influences on landscape change.

2.0 METHODS

We conducted two mail surveys of private non-industrial property owners in two WUI study areas in western Oregon (Lane and Linn Counties). The two questionnaires were designed and implemented using a modified Tailored Design Method (Dillman 2000). Both surveys queried respondents about the land uses and land cover types on their property, their motivations for owning their property, their perceptions of fire risk, value orientations, and demographics. The two surveys then differed in one section. The *Land Management Survey* (LMS) queried respondents about general land use and management strategies they were likely to employ in the near future (e.g., thinning forests, restoring sensitive ecological habitats, developing homes or home sites). The *Forest Management Survey* (FMS) asked respondents about specific forest management strategies they were likely to employ in the near future (e.g., fuels management, restoration of fire-resistant forest types, and timber production). While the two surveys were qualitatively different from each other, they covered many of the same conceptual topics at different levels of specificity.

Sampling for the two surveys was based on geographic information system parcel data from the two respective counties. Nontimber industrial, commercial, and government tax lot owners, and owners of tax lots smaller than 2 acres, were excluded from the sample, leaving a sample frame of mainly non-industrial private landowners (Oregon's rural residential zoning has stipulated a minimum lot size of 2 acres since 1974). The sample frame was then stratified by county, parcel size (<10 acres, 10-50 acres, and >50 acres), improvement value of the parcel (zero, <\$212,000, and

≥ \$212,000—the median improvement value for the two study areas), and the presence of at least an acre of oak, as classified by several spatial classifications of vegetation for the study areas. The strata were designed to target a diversity of potential respondents according to property size, real estate value, and selected vegetative cover types.

We then randomly selected property owners from each stratum and randomly assigned these selected property owners to the LMS and FMS surveys. LMS questionnaires were sent first. In addition to returning the questionnaire, respondents were asked to return a postcard with an ID number if they were interested in volunteering for the FMS questionnaire. FMS surveys were sent approximately 2 months later to the randomly assigned property owners and to those LMS respondents who volunteered for the FMS survey by returning the postcard.

In this paper, we report on several socio-demographic measures from the two surveys, including length of residence, political ideology, and experience with wildfire. First, length of residence was measured by asking respondents how many years they have lived in the study area. Length of residence responses were then dummy-coded to newcomer (1, respondents whose length of residence was less than 10 years) and old-timer (0, respondents whose length of residence was greater than or equal to 10 years). Political ideology was measured on a 7-point scale ranging from extremely liberal to extremely conservative, with a midpoint of neutral and an eighth option for *other*. Responses were dummy-coded to liberal (1) and not liberal (0). Third, experience with wildfire was measured through a series of questions that asked respondents to indicate when, if ever, they had experienced fear or discomfort from wildfire, evacuated their homes, or suffered losses from wildfire. Experience responses were dummy-coded as experienced (1, those who indicated any experience with wildfire) and inexperienced (0, those who indicated no experience with wildfire). Fourth, we measured landowner goals and objectives with 17 items using a 4-point Likert-type response scale

ranging from not important (1) to very important (4). We used SAS 9.1 (SAS Institute, Cary, NC) to identify the underlying motivations of landowner goals and objectives for their property. We conducted an exploratory factor analysis of all 17 items using a principal components method and a varimax rotation and output factor scores to represent the results of the factor analysis (Table 1). These four sets of measures are our independent variables (i.e., resident status, political ideology, past experience with wildfire, and underlying landowner motivations).

For the dependent variable, we created an index from responses to 11 items that addressed landowners' inclination to restore fire-adapted habitats. Respondents were asked how likely they were to engage in activities such as restoring native prairie habitats or converting existing forest habitat types to oak savanna or woodland in the next 10 years.

The index was measured on a probabilistic scale ranging from 0 to 100, where low values indicate the landowner is extremely unlikely and high values indicate the landowner is extremely likely to engage in restoration of fire-adapted habitats. Cronbach's alpha for the index measured 0.86, indicating adequate consistency of responses among items within the index.

We then developed two analysis of variance models. The first model tested for the effects of being a relative newcomer, holding a liberal political ideology, and having experience with wildfire, and interactions among those factors on the inclination to restore fire-adapted habitats. The second model tested for effects of the same factors as the first model while including the underlying landowner motivation factor scores as covariates. Finally, we compare group means for each socio-demographic group using Tukey's HSD test.

Table 1.—Item distributions and factor loadings for 17 landowner goals and objectives^a.

Goals and Objectives	% Very important	Mean ^b	Main factor loadings
1. Amenities			
Personal enjoyment	70	3.54	0.78
Peace and quiet	69	3.51	0.76
Maintain or improve scenic beauty	41	3.07	0.77
Reduce fire risks	40	3.01	0.50
Improve wildlife habitat	29	2.73	0.62
Conduct ecological restoration	13	2.08	0.57
2. Forest Management			
Manage forest health	26	2.59	0.77
Timber production	15	1.84	0.79
Reforestation of cleared land	13	1.91	0.81
3. Home and Family			
A place to live	75	3.49	0.59
A place to raise my family	36	2.39	0.75
A place for my extended family to live	19	2.10	0.74
4. Farming			
Provide income	21	2.13	0.60
Agricultural production	17	1.95	0.87
Raise stock	16	1.91	0.74
5. Development			
Land as a financial investment	32	2.76	0.78
Residential development	8	1.48	0.72

^a Items are listed under the descriptive factor titles for five factors, which together contributed to 65 percent of the total variance in the landowner goal and objective items (factor loadings less than 0.50 are suppressed, as is one substantial cross loading for A place to live, which also loads on Amenities at 0.58).

^b Responses range from not important (1) to very important (4).

3.0 RESULTS

We received 651 and 281 completed and returned LMS and FMS questionnaires, respectively, from randomly selected respondents, and 82 returned FMS questionnaires from respondents who volunteered to participate in the FMS questionnaire after receiving the LMS questionnaire. Final response rates to the two surveys were 40 percent and 49 percent, respectively. Of the 1,014 respondents, 71 were excluded from further analysis due to missing data on more than half the measures we analyzed and 4 were excluded because they appeared as outliers in a multivariate distributional analysis, for a final total of 939 respondents used in the analysis. We report results in the following order: (1) respondent socio-demographic characteristics, (2) characteristics of the underlying landowner motivation measures and factor results, and (3) ANOVA results.

Respondents tended to be long-time residents. Average length of residence was approximately 24 years and only 261 respondents (approximately 28 percent) indicated that they had resided in the study area for less than 10 years. Respondents also tended to be conservative (median response to the political ideology question was 1 point right of neutral). After political ideology was dummy-coded to liberal or not liberal, only 263 respondents (approximately 28 percent) self-reported a liberal political ideology; 676 respondents self-reported a conservative or other political ideology. Finally, 534 respondents (approximately 57 percent) indicated some experience with wildfire, whether discomfort from smoke, fear, evacuation, or suffering personal or property loss. The most common experiences reported were discomfort and fear (46 percent and 30 percent, respectively); evacuation and sustaining personal or property loss were the least reported experiences (6 percent and 5 percent, respectively).

In general, the most important goals and objectives landowners identified for their properties were related to providing amenities and living on their property, with more than two-thirds of respondents indicating that a place to live, personal enjoyment, and peace and quiet were very important. Only about 40 percent of

respondents indicated that maintaining and improving scenic beauty and reducing fire risks were very important goals (Table 1). Less than one-third of respondents indicated that improving wildlife habitat, managing forest health, providing income, or timber and agricultural production was a very important goal.

Factor analysis indicated five relevant dimensions in the landowner goals and objectives data (eigenvalues > 1.0), which together contributed 65 percent to the total variation in the data. We renamed each factor to reflect the underlying motivations of that dimension: (1) amenities, (2) forest management, (3) home and family, (4) farming, and (5) development. The amenity factor was strongly loaded on by seven items related to management objectives such as ecosystem restoration and scenic beauty. Also loading on this factor were several items related to receiving individual gratification. Three items loaded heavily on the forest management dimension, all related to production forestry: timber, forest health, and reforestation. Three items also loaded heavily on the home and family dimension, which included goals for providing a place for family and extended family. Agricultural and livestock production goals loaded most heavily on the farming dimension, which was also heavily loaded on by *provide income*. Last, only two items had loadings greater than 0.5 on the development dimension: *residential development* and *land as a financial investment*. *Provide income* loaded on the development dimension at just under 0.5. Only one item, *a place to live*, loaded heavily (≥ 0.5) on more than one factor, loading at 0.58 and 0.59 on the amenities and home and family dimensions, respectively.

Respondents exhibited a relatively low individual inclination to restore fire-adapted habitats (mean index likelihood is 28.6). Less than a quarter of respondents (22 percent) exhibited a likelihood above the index mid-point, indicating that fewer than a quarter of respondents were more likely than not to restore fire-adapted prairie, savanna, or woodland habitats on their property in the long-term. Being a newcomer, holding a liberal political ideology, and having experience with wildfire all significantly increased respondents' inclination to restore fire-adapted habitats; interactions

among these variables were not significant (Table 2, top panel). Relative newcomers exhibited a 28-percent greater likelihood, the politically liberal exhibited a 36-percent greater likelihood, and those with wildfire experience exhibited a 20-percent greater likelihood than their long-time, conservative, or inexperienced counterparts, respectively.

In the presence of underlying landowner motivations, however, experience with wildfire did not significantly affect respondents' inclination to restore fire-adapted habitats (Table 2, bottom panel). Being a newcomer and holding a liberal political ideology maintained their effect, resulting in 20-percent and 12-percent greater likelihoods of restoring fire-adapted habitats, respectively, even after controlling for the effects of all the other variables in the model. Landowners with high amenity and forest management motivations are significantly more likely, while those with greater focus on their property as a place of residence are less likely, to restore fire-adapted habitats.

4.0 DISCUSSION AND CONCLUSIONS

We examined the inclination of landowners in the Willamette Valley Ecoregion to restore fire-adapted habitats with the goals of reducing wildfire hazards and restoring habitat types of conservation value. Our results indicate that socio-demographic variables do play a role in understanding landowners' inclination to manage their land for both fire-hazard reduction and habitat conservation. While less than a third of our respondents were newcomers to the region or reported a liberal political ideology, both of these factors were associated with a significantly greater inclination to engage in ecological restoration. We also found that those effects remained significant after controlling for landowner motivations for owning their property.

Our findings support previous research about the influence of newcomers and political ideology on attitudes toward land management, sense of place, and environmental beliefs (e.g., Graber 1974, Nielsen-Pincus et al. 2010, Van Liere and Dunlap 1980, Yung et al. 2003). We also find that controlling for underlying landowner motivations removes the

Table 2.—Results of two analysis of variance models testing the effects of residential status, political ideology, and experience with wildfire on landowner inclination to restore fire-adapted habitats.

Model 1 – Socio-demographic Factors Only			
Main Effects	b	t-value	
NA – New arrival (residence <10 yrs)	6.9	4.1***	
Lib – Liberal political ideology	8.4	5.0***	
Exp – Experience with wildfire	4.5	3.0**	
Interaction Effects			
NA * Lib	-	<0.1	
NA * Exp	-	0.5	
Lib * Exp	-	<0.1	
Intercept	21.9		
N	918		
Model R-Squared	0.06		
	Group Means	% Difference	t-value
New arrival (1), n=261	34.1	27.8%	4.1***
New arrival (0)	26.7		
Liberal (1), n=263	35.4	35.6%	5.0***
Liberal (0)	26.1		
Experience (1), n=534	31.0	20.1%	3.0**
Experience (0)	25.7		

Model 2 – Socio-demographic Factors and Underlying Landowner Motivations			
Main Effects	b	t-value	
NA – New arrival (residence <10 yrs)	5.6	3.6***	
Lib – Liberal political ideology	3.5	2.2**	
Exp – Experience with wildfire	-	1.4	
Covariate Effects			
Amenities	7.7	10.6***	
Forest Management	5.5	8.0***	
Home and Family	(2.2)	(3.2)**	
Farming	-	(1.5)	
Development	-	0.8	
Intercept	25.0***	19.7***	
N	918		
Model R-Squared	0.22		
	LS Means	% Difference	t-value
New arrival (1), n=261	33.4	20.1%	3.6***
New arrival (0)	27.8		
Liberal (1), n=263	32.4	12.1%	2.2***
Liberal (0)	28.9		
Experience (1), n=534	31.6	6.8%	1.4
Experience (0)	29.6		

p<0.01; *p<0.001.

positive effect of experience with wildfire on interest in restoring fire-adapted habitats. We suggest that experience with wildfire heightens one's evaluation of the threat (Abt 1990), but that response is mediated by other factors including landowner goals and objectives for the property, which is consistent with the findings of Hall and Slothower (2009) and Vogt et al. (2005).

Our findings suggest that socio-demographic trends are likely to play a role in shaping the future landscape as more new residents move into the WUI or as political tendencies in the region swing one way or another. Given the projected population doubling for Oregon's Willamette Valley Ecoregion in the next 50 years, the nearly one-third greater likelihood that new residents and those with liberal political ideologies will restore fire-adapted habitats could have substantial effects at the landscape scale. In regions like the WVE, this type of information can help planners, stakeholders, and scientists consider the effects of continued demographic change on the landscape in long-term planning and modeling efforts (Baker et al. 2004, Hulse et al. 2009).

Specific decisions by individual landowners to restore fire-adapted habitats are undoubtedly related to a wide diversity of dynamics (e.g., Bright and Burtz 2006, Martin et al. 2007, Nelson et al. 2005, Vogt et al. 2005, Winter and Fried 2000). For example, responsiveness to financial incentives and sensitivity to property-rights concerns are two constructs that are relevant to the Willamette Valley Ecoregion. Conservation programs are available in the region to restore oak and prairie habitats; however, some landowners are wary of these programs due to concerns about potential property-rights challenges if threatened or endangered species make use of these habitats (Fisher and Bliss 2008). Further understanding of landowner characteristics associated with differing land management tendencies could help explain how sensitive the landscape will be to the policy environment, sociological trends, or feedbacks from biophysical changes that may result from a changing climate.

Understanding the broad sociological influences on landowners' inclination to restore fire-adapted and biodiverse habitats is an important component of understanding the potential for habitat restoration in the WVE. Long-term socio-demographic trends combined with the growing demand for livelihoods in the WUI will influence the pattern, structure, and composition of the landscape in the future. While landowners' decisions to undertake specific land-use and management actions are influenced by their motivations for owning their property and a variety of other factors (Koontz 2001), examining potential consequences of future sociological trends provides a useful means to explore potential changes in people's relationship to their land. When scaled across the multitude of individual landowners, these trends may shape the nature and magnitude of risk to both human and biological values on any future landscape. Understanding these dynamics at the scale of both individual land parcels and the landscape as a whole is critical both for climate-adaptation planning and for developing simulation models that adequately represent the interactions of human, ecological, and physical systems in human-dominated landscapes. Our modeling effort is only a first step to considering the long-range threats of climate, urbanization, and wildfire.

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The content of this paper reflects the views of the author(s), who are responsible for the facts and accuracy of the information presented herein.

INVOLVING THE PUBLIC IN RESTORING THE ROLE OF FIRE IN THE LONGLEAF PINE ECOSYSTEM OF UPLAND ISLAND WILDERNESS

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Abstract.—The 13,250-acre Upland Island Wilderness (UIW) in Texas was established in 1984 and is managed by the United States Forest Service (USFS). Historically, portions of it consisted of open and diverse longleaf pine (*Pinus palustris*) ecosystems which depend on frequent, low-intensity surface fires. As in many other relatively small wilderness areas, the vegetation and fuel conditions in the UIW underwent extensive changes after wilderness designation. Lightning-caused wildfires were no longer allowed to burn with the frequency or intensity that characterized the natural fire regime. This has resulted in an increase of shade-tolerant trees and shrubs, heavy accumulations of duff and pine litter, and loss of suitable habitat for several rare species, including the red-cockaded woodpecker (*Picoides borealis*). In addition, the unnatural fuel accumulations have created a serious fire hazard that threatens the safety of firefighters, private citizens, adjacent properties, and the wilderness resource itself. The USFS recently developed a fire management plan and conducted an environmental analysis (EA) involving all interested stakeholders. The primary goal of this effort was to reduce hazardous fuels in the wilderness to acceptable levels while restoring the ecological role of fire.

1.0 INTRODUCTION

Historic accounts of the dominant longleaf pine (*Pinus palustris*) communities of the southeastern United States describe an open, park-like stand structure maintained by frequent, low-intensity surface fires (Bray 1904, Harper 1920, Peet and Allard 1993). Ignited by lightning and native peoples, these fires limited hardwood encroachment and enhanced longleaf pine regeneration (Hiers et al. 2007). In recent decades, because of wildland fire suppression policies, lightning-caused wildfires have not been allowed to burn with the frequency or intensity that once characterized the natural fire regime.

Today, restoration of these degraded longleaf pine-dominated ecosystems is a regional priority (Gilliam and Platt 2006, Outcault 1997) and the reintroduction of fire is considered critical (Hanula and Wade 2003). In many cases, wilderness fire management includes allowing lightning-caused fire to play its natural role in the ecosystem. However, the natural lightning fire processes that once occurred at a landscape scale are no longer functional in many places. In addition, other present land management policies, land uses, and on-the-ground conditions complicate the reintroduction of fire.

1.1 The Upland Island Wilderness

The Upland Island Wilderness (UIW; Fig. 1), a United States Forest Service (USFS) site in Texas, has been managed with a policy of fire suppression since it was designated as a national wilderness area in 1984. At 13,250 acres, the UIW is too small to receive enough natural ignitions to approximate the fire frequency of the natural fire regime. Given existing conditions, lightning-ignited fires that do occur are not allowed to burn because they would threaten life and/or property within and outside of the UIW. At the same time, effective fire suppression programs and changes in the structure and continuity of wildland fuels have

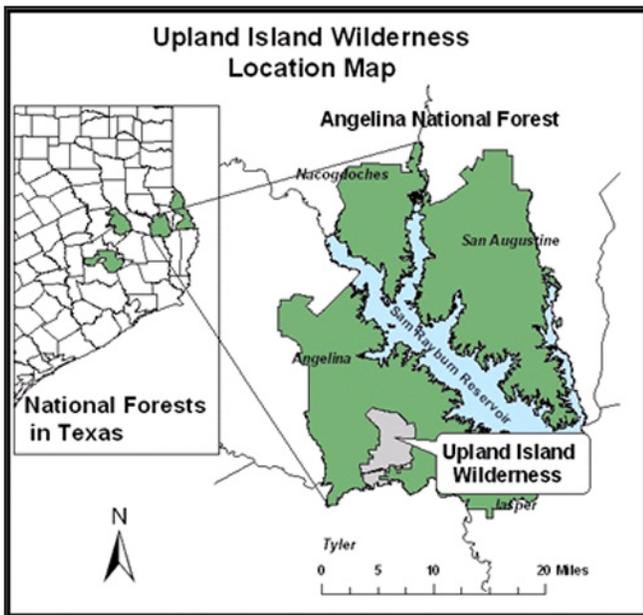


Figure 1.—Location of Upland Island Wilderness within the Angelina National Forest, USFS, in east Texas, USA.

reduced the potential for fire spreading *into* the UIW from surrounding areas. Fires originating outside the wilderness boundaries are either suppressed or contained by human-created fire barriers.

As a result of these changes in the fire regime over time, wilderness values and biological diversity are declining in the UIW, while hazard risks (like fuel, insects, and diseases) are increasing. Shade-tolerant trees and shrubs have increased, duff and pine litter have accumulated, and suitable habitat for several rare species, including the red-cockaded woodpecker (*Picoides borealis*), has been lost. In addition, unnatural fuel accumulations have created a serious fire hazard that threatens the safety of firefighters, private citizens, adjacent properties, and the wilderness resource itself.

2.0 RECENT CHANGES IN FIRE MANAGEMENT PLANNING AT THE UIW

The USFS has recently developed a fire management plan for the UIW and conducted an Environmental Analysis (EA) involving all interested stakeholders. In addition, an interdisciplinary team of private, state and federal agencies and organizations has evaluated and proposed the use of fire in UIW. The primary

goal of these efforts is to reduce hazardous fuels in the wilderness to acceptable levels while restoring the ecological role of fire. Fuel reduction is necessary to protect human life and adjacent private property, to increase the safety of wildland firefighters who would have to respond to wildfires within UIW, and to protect the ecosystems in UIW from possible wildfire conflagrations or high severity fires. A reduced fuel load will also make possible a wider range of options for responding to unplanned ignitions in the wilderness, including management of lightning-caused wildfires to achieve wilderness objectives.

2.1 Background on the UIW Fire Management Plan

Over the last 20 years, a number of collaborative milestones informed the current plan to reintroduce fire into the management scheme on the UIW. In 1994, Stephen F. Austin State University (SFASU) and The National Forests and Grasslands of Texas (NFGT, a management unit of the USFS) conducted a “Limits of Acceptable Change” (LAC) analysis for UIW. The LAC development process involved both public agencies like the Texas State Senate’s Committee on Natural Resources and private partners like the Sierra Club, The Nature Conservancy (TNC), and concerned citizens. The LAC report identified the important wilderness values threatened by human use, established standards for defining acceptable conditions, and developed strategies for addressing areas of concern. Recommendations included the use of prescribed fire to restore a safe and natural fuel structure that emulates the historic fire regime.

In 1996, the NFGT’s updated and revised forest plan for the UIW was approved. A cooperative project between TNC and SFASU developed an “Ecological Classification System for the National Forests and Adjacent Areas of the West Gulf Coastal Plain,” which provided the ecological framework for the proposed restoration effort at UIW. Between 2004 and 2006, SFASU and NFGT developed the first iteration of the Upland Island Wilderness Fire Management Plan, which identified human-ignited prescribed fire as the management option of choice to restore the longleaf pine portions of UIW.

In 2007, UIW managers, TNC, and SFASU engaged concerned citizens in the UIW fire management planning process via a public meeting, a field trip to UIW, presentations to Beaumont and Houston Sierra Club chapters, a scoping letter, a minimum requirement analysis, and numerous direct contacts with landowners. One of the many challenges in developing a burn plan for UIW was the lack of natural fuel breaks and the extent of private property (over 17 miles) adjoining the wilderness area (Fig. 2). The Sierra Club raised a number of concerns, many of which were addressed in the final plan. For example, the plan was amended to include the requirement that prescribed burning mimic the natural fire regime by replicating natural fire frequency, seasonality, rate, duration, start locations, and patchiness. In addition, preburning activities are required to include establishing fire lines outside of the UIW and all fire ignitions are to be done by hand. If natural lightning fires occur, they will be allowed to burn. Lastly, no one will be allowed to intentionally manipulate fire to favor any particular plant, animal, or community.

2.2 The 2010 UIW Fire Management Plan

The most recently proposed (2010) UIW Fire Management Plan has a number of updates and new features. It proposes conducting cool season prescribed burns on 12,000 acres in 6 units at 1-3 year intervals since the UIW is too large to burn in a single event while still maintaining burn objectives. In these cases, helicopter ignitions would be permitted because heavy fuel loads preclude safe hand ignitions, larger areas could be burned in single events, fewer interior fire lines would be required, and air quality effects would be reduced since smoke emissions would occur over a shorter time period.

The 2010 plan also proposes establishing approximately 17 miles of mechanically created fire lines on private property outside of UIW boundaries, with another 8 miles of line along adjacent USFS (Angelina National Forest) property (Fig. 3). Within the UIW, 6.3 miles of abandoned road beds and approximately 5 miles of creeks and wet areas will be used for fire lines. As part of the overall ecosystem approach to this project and reflecting the buy-in of

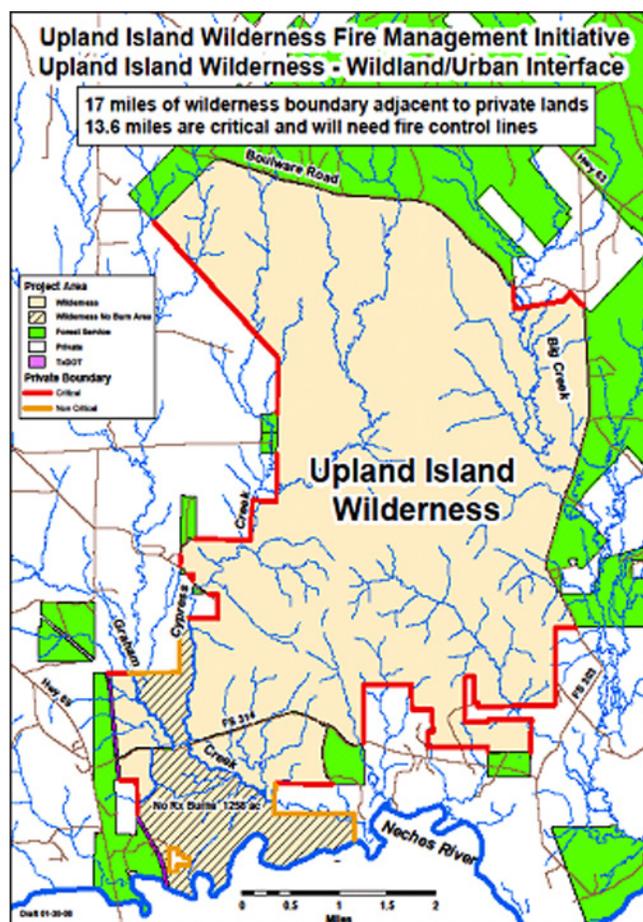


Figure 2.—Location of private property boundaries of Upland Island Wilderness, USFS, east Texas, USA.

some of the stakeholders, 566 acres may be burned on 13 private tracts within or adjacent to UIW boundaries. An additional 402 acres of Angelina National Forest will also be burned.

The environmental assessment (EA) associated with the 2010 plan also stipulated that chainsaws will only be used in emergency situations, leaf blowers will be allowed just prior to burn if time is critical to clear previously prepared firelines, and hose lays and pumps will be used only as needed. Post-burn assessments will be conducted to see if objectives have been met and to determine the timing of future burns.

The Regional Forester signed a Decision Notice and Finding of No Significant Impact on May 28, 2010. The Houston Chapter of the Sierra Club subsequently filed an appeal but withdrew it once the major issues described above were resolved. Negotiations with the

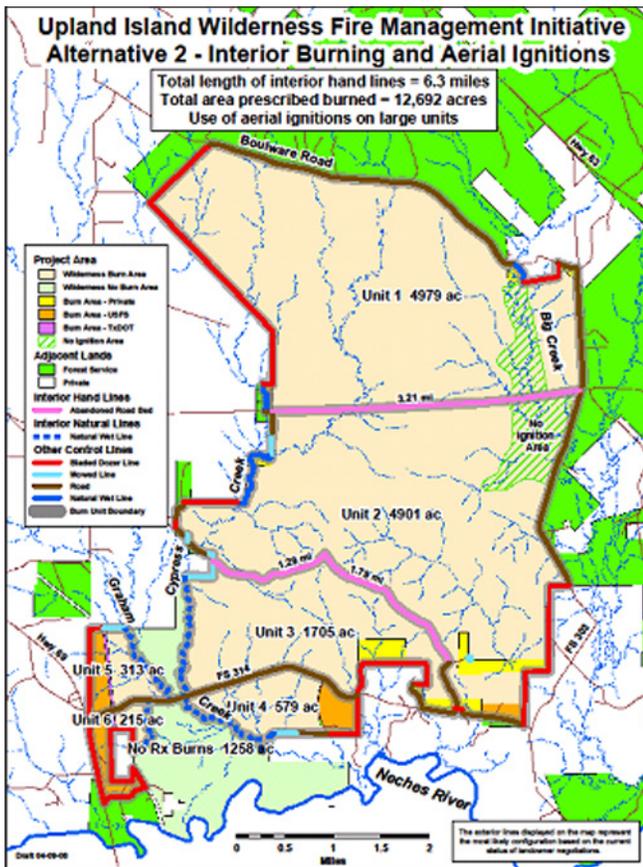


Figure 3.—Proposed burn units of Upland Island Wilderness, Angelina National Forest, east Texas, USA.

Sierra Club also led to agreements that leaf blowers would not be used in preparation of fire lines and that helicopter patrols after burns would be limited to one flight per day.

3.0 CONCLUSIONS

This collaborative process built on stakeholders' commonly held appreciation of wilderness values to reintroduce fire into the land management of the UIW, a small wilderness area. It became apparent during the plan development process that landowner cooperation was not only essential for success, but also resulted in an increased public understanding of the role of fire in this ecosystem. The current land management, fire, and burn plans address the critical ecological principles and a range of stakeholder concerns while making firefighter and public safety the top priorities.

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DEFENSIBLE SPACE FEATURES: IMPACT OF VOLUNTARY VERSUS MANDATORY PROGRAMS ON A HOMEOWNER'S ATTITUDES AND ACTIONS

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Abstract.—Our research examined homeowner responses to local efforts that encourage mitigation of wildland fire risks on private property. We were specifically interested in whether there were different attitudes toward, and different compliance responses to, voluntary versus mandatory programs aimed at managing vegetation for fire risks. We chose four sites for the diversity of their wildland fire policies and the presence of flammable vegetation, residential housing, and sizeable population. The mandatory policy communities were Oakland, California, and Ruidoso, New Mexico. The voluntary-compliance communities were Grand Haven, Michigan, and Larimer County, Colorado. A mail survey of homeowners revealed that the communities with local ordinances requiring vegetation management had higher levels of mitigation activities and homeowners there perceived mandatory mitigation to be more effective than voluntary programs at reducing risks. Homeowners living in the mandatory-policy study areas were also more likely to be motivated by laws and to support mandatory approaches than those living in the voluntary-program areas. Several risk-mitigation practices directed at vegetation and structures were on many homeowners' "to-do" lists, including enclosing porches and converting non-roof building materials and landscaping to fire-resistant materials; these plans may suggest homeowners' intent to undertake future projects to reduce wildfire risk. The paper concludes with a discussion about education and policy implications.

1.0 INTRODUCTION AND BACKGROUND LITERATURE

Many components of fire risk management in the wildland-urban interface (WUI) require action by local communities and individual property owners. According to some observers, too much emphasis is placed on federal and state policies aimed at motivating local jurisdictions to mitigate wildfire risks while more attention should be paid to what is actually happening at the local level (Steelman and Kunkel 2004). Natural hazards researchers have shown that it is difficult to encourage changes at the local level, yet this is where the greatest control over mitigation can be exercised (Burby and May 1998).

There are generally few local incentives to respond to a wildfire hazard since existing policies and practices tend to shift pre-disaster mitigation measures and the post-disaster recovery burden to state and national taxpayers (Davis 2001, Plevel 1997). However, recently enacted federal and state policies provide some strong incentives for local jurisdictions to manage the risks associated with wildland fire (USDA Forest Service and U.S. Department of Interior 2000, Western Governors' Association 2001), leading to an array of local policies, laws, and programs. Our research sought to understand what impact these programs might have on defensible-space practices at the household level.

We identified defensible-space programs that had different approaches to reducing wildfire risks and losses but had similar goals and target outcomes. The general focus of defensible-space programs is to encourage property owners to manage vegetation to decrease their fire risk and impacts and to make their buildings more fire-resistant. We wanted to examine differences in outcomes between programs where defensible space is mandatory (meaning the community adopted a required homeowner program

and/or a local ordinance was in place) and programs where it is voluntary (meaning a community may or may not have administered a program and homeowners could practice defensible space at their own volition). We also tried to identify and understand factors (i.e., motives, perceived effectiveness) that influence homeowner acceptance of, and compliance with, local government policies about defensible space.

2.0 METHODS

To address the research problem, we sent a mail survey to homeowners in four study communities selected to target the primary variables of interest: voluntary vs. mandatory policies, and incentives vs. no incentives (Tables 1 and 2). Both policies and incentives were largely directed at vegetation even though the building codes are enforced. Sites were also selected for the presence of WUI with flammable vegetation (fuels), significant residential housing (by density, including high-value real estate), and sizeable population levels (permanent residents, vacation homes, tourists). Local

officials who manage wildfire programs and services collaborated on selecting the geographic area of homes for each study site.

2.1 Community Profiles and Existing Wildfire Mitigation Policies

Larimer County-Front Range, CO, operates a grant-funded yard waste facility that offers free disposal and chipping services to county residents (an incentive). A full-time wildfire specialist offers on-site consultation to builders to recommend vegetation management actions that will comply with the County’s defensible-space guidelines. These vegetation management services are voluntary. The County requires that new construction in the County’s wildfire hazard area comply with wildfire hazard mitigation regulations. These regulations include provisions for fire-resistant construction and vegetation management to create defensible space around the new buildings. No such requirements apply to existing structures. We did not ask homeowners in the survey whether their house was new or existing.

Table 1.—WUI sample site scheme.

	Voluntary policies	Mandatory policies
With incentives	Larimer County – Front Range, CO <ul style="list-style-type: none"> • New home-building focus • Selective insurance incentives • Home risk assessments • Wildfire risk – high 	City of Ruidoso, NM <ul style="list-style-type: none"> • Mandatory vegetation management regulations • Cost-share arrangements • Wildfire risk – high
Without incentives	Grand Haven Township, MI <ul style="list-style-type: none"> • Firewise education by MSU Extension in partnership with township fire department and state forestry • Wildfire risk – low to moderate 	City of Oakland, CA <ul style="list-style-type: none"> • Mandatory vegetation management regulations • Tax assessment • Wildfire risk – high

Table 2.—Local wildfire safety law (requirements).

Coded by local policy at the time of the study: M=Mandatory; P=Partially Mandatory; N=No local requirements	Voluntary Policies (VP)		Mandatory Policies (MP)	
	Larimer Cty., CO	Grand Haven Twp., MI	Ruidoso, NM	Oakland, CA
Fire-resistant construction materials for all new homes	M	M	M	M
Fire-resistant landscaping and vegetation for all new homes	M	N	M	M
Fire-resistant landscaping and vegetation for existing homes	N	N	M	M
Annual fire department inspection of landscaping for fire safety	N	N	P*	M

* Re-inspections are required every 5 years, not annually.

The City of Ruidoso, NM, is a small village in southeastern New Mexico with about 9,000 permanent residents and a large seasonal population. Ruidoso was listed by New Mexico State Forestry as one of the “Twenty Most Vulnerable Areas” facing a high level of wildfire risk (Steelman and Kunkel 2004). In 2002, the Ruidoso Village Council passed a mandatory fuels-management ordinance in the highest risk areas of the city. The ordinance is actively enforced and offers incentives such as enhanced yard waste disposal and cost-share options for property owners who are willing to thin vegetation beyond the minimum standards.

Grand Haven Township and nearby area, MI, has no mandatory regulations, but township fire department officials recently partnered with Michigan State University Extension to develop defensible-space guidelines and education materials specifically for WUI homeowners along the fire-prone shoreline of Lake Michigan. Residents and fire officials are primarily concerned about the limited ingress and egress of the older lakeshore subdivisions and the highly combustible dune grass that is often the initial target of ignition sources, sometimes related to human recreational activities.

The City of Oakland, CA, has a long-standing mandatory defensible-space ordinance. The ordinance was enhanced in 2003 by a voter-approved property tax assessment proposition that created and funds a wildfire Prevention District covering more than 22,000 homes/parcels in the Oakland Hills area. The District has full-time staff members that inspect each property at least once per year. The inspections are meant to determine property owner compliance with state and local wildfire hazard-mitigation laws. The District also has an education/outreach program, enhanced yard waste disposal services, and a program to offset the costs of complying with mitigation on city-owned land (e.g., rights-of-way).

2.2 The Survey

The mail survey was sent to a sample of homeowners in each of the study communities. The survey was designed to allow us to analyze the influence of

scenario-specific factors and social characteristics on respondents’ attitudes towards, understanding of, and acceptance of mitigation policies and practices, and on their wildland fire hazard abatement practices. Scenario-specific factors were as follows: wildfire mitigation policy versus no policy, mandatory versus voluntary policy, and incentives versus no incentives. Social characteristics were demographics, social trust, general beliefs about policy outcomes, and attitudes towards humans’ roles in ecosystem management.

The questionnaire design and content were influenced by qualitative analysis of focus-group data collected in an earlier phase of this research (Winter et al. 2009). We also reviewed other questionnaires created by social science researchers such as Bruce Shindler of Oregon State University and Alan Bright of Colorado State University. We made additional efforts to review the literature for concepts and scales pertaining to opinions and judgments about policies and incentives. A copy of the questionnaire can be requested from the first author.

We obtained public information (name, mailing address, location address, home value) from local or county tax assessors for all properties in each study community that met the selection criteria. The selection criteria included specific WUI areas in each community, occupied homes, permanent residents, and seasonal residents; exclusion criteria included businesses, vacant land, land with hunting sheds only, and apartments. Once the list was obtained from each assessor, we drew a simple random sample of properties with homes to receive the survey.

Based on pre-test response rates, a sample size of 1,500 was deemed appropriate for Larimer County, CO, and Ruidoso, NM, given the size of the communities and their WUI area. Furthermore, past research in Colorado had had lower response rates than had California or Michigan sites. A sample of 1,000 was selected for Grand Haven, MI, and Oakland, CA. The project budget determined the total sample size of 5,000.

Questionnaires were mailed on April 10, 2008, with a personalized cover letter and a business reply envelope. Reminder postcards followed about a week later. A second mailing was sent to nonrespondents on May 9, 2008. Press releases were also sent to local newspapers in April and May to coincide with when homeowners received the survey. Seasonal homeowners were not likely to see announcements that appeared in the local newspapers. Almost 1,800 completed surveys were returned from a possible 4,802 (sample size minus bad addresses) for a 37.4-percent response rate. Larimer County had the highest response rate, 42.2 percent, Grand Haven's was 39.9 percent, Ruidoso's was 37.5 percent, and Oakland had the lowest rate, 27.5 percent.

A nonresponse study was completed in June 2008. In Oakland, we made phone calls to nonrespondents rather than sending another mailed survey in order to use multiple methods to test for nonresponse bias; mail surveys were used for the other sites. The nonresponse study found the following biases:

1. In Oakland and Larimer County, people who had not previously responded to the survey gave significantly higher ratings than previous respondents to the likelihood of wildfire occurring.
2. In Oakland, nonrespondents to the main survey had significantly more positive attitudes toward two measures: a visit by an official to show how to manage vegetation, and an ordinance that requires vegetation management.

These results are the reverse of what is often expected—that those who do not respond are less active or less concerned about wildfire.

Frequencies were prepared in tables for a basic review of patterns. We analyzed the data with a series of parametric tests to test similarities or differences in attitudes (effectiveness of actions) for the range of site factors. We calculated mean scores on interval attitudinal data for voluntary policy (estimating a composite mean for Colorado and Michigan sites)

and mandatory policy (estimating a composite mean for New Mexico and California) and then applied an independent sample t-test. ANOVA tests with post-hoc testing were used to test across the four sites. The hypothesis of the research was that mandatory policies yielded greater acceptance and compliance than voluntary policies.

3.0 RESULTS

Homeowners were asked which of 11 defensible-space practices existed on their property (Table 3). They were asked to indicate whether each practice did not pertain to their house and/or lot, already existed when they purchased the property, had been undertaken for wildfire safety, had been undertaken for other reasons, or had not been undertaken (yet). Few respondents across the four study sites indicated that vegetation or home features were not applicable to their property, although firewood stacked near a building was less common in Oakland. In the columns marked "action not necessary because already existed when purchased," most practices yielded a single-digit percent, suggesting that few homeowners found themselves in that situation or that vegetation management requires ongoing or frequent effort. The exception was fire-resistant roofs; between 17 percent of homeowners (Grand Haven Township) and 31 percent of homeowners (Ruidoso) had fire-resistant roof materials.

The column marked "my household took this action primarily for wildfire safe reasons" shows the extent of mitigation actions by Larimer County, Ruidoso, and Oakland homeowners. Each location had high levels of vegetation maintenance and roof replacement. Grand Haven Township residents appeared to perform vegetation management for reasons other than wildfire safety. Finally, vegetation management beyond keeping the roof and gutters free of debris were on many homeowners' lists of features not yet addressed. These items could be considered a "to-do" list or intended behavior, with particular attention to converting nonroof building materials and landscaping to fire-resistant materials and enclosing porches.

Table 3.—Features of properties and actions to protect homes from wildfires.

Vegetation to House Features	Percent (%) who selected each response																	
	1. Not a feature of my home or property			2. Action not necessary, as already existed when purchased home			3. My household took this action primarily for wildfire safety reasons			4. My household took this action primarily for other reasons			5. Have not done this to my home or property					
	VP ^a	MP ^b	CA	VP ^a	MP ^b	CA	VP ^a	MP ^b	CA	VP ^a	MP ^b	CA	VP ^a	MP ^b	CA	VP ^a	MP ^b	CA
Roof and rain gutters kept free of leaves/needles/twigs	21	28	12	4	5	4	4	6	4	24	3	30	23	45	62	49	66	5
Overhanging/dead branches removed w/in 10 feet of roof	11	9	7	9	8	3	8	6	6	49	9	53	61	16	60	22	19	16
Green veg. area maintained at least 30 feet around house	14	15	24	11	7	9	8	12	8	42	6	29	42	13	43	16	23	24
Trees/shrubs thinned w/in 30-50 ft. of house	7	11	8	8	8	4	9	6	4	51	7	54	52	9	42	14	20	25
Shrubs/lower tree branches that could carry flames from ground into crown are removed	4	10	9	7	5	3	7	5	3	52	8	58	52	9	32	14	15	30
Dead veg./leaves/needles cleared at least 30 feet from home	3	5	2	4	4	1	4	3	4	57	11	65	58	16	58	20	28	21
Yard is landscaped with fire-resistant vegetation	29	26	28	14	6	2	8	8	8	11	4	14	23	6	15	8	18	49
Firewood/lumber stacked at least 30 feet from all buildings	12	27	22	42	3	2	4	3	3	52	8	39	27	10	35	13	5	22
House has a fire-resistant roof	5	8	4	8	24	17	31	26	31	43	12	35	42	19	55	24	17	8
House materials are fire-resistant	23	20	23	17	8	8	16	18	16	14	6	13	22	6	27	7	8	50
Underside of deck enclosed to keep debris from collecting	29	30	27	38	7	6	13	10	10	11	4	15	9	7	26	11	13	46

^a "Voluntary Policies." ^b "Mandatory Policies."

Homeowners were asked to rate the effectiveness of the 11 actions in reducing the risk of severe damage to their house if a wildfire were to occur in their neighborhood. The data in Table 4 do not take into account whether or not each respondent actually undertook these practices. Homeowners living in the mandatory-policy study sites gave higher ratings to the effectiveness of most actions compared to homeowners living in voluntary-policy study sites. Respondents' from mandatory and voluntary sites gave similar ratings for three fire safety actions, all of which were generally perceived as effective: firewood and lumber are stacked at least 30 feet from all buildings, house construction materials (e.g., siding, porches, decks) are fire-resistant, and a green vegetation area is maintained at least 30 feet around the house.

Table 5 provides insight into homeowners' motivations for taking or not taking defensible-space actions. Homeowners living in the mandatory policy study areas were more likely to be motivated by laws. About 42 percent of Oakland homeowners and 29 percent of Ruidoso homeowners were partly motivated by local vegetation management programs. There were indications that insurance can have a small influence on homeowners' actions; 10 percent of homeowners in Ruidoso and 5 percent in Larimer and Oakland were motivated by insurance companies. In Larimer County and Grand Haven Township, very few respondents were motivated by laws (which more than likely did not exist unless the home was new and the building codes required fire-resistant materials for new construction). Almost half of the Grand Haven Township homeowners took no action, whereas almost 9 out of 10 homeowners in the other three study site areas took action on at least one of the 11 practices.

4.0 DISCUSSION

In recent years, social science research on wildfire has gained considerable attention. However, no previous studies have tested the influence or impact of mandatory policies on the acceptance of wildfire risk-mitigation policies and practices. Our findings show that mandatory programs drive some actions and lead to higher perceived efficacy of mitigation

activities. In Oakland and Ruidoso, mandatory policies clearly encourage a greater proportion of homeowners to create defensible space and undertake fire-wise vegetation management than in the two study communities with voluntary programs. Oakland residents in particular have undertaken extensive wildfire mitigation activities as mandated by a long-standing program funded by property taxes. Ruidoso has recently begun to organize stakeholders and has designed a wildfire risk-mitigation program funded mostly by grants and local matching funds. Larimer County has a high wildfire risk but lacks a formal approach to encouraging homeowners to mitigate their fire risk—yet 81 percent of respondents had voluntarily undertaken one or more defensible-space practices. Our results do not address how Larimer County homeowners might react to a mandatory policy for all homes. And finally, Grand Haven Township is an area with a history of wildfires (mostly caused by people) but with few local fire risk-mitigation programs, no wildfire ordinances except relating to new home construction, and the lowest levels of defensible-space practices among the study sites.

A very detailed set of questions about homeowner wildfire risk-mitigation actions revealed large differences in whether the actions applied to particular homeowners and whether homeowners had completed that action. For example, even though Oakland and Ruidoso each have a mandatory policy on fire-wise landscaping, homeowners in both communities still had not taken landscaping actions. Even in communities with mandatory programs, the majority of homeowners (64 percent in Ruidoso and 72 percent in Oakland) attributed their wildfire risk-mitigation actions to their own volition.

The findings about defensible-space actions also show that homeowners use different approaches to reduce risks to houses versus green vegetation. The actions related to thinning or maintaining vegetation (e.g., overhanging/dead branches are removed within 10 feet of roof; roof and rain gutters are kept free of leaves, needles, and twigs; green vegetation is maintained at least 30 feet around house) were more common than

Table 4.—Effectiveness of fire safety actions for risk reduction of severe damage to home by wildfire.

Vegetation to House Features	Voluntary Policies (VP)						Mandatory Policies (MP)						Overall (MP vs. VP)	Overall (4 states)
	Larimer Cty, CO		Grand Haven Twp, MI		Mean (Total)	Ruidoso, NM		Oakland, CA		Mean (Total)				
	Mean ^c	SD	Mean	SD		Mean	SD	Mean	SD					
Roof and rain gutters are kept free of leaves needles and twigs	3.8 ^{2,3,4}	1.09	3.5 ^{3,4,5}	1.11	3.7	0.97	4.0 ^{2,5}	1.03	4.0	1.03	4.0	6.61 ^{****}	ANOVA df=3	
Overhanging and dead branches are removed within 10 feet of roof	4.4 ^{2,3}	0.78	4.0 ^{3,4,5}	0.94	4.2	0.81	4.3 ^{2,4}	0.76	4.4	0.76	4.4	3.70 ^{****}	F=14.77 ^{****}	
Green veg. area is maintained at least 30 feet around house	4.1 ^{2,3}	0.93	3.8 ^{3,4,5}	0.97	4.0	1.00	3.9 ^{2,4,5}	0.89	4.0	0.89	4.0	0.91	F=1.08 ^{***}	
Trees and shrubs are thinned out within 30-50 ft. of house	4.3 ²	0.86	3.7 ^{3,4,5}	0.96	4.0	0.91	4.2 ²	0.90	4.2	0.90	4.2	3.00 ^{**}	F=9.62 ^{****}	
Shrubs and lower tree branches that could carry flames from ground into crown are removed	4.3 ²	0.84	3.8 ^{3,4,5}	0.93	4.1	0.83	4.3 ²	0.92	4.3	0.92	4.3	3.50 ^{****}	F=12.94 ^{****}	
Dead veg. and leaves/needles cleared at least 30feet from house	4.4 ²	0.77	4.0 ^{3,4,5}	0.89	4.3	0.77	4.4 ²	0.76	4.4	0.76	4.4	4.04 ^{****}	F=20.54 ^{****}	
Yard is landscaped with fire-resistant vegetation	3.6 ⁴	1.10	3.5 ⁴	1.06	3.6	1.13	3.7 ⁴	0.92	3.8	0.92	3.8	4.17 ^{****}	F=12.49 ^{****}	
Firewood and lumber are stacked at least 30 feet from all buildings	4.3 ^{2,3}	0.84	3.9 ^{3,4,5}	1.00	4.1	0.92	4.2 ^{2,5}	0.97	4.2	0.97	4.2	0.60	F=0.49 ^{***}	
House has a fire-resistant roof (e.g., asphalt shingles or metal)	4.6 ²	0.70	4.3 ^{3,4,5}	0.83	4.4	0.75	4.5 ²	0.68	4.5	0.68	4.5	2.41 [*]	F=5.77 ^{***}	
House construction materials are fire-resistant	4.1 ⁴	0.95	4.0 ⁴	0.94	4.1	1.02	4.0 ⁴	0.81	4.1	0.81	4.1	0.48	F=8.15 ^{***}	
Underside of deck is enclosed to keep debris from collecting	3.6 ⁴	1.14	3.6 ⁴	1.04	3.6	1.15	3.7 ⁴	1.02	3.8	1.02	3.8	3.53 ^{****}	F=8.05 ^{***}	

^c Scale where "1" is not effective, "3" is neutral, and "5" is very effective.

² Statistically different from Michigan; ³ Statistically different from New Mexico; ⁴ Statistically different from California; ⁵ Statistically different than Colorado.

* p < .05, ** p < .01, and *** p < .001.

Table 5.—Motives for defensible-space practices.

Motives	Voluntary Policies (VP)		Mandatory Policies (MP)	
	Larimer Cty, CO (%)	Grand Haven Twp, MI (%)	Ruidoso, NM (%)	Oakland, CA (%)
My household did not take any of the actions (refer to Table 3)	11.7	46.2	8.5	8.3
Voluntarily took one or more of these actions	81.1	39.0	64.2	72.3
Took one or more actions because it was required by law	7.4	0.9	29.0	42.1
My insurance company requires one or more of these actions	5.4	1.4	10.3	5.4
None of the above	4.3	15.3	7.4	4.1

converting landscape to nonflammable vegetation. Importantly, vegetation removal actions such as clearing dead vegetation, leaves, and needles at least 30 feet from a house and removing overhanging and dead branches within 10 feet of the roof were perceived as being almost as effective as the action that was rated most effective: having a house with a fire-resistant roof.

As communities work on the wildland-urban interface wildfire risk by creating or adjusting policies, they can select from the many housing and landscaping options in the 11 defensible practices studied here. Importantly, practices that are not made mandatory may need awareness-building through education and demonstration sites in order to show the benefits to homeowners and the broader community. Overall, this research found that local policies with mandatory provisions influence attitudes and actions toward fire-wise landscaping and home features.

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FIREWISE FOREVER? VOLUNTARY COMMUNITY PARTICIPATION AND RETENTION IN FIREWISE PROGRAMS

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Abstract.—Firewise Communities/USA® is a national program designed to encourage residents of wildfire-prone areas to take action to reduce wildfire risks to their homes and neighborhoods. Residents of homeowner associations and small communities who are interested in improving their wildfire safety work with state forestry and fire professionals and follow a simple, flexible process to become recognized as Firewise. To maintain their status, they must conduct annual mitigation work, hold a Firewise Day, and document their activity. This paper examines the successes and challenges of the program, taking into account the voluntary nature of participation, and explores challenges to program adoption, particularly factors that lead to loss of interest in pursuing ongoing Firewise activity.

1.0 INTRODUCTION: WILDFIRE AND HOMES IN THE UNITED STATES

Home destruction from wildfires in the United States is poorly documented compared with other kinds of fire loss. It is known, however, that wildfires destroyed 800 to 1,000 homes in the United States in a typical year from the 1980s to 2009. The limited data available show a trend of increasing home losses to wildfire over time. Very large losses have occurred repeatedly in California, Florida, Arizona, and Colorado. Emergency response to wildfires has been very effective in most incidents, but during extreme wildfires in vulnerable areas, emergency response sometimes fails to prevent multiple home losses in the absence of pre-fire preparation by residents.

The tremendous growth in the U.S. population between 1990 and 2000 (Perry et al. 2001), especially in the West and South, has led to extensive residential construction on land that until recently was rural or agricultural and that is prone to wildfire. In addition, meteorological studies related to the impacts of climate change predict more and larger wildfires over the next 30 years (USDA Forest Service 2010).

By modifying features of homes and the immediate surroundings, people can significantly reduce the likelihood of home ignitions during wildfires. Since the early 1960s, post-fire investigations have revealed that homes that burn during extreme wildfires tend to ignite because a roof catches embers blowing in from the fire and/or because accumulated fuel (vegetation, woodpiles, or other flammables) close to the home starts burning and catches the house on fire (Butler 1974, Foote 1996, Howard et al. 1973). Models, experiments, and case studies of fire behavior support the idea that the condition of the home itself and of everything within 100-200 feet of it is strongly related to whether a home will burn or survive during an extreme wildfire event in the area (Cohen 1999).

Unlike treatments and interventions in publicly managed forests or grasslands, non-emergency interventions to prevent home ignitions during wildfires must usually be initiated by a non-governmental entity, namely a landowner or resident. Although private citizens may obtain assistance from local, state, or federal government agencies to help conduct wildfire safety activities, the rights of property owners effectively prevent outside entities from conducting the work without their express consent, with a narrow range of exceptions. Thus tens of thousands of existing homes are beyond the reach of regulatory tools that could force changes to home and landscape design, construction, or maintenance.

1.1 Attempting to Reduce Wildfire Losses with the Firewise Communities/USA® Process

Firewise Communities/USA® is a national program designed to encourage residents of wildfire-prone areas to take voluntary actions to reduce wildfire risks to their homes and neighborhoods. Firewise is a cooperative effort among the National Fire Protection Association (NFPA), the U.S. Forest Service, the U.S. Department of the Interior, and state forestry organizations. It was designed to reach beyond governmental and regulatory attempts to solve the home loss problem. Firewise teaches residents the basics of wildfire behavior to help them understand how homes ignite and what they can do to protect their homes. The Firewise Communities/USA® recognition program works by asking neighbors to join together to agree on a plan of action and to begin to take steps toward safer homes and common areas well before a fire threatens the area. Individual properties may use Firewise principles effectively, but since many homes are within 100 feet of other homes and properties, neighbor-to-neighbor action is potentially more effective for reducing home ignition risk in the community.

The Firewise Communities/USA® recognition program was launched in 2002 after 2 years of pilot testing in 14 self-selected communities in Arizona, California, Colorado, Florida, Idaho, Michigan, Montana, New Mexico, Utah, and Washington. Communities can engage in Firewise activities and training without participating in the formal recognition program, but they must participate in the recognition program and complete the required steps in order to become recognized Firewise communities. The recognition program was designed by a consultant, Leraas Cook and Associates, and was tested in cooperation with and on behalf of the National Wildfire Coordinating Group's Wildland/Urban Interface Working Team. Designed to be flexible, the template initially required communities to take four steps:

1. Complete a community assessment and create a plan
2. Form a Firewise Board
3. Hold a Firewise Day event
4. Invest a minimum of \$2 per capita in local wildfire mitigation projects annually

Although each community is subject to the same basic laws of physics with regard to how homes ignite, the community assessment of wildfire risk is the important first step to help residents understand what “their” fire could look like and how it could impact homes and properties. The assessment informs the plan, which can be elaborate or very simple. The plan should address home ignition risks based on the findings in the assessment and should include action items for residents. The Firewise Board is intended to include residents as well as fire and forestry staff, who can provide expert advice. The board maintains the action plan and organizes events. The requirement for an annual Firewise Day—a public education event or workday—was based on social science research on what causes people to adopt new behavior and how people are influenced by their peers (Nathe et al. 1999, Rogers 2003). The \$2 per-capita annual expenditure requirement was borrowed from the National Arbor Day Foundation's successful Tree Cities/USA program. McKenzie-Mohr and Smith (1999) have shown that steps like these that require communities and individuals to demonstrate their commitment to a process is an important part of changing social behavior.

A fifth step was added when the program was formally launched in 2002. Communities were asked to confirm their completion of the first four steps on a one-page application form and to renew their status annually by documenting the continued existence of the Firewise board and annual Firewise Day, and their annual investment in wildfire safety activities.

The launch of the Firewise Communities/USA® recognition program required a method for ensuring that communities had the expertise and other support

to conduct wildfire risk assessments and navigate the Firewise process. In 2002, the NFPA, U.S. Forest Service, and the National Association of State Foresters (NASF) signed a memorandum of understanding that outlined NFPA’s responsibilities to provide program management and resources in return for assignment of a state-level liaison for the program in each of NASF’s member states. While this assignment was voluntary, many states already had Firewise or a similar type of program where a community outreach program would fit. In addition, many states welcomed the new program as a tool to assist them with the challenging task of reaching residents with wildfire safety messages and delivering a call to action. State forestry departments have also helped residents get involved in Firewise and have assisted in creating and retaining active communities in the Firewise program.

2.0 FIREWISE PROGRAM GROWTH AND LESSONS

From a handful of pilot communities in 2002, the Firewise recognition program grew to include nearly 600 sites in 38 states by the end of 2009 (Fig. 1). From 2006 to 2009, the number of communities participating increased roughly 50 percent over any 18-month period. Retention—the proportion of communities that renewed their status annually—equaled or exceeded 90 percent each year through 2007. In 2008, retention dropped to 85 percent but increased to 88 percent in 2009.

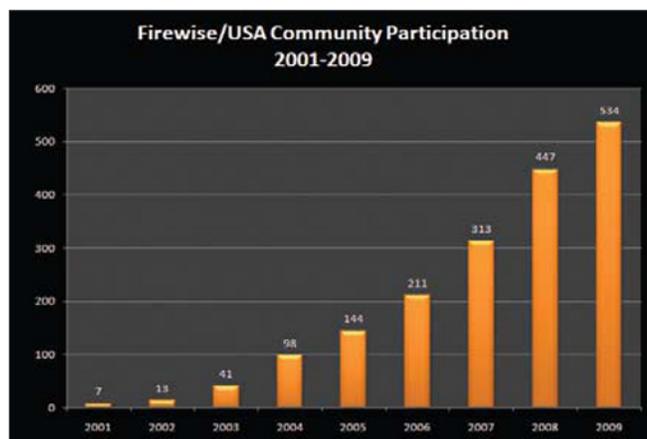


Figure 1.—Number of communities participating in Firewise Communities/USA Program.

Investment in Firewise activity, measured in dollars per capita that each new and renewing community documented each year, soared from a bit over \$1.5 million in 2003 to nearly \$18 million in 2008 (Fig. 2). In 2009, investment by new and renewing communities exceeded \$13 million. The 7-year annual average for all communities ever participating between 2003 and 2009 was \$79 per capita. Participants document all activity within the community and may include volunteer hours, grants, in-kind services, loans, or cash. With a volunteer hour valued at \$17.19 in 2003 and \$20.85 in 2009 (Independent Sector 2010), many communities achieved the required financial commitment primarily by using volunteer time.

The drop in investment from 2008 to 2009 may be due to the economic downturn, but may also be related to the number of “mature” communities that have already made their initial large investments in wildfire mitigation projects and are incurring lower costs for maintaining existing Firewise landscapes.

2.1 Why Do Communities Seek Out Firewise?

A review of community stories and profiles from the Firewise website and the quarterly “How To Newsletter” published by the program since 2006,

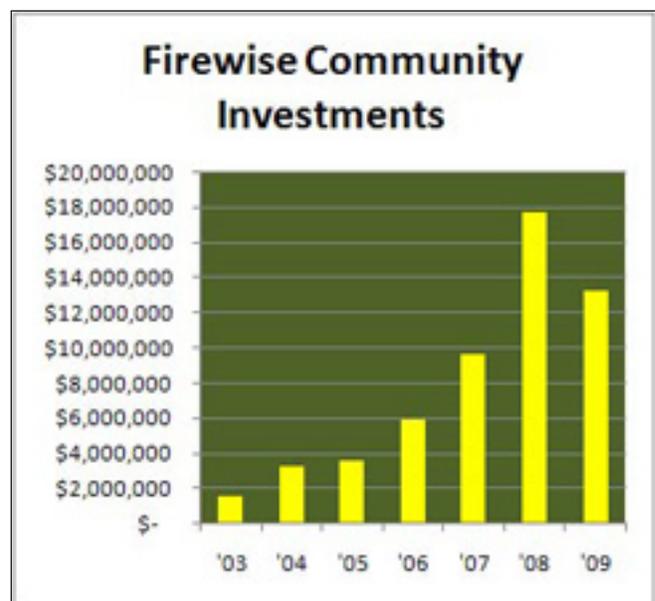


Figure 2.—Total annual investments made by participating Firewise Communities.

suggest some common reasons for participating in the Firewise program. Many residents in drought-impacted areas or areas with important environmental or agricultural resources are already very aware of wildfire risks. People who experience a damaging wildfire, witness a nearby fire, or experience a near-miss “scare” may become aware of the local wildfire risk and look for some way to address it. Outreach by state forestry and local fire service staff to residents who have never experienced fire may make them curious about how they could avoid or lessen a wildfire’s impacts. Residents may also become engaged in community wildfire discussions because of other concerns, such as poor roads or an inadequate local water supply. In these cases, fire may not be at the top of their list, but wildfire mitigation can be tied in to their existing concerns.

In communities where wildfire risk awareness is low, wildfire safety advocates such as state forestry and local fire services have successfully engaged residents via door-to-door contact, high-visibility demonstration projects, and public education meetings. As residents learn more about wildfire risk, they may want to visit again with these experts to get advice. Personal contact with fire safety professionals may help residents to engage in wildfire safety actions more readily.

The Firewise process can also be used to build community awareness and is designed to help residents learn from, and feel supported by, local and national experts. Communities that have undertaken the process respond well to this support and many residents enjoy being part of a community group where they can share common struggles and successes.

2.2 What Helps a Community Firewise Program Succeed?

Communities are most likely to succeed with Firewise when they follow the process, which encourages people to focus on and communicate about their community. When the focus is on the community and what it can do within its boundaries, the process is more likely to result in successful and sustained action.

A successful Firewise community starts with a comprehensive community wildfire risk assessment. A successful assessment results in a report that includes multiple photographs demonstrating not only problems or risky elements, but also good practices already adopted by local homeowners. The assessment report can help residents understand and visualize wildfire risks and the specific actions that can reduce those risks. After the community accepts its assessment, residents create a plan that can be elaborate or simple to address the issues brought up in the assessment.

Members of the community must commit to and engage in the Firewise process in order to get an assessment accepted and a plan created. Joining a Firewise committee is a public commitment to take action, and puts the “ownership” of Firewise planning and action in the hands of local residents, not outsiders. Even when communities receive a lot of outside help, local ownership of the process is a strong motivator since it puts a public spotlight on committee members to put their plans into action. The Lake Camelot community in Wisconsin, for example, was informed that it was eligible for a state grant to conduct Firewise activities after an early spring assessment by the Department of Natural Resources identified high-risk areas. With an assessment and plan in hand and an organized committee, the residents did not wait for final grant approval to jump into action. Their summary report describes their accomplishments:

The grant was applied for and, while we waited to hear something, we began to clean up a trial area of about five acres along one of the most frequently traveled roads in Chester Subdivision. We had volunteers working to drag out the dead and down wood; we had other volunteers using a chain saw to cut branches into sizes that could be handled. Still other volunteers brought trailers to haul loads of wood to the recycle center in the town of Rome. Over the summer, we had 27 volunteers that worked 430 hours—59 hours with chain saws, 80 truck/trailer loads hauled to the recycle center, and seven cleaning and disposal

days. In addition, three residents completed major Firewise projects to reduce their personal risk of wildfire. (NFPA Firewise Communities Program 2008, p.4)

Most communities need more convincing before volunteers begin to engage in Firewise actions. The requirement to hold an annual “Firewise Day” is designed to heighten awareness of Firewise within the community and to inspire active participation. Firewise Days make the community commitment evident and tend to attract more people each year. Continued annual activity helps convince residents who are in a “wait and see” mode that the program is real and is being implemented by their peers in the community. The Firewise Day can also serve as the primary workday where activities are completed in commonly-owned areas or among a particular set of homes.

As shown by the actual investment numbers, \$2 per capita per year is an attainable goal even for small communities that are initiating Firewise activities; most communities invest much more. Residents calculate the value of volunteer time using the website IndependentSector.org (Independent Sector 2010), which is linked from the Firewise website. Independent Sector researches and tracks the value of volunteer time by analyzing U.S. Bureau of Labor Statistics information. Independent Sector’s research group announces new figures each spring; the 2009 rate announced in spring 2010 is \$20.85 per hour. At this rate, a community of 500 residents could easily meet its requirement using volunteer time alone. For example, 20 people conducting 3 hours of work for the whole year at the current rate would claim a value of \$1,251, exceeding the \$1,000 minimum for the community. The “on-the-ground” activity, in whatever form it takes, is a crucial requirement for Firewise communities.

Finally, communities document their accomplishments in a one-page application. This form is signed by the Firewise state liaison or designee and routed to the NFPA Firewise office. This process establishes commitment and leads to formal recognition of the

community’s Firewise status. The annual Firewise renewal process affirms that work is ongoing in the community and that residents continue to chip away at the problems (sometimes quite literally). In high-risk communities, residents need to understand that wildfire threats will not be averted in one season or with a single mitigation project. For example, ongoing care and maintenance are needed around homes to ensure that the threat to structures is being monitored and reduced.

National program staff members have observed the dynamics of community engagement in Firewise through site visits, informal interviews with community leaders, and the stories that communities share on the program website and in publications and presentations. In communities that successfully initiate and stay with Firewise, some important features have emerged. First, they tend to have shared leadership. One overall leader may remain in charge for several years, but she or he must have a functioning board or committee that takes on work as needed. Partnerships both inside and outside the community are another key to success. Communities that recognize that there is enough credit to go around tend to form beneficial partnerships and are able to leverage limited resources. Finally, residents may get “hooked” on Firewise activity and find that they enjoy the process of engaging, planning, and participating in particular activities. Many successful Firewise communities are led by creative people who are always thinking about the next step toward achieving wildfire safety and spreading this information to their neighbors.

2.3 Why Do Some Communities Drop Firewise?

Of all the communities that entered the Firewise program between 2002 and the end of 2009, 12 percent “dropped out” at one point or another. Approximately 12 communities have since rejoined the program, but the great majority (more than 100) have not. Though it is difficult to determine why communities never engage in the first place, the experiences of communities who disengage give some clues about the challenges of creating a sustainable grassroots wildfire safety movement in a residential community.

Just as communities that follow the Firewise process are likely to be successful, those who do not follow it tend to fail at sustaining ongoing Firewise activity. Thinking about Firewise as “it’s all about the community,” helps advocates stay focused on the process as it was designed. When the focus of community effort is placed on something outside the community—or outside the goal of ignition reduction for homes—the process tends to be ineffective. When the process is not followed or shortcuts are taken, communities tend to spend a lot of time on activities that fail to help them achieve their wildfire safety goals. Problems that program staff have identified through observation, informal interviews, and review of community documentation are: 1) focusing on areas outside homeowner control; 2) lack of financial capacity; 3) lack of communication about wildfire risk assessment; 4) conflicting community agendas; 5) lack of community cohesion; 6) lack of outside help; 7) emphasis on legal mandates vs. voluntary action; and 8) difficulty completing paperwork.

Wildfire safety has many complex components that include many elements outside a homeowner’s control. For instance, many wildfire safety advocates are experienced in wildland fire response and see the pressing need for better infrastructure when they visit communities. Narrow, winding roads and driveways, poor road conditions, poor or non-existent signage, and inadequate water supply, combined with heavy vegetative fuels, will stand out to many wildfire experts as serious wildfire safety issues. However, most of these problems are outside the control of an individual resident and almost none of them are a typical part of the home ignition zone. Improving fire service response is a worthy goal, but not the goal of the Firewise recognition program; here the interests of Firewise residents and wildfire safety experts may not be compatible. When a strong emphasis is placed on large (and often controversial) projects such as widening roads or installing water supply alternatives, residents look to municipal government to take on this burden. A lack of emphasis on the home ignition zone means that residents are not given an avenue to take control of their own home ignition potential. An emphasis on fire response also sends the message that

wildfire is something for emergency responders to deal with and control, implicitly promising that there will be swift and effective response in the case of a wildfire. In fact, in extreme wildfire events, response to threatened structures can be limited or non-existent. Communities where the responsibility for Firewise activities was placed solely on the fire department have tended to be among the quickest to drop out of the recognition program.

While most communities are able to sustain investment in local Firewise activities beyond the \$2 per-capita minimum, inability to maintain investment has stymied a few. Although community size is not explicit in the Firewise Communities/USA® process, most communities active in the program have about 400 residents. Some very large communities (in a few cases, whole cities) have initiated the process but failed to sustain the initial level of activity over subsequent years. In very large communities, individual homeowners may not feel that they are part of the program.

Communities may ultimately fail to engage, or be very slow to do so, in part because inadequate time and effort were spent on the assessment phase of the process, or the process was poorly conveyed to residents. If the community wildfire risk assessment is not done—or is not communicated to the community—residents never learn about “their fire” and the relationship of the home ignition zone to personal safety and wildfire risk reduction. Again, wildfire experts are trained to see wildfire risk issues and problems as they drive through a community or walk onto a site; the assessment and resulting report must help residents learn to see them as well. One state forestry wildfire expert expressed frustration about how much time she had spent getting one community to the Firewise application phase, and how much “hand-holding” was required for the local Firewise Board to get projects done, even though they had received significant state grants. Her “assessment” in this case was a quick drive-through of the community and a discussion with a few board members. Without the assessment report in hand, it is doubtful that even motivated residents will fully understand the wildfire

risk, and it is very unlikely they will be able to educate other residents.

As with any group of individuals, Firewise Committee leaders may have personalities, agendas, or other responsibilities that detract from their work on the project. When other agendas are being advanced via Firewise, mistrust can develop among board or community members and can make the process less appealing for residents. Often, the most engaged and dynamic leaders are also the people who have multiple roles in the community and are juggling an overly full plate of activities. If these leaders cannot get the board or committee to assist, or have trouble delegating, they may simply become overwhelmed by the responsibility. Faltering leadership is another important reason that communities drop out of the Firewise process.

Some communities are also more cohesive than others. While formal homeowner associations are not necessarily free from problems such as difficult personalities, volunteer burn-out, or competing agendas, they often have support and organizational structures that help them to be successful. Many successful Firewise sites are not structured like homeowner associations, but the challenges of organizing and staying organized can sometimes overwhelm the desire to meet Firewise goals.

Successful communities, no matter how organized, use outside help to move forward on Firewise programs. State forestry agencies provide much of this assistance. The critical link between NFPA Firewise and state forestry departments cannot be overemphasized when it comes to the impact of outreach, education, and expert advice on communities. State forestry agencies face the challenge of maintaining Firewise activities, often without funding or mandates. Limited budgets and fewer people doing more work are an unfortunate reality for many state forestry agencies. As a result, they may lack the capacity to assist communities, or state resources may be shifted to try to get communities to comply with state mandates. When communities hear about Firewise, it may be in the context of a grant program with additional or different

requirements from the recognition program, or a regulatory program with which they must comply.

Finally, as free of bureaucracy as the NFPA Firewise program would like it to be, the Firewise Communities/USA[®] recognition program still requires a modicum of paperwork and documentation. Experience in the last 2 to 3 years has shown that the majority of annual dropouts and very late renewals occur because the community contact either forgot or was unwilling to do the paperwork to maintain Firewise status. There have been only a few cases where communities who had previously initiated or participated in the Firewise process had done no Firewise activities at all that year. State forestry agency liaisons have helped to remind communities about the annual documentation and NFPA has changed its requirements to make it somewhat easier to meet the annual goal. The deadline to report is December 31, so program staff members are working to encourage more communities to report throughout the year, whenever their activity is completed for the season, in order to avoid the stress of meeting a deadline around the winter holidays.

3.0 IMPROVING FIREWISE PARTICIPATION AND RETENTION

As the recognition program has grown and matured, the Firewise program has successfully encouraged peer-to-peer learning across communities on a national scale. Firewise has provided numerous avenues for communities to learn from one another via community profiles online and in newsletters, a social networking site (MyFirewise at <http://network.firewise.org>), and a series of conferences held in 2004, 2006, and 2008. The community-to-community learning mirrors the peer-to-peer learning happening within the communities themselves as neighbors are influenced by one another to adopt new wildfire safety behaviors. Experience suggests that the closer the program can get to achieving neighbor-to-neighbor influence, the more successful it will be in altering not only people's behavior, but also wildfire behavior in communities that have taken mitigation actions. The existing support networks help to facilitate this learning but could be strengthened and improved.

Although local fire departments are not part of the recognition program, local firefighters could provide more education and resources about wildfire and how homes ignite. To counter the expectation that fire trucks will be there no matter what, Firewise education can assist firefighters in helping residents figure out the best mitigation actions for their home ignition zones.

More support for state-level advocates would also help improve Firewise participation and retention. The simple one-sheet application may not seem daunting by itself, but as the program grows, state liaisons must keep up with paperwork for multiple communities. Like local fire departments, state forestry staffs need to keep current with wildfire education and resources. They will benefit directly, and will help residents engage more readily. The national program relies on state partners to conduct the initial community wildfire assessment. Workload and budget constraints limit the number of assessments that can be done in a given time in many states. More trained and funded assessors could help initiate and spread program adoption.

Finally, documentation of community successes is a critical factor in advertising the value of the Firewise Communities/USA® recognition process. In many cases, communities have successfully accomplished mitigation projects, built local capacity and cohesiveness, educated residents, and leveraged partnerships. However, additional research and analysis are needed to determine whether or not following the Firewise process results in fewer homes damaged and destroyed during wildfires. To sustain Firewise engagement over a long time—perhaps forever—data and experience must bear out the claims of reduced wildfire losses in Firewise communities.

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UNDERSTANDING HOMEOWNER PREPARATION AND INTENDED ACTIONS WHEN THREATENED BY A WILDFIRE

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Abstract.—As wildland fires affect more houses, increasing attention is being paid to how homeowners in affected areas respond to the wildfire threat. Most research on homeowner responses to wildfire has focused on actions homeowners take before a fire to mitigate their fire risk, particularly vegetation management. Less attention has been paid to homeowner response during fires, their planned course of action, and whether or not they understand which preparation and response actions contribute to or reduce the risk to their property and lives during a fire. In addition, given anecdotal evidence that homeowners do not always choose to evacuate, a better understanding of intended actions during a fire is of growing importance. This paper presents preliminary findings from a survey in California, Florida, and Montana. The survey was designed to assess homeowners' mitigation actions before a fire, their planned course of action if their property is threatened by a fire, and factors that influence homeowners' responses before and during fires. Results indicate that homeowners are taking responsibility for mitigating their property's risk and a significant proportion plan to protect their property during a fire.

1.0 INTRODUCTION

As wildland fires affect more houses, increasing attention is being paid to how homeowners living in the wildland-urban interface (WUI) respond to the wildfire threat. Actions homeowners take before a fire to mitigate their fire risk, particularly what shapes willingness to modify vegetation (Brenkert-

Smith et al. 2006, McCaffrey 2008, Nelson et al. 2004, Steelman 2008), have been the subject of most research on homeowner response to wildfire. Recently, more attention has begun to be paid to homeowner response during fires (Cohn and Carroll 2006, McCaffrey and Rhodes 2009, Paveglio et al. 2010). There is growing, mostly anecdotal, evidence that homeowners do not always choose to evacuate during a fire (Cohn et al. 2006, Mozumder et al. 2008, Pool 2007). Therefore, any effort to decrease loss of life and property from wildfires depends on a better understanding of homeowners' intended actions during a fire, and homeowners' knowledge of what preparation and response actions put their property and lives at most or least risk.

This paper presents preliminary findings from a survey in three locations in the United States. We designed the survey to assess homeowners' mitigation actions before a fire, their planned course of action should their property be threatened by a fire, and factors that influence their responses both before and during fires. Findings provide information on specific actions homeowners are taking to mitigate their risk, the proportion of homeowners that intend to ignore an evacuation order and stay with their homes, and how well homeowners understand the factors that contribute to and mitigate the risk to lives and property. Better understanding of homeowners' intended actions can help fire agencies design outreach programs that provide information to ensure that homeowners fully understand the risks and take appropriate actions in response to a wildfire.

2.0 METHODS

The results presented in this paper are based on data from a self-administered mail survey sent to randomly selected homeowners in high-risk wildfire areas. Three sites were chosen to represent a range of WUI conditions: Ventura County, California (Oct.-Dec. 2009); Alachua County, Florida (Oct.-Dec. 2009);

and the area around Helena (Lewis and Clark, and Jefferson Counties), Montana (Feb.-April 2010). Within each site, local fire managers were consulted to delineate the high-risk areas and county tax assessor data were used to develop sample frames that included only those properties within high-risk areas.

At each site, local cooperators issued a press release announcing the survey and at least one newspaper article resulted in each community. Survey mailings contained a cover letter, the survey questionnaire, and a postage-paid return envelope. Reminder postcards were sent to the entire sample 1 week after the initial mailing, and a replacement mailing was sent 2 weeks later to individuals who had not yet returned a survey. The overall sample included 4,762 households; 1,483 responded for an overall response rate of 31 percent. By site, the response rate ranged from 25 percent in Florida to 36 percent in Montana.

The three study sites are diverse in population demographics, mix of land use and ownership, and the regulatory nature of wildland fire mitigation guidelines for homeowners. Of the three sites, Ventura County is the most densely populated and most affluent, and has the most actively enforced regulations requiring regular vegetation management by private homeowners. The Helena area is the least densely populated of the three sites and has the highest proportion of seasonal homes. Alachua County, FL has the lowest median income (more than 20 percent of the population is below the federal poverty level) and the lowest proportion of land in public ownership. Like many other WUI communities, all three sites are challenged by the co-occurring phenomena of high fuel accumulation and increasing residential development.

In this paper, we report on survey items that measured homeowners' actions to mitigate their fire risk as well as their intended actions in the event of a wildland fire. In a few cases, we note differences between communities, but due to space constraints, these differences will be examined in more detail in subsequent papers.

3.0 RESULTS

In Ventura and Alachua Counties, more than 90 percent of respondents were full-time residents while 73 percent of Montana respondents were full time. Average length of homeownership was 16 years. The two Montana counties and Ventura were dominated by single-family homes (89 and 95 percent, respectively); 25 percent of Alachua County homes were manufactured or mobile homes and the remainder were single-family. Overall, 43 percent of respondents were retired and 62 percent were male; these proportions were higher in Montana. The average age was 59 years old.

3.1 Mitigation Actions Taken

Overall, respondents indicated that they were taking more actions on their properties to manage vegetation than to make their homes fire-resistant, although a large majority of respondents at each site had taken at least some actions to prepare their property for fire (Table 1). Ventura County appears to be most prepared, particularly in terms of vegetation management; 77 percent of Ventura respondents indicated they had done a great deal of vegetation management. Alachua County was least active, with the largest proportion of respondents who indicated they had taken little or no action to manage vegetation (24 percent) or make their buildings fire-resistant (39 percent).

At least two-thirds of respondents indicated that they had done a lot or some degree of work on seven specific vegetation management activities (Table 2). For the remaining respondents, results indicate that these seven actions were often not applicable to their property. Overall, when these actions were relevant for a property, only a very small portion of respondents (12 percent or less) had taken no action.

Several patterns are noteworthy regarding actions to make homes more fire-resistant (Table 3). For almost half of the homes, structural elements such as a fire-resistant roof or covered vent openings were already in place when the home was purchased—or were not applicable. In homes where the homeowner had taken the action since the home was purchased, roughly

Table 1.—How much work respondent had undertaken to prepare for wildfire (all respondents).

	A great deal (%)	Somewhat (%)	Only a little or Not at all (%)
Managed vegetation (e.g., cleared or pruned weeds, brush, and trees; used fire-resistant plants or landscaping)	58	31	11
Made my house more fire-resistant (e.g., installed non-flammable roofing; installed dual pane windows; enclosed the space under my deck)	38	38	24

Table 2.—Vegetation management actions respondent had taken (all respondents).

	Have done a lot of work (%)	Have done to some degree (%)	Haven't done at all (%)	Not applicable to my home (%)
Removed dead or dying vegetation within 30 feet of my home	68	24	2	6
Removed leaf litter (dry leaves/pine needles) from yard, roof, and rain gutters	53	35	5	7
Relocated woodpiles or other combustible materials 30 feet from the house	46	26	9	19
Removed or pruned vegetation near windows	42	29	6	23
Removed combustible material and vegetation from around and under decks	40	22	6	22
Removed "ladder fuels" (low-level vegetation that allows the fire to spread from the ground to the tree canopy)	39	38	9	14
Trimmed tree canopies to keep their branches a minimum of 10 feet from structures and other trees	36	43	12	9

Table 3.—Fire-resistant features of home (all respondents).

	Already Existed	Have Done Since Purchased		Does Not Have		
	Existed when I purchased home (%)	Primarily for fire reasons (%)	Primarily for non-fire reasons (%)	Haven't done; plan to do in future (%)	Do not plan to do (%)	Not applicable to my home (%)
Roof is made of fire-safe material such as composition (asphalt), metal, or tile	60	18	13	4	4	2
All vent openings are covered with 1/8-inch mesh (or smaller) that is not plastic or fiberglass	46	8	10	11	12	12
Exterior walls are covered with or made of fire-resistant materials	45	5	6	7	30	7
Eaves are boxed in with non-combustible materials	36	5	6	10	31	12
Underside of decks is enclosed with fire-resistant materials	8	4	6	13	26	42

half took the action primarily for fire resistance and half took the action for other reasons. A particularly positive finding was that only 10 percent of homes did not have a fire-resistant roof; however, almost 30 percent indicated that they did not plan to box their eaves, enclose their decks, or cover their exterior walls with fire-resistant materials.

When asked about their reasons for undertaking specific actions, more than 80 percent indicated that protection from direct flame contact (87 percent), reducing ember ignition (86 percent), and improving survival odds without active firefighter protection (83 percent) were very important reasons. A smaller but still large proportion of respondents indicated that a very important reason they had taken action was to provide firefighters room to work (67 percent) or because firefighters would be more likely to protect their homes (63 percent). Legal requirements were the least common reason for taking actions—only 34 percent overall said legal requirements were a very important reason although 60 percent of Ventura County respondents indicated they were very important. This response likely reflects Ventura County’s long-term and well enforced weed abatement (vegetation management) ordinance.

Respondents were also asked their views about the relative importance of vegetation management compared to actions that would make their houses more fire-resistant (Table 4). Although 55 percent of all respondents indicated that the two categories were equally important (55 percent), 35 percent responded that vegetation management was more important or “all that was needed.” When asked who they felt was most responsible for protecting private property from wildfire, they clearly leaned toward individual homeowners (Table 5). Only 18 percent put most or all of the responsibility for protecting homes on firefighters whereas more than half put all (23 percent) or more (35 percent) of the responsibility on homeowners.

3.2 Planned Action during a Fire

Respondents were asked whether they had a household disaster plan in case of a wildfire. Overall, only 38 percent of respondents indicated that they had a plan; this percentage was largest in Ventura County (48 percent), followed by Montana (35 percent) and Alachua County (30 percent). When asked whether they had ever been threatened by a wildfire, 38 percent of respondents indicated they had, with the highest proportion in Ventura County (52 percent), followed

Table 4.—Importance of vegetation management compared to house fire-resistance in decreasing fire risk (all respondents).

	%
Vegetation management is all that’s needed to reduce the risk	3
Vegetation management is most important, but making the house fire-resistant helps, too	32
They are equally important	55
Making the house fire-resistant is most important, but vegetation management helps, too	8
Making the house more fire-resistant is all that’s needed to reduce the risk	0
Neither can significantly reduce the risk	1

Table 5.—Agent most responsible for protecting private property from wildfire (all respondents).

	%
Firefighters	2
Shared responsibility between homeowners and firefighters (more on the firefighters)	16
Equal responsibility between homeowners and firefighters	24
Shared responsibility between homeowners and firefighters (more on the homeowner)	35
Individual homeowners	23

by Montana (40 percent) and Alachua County (21 percent). Given the parallel overall response for the two questions, a chi-square analysis was conducted on overall responses. This analysis indicated that there was a significant difference in development of a disaster plan based on prior wildfire experience: respondents who had been threatened by a wildfire were more likely to have a disaster plan (50 percent) compared to respondents with no prior fire experience (31 percent) ($p < .001$).

When respondents who had been threatened by a wildfire were asked how they had responded during the most recent fire, a smaller proportion indicated they either left early or left when instructed by authorities (38 percent) than indicated they waited to see what would happen (48 percent) before they decided to stay or leave (Table 6). Overall 20 percent indicated that they stayed throughout the fire and tried to protect their property. Of the 14 percent that marked “Other,” the largest proportion (5 percent of all respondents whose property had been threatened)

indicated that they had not been at the property at the time of the fire, about half because it was a second home. Interestingly, a small number of respondents indicated that they either assisted with putting the fire out or stayed because there were firefighters on their property.

All respondents were asked to indicate what they would do if they were at home when a wildfire was in the area (Table 7). Only one-third would leave early or when authorities indicated they should leave while 11 percent said they would stay throughout to protect their property. (Although we had expected a large percentage of respondents in Montana would plan to stay, given its more rural nature, only 10 percent of Montana respondents planned to stay compared to 13 percent of the respondents from each of the other two sites.) Notably, half of our respondents indicated they would do what they could to protect their houses and leave if imminently threatened by the fire. In further analysis, we hope to explore what “imminently” may mean for our respondents.

Table 6.—Action taken when last threatened by a wildfire (respondents who indicated they had ever been threatened by a wildfire, n = 551)

	%
Left before there was a mandatory evacuation order for my area	8
Left as soon as I heard there was a mandatory evacuation order	14
Planned to evacuate but waited until I was personally told to leave by an authority	16
Waited to see what happened and stayed because the risk was not great	30
Waited to see what happened but left when the danger felt too great	17
Stayed throughout the fire and tried to protect my property	3
Other	14

Table 7.—Likely future action if at home when threatened by a wildfire (all respondents)

	%
I would not be home as I intend to leave the area on days of high fire danger	1
Leave as soon as I am aware that there is a fire in the area	5
Wait until authorities indicate I need to leave, and then leave	28
Do as much as possible to protect the house but leave if imminently threatened by the fire	50
Stay throughout the fire to try to protect the house and property	11
Don't know what I would do	2

Finally, we asked two questions about respondents' perceptions of how their lives were put at risk during a fire. When asked how common they thought various causes of death were during wildfires, respondents clearly indicated that they expected inability to breathe to be the primary cause of death. Smoke inhalation was listed as a very common cause of death by 80 percent of participants; 60 percent indicated lack of oxygen was a very common cause of death (Table 8). Radiant heat, which in Australia is generally believed to be the main cause of death during wildfires (Haynes et al. 2008), was considered a very common cause of death by only 48 percent of respondents. We also asked how safe different actions were in protecting life if the respondent could not evacuate safely (Table 9). Although few people saw any action as very safe, half said that lying down in a ditch, swimming pool, or open area was a reasonably safe course of action; 22 percent indicated leaving the area on foot or bike

was a reasonably safe response. Around half of the respondents thought going inside the house was a very unsafe action while driving through the flames or taking refuge in a car were perceived as the least safe options (67-70 percent rated each action as very unsafe).

4.0 DISCUSSION AND CONCLUSIONS

Our findings indicate that, although there is some variability between proportions in three very different areas of the United States, the vast majority of WUI homeowners in our study locations are taking action to reduce their risk from wildfire. According to our survey results, homeowners understand that mitigation measures apply both to their vegetation and to the home itself, although there is a sense that vegetation management is more important (see Tables 1 and 4). It is notable that making structural modifications is relevant for only a small proportion of the

Table 8.—How common is each potential cause of death during a wildfire (all respondents).

	Very Common (%)	Somewhat Common (%)	Not at all Common (%)
Smoke inhalation	80	18	2
Lack of oxygen	60	32	8
Superheated air (radiant heat)	48	44	8
Exacerbation of existing physical condition (e.g., heart attack)	38	54	8
Direct flame contact	11	41	48
Traffic accidents	10	58	32

Table 9.—How safe an action is in protecting life if evacuation route is blocked (all respondents).

	Very safe (%)	Reasonably safe (%)	Somewhat unsafe (%)	Very unsafe (%)
Lie down in a ditch, swimming pool, or an open area such as a horse paddock or playing field (n = 1,370)	8	53	29	10
Leave the area on foot or bike (n = 1,339)	5	22	37	37
Put out embers that land around/on my property, but if it gets too hot, go inside and monitor the fire from there (n = 1,382)	2	16	38	44
Wait inside my house until the fire front has passed through (n = 1,380)	2	11	33	54
Quickly drive through the flames to get out of the fire area (n = 1,384)	1	6	26	67
Take refuge in my car (n = 1,381)	1	4	26	70

population—either because their property already had the modifications at the time of purchase or because they do not apply to that particular structure. It is also notable that structural elements are put in place as often for non-fire reasons as for fire-related reasons. Therefore, fire managers who want to encourage certain actions, particularly those that a relatively large portion of our respondents indicated they had no intention of doing, may want to promote both the nonfire reasons and the fire-related reasons for taking the actions.

Responses also indicate that most homeowners see protecting their property from wildfire as predominantly their responsibility. While firefighter protection during a fire does appear to be a consideration in the decision process, more homeowners indicated they took mitigation actions because of their potential effect on decreasing home ignition and increasing structural survival, with or without firefighter protection. Although not as important, legal requirements appear to play a role in communities that have actively enforced ordinances.

In terms of actions during fire, only one-third to one-half of respondents had prepared a disaster plan, suggesting that homeowners are spending more energy on mitigation actions than on considering what they will do during a fire. This result is notable given that, depending on the location, one-fifth to one-half of the respondents had at some point felt threatened by a wildfire, although experience with a wildfire threat in the past does increase likelihood of having a disaster plan.

Results support anecdotal evidence that a number of homeowners intend to stay to defend their properties rather than evacuating during a fire. In addition, many respondents do not intend to evacuate based on official evacuation orders and advice but instead plan to wait to see conditions and make their own decision about the risk. This response raises questions about whether homeowners have the knowledge to accurately assess conditions and decide what will put them at risk. Although there is surprisingly little documentation about the causes of civilian deaths during wildfires

in the United States, studies from Australia suggest that radiant heat is the primary cause of death and that being outside, particularly on foot, is more dangerous than being inside a structure (Haynes et al. 2008). Respondents' perceptions that smoke inhalation was the most common cause of death and that being outside was safer than being inside raises questions as to whether people have the knowledge to make the safest decision should they, for whatever reason, be faced with direct exposure to a fire front.

Overall, our findings show that most people are thinking about fire risk, have a sense of responsibility for doing something to mitigate their risk, and are taking action. Further, a significant proportion of participants plan to protect their homes in the event of a wildfire, even after an evacuation order has been given. This finding suggests that many people view the evacuation decision as one they should make instead of automatically following orders from authorities. This dynamic further highlights the importance of providing appropriate information to residents of fire-prone areas to help them make the safest possible decisions before and during a fire event.

The results described here paint a picture of a population that is reasonably engaged when it comes to wildfire awareness and prefire mitigation, but they only touch on possible reasons for the actions people take. Our next step will be to examine these underlying reasons: What specific factors, such as cost and perceived effectiveness, affect mitigation actions; what considerations shape planned actions during a fire; and how are level of preparedness and planned course of action during a wildfire linked?

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IMPROVING AN INHERENTLY STRESSFUL SITUATION: THE ROLE OF COMMUNICATION DURING WILDFIRE EVACUATIONS

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Abstract.—Wildfire evacuations are inherently stressful and homeowners have reported in previous studies that uncertainty over what is happening is perhaps one of the most stressful aspects. Although many difficult elements of evacuation cannot be mitigated and lives will certainly be disrupted, fire-management agencies can significantly reduce residents' uncertainty with frequent, open, and detailed communication. We illustrate this point with two case studies. In one community, there was little communication between fire-management professionals and residents before, during, and after a wildfire evacuation while in the other there was regular communication throughout the event. Where agency communication was lacking, the media filled the information gap with conflicting and often inaccurate reports. Two years after the fire, residents from this community recalled the event in vivid detail and many still expressed fear of wildfire and lack of trust in fire-management agencies. Conversely, residents of the community that received abundant, timely information had largely positive comments about how the fire was managed and expressed trust and confidence in the fire-managing agency. These experiences reinforce the notion that agency communication during a fire can

help reduce the stress of evacuation and help maintain positive long-term relationships between residents and fire-management agencies.

1.0 INTRODUCTION

Evacuation from one's home during a wildfire is inherently stressful because of the disruption to daily life and the uncertainty about what will happen (Cohn et al. 2006). Indeed, evacuees have cited a lack of current information about fire activity and fire impacts as one of the greatest challenges of evacuation (Kent et al. 2003, Sutton et al. 2008). Although individuals vary in their responses, evacuations often elicit strong negative emotions that can have a lasting impact (e.g., post-traumatic stress, anxiety, health problems, lack of trust) on both the individual and the community (Hodgson 2007).

While fire managers cannot completely eliminate the stress experienced by evacuees, reducing uncertainty by providing frequent, accurate, and detailed fire information has been found to significantly reduce the intensity of the negative emotions resulting from the evacuation, thereby reducing lasting negative impacts (Hodgson 2007). As McCool et al. (2006) note, the "significance of quality information during an emergency cannot be overstated" (p. 448). In addition, Kumagai et al. (2004) found that evacuated residents who believed they had received adequate information during the fire were less likely to blame fire management agencies for their losses and were more likely to attribute fire damages to "nature."

When people encounter such unfamiliar situations as a wildfire, they develop explanatory theories to make sense of what is happening and reduce uncertainty (Hodgson 2007). This sense-making is social in nature as people process and share information with each other. People often seek information first from official

sources, but if their needs are not met through these channels, they will turn to other sources (Sutton et al. 2008). The absence of credible information also does not cause theory-making to cease; the consistency and validity of people's explanatory theories can be severely impacted when they rely on less credible information-providers (Hodgson 2007), possibly resulting in inaccurate and negative public perceptions of the fire and fire-management agencies.

This is not to say that communication during a wildfire is easy; the high stakes increase both the complexity and significance of the communication process (McCool et al. 2006). During a large wildland fire, federal fire managers are required to provide daily updates that include the size of the fire and the extent of resources dedicated to suppression. While useful to some, this type of information often fails to meet the specific needs of evacuated community members who want to know whether their homes are being threatened or have burned (Cohn et al. 2006, Taylor et al. 2007).

Despite the importance of real-time, specific information, there are few official incentives for agencies to provide it. Agency concerns about providing inaccurate or unsubstantiated information can lead to a cautious communication style at odds with public demands. Fire management agencies generally have an immediate focus on containment and suppression of the fire and may not provide adequate communication resources for their on-the-ground personnel. Ultimately, the content and extent of agency communication with the public are usually at the discretion of those managing the fire and individual agency personnel.

Moreover, it is important to note that fire events and associated communication efforts occur within a larger context. Although the fire itself may be a relatively discrete incident, pre-fire preparations, decisions and experiences during an event, and post-fire decision-making and recovery are all linked. Relationships, interactions, and decisions made at each stage will influence subsequent stages. While specific

information needs vary, citizen-agency communication is important at each stage. Agency personnel and community members who have a history of working together prior to a fire event are likely to find communication easier if a fire does occur (McCool et al. 2006).

To date, few studies have examined the temporal connectivity of fire issues. Insights about how current actions and choices can influence future events could be useful to agency managers. This paper uses interview data to examine the experiences of residents from two communities in the western United States that recently evacuated during wildfires. These communities had substantially different interactions with agency personnel before and during the fire event, which is reflected in the very different ways they recount their experiences. The interviews suggest that building strong citizen-agency relationships prior to a fire event and providing frequent, current, and detailed information during a wildfire can contribute to reduced stress during the evacuation, and improved community recovery afterward.

2.0 METHODS

The data reported here are a subset from a larger study of wildland-urban interface residents' perspectives on wildfire risk and mitigation. While this larger study did not focus on evacuation, two of the six study communities had experienced wildfire evacuations and many participants described their evacuation experiences in great detail. Because few studies have documented wildfire evacuation from the evacuees' perspective, and in light of the dramatically different impressions the experiences left on the two communities, these accounts warrant reporting.

Data were collected in 2007 in Oregon and Utah. Interviews followed a structured format; in addition to recording responses to fixed questions, interviewers took detailed notes on the interview conversation, including participants' recollections of being evacuated. These notes were typed up immediately following the interview; verbatim quotes that were recorded formed an abbreviated transcript of the

interview (Kvale 1996). As part of the larger study, participants were selected based on their association with a community that was actively preparing for wildfire (Babbie 2001, Rubin and Rubin 2005). The two communities varied in the number of properties, and thus number of study participants (Table 1). At each site, we continued sampling until data saturation occurred; we feel confident that the resulting samples are representative of the study communities. All participants are given a pseudonym here to protect their identities.

2.1 Site Descriptions

The Oregon study community (Table 1) is a planned community surrounded on all sides by the Deschutes National Forest. It is situated on the east side of the Cascade Mountains in a transition zone between ponderosa pine and juniper- and bitterbrush-dominated ecosystems. Ponderosa pine forests in and around the community historically experienced frequent, low-intensity wildfires; this fire regime has been altered by human activities over the last century, increasing the risk of an uncharacteristically large and severe wildfire (Noss et al. 2006). The neighborhood has 200 forested lots, approximately 1 acre each, and the majority has buildings on them. Community governance is structured around a homeowners' association, which has been diligent about providing residents with fire safety information and encouraging the creation and maintenance of defensible space. The association has historically had a good working relationship with the local U.S. Forest Service office. Forest Service personnel have worked closely with association board members to improve community fire safety, including

conducting site assessments of local properties and participating in the annual homeowners' meeting. In the past 5 years, several large fires have occurred nearby, but the community has been evacuated only once.

The Utah community (Table 1) shares one border with the Dixie National Forest in southern Utah and is at the base of the Pine Valley Mountains in the transition zone between pinyon-juniper/hardwood and sage-steppe ecotones. Pinyon-juniper forests historically experienced frequent fire (Bradley et al. 1992). The neighborhood has 33 forested lots, ranging in size from 2 to 3 acres each. Approximately half of the lots have homes on them. There is no formal community governance and, before the fire, individuals implemented preparation and defensible-space activities without community coordination. Historically, residents here had limited contact with fire-management agency personnel. While several fires had erupted in the region over the past 5 years, only one had caused the community to evacuate at the time of the study.

3.0 RESULTS

3.1 Oregon Case Study

In 2006, the Black Crater fire caused the evacuation of several Oregon communities, including the one in this study. A lightning strike ignited a fire in the Three Sisters Wilderness upslope from the community. While residents were aware of the fire start and knew they might need to evacuate, the speed of the fire spread was unexpected. Typically, a pre-evacuation notice

Table 1.—Study site characteristics.

	Oregon	Utah
Forest Type	ponderosa pine	pinyon-juniper/ hardwood
Parcel Size (acres)	1	2-3
Number of Properties in Community	200	33
Number of Study Participants	40	9
Duration of Evacuation	~ 4 days	~ 24 hours
Name of Wildfire (year)	Black Crater (2006)	Blue Springs (2005)
Size of Fire (acres)	9,407	12,286
Wildfire Entered Community?	No	Yes

would encourage residents to prepare themselves and their homes for an evacuation. In this case, however, there was no time for a pre-evacuation notice and residents were told to evacuate immediately through reverse-911 calls and a truck with a siren and loudspeaker that came through the neighborhood. Residents evacuated for 4 days, during which the fire was contained about a quarter mile from the southwestern edge of the neighborhood.

During the evacuation, the Forest Service held two daily community meetings at the local high school (also the evacuation shelter), providing up-to-date information and displaying current fire maps. A fire information officer was onsite from 8 a.m. to 5 p.m. each day to answer questions. The following quotes describe local residents' experience with the fire, their perceptions of how it was managed, and their interactions with Forest Service personnel. These quotes were chosen to tell the story of each community's evacuation experience in its own words. While this is a slightly unorthodox approach to presenting qualitative data, it is particularly useful here because of the difference in the manner in which the communities as a whole related their experiences. During the interviews themselves, there were palpable differences in emotion: in Oregon, where residents were interviewed 1 year after the fire, accounts were largely matter-of-fact with little lingering emotion. In contrast, residents in Utah recounted events using vivid imagery and great detail as if they had just happened, even though the fire had occurred 2 years before the interviews.

3.1.1. Oregon Evacuation

"[The District Ranger] and [Fire Chief] worked in concert; we were very informed . . . We didn't get a warning call, only got the 'evacuate now' call. The fire moved too fast—I was surprised at how quickly the fire moved and got serious."
~ Allison

"We got a call to leave immediately and meet at the high school." ~ Betsy

"We were evacuated for 5 days and nights. Weird. We did not believe we would be evacuated and that the fire would get that close. Disconcerting." ~ Denise

"I was convinced for a time that we would lose the house—our home was closest to the fire—but the wind died and the fire went out." ~ Frank

"Not too worried about the house, have always tried to meet the standards for fire safety and we knew there was a fire truck at every corner. It was more of an inconvenience than anything."
~ Braden

3.1.2. Oregon Information Activities

"[We were] evacuated on a Thursday, had two meetings a day." ~ Frank

"After the fire started we were able to stay at the school and got lots of up-to-date information. That was very reassuring—they need to be commended for that." ~ Jessica

"We learned a lot from the meetings during the fire." ~ Kevin

3.1.3. Oregon Post-fire Sense-making

"[I] can't say enough good things about the firemen. [They] had 21 trucks in here last year and they did a lot of extra things to make sure our properties were safe." ~ Trisha

"Fire is not a bad thing, but last year the fire could have been contained earlier if they'd have had enough resources." ~ Allison

"Last year they let it get out of hand before they attacked [the fire]. [It is] government policy that your fire has to get so big before they will bring in planes, and other fires were bigger first."
~ David

Residents reported the fire's making a run at the community and their having to suddenly evacuate. Several participants indicated that ash and embers were falling in their neighborhoods as they were

evacuating. When they got the “evacuate now” call, they were told to meet at the high school for further information. Many of the residents reported that they were grateful to receive up-to-date information at the twice-daily meetings with fire officials.

While residents with homes closest to the fire front recalled concern that they would lose their home, most residents did not. Post-fire sense-making left most residents grateful for the firefighters’ efforts. Shortly after the fire was contained, the community sponsored an event to honor and express gratitude to the firefighters. News reports quoted firefighters saying they had never experienced a comparable display of gratitude from a community before (Springer 2006).

A couple of residents expressed frustration that the fire had not been contained earlier, but they were consistent in their explanation that limited resources were the reason. No residents expressed theories that the fires were being intentionally mismanaged, nor did they say they would not evacuate in the future.

3.2 Utah Case Study

3.2.1 Utah Evacuation

“We were suddenly evacuated when we showed up for an evacuation meeting; we drove back to the community to pick up our cars and were chased out by the fire. Firefighters were evacuated at the same time. The fire came right through the neighborhood... We were evacuated overnight and when we came back we had to keep putting out embers. The fire melted the siding on one side of my house... I wouldn’t leave if there was another fire—I’d stay and fight it.” ~ Harlan

“We were getting ready to go to a fire meeting, went outside and the fire was so loud, sounded like a roar, and we just knew we had to get out now... During the fire, there was a 40-foot wall of flames—the firefighters had to leave, but there was one helicopter that kept on the fire all night bringing load after load of water and dumping it on the neighborhood. Just as the fire was getting to the neighborhood the wind shifted and pushed back at the fire; there were also two rain storms

right over the neighborhood that night when there wasn’t any other rain anywhere else in SW Utah—it really seemed like an act of Providence that saved the neighborhood.” ~ Stewart and Debbie

“The fire really was an amazing occurrence. We saw the wall of flames coming down the hill and had about 5 minutes to get out. We grabbed our cats and dogs and left. Thought for sure we were going to lose the house. The closest we could be was the gas station down by the freeway and a bunch of neighbors gathered there to watch. It was dark by that time, so we couldn’t really see what was going on. Every once in a while we could see a big puff of flames, assumed it was a propane tank exploding or an outbuilding going up in flames. Someone who was up in the neighborhood reported an outbuilding being lost. We just thought we’d lost it all.” ~ Steve

3.2.2 Utah Information Activities

“The evening news and local officials offered conflicting reports—two houses destroyed, no houses destroyed, but three threatened, one house destroyed. We went to sleep not knowing if we had a home.” ~ Marvin

“One thing that was a real failure was the communication... There were 19 homes in the neighborhood at that time and there were news reports that 1 had burned, then that 19 had burned, then that none had burned.” ~ Stewart and Debbie

3.2.3 Utah Post-fire Sense-making

“The fire came within 50 ft of the house—the helicopter drops saved our house. We are now scared to go on vacation during the summer because we can see how quickly things can happen and we won’t be here to protect our home from fire.” ~ Rebecca

“The fire could have been stopped days before it reached us when it hunkered down—not sure if it wasn’t an attempt to extend firefighting income or from lack of resources.” ~ Keith

“The people fighting the fire made a colossal mistake. For two days prior to the evacuation we heard the air tanker flying over our home to drop water on the fire, but then on Monday morning, the day of the evacuation, there were no flights. When I asked at the fire meeting after the evacuation... the fire manager gave these really weird excuses, the planes needed maintenance, the pilots needed rest, stuff like that—it just didn’t sound right at the time. Well a few days later a co-worker [who] is friends with a manager at the airport for tankers [told me] that maintenance was always done on the planes at night and that there had been an argument that morning about the planes. Apparently the fire manager wanted to pull the tankers from that fire and put them on another fire... [but] some of the pilots said the fire would pick up that afternoon and threaten the community. The tankers ended up being called off, and the wind did indeed pick up, and then we were evacuated that evening. I’m not angry or anything, I think he made the best decision he could with the information he had at the time, but it was an unfortunate decision. However, we did not like not being told the truth at the meeting, the way we were treated with that story was disrespectful and we wouldn’t have been nearly as upset if we had been told the truth.” ~ Stewart and Debbie

As the above quotes illustrate, residents in Utah used vivid imagery and extensive detail in their recollections of the fire. Perhaps what is most interesting is in the post-fire sense-making. While one resident had no negative things to say, two others proposed separate conspiracy-type theories to explain why firefighters had been called off the fire the morning of the evacuation. Many residents expressed lingering negative emotions, some even reporting that they would not evacuate in the future, or that they were frightened to go on vacations during fire season.

4.0 DISCUSSION

Some of the differences in the evacuation experiences of these two communities were likely caused by the

specific circumstances of their evacuation. The Utah neighborhood had completed few fire preparations; in fact, only a couple of property owners had taken any preparatory actions at all. With no community evacuation plan in place, residents did not know what to expect or how to obtain accurate information. In contrast, the neighborhood in Oregon was collectively very well prepared for fire and had an evacuation plan in place. Through their preparations, the local homeowners’ association had developed a strong, long-standing relationship and regular communication with Forest Service personnel. These communication channels were utilized during the evacuation; with the evacuation call, residents received information on where they could meet with fire personnel for further information. Throughout the evacuation, residents received up-to-date, detailed information from the Forest Service. Many residents reported that the information both taught them about fire behavior and provided them with a sense of reassurance. Conversely, Utah residents received no information during their evacuation other than conflicting news reports, and most spoke of going to sleep that night not knowing whether they had a home. These findings corroborate previous research that has reported that uncertainty about what is happening can be one of the most stressful aspects of an evacuation.

How residents perceived fire management activities also varied between the two communities. Overall, the Oregon residents were positive in their reporting of the evacuation experience and felt confident in fire-management agencies. Many mentioned the effort by the Forest Service to provide them with timely, accurate information, both at the twice-daily fire information meetings and when they called or spoke to the fire information officer stationed at the evacuation shelter. On the other hand, while Utah residents universally appreciated firefighters’ efforts, several commented on the mismanagement of the fire and blamed fire managers for fire damages. In addition, some Utah residents suggested that managers were not entirely truthful in their explanations about management decisions.

Ultimately, residents in both locations tried to make sense of their situations. The difference between the sites is that in Oregon this process was informed by direct information from the Forest Service on fire behavior, impacts, and management efforts while in Utah, residents were left to develop their own stories based on information provided by media and peers with limited direct access to the fire. These differences resulted in largely consistent theories in Oregon (i.e., delays in fire management activities were because of lack of resources and/or another wildfire start) whereas a variety of theories were offered in Utah.

Several Utah interviewees proposed conspiracy-type theories about why fire resources were diverted the morning of the evacuation. One person proposed that this reallocation was done to increase firefighters' salaries. One couple developed an alternate theory; they believed the fire manager was lying when he said at a post-fire meeting that firefighting planes had been grounded for maintenance. From a friend of a friend, the couple heard a different story (about the diversion of the planes to other fires), which they perceived to be more credible than the official version. Because they thought they had been lied to, this couple retained feelings of mistrust and discontent toward the fire manager 2 years after the fire. In previous work, Hodgson (2007) hypothesized that when fire-management agencies are not open with information, the public may perceive that there is something to hide, leading to persistent rumors that may or may not contain elements of truth. These findings appear consistent with that hypothesis and provide additional support for the importance of open, honest communication.

5.0 CONCLUSIONS

This paper examined the evacuation experiences and post-fire sense-making of two communities in the western United States. There were substantial differences between these communities in levels of pre-fire preparation and citizen-agency relationships that appeared to contribute to the quality of communication during the fire event. In turn, higher-quality communication during the fire appeared to

contribute to reduced stress during the evacuation and, based on the responses and descriptions offered during the interviews, a more complete recovery afterwards.

More research is warranted; this study did not set out to analyze the long-term effects of evacuation and the results cannot be generalized to other communities and other fire events. However, these experiences support previous research that has found both short- and long-term benefits from providing residents with up-to-date, detailed information for the entire duration of a wildfire evacuation event. When information is not available, this situation should be openly and honestly communicated to residents to prevent conspiracy-type theories from developing.

It appears to be vitally important that agencies build relationships with local communities long before a wildfire starts. In central Oregon, the local Forest Service has made it a priority to build and maintain relationships with neighboring communities; their communication strategy during the fire can be seen as an extension of that relationship. The time and effort spent on that relationship seems to have "paid off," not only in relatively positive perceptions of the fire's management, but also in general community preparedness for fire. Both of these aspects played an important role in decreasing residents' anxiety during and after the fire. Given the increasing trends in fire prevalence and intensity, the number of communities directly impacted by wildfire is likely to increase in the future; developing positive citizen-agency relationships before and during a fire event will be vital in helping communities prepare for and cope with future wildfire events.

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The content of this paper reflects the views of the author(s), who are responsible for the facts and accuracy of the information presented herein.

CLARIFYING EVACUATION OPTIONS THROUGH FIRE BEHAVIOR AND TRAFFIC MODELING

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Abstract.—Communities are becoming increasingly concerned with the variety of choices related to wildfire evacuation. We used ArcView with Network Analyst to evaluate the different options for evacuations during wildfire in a case study community. We tested overlaying fire growth patterns with the road network and population characteristics to determine recommendations for evacuation routes. We were able to develop time- and distance-based transportation models to identify preferred and alternate evacuation corridors. We also defined and applied network accumulation models to inventory, queue, and route evacuees using private and public transportation via the safest and fastest routes, without overloading the transportation system. The output from this type of modeling can be used as a decision support tool. Knowing the pace of the evacuation provides decisionmakers with information about the consequences of timing the decision to evacuate. The analysis can also quantify the effect of including additional residences or neighborhoods on the total evacuation time. This analysis makes it possible to identify information that is of vital importance to communities, such as specific routes and intersections that are appropriate and effective for evacuation and others that should be avoided.

1.0 INTRODUCTION

Evacuations during wildfires or other natural disasters can involve large and somewhat unpredictable numbers of private citizens, both informed and uninformed, traveling largely in private vehicles. An evacuation is often an immediate or nearly immediate event and successful outcomes depend on careful prior planning, proper notification, safe and timely community response, and much more. Defining, understanding, and anticipating traffic behaviors are key to a safe and efficient evacuation.

Ample information is available for homeowners or residents about how to prepare for and safely carry out an evacuation during an emergency or disaster (International Association of Fire Chiefs 2010, University of California Agriculture and Natural Resources 2010, University of Nevada Cooperative Extension 2010). However, there are few guides for evacuation decisionmakers and there are even fewer analysis tools to help fire or community planners make good decisions about when to call for evacuation and which evacuation routes to recommend. Time-based evacuation modeling can help provide this information. Evacuation modeling is an important component of any disaster plan when large numbers of affected citizens may be required to assemble, relocate to safe areas, or simply leave their community.

This paper presents a generic overview of the process of conducting a time-based analysis of wildfire evacuation scenarios, but we also tested this analysis on the case study town of Angwin, CA. The scenarios combined fire growth modeling, population density, and traffic flows in order to learn about the potential outcomes. This approach yielded information regarding how many cars would be expected to pass through each intersection, how long it would take to evacuate the community, preferred routes, and appropriate spatial triggers for evacuation.

The combination of population density data with fire growth modeling and traffic conditions modeling represents a new analysis approach for developing a workable community evacuation plan. It allows the user to determine, for example, whether a location can be evacuated prior to being included in the fire perimeter or whether it will be blocked by spot fires. The user can also see where choke points develop so that alternate evacuation routes can be designated. Planners can use different likely fire growth scenarios to evaluate evacuation routes and timing under different wildfire conditions.

1.1 Case Study Community of Angwin, California

Examples from the Angwin, CA, analysis are presented in several figures in this paper. Angwin is a largely forested wildland-urban interface community of about 3,300 people located 70 miles north of San Francisco in Napa County (<http://www.city-data.com/city/Angwin-California.html>). The town is home to Pacific Union College, a few independent vineyards, and a number of seasonal or retirement houses (<http://www.angwincouncil.org>). Community growth and immigration are limited by a dearth of local employment, a long-range county plan that discourages housing growth throughout Napa County, and very limited public utilities that force most new homes to dig their own wells and septic systems (<http://www.angwincouncil.org>). Angwin's residents are aware of the community's wildfire risk and the town has the largest volunteer fire department in the county (<http://www.angwincouncil.org>). Proposed development in Angwin prompted an analysis of how added traffic could affect a wildfire evacuation.

2.0 METHODS

2.1 Time-based Evacuation Modeling with ArcGIS Network Analyst

Developed and supported by Environmental Systems Research Institute (ESRI; Redlands, CA), ArcGIS Network Analyst provides an excellent tool for mapping and modeling time- and distance-based travel using properly prepared street datasets. The Closest Facility (CF) solver tool was designed to locate the

service or care facility closest to a specific event. For example, an automobile accident (the "incident") may require patient transport to a medical care facility and a towing company to remove damaged vehicles from the scene. The CF solver maps the accident location and searches for one or more nearby medical facilities using a travel time solution. Since a tow truck may not be needed in a time-based sense, the CF solver might identify several facilities that are a short travel distance from the accident.

To model wildfire evacuations with the CF solver, the at-risk households become the "incidents" and the evacuation centers, outside gates, or other points of egress become "facilities." If several shelters or gates are available, models can consider several destinations for each evacuee. Network Analyst's Closest Facility solver routes each evacuee from his or her starting point to each identified shelter or egress point; for whole communities, it aggregates this information and calculates the optimal travel time and distance for many evacuees to one or more safety points. In ArcGIS 10, point, polyline, and polygon barriers may be used to restrict and reroute travel on roads closed by flooding, wildfire, earthquake, toxic plumes, and more. Evacuation routes with available lane counts can be modified to include both responding and evacuating traffic. High-traffic intersections and corridors are readily identified and may be mitigated by traffic control and/or diverting some evacuees to a secondary route. The solver returns an arrival time and distance for each evacuee at each destination (shelter) and calculates the arrival order at each destination as well. The solver also identifies evacuees and other residents who may become trapped by an expanding emergency.

2.2 Input Data

Input data can be obtained from a number of sources (see Table 1 for some examples). First and foremost, time-based travel modeling requires complete, accurate, and current street data. The street dataset must perform well in a network modeling environment and it must have correct information about proper impedance (speed and distance), connectivity, directionality, crossing geometries, and turn modifications. For more information about street

Table 1.—Possible sources of data.

Evacuation Candidates	
<i>Existing</i>	<i>Proposed</i>
Census block-level data	Site plans
Assessor parcels	Tentative tract maps
Residence counts - use class, zoning designation; building footprint or effective area	Estimated points
Network Streets	
<i>Existing</i>	<i>Proposed</i>
Local jurisdiction	Site plans
Commercial streets	Tentative tract maps
	Estimated centerlines
Evacuation Destinations, Shelters	
<i>Existing</i>	<i>Proposed</i>
Local or regional jurisdiction(s) having authority	Site plans
Emergency response plans	Tentative tract maps
Local or regional mapping datasets	Estimated locations
Evacuation Hazards	
<i>Recognized, Existing Hazards</i>	<i>Anticipated Hazards</i>
Local or regional jurisdiction(s) having authority	Modeled natural hazards – Slope, vegetation/fuels, geologic hazards, flooding, wind damage, ice storm
Emergency response plans	Transportation concerns – Roads, bridges, terrain, blockage
Local or regional mapping datasets	

networks, refer to “It’s All about Streets” on ESRI’s support site (ESRI 2011). It is advisable to compare streets to current aerial imagery, checking alignments for accuracy and completeness. Good quality, up-to-date aerial imagery is very helpful for mapping obscure and private access points.

The next step is to identify potential evacuees and locate them on a map. For existing residents, County Assessor parcels and actual building footprints are often the most useful. Aerial images can also be used to locate and count individual occupied structures. With good aerial imagery and no building polygons, it may be possible to add points (dots) on individual structures on the geographic information systems map. As Census 2010 block-level data become available, dwelling counts can be verified. Community-level mapping and structure vulnerability assessments are also valuable.

Proposed and future at-risk populations may be

identified using development plans, neighborhood as-built drawings, and population projections from growth plans. Proposed transportation corridors can also be determined from transportation plans and growth management information. These corridors must be added to a separate (future) version of the street network discussed above. Future scenarios can help show how added population in a particular part of town or the addition, extension, or expansion of a road could change evacuation rates or overall evacuation routes. Regional evacuation corridors can also be added from local and regional emergency response plans. The carrying capacity of evacuation corridors should be integrated into the street dataset.

Finally, essential facilities such as fire stations, hospitals, and evacuation shelters must be represented in mapped data.

2.3 The Closest Facility Solver

After the above data are obtained, standardized, and mapped, a preliminary evacuation model is prepared. First, an ArcGIS network is created and tested for connectivity and performance. Next, evacuation shelters and/or egress portals are added to the map. Finally, residence points are added; each point represents one occupied structure, not one individual or one vehicle. If available, commercial or institutional facilities are added along with attributes describing their occupancy.

Once input data are loaded, an initial Closest Facility solver is constructed. Shelters and egress points load as “Facilities” and the occupied structure points load as “Incidents.” Multiple potential Facilities may be modeled, routing evacuees to closest and alternate destinations. Travel direction is set from the Incidents to the Facilities. In most evacuation models, a maximum travel time is not specified. Routes are constructed to follow the street network. Both travel time and distance accumulate as the scenario plays out. The CF solver will now execute.

Upon completion (a large model requires significant time to run), results are inspected and verified. Superimposed routes are tabulated and the route count is joined to the underlying street dataset. Polyline symbols of varying width and color represent the accumulation of evacuees along optimal routes. Stacked routes at street intersections are summarized to provide counts of all vehicles that will pass through them. If certain routes or intersections are overloaded, secondary evacuation routes may be assigned to selected evacuees. Routes and intersection events are recounted and the model is optimized.

If the model is to be modified with closed or restricted egress, the base case CF model is saved and replicated. Point, polyline, or polygon blocks representing road closure or blockage are added to the model. With recently released ArcGIS 10 software, fire progression shells, expanding flood corridors, and mobile toxic plumes may be included. The CF model may be run multiple times, testing the effect of an expanding or moving hazard.

This type of computation is analogous to studies of

hydrology. Roads are like little tributaries of cars with various flow rates. The cars accumulate at junctions, which act like minor dams, creating short delays. A car accident may create a longer delay and a more serious logjam. Law enforcement officials directing traffic could be seen as historical loggers riding down the river on a log, breaking up logjams.

2.4 Adding Fire Growth Modeling to Evacuation Planning

This analysis also used the FARSITE fire growth prediction model (Finney 1998), which allows managers to locate where a fire might spread over time under various weather conditions and ignition locations. Inputs to the model are presented in Table 2.

We compared fire growth time with the time it takes to evacuate to illustrate the risks to life and/or the need for additional traffic control. Visual inspection of the fire perimeter and dwellings indicates which roads are blocked at each time step. The delineation of the fire perimeter allows calculation of the number of dwellings blocked by fire in each time step and the number of cars that can leave an area before the fire blocks it off. In some cases, roads can be blocked in one time step, become engulfed in the fire perimeter in a subsequent time step, and be cleared again in another time step as the fire passes by. This scenario should be noted, as it represents a potentially dire outcome. Figure 1 shows one potential fire footprint in the Angwin community case study.

3.0 RESULTS AND PRODUCTS OF THE ANALYSIS

3.1 Accumulations and Critical Intersections

Several different specific types of information are produced by this analysis. First, we get a count of how many cars pass through a certain section of road (for example, a hairpin turn) or the number of residents that feed from narrow routes to larger arterials over the course of the evacuation. We can also identify critical intersections or choke points. For example, in one simulation in the Angwin case study, we discovered that 500 cars would need to pass through

Table 2.—Input parameters for two FARSITE fire behavior scenarios

Input Parameter	Value or Units	
	1st Scenario - SW Winds	2nd Scenario - NE Winds
Fuel Model (LANDFIRE)	1 - 13, 98, 99	1 - 13, 98, 99
Elevation	Feet	Feet
Slope	Degrees	Degrees
Aspect	Degrees	Degrees
Canopy Cover	Percent	Percent
Stand Height	meters * 10	meters * 10
Canopy Base Height	meters * 10	meters * 10
Canopy Bulk Density	kg/m3 * 100	kg/m3 * 100
Temperatures	77 max/50 min	97 max/70 min
Relative Humidity	60 max/ 30 min	30 max/16 min
Wind Speed	10 mph max	25 mph max
Wind Direction	south to south west	north to north east
Foliar Moisture Content	120%	100%
Fuel Moisture Percent		
1hr	8	3
10hr	9	4
100hr	10	5
Live Herbaceous	110	60
Live Woody	110	70
Ignition Point	SW shrubby area	NE grassy area
Duration (31st of August)	10am to 4pm	10am to 4pm

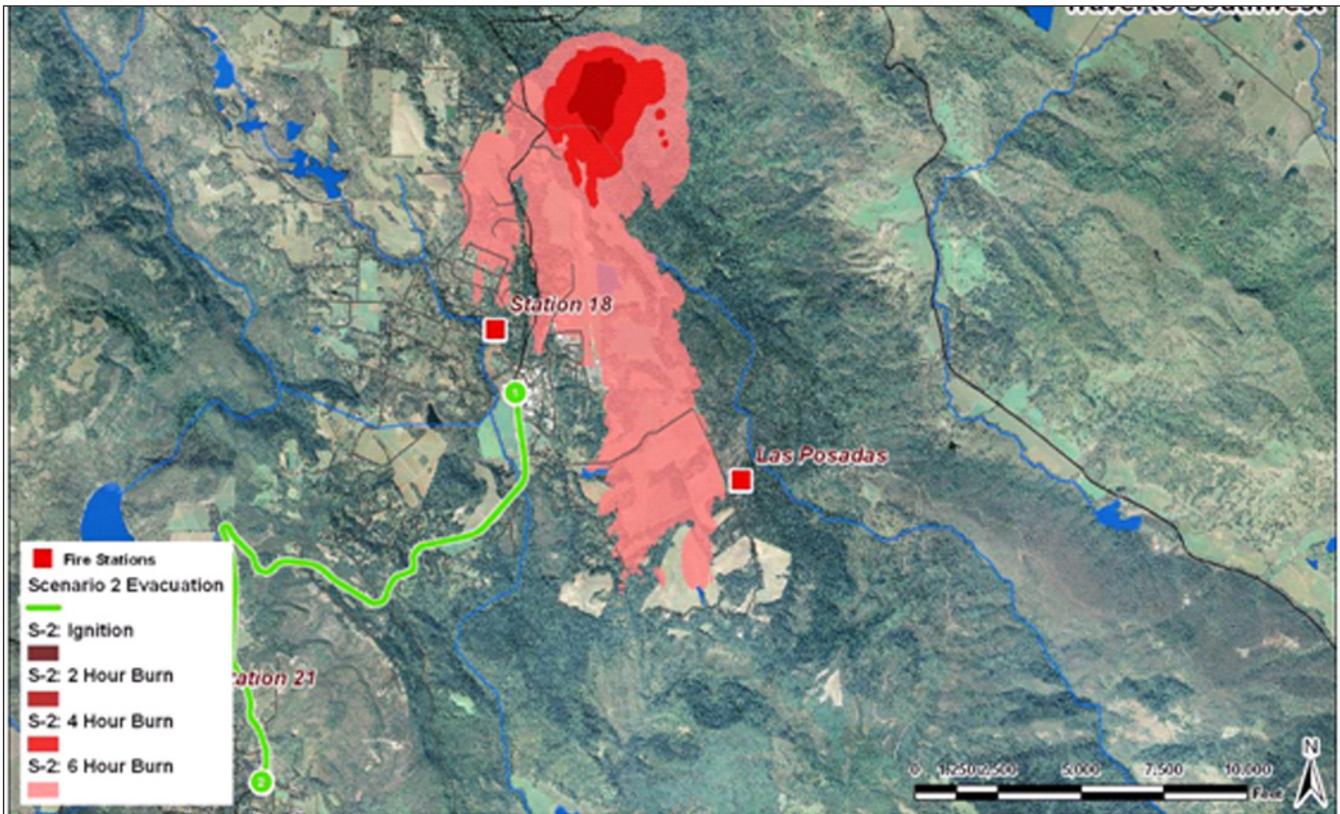


Figure 1.—Map of footprints from a hypothetical fire starting in the northeast portion of the Angwin, CA, community. It assumes extreme wind conditions with wind from the east driving the fire in a southwesterly direction. The map provides perimeters in 2-hour increments. The green line illustrates the route the community evacuation must follow.

one intersection in the downtown area of a community. This information can be used to make critical refinements to the community's evacuation plan. In Angwin, for example, someone could be assigned to monitor and direct traffic at this critical intersection. In all cases, once such a refinement is identified, the involved decision makers can allocate the needed resources ahead of time.

Once a simulation is conducted, an analysis of identified choke points may suggest the need to identify alternative routes. For example, Figure 2 illustrates a scenario in which residents could get farther away from the incident faster by traveling on

a western route; in this case, the rerouting could also relieve traffic on the congested route, helping the rest of the community travel faster to the downtown area. If the community practices the evacuation, the residents in this neighborhood could practice using the alternate route.

3.2 Clearance Time

This type of analysis provides information about the total time required to move all evacuees through the road network—the length of time between the first and the last car leaving the area. Clearance times do not reflect how long it takes for an individual vehicle to go from a residence to any specific destination.

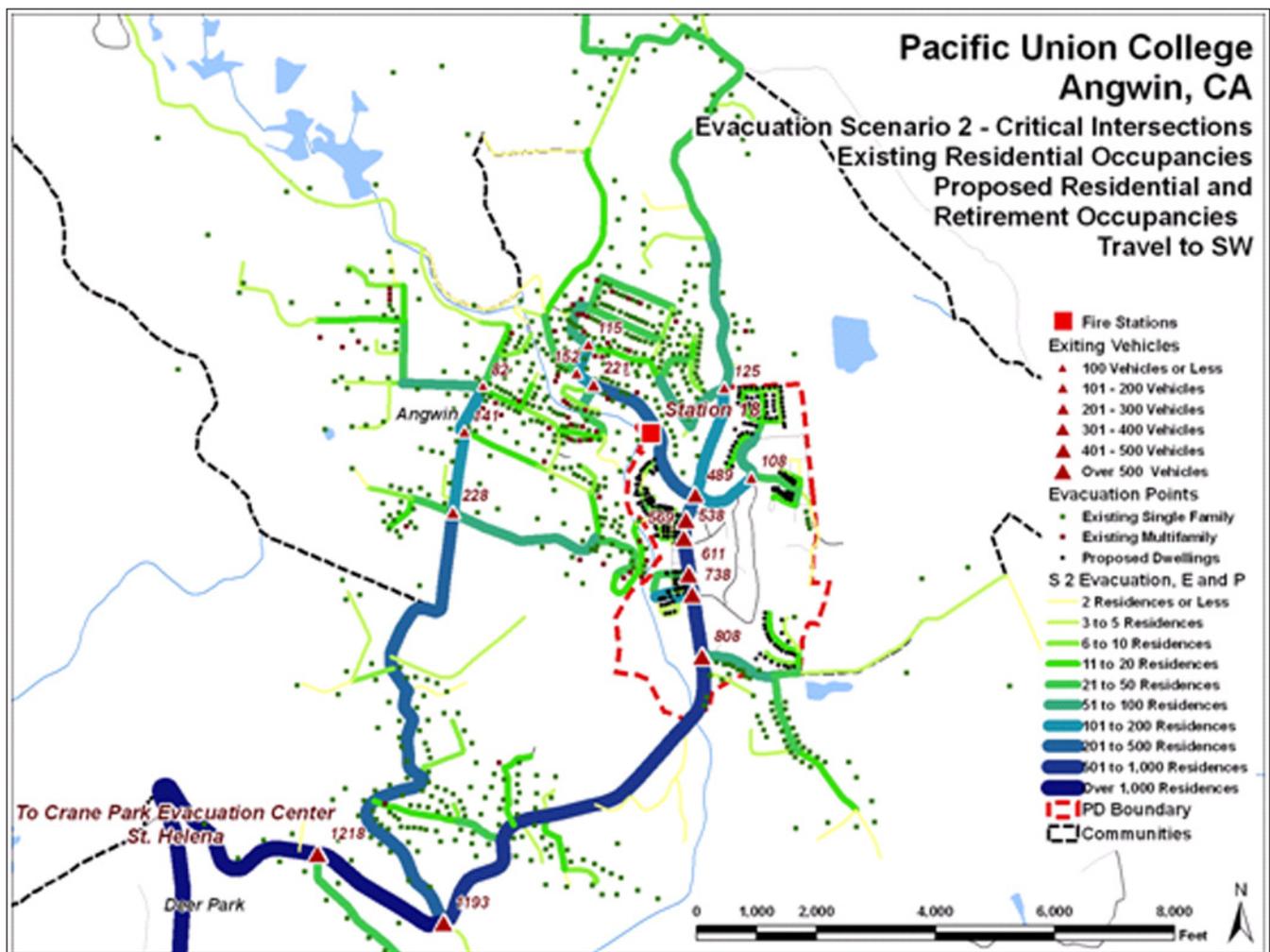


Figure 2.—Map of one Angwin community evacuation scenario with traffic counts for roads along the evacuation route. In a scenario where a fire burns to the northeast of the Angwin community, evacuation traffic is concentrated on Howell Mountain Rd. All intersections south of College Avenue experience more than 500 vehicles during the evacuation process. The intersection of Howell Mountain Rd. and Cold Springs Rd. experiences 808 vehicles, with 70 cars contributed from Cold Springs Rd. Farther to the west, Crestman Drive contributes 25 cars onto Howell Mountain Rd for a total of 1,218 cars at that intersection.

Different levels of background traffic are assumed in different model scenarios. For example, under optimum conditions in the Angwin case study, all dwelling units can travel through the road network to Howell Mountain Road in order to exit the community. If there are two lanes available on all roads and 1,000 cars per lane can flow per hour, the entire community can evacuate in about 90 minutes (assuming no car accidents). See Figures 2 and 3.

By comparing fire location and growth rate with clearance time, the evacuation planner can know whether any residents may be caught in the approaching fire. This information can be used for determining evacuation triggers.

This type of analysis also allows planners to conduct ‘what if’ scenarios, for example by adding car accidents to assess the impacts on clearance times and reverberations at critical intersections, or increasing the number of residents in a particular part of town to see whether the clearance time is slowed or choke points are added.

4.0 CONCLUSIONS

The analysis of wildfire evacuation scenarios underscores the importance of having a well thought-out evacuation plan that accounts for a range of contingencies. It is important for communities to have a specific evacuation plan with a target destination (or several destinations) that is shared with, understood by, and practiced by the community.

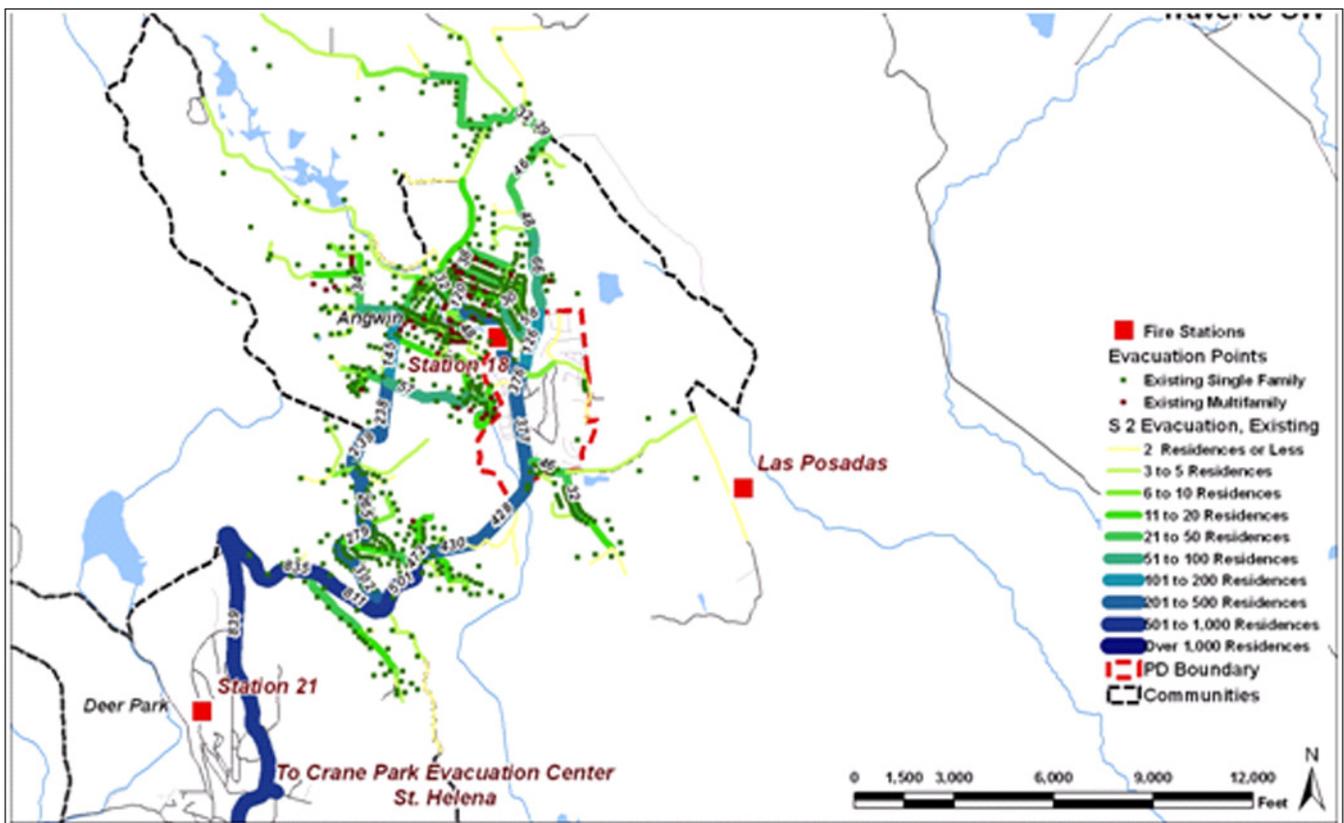


Figure 3.—Map of traffic accumulations and direction of evacuation for the Angwin community in one evacuation scenario. This map illustrates the theoretical accumulation of individuals on the transportation network in an evacuation to the southwest. Each residential unit is a dot on the map. The number of vehicles required to move the population along each route is indicated by the color coding on the street network. The lighter colors indicate very few vehicles (low traffic) and the dark blue color illustrates the maximum number of vehicles (heavy traffic). The arrow points to Howell Mountain Road, the main road out of the community to the southeast.

The combination of fire behavior modeling and traffic modeling for analyzing a proposed wildfire evacuation can be a valuable decision support tool. This type of analysis offers insights into:

- The timing necessary to get people to safety under various evacuation scenarios
- The likely choke points and troublesome routes
- How unforeseen events like car accidents or fire behavior may affect the evacuation in real time
- Possible alternative routing scenarios

We also found that analyzing the evacuation process provided valuable information about the trigger points that call for action, as well as the thresholds for and impacts of alternative scenarios. This type of analysis is a new tool for building better community wildfire response plans.

5.0 LITERATURE CITED

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The content of this paper reflects the views of the author(s), who are responsible for the facts and accuracy of the information presented herein.

*ADDITIONAL
PRESENTATION ABSTRACTS*

ABSTRACTS FOR THE 2010 HUMAN DIMENSIONS OF WILDLAND FIRE CONFERENCE PROCEEDINGS

1.0 PLENARY SESSIONS

1.1 Australian Response to the Black Saturday Fires: What is and isn't Changing?

Presenters

Naomi Brown, Australasian Fire Authorities Council
Alan Rhodes, Country Fire Authority

Abstract

The wildfires of 7 February 2009 in Victoria, Australia, that killed 173 people and destroyed more than 2,000 homes shocked the world. The government quickly established a Royal Commission, the highest form of inquiry possible in Australia, to investigate all aspects of the disaster. Both the fires and the proceedings of the Royal Commission have significantly altered public perceptions of the wildfire risk and how agencies need to respond. Key issues such as the “stay or go” approach, warning systems, and incident

management have been under intense scrutiny and have been the focus of public debate. The presentation will provide an overview of the fires, the Royal Commission findings, and the implications that flow from these events. The presentation will also include reflection on some fundamental issues that have arisen, such as the community's role in responding to the risk of wildfire and whether agencies and the community can share responsibility for dealing with the risk.

1.2 When the Incident doesn't End: Life in the Grinder (The Experiences of a State Agency Tasked with Managing Multiple Long-Duration Incidents and the Impact on its Personnel)

Presenter

Mark D. Stanford, Fire Operations Chief,
Texas Forest Service

Abstract

From 2005 through 2009, Texas Forest Service (TFS) personnel spent more than 1,000 days leading the State's response to three extended fire seasons and providing incident management teams and support personnel for multiple all-hazard incidents: six hurricanes, two tropical storms, eight floods, and two tornados. This effort equates to TFS personnel being actively engaged in emergency response operations

for more than 65 percent of the 5-year period. Agency leadership was concerned about the cumulative effect of physical and mental fatigue, and the impact on employees, their families, and the ability to maintain a safe working environment. Topics covered in this presentation will include actions taken by TFS leadership to identify and mitigate these impacts.

1.3 Closing the Science-Practice Gap: Lessons Learned from Collaboration Between Research and Practice in Community Wildfire-Protection Planning

Presenters

Daniel R. Williams, U.S. Forest Service,
Rocky Mountain Research Station

Pamela J. Jakes, U.S. Forest Service,
Northern Research Station

Judy Serby, Colorado State Forest Service

Abstract

This plenary session will examine the research-practice nexus by presenting lessons and reflections from a Joint Fire Science Program-sponsored project investigating collaborative capacity in community wildfire protection planning. The session will contrast a standard agency model of knowledge transfer (based on management's needs) with an approach used in this project, in which a collaborative team of researchers and practitioners guided knowledge transfer. In

addition, as this project unfolded, a key lesson for the researchers was that the planned knowledge-transfer activities needed to focus less on delivering specific knowledge and lessons (which themselves were highly contextual) and more on supporting the development and strengthening of formal and informal networks of intermediary practitioners. This plenary session will engage the audience in a discussion of how to narrow the research-practice gap.

2.0 PUBLIC ACCEPTANCE OF FIRE MANAGEMENT

2.1 Community Attachment as a Mediating Factor of Firewise Actions in Wildland-Urban Interface Settings

James D. Absher, Research Social Scientist,
U.S. Forest Service, Pacific Southwest
Research Station

Gerard T. Kyle, Associate Professor,
Texas A&M University

Gene L. Theodori, Associate Professor,
Sam Houston State University

Abstract

Responsibility for wildland fire hazard mitigation in the wildland-urban interface (WUI) falls largely on the landowner or homeowner. Agencies at all levels have programs to educate and assist in this process. Codes and standards are constantly being developed and enforced. Nonetheless, from a scientific standpoint, there is still much we do not know about what creates the greatest level of preparedness or how best to motivate homeowners to act on agency firewise requests. Social science has focused our attention on the psychological and setting attributes as particularly important in understanding the underlying processes. Various measures of homeowner concern and action are available and have been reported.

Another aspect that seems especially important is the cohesiveness of the community and how it affects homeowner involvement in wildland fire mitigation. Some research has shown that, in general, residents do not participate broadly at this level. Yet, work in similar settings shows that high levels of community attachment are associated with increased levels of community action. Such research suggests that attention to this factor may improve WUI fire-preparedness efforts.

This paper furthers our understanding by employing a community attachment scale and comparing it across three southern California National Forest WUI settings. Respondents come from a WUI-focused survey of 1,659 residents living close to fire-prone wildlands. These respondents vary in their psychological, situational, and past firewise actions and are grouped according to these aspects with community attachment as an intermediate, or mediating, variable. From this model we better understand the forces that improve residential defensible-space actions and the particular role of community attachment.

Results suggest that we can improve homeowners' wildland-fire preparedness (firewise actions) by attending to the community as a unit, and by focusing efforts on particular action sequences, especially as they relate separately to structure and landscape modifications. Community cohesion is an important factor in this process. The results place attention on the community context of achieving hazard mitigation, assist managers' and educators' understanding of the particular setting within which they seek to encourage mitigation activities, and offer possible improvements to focused education efforts as well.

2.2 Public Perceptions of Fire Management Strategies in Banff National Park of Canada

Bonita L. McFarlane, Fire Social Science Researcher,
Natural Resources Canada, Canadian Forest Service
David O.T. Watson, Human Dimensions Researcher,
Natural Resources Canada, Canadian Forest Service
Tara K. McGee, Associate Professor,
Department of Earth and Atmospheric Sciences,
University of Alberta

Abstract

Fire management in Banff National Park, Canada, uses a combination of mechanical vegetation removal, prescribed fire, and fire suppression. Fire is used to restore ecosystems to more natural levels of variation, and to reduce the risk of wildfire to local communities and adjacent industrial forest lands. To be successful, however, fire management in national parks must have a broad base of public support. In particular, it requires understanding and collaboration among local citizens and other jurisdictions, such as municipalities and provincial land management agencies. This cooperation requires the acceptance of Parks Canada's fire management activities and the participation of nearby communities and residents in wildland fire risk-reduction measures.

In 2008, we conducted a mail survey of a random sample of residents of Banff National Park and nearby communities ($n = 1,204$). The purpose of this study was to examine the perceptions of wildfire risk associated with residing in or near the park, acceptability of risk, and knowledge and acceptance of the park's fire-management strategy and wildfire risk-mitigation measures. This paper will present results

from the survey focusing on the public's acceptance of fire management options and the factors that influence support for the use of prescribed fire. We found that about an equal number of respondents chose protecting communities and restoring ecosystems as the most important vegetation management goal. More than 90 percent of respondents supported some use of thinning or prescribed fire in the park. Although residents appear to have a moderate level of trust in Parks Canada, respondents agreed only slightly that Parks Canada is open to input and is doing a good job at providing information. About half of respondents indicated they had little or no knowledge of the park's vegetation management strategy, but they were quite knowledgeable about basic fire ecology and most had considerable experience with wildfire. Management implications include improving citizen engagement and agency interaction with local residents. Regarding public education, information on the park's fire management strategy, causes of wildfire in the park, and differences in the ecological outcomes of fire and thinning were identified as potential areas for improvement.

2.3 Examining the Complexities of Factors Affecting Community-Agency Trust Before, During and After a Wildfire in Victoria, Australia

Emily Sharp, Institute for Land, Water and Society,
Charles Sturt University

Rik Thwaites, Institute for Land, Water and Society,
Charles Sturt University

Allan Curtis, Institute for Land, Water and Society,
Charles Sturt University

Joanne Millar, Institute for Land, Water and Society,
Charles Sturt University

Abstract

Wildfire management is a complex and often contentious issue in fire-prone communities in Victoria, Australia. Significant fires in 2002-03 and 2006-07 resulted in approximately 2.5 million acres of land burned in each fire season. One hundred and seventy-three lives were lost and more than 2,000 homes destroyed in wildfires in February 2009. The challenge of managing increasingly frequent and severe fires has prompted fire-management agencies to recognize the importance of community-agency trust in working with communities to prepare for, respond to, and recover from wildfire. Previous research has identified components of trust important to wildfire management in general or for a specific management stage (e.g., preparation for fire). However, we have limited understanding of how factors affecting community-agency trust may be similar or different at each stage of fire management (i.e., before, during, and after).

In this presentation, we draw upon a mail survey (n = 329) and 26 semi-structured interviews with 38 residents of a fire-affected community in rural Victoria, Australia. We describe how community-agency trust was built, lost, or maintained before, during, and after a wildfire event. Study findings suggest that communication, cooperation, institutional policies and procedures, shared values and trustworthiness were common factors affecting trust before, during, and after a wildfire. We discuss the relative importance of these factors to community-agency trust at each management stage and demonstrate how they differ among the stages of a wildfire event. The discussion is aimed at showing managers how they can target community engagement strategies to build or maintain trust in each management stage but still retain the “big picture” of community-agency trust across the management stages of a wildfire event.

2.4 Longitudinal Analysis of Public Response to Wildland Fire and Fuel Management

Bruce Shindler, Department of Forest Ecosystems and Society, Oregon State University
Eric Toman, School of Environment and Natural Resources, Ohio State University
Sarah McCaffrey, Research Forester, U.S. Forest Service, Northern Research Station

Abstract

In this presentation we discuss findings from longitudinal research in fire-prone communities adjacent to federal lands in seven states. The research replicates previous studies to measure change in public responses to wildland fuel programs and the federal agencies that implement them. In 2002, two separate studies surveyed residents from selected communities in the western states of Arizona, Colorado, Oregon, and Utah and the Great Lakes region of Michigan, Wisconsin, and Minnesota. In 2008, questions replicated measures from the original project and included additional items to address current issues. Overall, 546 questionnaires were completed for a 55-percent adjusted response rate. Questions focused on public acceptance of a range of fuel-reduction treatments with a specific focus on prescribed fire, examination of citizen-agency interactions, usefulness of agency communication and outreach programs, and trust in agency personnel to conduct management

activities. The study design enables comparisons between responses over time and across geographic locations.

In brief, findings show that respondents demonstrate strong, stable support over the study period for the use of prescribed fire and thinning practices to reduce forest fuels. Overall, public concerns for treatment use decreased across the study period. However, the federal agencies received relatively low scores for providing information about their management activities, giving citizens an opportunity to participate in planning processes, and building trust with local citizens. Findings also demonstrated geographic variability, particularly between responses in the western and Lake states. We conclude by examining the influence of relevant variables on participant acceptance of agency treatments and discuss resulting implications for fire-management programs.

3.0 SOCIAL ACCEPTANCE – DEFENSIBLE SPACE

3.1 Understanding Risk Mitigation in the Western United States

Wade Martin, California State University, Long Beach

Abstract

An important policy question receiving considerable attention concerns the risk perception-risk mitigation process that guides how individuals choose to address natural-hazard risks. We consider the issue in the context of wildfire. The relationship between direct experience with wildfire, knowledge of wildfire risks, perceptions of responsibility to protect oneself and one's property, full-time/seasonal status, and self-efficacy and their direct and indirect impact on risk-mitigation activities by homeowners living in the

wildland-urban interface (WUI) in the western United States is analyzed. Our data are from four communities in two western states. Results demonstrate that the effects of knowledge and locus of responsibility are mediated by homeowners' risk perceptions. We also find that beliefs of self-efficacy and full-time/seasonal status have a direct influence on risk-reduction behaviors. Finally, we find, surprisingly, that direct experience with wildfire does not directly influence the risk perception-risk mitigation process.

3.2 Living with Wildfire in Colorado: A Survey of Two Front Range Counties

Hannah Brenkert-Smith, Institute of
Behavioral Science, University of Colorado
Patricia Champ, U.S. Forest Service,
Rocky Mountain Research Station
Nicholas Flores, Department of Economics,
University of Colorado

Abstract

Wildfire and its associated impacts on residents living in fire-prone areas make a common story in the media during the wildfire season. Wildfire risk in areas such as the Rocky Mountain West is exacerbated by the influx of individuals choosing to live in the areas most susceptible to wildfires. Although extensive efforts have been made to inform new and existing residents in these fire-prone areas of the risk, it is not clear how the message has resonated with the target population. In this study we measured the extent to which homeowners have implemented 12 wildfire risk-mitigation measures in two Colorado Front Range counties. While the counties are situated next to each other, they have different wildfire risk-reduction programs and different landscapes, and the residents have different demographic characteristics. Initial analyses comparing cumulative mitigation

behavior indicated significant differences between counties. When the individual mitigation measures are assessed separately, it is apparent that despite all these significant differences, homeowner decisions about taking wildfire risk-reduction actions are influenced by similar factors across the two counties. In examining factors that affect homeowners' decisions to undertake each of the 12 measures, we found that firsthand experience with wildfire, attitudes about sources of wildfire risk, and interactions among neighbors were related to implementation of mitigation measures in a significant manner. Furthermore, we found that decisions about implementing fuels-reduction measures were related to different factors from those influencing decisions about implementing structural mitigation measures.

3.3 Homeowners and Defensible Space: Motivation to Maintain and the Role of Local Programs

Sarah McCaffrey, Research Forester,
U.S. Forest Service, Northern Research Station
Melanie Stidham, Research Associate,
Oregon State University
Eric Toman, Assistant Professor, Ohio State University
Bruce Shindler, Professor, Oregon State University

Abstract

A key strategy in reducing the wildfire threat to communities is engaging private landowners in mitigating fire hazard on their land. Over the last several years, an array of federal, state, and local education and financial assistance programs have developed to encourage home protection activities. These efforts have led to growing interest in understanding what makes landowners in the wildland-urban interface more or less willing to create defensible space on their property. To date, most of these studies have been mail surveys that are snapshots in time. Yet to be successful, defensible space must be a continuous effort as vegetation grows back and thus requires long-term maintenance by the homeowner. This study used structured interviews of homeowners in communities in three states in the western United States with different types of programs

supporting defensible-space practices. Homeowners were interviewed on their property to identify what fire mitigation means to them, the specific challenges they faced, and how local programs did or did not influence their mitigation decisions and actions. A short written questionnaire was also gathered to assess homeowner views of fire management on neighboring public lands. The study is designed to assess maintenance over time by returning to the same properties after 3 years to examine whether defensible space was maintained and why. This presentation will report on findings from the first half of the study, identifying the activities homeowners are taking to mitigate fire risk, the factors—including local programs—that first motivated them to undertake the actions, and their expectations and efforts regarding long-term maintenance.

3.4 Defensible Space Features: Impact of Voluntary Versus Mandatory Programs on a Homeowner's Attitudes and Actions

See full paper on page 71.

3.5 Changes in Southern California Landowner Attitudes and Behaviors About Forest Health and Fire Safety After Participation in a Fuels-Reduction Cost-Share Program

Allison Roth, San Bernardino National Forest
Association

Abstract

Forest Care is a fuels-reduction cost-share program for private landowners living in San Bernardino National Forest, the most heavily populated National Forest in fire-prone southern California. The Forest Care program is made possible through an innovative state-federal-private partnership among a local non-profit, the National Forest Association; the California Department of Forestry and Fire Protection; and the U.S. Forest Service State and Private Forestry Program. The successful implementation of the Forest Care program has been contingent upon public acceptance and understanding of forest health and fire

safety. This study examines landowner perceptions and behaviors regarding the creation and maintenance of defensible space on private lands in and around the San Bernardino National Forest. A mail survey was sent to 1,500 program participants to determine trends in landowners' perceptions of forest management for forest health and fire safety on their properties, as well as their continuing roles in maintaining thinned conditions. We examine how public attitudes and behaviors influence metrics of stewardship behavior and how these metrics have changed as a result of hands-on forest management through Forest Care.

4.0 EVACUATION AND ALTERNATIVES

4.1 Improving an Inherently Stressful Situation: The Role of Communication During Wildfire Evacuations

See full paper on page 96.

4.2 Development of Alternatives to Evacuation in the Wildland-Urban Interface: Does Emerging Practice Reflect Community Diversity?

Travis B. Paveglio, Doctoral Candidate,
Department of Natural Resource Sciences,
Washington State University
Matthew S. Carroll, Professor, Department of Natural
Resource Sciences, Washington State University
Pamela J. Jakes, Research Forester,
U.S. Forest Service, Northern Research Station

Abstract

The Black Saturday Bushfires of 2009 in Victoria, Australia, served as a focusing event in the debate over the development of alternatives to evacuation during wildfires. Prevailing responses from officials in the United States have shifted away from increasing support of alternatives in favor of early evacuation. This case-study research of Wilderness Ranch, a mountain community outside Boise, Idaho, demonstrates how the development of alternatives may be necessary or desired in areas with decreased ability to evacuate effectively. We conducted approximately 50 interviews with local residents and professionals to explore the characteristics that allowed this community to build capacity for dealing with possible wildfire impacts. These characteristics include the continual improvement and funding of their volunteer fire protection district, fuel reduction programs, and plans for some residents to remain at home during wildfire events. We found that recognition of poor ingress/egress, local knowledge and experience with

wildfire risk, and the residents' independent nature all contributed to support for alternatives. Key individuals in the community have helped build capacity through a focus on Firewise standards and the dissemination of information. Local residents' awareness and ability to carry out alternatives to evacuation varied among smaller "micro-communities" due to the presence of knowledgeable residents (often volunteer firefighters) and diverse fuel types. In response, community leaders began developing plans for "sheltering points" at homes with excellent fire protections. Our discussion provides recommendations that would aid further development of alternatives to evacuation in communities that may not be able or willing to evacuate. We also question whether national policy advocating early evacuation or alternatives as a primary response to fire risk reflects the wide variety of capabilities, fuel types, and infrastructure among wildland-urban interface communities.

4.3 Research Results from the 2009 “Black Saturday” Bushfires: Human Behavior and Community Safety Issues

Joshua Whittaker, RMIT University and Bushfire
Cooperative Research Centre, Victoria, Australia

Abstract

On 7 February 2009, Victoria experienced the worst bushfires in Australia’s recorded history. One hundred seventy-three people lost their lives and more than 2,000 homes were destroyed, in addition to other substantial economic and environmental impacts. In response to these events, the Bushfire Cooperative Research Centre established a Research Task Force to undertake research for the Fire and Land Management sector and the fire research community in Australia and internationally. The Research Task Force covers three key areas: fire behavior; human behavior and community safety issues; and building (infrastructure) and planning issues.

This paper presents key findings from the “Human behavior and community safety issues” research. The “human behavior” team consisted of social science researchers from a number of universities and community safety personnel from fire- and land-management agencies. The primary aim of the research was to investigate the human behavioral

factors that influenced patterns of life and property loss/survival during the February 7 fires. Teams were deployed into the field in the days and weeks immediately following the fires, interviewing more than 600 affected residents. Qualitative analysis of the interview data provided insights into a range of human behavior and community safety issues arising from the fires, including: levels of household planning and preparedness; the provision of, and responses to, information and warnings; how individuals and households responded to the fires; and the differences between people’s intended and actual responses. These issues were quantified in a survey of approximately 1,350 households affected by the fires.

The paper presents key qualitative and quantitative findings relating to behavior and community safety issues during the February 7 bushfires, with a discussion of the implications for the “Prepare, stay and defend or leave early” policy.

4.4 Public Response to the Threat of Wildfire: Evacuation or....?

Alan Rhodes, Country Fire Authority
Sarah McCaffrey, Research Forester,
U.S. Forest Service, Northern Research Station

Abstract

With a growing number of people exposed to wildfire risk and predicted increases in fire frequency and severity, the way individuals and communities respond during a fire will be critical in influencing the impact of wildfire. Although the traditional approach in the United States has focused on large-scale evacuation as the most appropriate option, both local communities and some fire agencies have recently shown increasing interest in alternative approaches, such as the Australian “stay and defend or leave early” policy. The large, deadly fires in 2009 in Victoria, Australia, however, have raised questions about this approach even in jurisdictions where it has been widely promoted.

This paper presents findings from a 2008 study focused on understanding public response to alternatives to wildfire evacuation in the United States. The research used a case study approach in four communities in Montana, California, and New Mexico, where issues in fire management and concerns about the effectiveness of evacuation had

prompted consideration of alternative approaches. Each community had adopted a different approach and the study interviewed community and agency representatives about their views on the nature of the alternatives, the rationale for the approach, the perceived benefits and risks, and the conditions in each community that facilitated or hindered the change process.

The findings highlight the different perspectives on the pros and cons of various approaches and a range of factors that influence both the nature of the alternative being considered and the degree of success in implementing it. A key aspect to emerge from the study has been the changing role of agencies and the changing relationship between agencies and communities in light of the alternative approaches.

The presentation will end with implications arising from the alternative approaches being considered and highlights of similarities between what is emerging in both Australia and the United States.

4.5 Clarifying Evacuation Options Through Fire Behavior and Traffic Modeling

See full paper on page 104.

4.6 Understanding Homeowner Preparation and Intended Actions When Threatened by a Wildfire

See full paper on page 88.

4.7 Understanding “Ready, Set, Go” Outreach - The Orange County Experience

Laura Blaul, Orange County (California)
Fire Authority

Abstract

The cost of fighting wildfire continues to escalate and, despite an increase in resource dedication and training, so do the number of homes lost to these fires. For years, the Orange County Fire Authority (OCFA) in California has conducted inspections and enforced defensible-space regulations. The governing bodies of the communities served by the OCFA have been at the forefront of adopting new construction codes and standards that “harden” homes against wildfire. The losses nevertheless have not been notably reduced, particularly in older communities. In 2009, the OCFA revised the prevention strategy to employ education rather than enforcement and attempt to motivate homeowners to take corrective action to protect their homes and community. The effort focused on 15 high-risk communities in Orange County and included

town hall style meetings, distribution of materials, and door-to-door home assessments by firefighters. The questions of efficiency and effectiveness, as well as impact, of this new strategy were at the forefront of post-action analysis. This presentation will focus on the evaluation of program results, which were four-pronged: 1) Data collected by more than 70 fire crews throughout the 3-month program; 2) Subjective assessment by 50 participating firefighters during an after-action debriefing session; 3) A survey of residents in each of the 14 communities; and 4) An analysis of building permits issued by the County and cities with authority in each community (ongoing). Results of the evaluation of the 2009 program are being used to develop 2010 efforts.

5.0 COMMUNITY RESILIENCE

5.1 Citizen Acceptance of Post-Fire Management Strategies: Community Responses After Two Large Fires in Oregon

Christine Olsen, Oregon State University

Abstract

Recovery and restoration after large wildfires on public lands have become increasingly important topics in recent years as the number and size of fires have increased. Citizen acceptance of management strategies is central to successful planning and decisionmaking in these settings. This research examines citizen opinions of common post-fire management practices, as well as factors that may influence these opinions. Interviews with agency personnel and forest community members were followed by surveys among the public in communities near two recent fires in Oregon: the 2003 Bear and Booth Complex Fires and the 2002 Biscuit Fire. Results indicate an agency's commitment to long-term interactions with citizens influences acceptance of post-fire management strategies. Though there is broad public support for several post-fire management

strategies (e.g., erosion control, replanting, reseeding), acceptance is highly dependent on trustworthy relations. Further, results suggest it is not enough for agencies to simply offer opportunities for public engagement; citizens need to feel that these opportunities are meaningful activities in which to participate. Citizen respondent perspectives on different communication practices are discussed, as well as factors that contribute to successful communication in post-fire environments. Overall, the majority of respondents did not agree with how the local U.S. Forest Service and Bureau of Land Management handled forest planning after recent fires. This research indicates that managers need to develop positive citizen-agency relations well before a fire occurs if communities are to support post-fire actions.

5.2 Incorporating Adaptive Capacity into Existing Concepts of Hazard Vulnerability and Resilience: What Social Characteristics Lead to Fire-Adapted Human Communities?

Matthew S. Carroll, Professor, Department of Natural Resource Sciences, Washington State University

Pamela J. Jakes, Research Forester,
U.S. Forest Service, Northern Research Station

Travis B. Pavaglio, Doctoral Candidate,
Department of Natural Resource Sciences,
Washington State University

Daniel R. Williams, U.S. Forest Service,
Rocky Mountain Research Station

Abstract

The increasing threat and damages caused by wildfire in the United States have spurred the development of many policies and programs that encourage communities in the wildland-urban interface (WUI) to reduce their vulnerability and increase their resilience. Efforts have been made to delineate and define WUI vulnerability using primarily bio-physical variables, but there has been little or no analysis of the interactions among demographic, structural, and emergent elements of social context and their impact on community ability to adjust to the risk and reality of wildfire. We argue that current assessments of social vulnerability or resilience to hazards do not fully take into account communities' adaptive capacity. For instance, they rarely recognize the impact of place-based knowledge/experience, interactions/relationships between local community members, and local ability to access/adapt scientific/technical information. Existing assessments are based largely on structural/demographic characteristics and macro-scale assessments of resources, not strong indicators of the emergent community characteristics or social context that affect adaptive capacity.

Our proposed research agenda would address this conundrum while contributing to theoretical discussions of hazard-resistant communities and the long-term sustainability of social-ecological systems. More specifically, we argue that emerging fire and hazard literature should further adapt and expand the concepts of adaptive capacity, resilience, and vulnerability to the study of wildfire. It will help make sense of results derived from the wealth of recent case studies on efforts to reduce wildfire risk to human settlements. It will also provide new insights into the theoretical relationships among adaptive capacity, resilience, and vulnerability by integrating critical elements of community social theory. We also argue that researchers need to better identify, quantify, and describe the social characteristics of human communities important for such adaptive capacity relative to wildfire. We build from established theory and research in an effort to further define adaptive capacity as a critical element in the performance of hazard-resilient actions and the reduction of vulnerability to wildfire or other hazard events.

5.3 Trial by Fire - Putting Community Wildfire Protection Plans to the Test

Pamela J. Jakes, U.S. Forest Service,
Northern Research Station
Victoria Sturtevant, Southern Oregon University

Abstract

Our recent research on collaborative Community Wildfire Protection Plans (CWPP, as directed by the Healthy Forest Restoration Act of 2003) found the process allowed communities to access resources, build organizational networks and relationships, develop leadership, enhance understanding of wildfire risk, and engage local people in mitigation. These planning and learning activities reduce a community's vulnerability to wildland fire by building resilience and adaptive capacity; in short, they contribute to the development and support of fire-adapted human communities. Natural hazards researchers have called mitigation activities such as those identified in a CWPP the most critical activity of the four phases of emergency management (mitigation, preparedness, response, and recovery). They have suggested that by moderating the magnitude of future disasters, effective mitigation can substantially reduce the

cost of disaster response and recovery. Does it? Our current research, based on four case studies of communities experiencing a recent wildland fire event, explores how the capacity built during their CWPP collaborative planning process enabled communities to better mitigate, prepare, and respond. We discuss how the CWPP and other fire preparedness activities and programs such as Firewise helped engage local organizations and residents in wildland fire management and recovery, facilitate integration of various levels of agency response, and promote revision of community planning in response to the wildfire experience. Drawing on a model derived from our earlier research and incorporating resiliency literature, we suggest the possible contributions of CWPP for achieving what the U.S. Department of Agriculture and Department of Interior's Quadrennial Fire Review (2009) calls "fire-adapted communities."

5.4 Lessons Learned from Wildfire-Affected Rural Communities in New Zealand

E.R. (Lisa) Langer, Scion, Christchurch, New Zealand
Pamela J. Jakes, U.S. Forest Service,
Northern Research Station

Abstract

New Zealand is vulnerable to natural disasters. Strong winds, often associated with high temperatures, and low humidities and seasonal drought combine to produce dangerous fire conditions in some regions. Although New Zealand does not have wildfires on the scale of those experienced in the United States or Australia, an average of 3,033 wildland fires and nearly 14,500 acres burned have been recorded annually since 1991. The majority were vegetation fires in nonpopulated areas, and hence relatively infrequent fire events of limited extent have affected rural communities. Few residents have experienced major wildfire impacts or have taken the steps necessary for wildfire preparedness or mitigation. The predicted increase in severe fire weather and fire danger through future climate change could find an increasing number of local communities and individuals largely unprepared, and hence vulnerable to potentially devastating impacts.

Several recent wildfires have impinged on rural communities in New Zealand. These fires have caused loss of houses, farm buildings, and other assets (such as fencing, stock, and forests), and have

necessitated evacuation of residents from threatened properties. Detailed case studies interviewing residents, fire managers, firefighters, and providers of relief services have highlighted some major issues in three fire-affected communities. These case studies feature different settings—pastoral farmers on Wither Hills surrounding the provincial town of Blenheim in Marlborough in December 2000; old and new “lifestylers” with different perceptions of wildfire risk on small properties of West Melton in the wildland-urban interface close to Christchurch (largest city in the South Island) in December 2003; and close-knit, resilient residents of the remote rural township of Mt. Somers and adjoining farm properties in mid Canterbury in January 2004. Major lessons learned have been identified which will assist Rural Fire Authorities in working with rural communities to improve firefighting and community recovery processes following wildfires in New Zealand. Comparisons are made with case studies of communities affected by wildfires in the United States, and lessons learned are highlighted in the broader international context.

5.5 Community Resiliency as a Response to Wildfires: Canadian Case Examples

Judith C. Kulig, Professor and University Scholar,

University of Lethbridge

Ainslee Kimmel, Graduate Student, Faculty of

Education, University of Lethbridge

Dana Edge, Associate Professor, Queen's University

Nancy Lightfoot, Director and Associate Professor,

Laurentian University

Bill Reimer, Professor, Concordia University

Ivan Townshend, Associate Professor,

University of Lethbridge

Abstract

Wildfires have always been a natural feature of rural and remote areas, but climate change, insect infestations (e.g., pine beetle), and the relocation of individuals into wildland areas are exacerbating fires' effects on lives and personal property. An ongoing study is being completed in two rural Canadian communities (Barriere, British Columbia, and La Ronge, Saskatchewan, both of which are home to First Nations populations) that experienced wildfires, required evacuation, and resulted in property loss. This mixed-method study includes qualitative interviews, household surveys, and community profiles to identify processes associated with community resiliency. In this study, community resiliency refers to communities' ability to deal with adversity and subsequently become collectively stronger. Fifty-seven qualitative interviews have been completed with a variety of individuals in each affected community. The interviews emphasize personal (e.g., mental health stress) and community challenges (e.g., loss of economic sustainability), in addition to lessons learned (e.g., communication between fire management and local community members) from experiencing such a disaster.

In each participating site, the wildfire experience enhanced community resiliency. Household surveys were concurrently collected in both affected communities (n = 201 in Barriere; n = 111 in La Ronge) and in a comparison community (n = 189) that did not experience a wildfire. The quantitative survey data will enhance the qualitative findings and provide additional information about the disasters' effects on personal health and community resiliency. Community resiliency will be described at both an individual and community level. The aspects of local governments, forestry services, and provincial emergency planning services that contribute to, or hamper, resiliency will be highlighted. Finally, the ongoing work of the international study advisory group will be highlighted in relation to its knowledge translation plans (i.e., the creation of fact sheets and digital stories) that will inform disaster management at various governmental levels and provide specific information for other rural communities, including those where First Nations peoples reside.

6.0 EDUCATION AND INFORMATION DISSEMINATION

6.1 Firewise Forever? Voluntary Community Participation and Retention in Firewise Programs

See full paper on page 79.

6.2 Following Black Saturday - A Systems Approach to Bushfire Safety

Gwynne Brennan, Manager of Community Development, Country Fire Authority, Victoria, Australia

Lisa Sturzenegger, Director of Community Safety, Country Fire Authority, Victoria, Australia

Alan Rhodes, Country Fire Authority

Abstract

The bushfires which occurred in Victoria, Australia, during February 2009 have been described as the worst in Australia's recorded history: 173 people died, 2,029 properties and 61 businesses were destroyed and more than 1 million acres of land were burned. The majority of the fatalities and damage occurred on Black Saturday (7 February 2009).

On 16 February 2009 the government of Victoria established the Victorian Bushfires Royal Commission to examine all aspects of the fires, such as causes, preparation for wildfire, and responses. The Commission was provided broad terms of reference to investigate and report on the fires. On 17 August the Commission handed down its interim report to the Victorian government in order that recommendations be implemented prior to the 2009-2010 bushfire season.

Primacy of life was the overarching premise of the interim report with a number of themes identified, such as community education and responsibility,

warning messages (content, timing and delivery), and relocation. The Victorian Government accepted all recommendations of the interim report.

This paper outlines how, in response to the recommendations, the Country Fire Authority (responsible for prevention and suppression of fires in Victoria) created a systems model entitled the Bushfire Safety System to address the complexity of issues identified in the interim report. These issues are in most cases interdependent and interact not only with each other but also with others yet to be identified. A systems approach to bushfire safety was deemed an apt concept for analyzing and responding to these issues, which in turn led to the development of a set of key initiatives designed to mitigate risk across many different segments. The Victorian Government endorsed these initiatives, which became known as the Bushfire Preparedness Program 2009/10. The projects in this program will be described in more detail in this paper.

6.3 Youth Wildfire Education Programs: Ingredients for Fire-Adapted Human Communities

Martha Monroe, Professor, University of Florida
Pamela J. Jakes, Research Forester,
U.S. Forest Service, Northern Research Station
Victoria Sturtevant, Professor Emeritus,
Southern Oregon University
Heidi Ballard, Assistant Professor,
University of California—Davis

Abstract

The Quadrennial Fire Review has identified as a societal goal the achievement of fire-adapted human communities, defined as knowledgeable, engaged, and aware of fire as part of the surrounding landscape. Fire managers and fire plan coordinators, however, report that developing and implementing the public education and outreach necessary to achieve this goal is one of their greatest challenges. The combined literatures from science education, environmental education, service learning, disaster education, and community development offer some clues about what effective youth education should include to promote fire-adapted human communities:

- 1) Engaging parents in assignments or projects can increase the potential for information to travel beyond the classroom
- 2) Place-based service learning or community projects can make learning relevant and meaningful while significantly affecting the community

In addition, our recent study reviewed 68 youth education programs on wildfire across the nation and identified two critical concepts that affect what the programs convey:

- 1) The degree to which information about fire and ecosystems is localized and specific
- 2) The attitudes that are expressed by the implementing organization or agency about fire as a destructive force or natural process

We hypothesize that these pedagogical and conceptual components—locally relevant information, parental involvement, community-based action projects, agency or organizational support—are necessary for effective youth wildfire education programs that help support community understanding of and preparedness for wildfires. The successful implementation of these programs will likely depend on the willingness of educators and agencies to support the program, knowledgeable leadership, and the resources available for action projects. The crucial question is: What are the links between youth wildfire education programs and fire-adapted human communities? We propose to introduce these themes with examples of programs that include the above components, and engage session participants in a discussion of their examples and additional components that could be essential to successful youth education programs.

6.4 Regaining Community Trust after the Big Meadow Fire at Yosemite National Park: Fire Information, Community Relations, Social Media, and Transparency

Gary Wuchner, Fire Communication and Education Specialist, Yosemite National Park
Deb Schweizer, Fire Education Specialist, Sequoia and Kings Canyon National Parks
Rudy Evenson, Fire Communication and Education Specialist, Southeast Regional Office, National Park Service

Abstract

On August 26, 2009, Yosemite National Park started a prescribed fire at Big Meadow near Foresta. The fire crossed containment lines and suppression efforts were initiated immediately. After 2 weeks of road closures and evacuations, the Big Meadow Fire was declared 100-percent contained. No lives or structures were lost and no one was seriously injured. At 7,425 acres, it was the third-largest escaped prescribed fire in Park Service history.

Park Service information officers assigned to this incident will discuss three factors in the Big Meadow information effort: community relations, social media, and transparency. The paper combines a chronological narrative of the fire with analysis of successes and failures in each factor.

In the area of community relations, the Park was successful in establishing a community liaison with evacuated communities. Community meetings were generally successful in meeting residents' and neighbors' demands for information. However, communities that felt the heaviest economic impacts of the road closures remained hostile to the Park throughout the event, and the road closures themselves hampered outreach to these communities.

In the area of social media, the Park took advantage of its experimental Twitter account to draw traffic to the Inciweb fire home page. Visitors reported receiving electronic updates in a timely fashion. However, the incident also demonstrated that the speed of social media frequently exceeds that of management decisionmaking, showing that units need to establish social media strategies as part of their crisis communication plans.

Finally, a variety of audiences, including Congressional representatives, neighbors, and visitors, indicated their approval of the park's policy of complete transparency. Top management's commitment to transparency helped re-establish the trust of neighbors, visitors, and employees. By committing to transparency early in the incident, the Park was able to take advantage of a negative situation to educate various audiences about the importance of prescribed fire in reducing hazardous fuels and maintaining fire-dependent ecosystems, and ultimately strengthen the legitimacy of the Yosemite fire-management program.

The talk will conclude with an update from the Park on the generally positive long-term impacts of the fire information effort.

6.5 The U.S. Fire Learning Network: Springing a Rigidity Trap through Multi-scalar Collaborative Networks

William Butler, Florida State University
Bruce Goldstein, University of Colorado

Abstract

Wildland fire management in the United States is caught in a rigidity trap. Despite wide recognition that public agencies should engage in ecological fire restoration and public policies that support restoration planning and management, fire suppression continues to dominate fire-management practice on the ground. The U.S. Fire Learning Network (FLN), a multi-scalar collaborative endeavor between federal land management agencies and The Nature Conservancy, offers the potential to spring the trap. By circulating people and planning products among landscape- and regional-scale collaboratives, the network develops and disseminates innovative approaches to ecological

fire restoration planning and management. Through experimentation and innovation generated in the network, the FLN catalyzes change at multiple scales in the social-ecological systems associated with fire management. This network action has informed land- and resource-management plans and organizational procedures, as well as federal policy to support ecological fire restoration on the ground. We suggest that multi-scalar collaborative planning networks could enable resource-management agencies to overcome rigidity traps that prevent them from responding to complex cross-scalar problems and applying more ecologically informed practices.

7.0 KNOWLEDGE UTILIZATION AND EVALUATION

7.1 Wildland Fire Lessons Learned Center 2002 to Present

David Christenson, Acting Center Manager,
Wildland Fire Lessons Learned Center

Abstract

The national, interagency Wildland Fire Lessons Learned Center (LLC) is now in its eighth year. It has become for many a resource center that is a regular part of the way they do their work. Others are only beginning to become aware that the LLC exists at all!

The mission of the Center has always been to “actively promote a learning culture to enhance and sustain safe and effective work practices in the wildland fire community. The Center provides opportunities and resources to foster collaboration among all fire professionals, facilitates their networks, provides access to state-of-the-art learning tools, and links learning to training.”

What have LLC staff members learned? What lessons and effective practices have they found especially helpful regarding the human dimensions of the

wildland firefighting community? What challenges do they face in the years ahead and how do they intend to meet them? What impact have they had in the areas where they intended to make a difference and where are the gaps that they have identified for future emphasis? The LLC has declared that it plans to help the wildland fire community become a learning organization. Are staff members walking the talk themselves? Is it overly ambitious for them to seek to build a healthy safety culture? What does that term mean?

A great deal has been learned and of course in many ways lessons learned have only identified the need for more effective learning. This presentation will bring several ideas and a few answers to questions that will be tailored to this audience.

7.2 Research to Utilization: An Australian Experience

Noreen Krusel, Bushfire Cooperative Research Centre,
Victoria, Australia

Abstract

Australia's national innovation system includes Cooperative Research Centres (CRC), which are organizations formed through collaborative partnerships between publicly funded researchers and end users. They have typically been funded for periods of 7 years. Many CRCs support product development for commercial gain, and research for "public good" is less common. The Bushfire CRC was established in response to demand from industry (fire and land management agency) and the community in the context of a series of significant bushfire losses and hence is for the public good. It brought together researchers and industry users with limited experience or culture in research and its adoption. Unfortunately, the CRC community provided little guidance about how to manage research for the "public good." The Bushfire CRC is now in the final months of its initial 7-year program and much has been learned about how to conduct and utilize research. Two key elements of the successful adoption of the Bushfire CRC research

have been building and nurturing relationships between the researcher and user communities. The strategic alignment of the fire industry's national approach to knowledge management and the Bushfire CRC's research adoption program has also been critical. Deliberately including an "industry assessment" process has enabled end users to engage with the research in their own problem context and thus better define the most suitable products to aid adoption. Finally, incorporating the research into industry practice is planned through utilization of an industry Knowledge Web and by modification of training and learning materials. Recent public debate following the Black Saturday fires of February 2009 has highlighted that the level of fire literacy is alarmingly low beyond the core agencies. The Bushfire CRC will be working on a program of partnering with universities to integrate new research into existing courses and to create new courses where there is a demand.

7.3 Individual and Organizational Influences on Research Use in Fire Management

Vita Wright, Science Application Specialist/
Social Science Analyst, U.S. Forest Service,
Rocky Mountain Research Station/National Park
Service – Fire Management Program Center

Abstract

Drawing on theories about human behavior, communication, and organizations, I surveyed federal fire/fuels managers and decisionmakers about their individual innovativeness, beliefs about research usefulness and ease of use, attitudes toward using research, relationship history with scientists, beliefs about scientists, organizational learning culture and processes, supervisor and agency support of science, and self-reported research use. Survey results indicated the fire-management community comprises subgroups with varying levels of receptivity to research.

Respondents working as fire ecologists and/or long-term fire analysts, at higher grade levels and/or in centralized positions, in the National Park Service, and those with graduate degrees were more likely to be innovative, have positive beliefs and attitudes about research, and use research than respondents in other categories. Science communicators can use these results to shorten the time to diffusion by identifying early versus late adopters and tailoring science delivery strategies to different audiences.

Organizationally, respondents working at higher pay-grade levels had more positive perceptions of psychological safety, openness to new ideas, appreciation of differences, analysis, and information transfer than lower grade levels. Across grade

levels, respondents slightly agreed that they felt psychologically safe to introduce new ideas; however, respondents were neutral about whether different ideas were appreciated or likely to be analyzed. Of nine organizational learning measures, respondents clearly disagreed with statements regarding time for reflection. Organizational leaders can use these results to identify strengths and weaknesses in their programs and to improve the organizational environment for innovation.

When asked about 16 potential barriers to using research, 70 percent of respondents agreed lack of time was a barrier. Barriers related to politics and public acceptance of science had the next highest agreement. Next, respondents agreed with organizational barriers such as lack of appreciation and rewards. Finally, respondents had the lowest mean agreement with research-related barriers; of all barriers, they disagreed most that lack of relevant research, knowledge of how to find research, and knowledge about who to contact were barriers.

This study is the first comprehensive attempt to use social science theory and methods to understand and improve fire science application.

7.4 Creating Firesafe Communities: Building Partnerships within the Wildland-Urban Interface

Ryan Gordon, Oregon State University
Bruce Shindler, Oregon State University
Eric Toman, Ohio State University
Sarah McCaffrey, U.S. Forest Service,
Northern Research Station

Abstract

Forest health and wildfire conditions currently dominate management decisions on public lands across much of the United States. Recent wildfires, or the threat of wildfire, as well as new government initiatives, have significantly motivated management agencies and local citizens to work together for creating sustainable, fire-safe communities at the wildland-urban interface. While citizens, businesses, and government agencies may have different ideas and priorities, there is growing evidence they can find agreement through collaborative action.

This project includes a video program that explores important elements of successful collaborative partnerships. Designed with the agency audience in mind, the production showcases five locations around the country where local, state, and federal agencies are working together along with citizen groups and homeowners. Through targeted interviews with community leaders, property owners, and agency officials, the program examines how partnerships

develop, the contributions necessary to make them successful, and how to maintain them over the long term. Using these interviews as a backdrop, the production identifies key strategies and demonstrates practical examples of their successful implementation on the ground.

Our intent is to create a training tool for agency use—a product that communicates important research concepts in a practical, hands-on context, especially for sites that have had limited public outreach thus far. In contrast to journal publications, this video may be useful across all levels of an organization. Video is an engaging format that can provide real-life examples of successful interaction among participants.

This presentation gives an overview of the production, including a synthesis of the key points discussed in the video program, as well as a brief explanation of our motivation and approach for the project.

8.0 FIREFIGHTER DECISIONMAKING AND RISK PERCEPTION

8.1 Risk Perception: The Firefighters' Last Line of Defense

David Clancy, Managing Director,
Human Safety Systems

Abstract

Firefighting is a potentially dangerous activity that requires the exercise of skilled individual and team judgment to be executed efficiently and safely. Personnel at all levels within the incident-management structure are required to identify and act on risks. Accurate risk perception provides the ability to anticipate future behavior in a wildfire situation and forms a key component of the risk-management process. When risks are identified, the expectation is that they are managed accordingly. There have been many documented cases where these expectations either are not managed or following investigations, gaps in risk perception are identified as contributing factors. Perception of elements in the environment is considered to be the first action in forming accurate situation awareness. That is not to say that the individual is a poor decisionmaker, but rather the information available at the time was incomplete or the individual was overloaded, leading to errors. Developing accurate risk perception will aid the firefighter and fire manager in gaining a stronger

understanding of future fire behavior and assist the management of risk. The common denominator that is often present in incident investigations is the individual's failure to anticipate future fire behaviors or activity. Humans are prone to errors; hence the common saying "To err is human." Gaining an understanding of where these errors may occur and why, will aid in developing strategies and training regimes. Adoption of these strategies and training programs will help fire departments and firefighters to become more "risk aware" and increase the effectiveness of the risk-decision process. The manner in which information is provided also plays a key role in determining the level of anticipation of risk. When briefings are incomplete or the seriousness of the situation is downplayed, personnel can be lulled into a false sense of security, which can contribute to a failure to identify the seriousness of the situation. This paper provides practical strategies for firefighters and fire managers to understand and therefore improve the perception of risk in the firefighting environment.

8.2 Responding to Wildfire Events: Risk-Based Decisionmaking Among a Group of Experienced Fire Managers

Robyn S. Wilson, Assistant Professor,
Ohio State University

Patricia L. Winter, Research Social Scientist, U.S.
Forest Service, Pacific Southwest Research Station

Lynn A. Maguire, Professor, Duke University

Timothy Ascher, Graduate Research Assistant,
Ohio State University

Abstract

Understanding the behavioral decision patterns that underlie fire management is essential to improving decisionmaking. While many factors can influence decisionmaking in the wildland fire environment (e.g., safety concerns), what is less certain is how various heuristics and biases influence how a fire manager responds to a wildfire event (Williamson 2007). Maguire and Albright (2005) have suggested that fire managers may use mental shortcuts for decisions involving risk, resulting in outcomes contrary to the managing agency's objectives. These shortcuts cause systematic biases, including excessive aversion to losses (Kahneman and Tversky 1979), a desire to maintain the status quo (Samuelson and Zeckhauser 1988), and inordinate attention to short-term risk (Camerer and Kunreuther 1989). To explore possible biases in fire-management decisionmaking, we conducted a Web-based experiment among line officers and incident personnel in a federal land management agency. Participants ($n = 206$) were randomly assigned to one of four instruments. Descriptive analyses indicate that the majority of managers (88 percent) avoid risk and behave cautiously when managing a wildfire event. Experimental analyses indicate that

individuals 1) exhibited loss aversion, taking greater risks when primed to think about the potential losses (houses lost) resulting from a decision as opposed to the gains (houses saved), 2) discounted future risk when thinking about tradeoffs between short- and long-term risk reduction for multiple management objectives, and 3) exhibited a status quo bias, choosing suppression more often than fire use for new decisions when their status quo was to choose suppression in the past. Our findings indicate that fire managers are subject to biases in judgment that might result from how information is framed or presented. Although greater years of experience seemed linked to more comfort in risky decisionmaking contexts, findings also suggested a reliance on past experiences. This reliance may result in a less than ideal consideration of new approaches to management of fire and fire risk. These findings point to a need for decision support tools that fire managers can use to avoid an over-reliance on past personal experience and unconscious decision heuristics. They also highlight the need to frame information in a way that helps counteract the decision biases identified.

8.2 Responding to Wildfire Events: Risk-Based Decisionmaking Among a Group of Experienced Fire Managers (continued)

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8.3 Anticipating the Worst: The Challenges of Preparing for Worst-Case Scenarios in Wildfire Incident Management

Claire Johnson, La Trobe University,
Victoria, Australia

Abstract

Examinations into major Australian wildfires have highlighted the failure to anticipate worst-case scenarios (WCSs) as a critical influence on effectiveness of incident control and organizational performance. A semi-structured interview study was conducted to explore this important topic, which has had little previous research attention. Thirty Australian fire agency personnel with extensive experience in wildfire management were interviewed about a past critical incident, selected for its challenging nature, which required the interviewee's expert skills. Findings suggested that interviewees considered anticipation of WCSs during an incident as vitally important for effective incident management. Interviewees reported that anticipation of WCSs helped to maintain an overall perspective of the fire. However, it was clear that keeping the "big picture" in mind was difficult in the dynamic and complex situations of wildfire fighting, even for these highly experienced incident managers. Particularly during periods of fire escalation, interviewees reported that it was easy to get tunnel vision, be unduly optimistic, or forget to develop back-up plans with associated

trigger points in case the situation deteriorated. However, many of the experts interviewed were aware of these threats to effective decisionmaking and had several strategies to manage these challenges. These strategies included: having a timeout to see the incident with fresh eyes, ensuring a working environment where others are encouraged to critique plans, and establishing an independent planning group to focus on long-term fall-back plans. If anticipating the worst is difficult for experts in fire management, it is no surprise that community members might find planning ahead and developing back-up plans for extreme events a psychologically challenging task. This hypothesis seems to be supported by reports from community members interviewed as part of a large research project conducted by the Bushfire Cooperative Research Centre after the tragic Black Saturday fires on 7 February 2009, when 173 people were killed in a series of fires in southeast Australia. With further development, the strategies used by expert wildfire managers may provide the foundation for methods and tools to improve skills of anticipating WCSs in both firefighter and community populations.

8.4 Leadership Skills and Knowledge Transfer: A Mixed-Methods Study of Training Efficacy

Michael DeGrosky, Guidance Group, Inc.

Abstract

The L-380 (Fireline Leadership) training exists as one of six courses in the National Wildfire Coordinating Group (NWCG) leadership curriculum. The Leadership Subcommittee of the NWCG Operations and Workforce Development Committee estimates that more than 10,000 wildland firefighters have attended the L-380 course since 2001, a commitment of substantial scale, expense, and strategic importance. Given the scope of participation, the costs to participating agencies, the ever-present vulnerability of agency training funds, and the importance of the L-380 training, the sponsor organizations have strong incentive to evaluate the training to maximize the return on their substantial investment in this training. In addition, when the NWCG established its Leadership Committee, now the Leadership Subcommittee, the group charged the committee with establishing a mechanism to evaluate the effectiveness of its leadership training, with the intent of accurately assessing how the training affects job performance.

The author developed a comprehensive strategy for collecting and analyzing training-related data to support the NWCG leadership initiative, with the intent of verifying that the L-380 training is on track. The resulting strategy employed a mixed-methods approach with both quantitative and qualitative approaches to data collection and analysis. The author twice implemented the quantitative elements of the method, finding that the L-380 training is indeed proving effective. In this paper, the author describes his ongoing research into training evaluation, specifically his efforts that could ultimately validate the results of previous L-380 evaluations qualitatively by documenting stakeholder perspectives not captured by survey instruments and questionnaires. His research has the potential to expand efforts to evaluate how well L-380 addresses identified problems associated with the practice of leadership in wildland firefighters' work environment.

8.5 Just Culture: From Retributive Justice to Restorative Justice

James Saveland, U.S. Forest Service
Rocky Mountain Research Station

Abstract

James Reason outlined four subcultures that make up an informed culture: a reporting culture, a flexible culture, a learning culture, and a just culture. Reason concluded that an informed culture results in a culture of safety. For Reason, a just culture is how people apportion blame when something goes wrong. Just culture is foundational as it will affect what gets reported and thus impacts individual and organizational learning. Some fire managers look to justculture.org for a process designed to draw a line between acceptable and unacceptable behavior. They make distinctions among human error, where the response is to console; at-risk behavior, where the response is to coach; and reckless behavior, where the response is to punish. While superficially and intuitively appealing, this approach has several problems, not the least of which is the ever-present problem of hindsight bias. Other fire managers are looking to Sidney Dekker's inquiry into the balance between learning and accountability. For Dekker, the critical question is not where the line is drawn, but who gets to draw the line between acceptable and unacceptable behavior. Dekker's challenge provides us with a goal but limited direction or guidance.

Lady Justice is usually depicted with three symbols: a sword representing a court's coercive power, scales to represent the weighing of competing claims, and a blindfold to signify impartiality. Historically, many organizations have considered any difference between work as designed by management and work as performed in the field to be "human error" and the simple answer has been to describe this deviance as "failure to follow policy/procedure" (e.g., Vaughan's "normalization of deviance" or Snook's less judgmental label, "practical drift"). Any departure from work as designed is a function of Hollnagel's "efficiency-thoroughness trade-off." This paper will synthesize the work of Reason, Dekker, Vaughn, Snook, Hollnagel, and justculture.org to show how wildland fire management can evolve from retributive justice (focus on punishment) to restorative justice (making victims whole). The development and maintenance of a restorative just culture is a cornerstone to improving safety and morale at all levels of the organization.

9.0 FIREFIGHTER DECISIONMAKING

9.1 Identifying Risk Factors for Injury in Wildland Fire

Carla Britton, University of Iowa

Abstract

Wildland fire is an important ecologic and economic force on federal lands within the United States. Fire management on federal lands requires diverse skills and involves personnel from within traditional land-management organizations, state and local agencies, and contractors. Fire suppression is generally acknowledged as an inherently risky occupation. Although fatalities are painstakingly investigated, little is known about the types, causes, and risk factors for injury among wildland firefighters.

Using readily available data sources, we examined rates of injury and associated risk factors over a 5-year period on large wildfires within federal jurisdiction. We also describe types and causes of injuries reported among a large group of federal employees involved in fire suppression during the same 5 years.

After adjusting for year of occurrence, region, and cause of fire, we found that both type of incident management team assigned at the fire's peak and

peak reported fire-growth potential increased the odds that at least one injury would be reported. Sprains and strains were the most commonly reported injuries. Fractures and dislocations were the least commonly reported injury but were most likely to lead to temporary or permanent disability. The lower extremity was the most frequently reported injured body part. The largest proportion of injuries was caused by equipment, tools, and machinery.

To more adequately assess the impact of individual and fire-level risk factors for injury, the wildland fire community needs to be actively engaged in injury surveillance. This effort should encompass the entire wildland fire community and be supported at a national level. Improved injury surveillance among wildland firefighters can better quantify the true costs of non-fatal injuries, identify promising points of intervention, and provide important baseline information from which to gauge the effects of future prevention efforts.

9.2 Decisionmaking Processes, Decision Support Systems, and Standard Operating Guidelines

Patrick Withen, University of Virginia's
College at Wise

Abstract

Because decisionmaking is perhaps the critical component when one is considering human factors on the fireline, it is explored in many wildland firefighting courses and firefighting aids, a.k.a. decision support systems (DSSs), such as the Incident Response Pocket Guide. The author proposes that the “building blocks,” the very decisions and actions that constitute the firefighting effort, are not the DSS's themselves nor the decisions; rather, they are the standard procedures that make up the routine, and in some cases non-routine, action on the fireline—i.e., the standard operating procedures. To a large extent, while the DSS's and training about decisionmaking guide us toward making standard decisions and taking standardized actions,

the truth of the matter is that we have few standard operating guidelines. The present analysis examines the DSSs and extracts those rules, guidelines, caveats, and examples and divides them into categories such as safety rules, operations guidelines, and rules of thumb. The final task of this analysis is to take these operations guidelines and begin to establish a set of standard operation guidelines (SOGs) that are safe, and yet are not safety rules. These SOGs would be used in tactical operations which complement the DSSs and clearly delineate where planning is to be done, where decisions are to be made, and where guidelines are to be followed.

9.3 Combining Social Science and Economics: The Effect of Newspaper Coverage and Political Pressure on Wildland Fire-Suppression Costs

Krista Gebert, Economist, U.S. Forest Service,
Rocky Mountain Research Station

Geoffrey Donovan, Research Forester, U.S.
Forest Service, Pacific Northwest Research Station

Jeffrey Prestemon, Research Forester, U.S.
Forest Service, Southern Research Station

Abstract

With wildfire-suppression costs in the United States increasing since the mid-1980s, land management agencies and policy-makers are struggling to find ways to contain costs. However, most policy discussions seem to focus on biophysical determinants of suppression costs: fuel loads and weather, for example. Although weather, topology, and vegetation undoubtedly influence fire activity and, hence, suppression costs, this view neglects the human dimensions of suppression decisions. It is managers who make all suppression decisions, and non-biophysical factors may play an important role in this decisionmaking process. In 2004 and 2005, two of the researchers involved in our current study were also involved in a study that conducted in-depth interviews with Incident Management Team members (command and general staff) regarding the factors that influence suppression expenditures. According to interviewees, two important non-biophysical influences on suppression expenditures are fire managers' concern about the personal consequences of adverse fire

outcomes, which causes risk aversion, and the social-political pressure sometimes put on fire managers to use resources, strategies, or tactics that they might not ordinarily use. In this study we combine qualitative sociology and economics by attempting to quantify two nonbiophysical or human factors and then to quantitatively analyze their effect on suppression expenditures. We show these two variables—newspaper coverage and political pressure—have a significant effect on wildfire-suppression costs. In a follow-up to this study, we hope to delve further into this issue by using content analysis to see whether the tone of the article (favorable, neutral, or unfavorable) has a differential effect on expenditures, as well as to determine who is being influenced (Incident Management teams or Agency Administrators). By providing information concerning the effect of non-biophysical factors on suppression expenditures, policy-makers may be able to come up with more avenues for reducing costs than by solely focusing on changing or reacting to the physical environment.

9.4 Can you Define Acceptable Risk in Wildland Firefighting?

See full paper on page 1.

9.5 Change as a Factor in Advancing Fire Management Decisionmaking and Program Effectiveness

See full paper on page 14.

10.0 FIRE POLICY/MANAGEMENT

10.1 Examining Changes in Wildfire Policy and Governance in the United States Through Three Analytical Lenses

See full paper on page 24.

10.2 Opportunities for Wildfire Risk Mitigation and Forest Restoration Among Private Landowners: Combining Quantitative and Qualitative Analyses to Identify Policy Target Groups

A. Paige Fischer, Research Social Scientist, U.S.
Forest Service, Pacific Northwest Research Station

Abstract

The success of any policy effort depends on an accurate understanding of the target group. Different policy tools may be appropriate for different groups of people depending on their values, motivations, and circumstances. In areas such as the fire-prone ponderosa pine forests of eastern Oregon, where fire risk, forest health, and productivity are all salient concerns, private landowners can be driven by a multitude of sometimes competing interests. Understanding the management intentions and constraints of different groupings of landowners can help decisionmakers tailor policies and programs to their unique contexts. A policy strategy that recognizes the unique motivations of different groupings of owners and pairs tools (e.g., incentives, education) appropriately may have greater chances of success at encouraging wildfire mitigation and restoration behavior.

This research follows a multi-method design to describe and explain how private forest owners perceive and address wildland fire risk. Findings from qualitative analysis of interviews and factor and cluster analysis of survey data identified four main management approaches used by private forest owners to address wildland fire risks, and four groupings of owners with different likelihoods for working to reduce fire risk in the future. These groupings comprise owners that use different practices, perceive different levels of risk associated with fire, hold properties of different sizes, and manage their properties from different proximities (i.e., on-site residences, absentee ownership). These groupings of owners may constitute unique target groups for policies and programs. One group of owners may be a particular opportunity for policy; these owners have experience and skills with fuels reduction yet are uncertain about continuing work in the future.

10.3 Highly Underestimated Risks of Wildland Fire in Rural–Urban Interface Areas in The Netherlands and Recent Agenda-setting in the National Risk Assessment

Alette Getz-Smeenk, VNOG Regional Organization for Public Safety, Apeldoorn, Netherlands

Abstract

The general public, researchers, and policy- and decisionmakers in public and private organizations still underestimate the risk of wildland fires in the Netherlands despite (recent) incidents. Research has shown, however, that it is quite probable that uncontrollable wildland fires will occur in any given year: a 4-percent annual likelihood on average, and up to 50 percent in years with drought in the country's largest forest and nature area, the Veluwe area. These probability rates are much higher than those considered to be socially acceptable for other environmental risks, such as floods or the transport, storage, and use of hazardous substances. Additionally, the latest National Risk Assessment shows a rapidly expanding wildland fire incident scenario having a considerable disruptive impact that transcends the regional capacity of disaster management in various ways. National involvement is required to reduce risks to a socially acceptable level.

Recently an initiative was launched to start developing a national program of intergovernmental cooperation in wildland fire risk management.

The aim is to develop a strategy of public-private cooperation that eliminates wildland fire risk and improves performance of the multi-disciplinary crisis organization in situations of large wildland fires. Additional measures are needed, including research on:

- Issues of access, escape routes, traffic measures, and evacuation strategies in natural areas visited by large numbers of tourists, especially during dry seasons
- Situational factors that increase the capacity of self-reliance in crisis situations of large wildland fires, such as do's and don'ts and visibility of escape routes
- Effective strategies of risk and crisis communication that allow civilians and public and private organizations to be prepared for crisis situations.

The Netherlands urgently needs to learn from experiences and research abroad in order to develop effective evacuation strategies, or alternatives, in cases of wildland fire incidents in the rural-urban interface.

10.4 Wildfire in the UK: Status and Key Issues

See full paper on page 44.

11.0 FIRE MANAGEMENT

11.1 Exploring the Meanings and Significance of Living with Wildfire in the Rural West: The “Lived Experience” of Everyday Interactions Between Firefighters and Wildland-Urban Interface Community Members

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University of Idaho

Chuck Harris, Department of Conservation
Social Sciences, College of Natural Resources,
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Abstract

Agencies such as the U.S. Forest Service and Bureau of Land Management manage wildfire according to agency policies and local fire management plans, and they communicate with rural western communities living with wildfire through a variety of formal channels and media. However, frontline agency employees such as seasonal firefighters working and living in these communities also represent these agencies, communicating on-the-ground with residents about fire-management activities, direction, and assumed responsibilities. Moreover, as risks from managing wildfires in the wildland-urban interface (WUI) continue to grow—especially given increasing pressures to provide structural fireprotection—so do risks and presumed job responsibilities for these frontline employees. In this context, dialogue between firefighters and community members, which represents direct interactions of agency personnel with local stakeholders, can be significant for a number of reasons. For example, these employees can quickly communicate fire-related information (e.g., current wildfire activity, planned prescribed burns, and fire restrictions), as well as information about other local agency management activities, such as forest health or recreation planning. We have initiated exploratory

research into the “lived experiences” of locally-based firefighters as community members: What is the nature of direct interactions between on-the-ground agency fire personnel and residents, and what are the implications for fire-management planning, communication and education, and community well-being? In what ways do these frontline employees represent their agency, its mission, and fire-management activities through daily communications, and how? What is the perceived (and expected) role of these employees in accepting new-found risks in the WUI, such as medical emergencies, structure fires, and other hazardous situations in communities? To what extent can these on-the-ground working relationships and communications of firefighters with residents be harnessed to positively influence fire management and the social well-being and quality of life of fire-affected communities, and how? Our research has begun to explore the impacts of these relationships for local fire employees, seasonal firefighters, and residents, as well as their significance and ramifications for future fire management, stakeholder involvement, and agency impacts in rural communities in the western United States.

11.2 Choice Matters: Bureaucratic Discretion in Hazardous Fuels Reduction on National Forests

Ellen Donoghue, U.S. Forest Service,
Northwest Research Station

Abstract

Discretionary choice is an intrinsic aspect of public agencies' delivery of service. Many public servants work in an environment that is too complicated to be reduced to programmatic prescriptions for fulfilling agency missions. Discretion becomes critical to taking action and administering public programs. Discretionary choice implies that public servants use judgment in weighing a complex set of pressures, rules, cultural norms, and opportunities when selecting courses of action or inaction. Hazardous fuels reduction provides a good case for exploring bureaucratic discretion in a natural resource management context because fire is perhaps the biggest land management problem that U.S. Forest Service managers have faced in recent years.

Since the early 2000s, the Forest Service has sought to reduce fire hazard and restore fire-adapted ecosystems

on public lands. Managers make choices about what treatments will be conducted (e.g., burning and mechanical/manual) and what work agent will be used to implement the treatments (e.g., stewardship contracts, timber sales, Forest Service workforce, service contracts). Forest managers weigh a number of contextual factors when making choices, such as budgets, targets, staffing, forest size, ecological conditions, wildland-urban interface, history and familiarity with work agents, and local business capacity. With consideration of the social, economic, and ecological implications for local communities, this research project tries to better understand the factors that influence choices about hazardous fuels reduction on national forests. The research uses corporate data on 91 national forests and survey results from forest managers on 30 national forests.

**11.3 Securing the Human Perimeter:
Beyond Operational Approaches to
Managing Community Fire Safety.
Two Examples from Victoria,
Australia**

See full paper on page 36.

11.4 Using Stewardship Contracting to Reduce Hazardous Fuels: Choices in the Field

Cassandra Moseley, Senior Research Associate,
University of Oregon

Ellen Donoghue, Social Research Scientist, U.S.
Forest Service, Pacific Northwest Research Station
Susan Charnley, Social Research Scientist, U.S.
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Abstract

Stewardship contracting allows national forests to combine timber sale and service contracting provisions in a single contract. Stewardship contracting was designed to foster comprehensive forest restoration and create local community benefit. It promises to address some of the challenges of hazardous-fuels reduction by allowing end-results contracting, the removal of both commercial and noncommercial trees, and the mixture of appropriated funds and timber sale revenue. In some cases, stewardship contracting could lower net treatment costs. Some national forests use stewardship contracting extensively, making it a core part of their hazardous-fuels reduction strategy. Other national forests have shied away from stewardship contracting and use other mechanisms (timber sales, service contracts, and in-house staff) to conduct hazardous-fuels reduction. This paper

seeks to understand the circumstances under which national forests chose to use stewardship contracting to implement hazardous-fuels reduction. Our model suggests that when local land managers are deciding whether to use stewardship contracting, they are influenced by competing and supporting pressures from “above” (i.e., direction, budgets, targets), local business capacity (i.e., contracting and utilization capacity), local political support (i.e., positions of elected officials, interest groups, and collaborative partners), local biophysical conditions, and local internal agency dynamics (i.e., culture and leadership). This paper will illuminate how these factors are playing out in the West, using data from in-depth case studies on four national forests and survey results from 30 national forests.

12.0 MITIGATION AND FIRE MANAGEMENT

12. 1 The Sociology of Landowner Interest in Restoring Fire-Adapted, Biodiverse Habitats in the Wildland- Urban Interface of Oregon's Willamette Valley Ecoregion

See full paper on page 58.

12.2 A Unique Wildfire Risk Reduction Program in an Aboriginal Community: Peavine FireSmart Projects

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Lorne L'Hirondelle, Forestry Coordinator,
Peavine Métis Settlement

Abstract

Peavine Métis Settlement is an Aboriginal community of approximately 1,000 located in northwestern Alberta in the boreal forest. Wildfires are a common occurrence in this region, and the risk is increasing due to population growth, increased fuels resulting from fire suppression, climate change, and mountain pine beetle-killed trees. There has been an increasing call in Canada at both the federal and provincial levels for research to be conducted in Aboriginal communities that are at high risk to wildfire as little is known about how these communities currently perceive wildfire. It is also unknown if unique approaches to wildfire risk reduction are needed for Aboriginal communities.

This presentation includes initial findings from Ph.D. research that aims to examine wildfire risk

reduction in the community. Qualitative research methods (interviews, focus groups, and participant observation) were used for this research. The development and implementation of Peavine's wildfire risk reduction program, Peavine FireSmart Projects, have been influenced by social and cultural factors in the community, such as the high regard for community Elders, the need to provide employment for community members, and traditional burning practices. The high number of wildland firefighters in the community has also affected the development and acceptance of the program. However, economic constraints in the community are currently threatening the continuation of this program, which has been funded almost solely by the settlement.

12.3 Natural Resource Students’ Understanding of the Social Construction of Trust and Its Implications for the Practice of Fire Management

Margarida Washburn, University of Missouri

Bruce Cutter, University of Missouri

Abstract

The U.S. Forest Service’s 2000 National Fire Plan introduced a new strategic research and practical focus: the social science of fire management. The implication of this focus is a recognition that the social relationships among the public and fire-management professionals affect their efforts to collaborate in developing and deploying fire-management plans. This recognition is not unique to fire management as other fields such as organizational studies, education, sociology, and psychology have also noted that the social relationships that people form affect how well they work together and the quality of their work—especially under stressful, risky conditions. Trust has been identified as a key factor in mediating such social relationships and the outcomes of collaborative work. Research on trust in the context of wildland fire management supports the notion that the public’s trust in fire management professionals and their institutions affects whether it will support fire management plans.

This emphasis on the social science of fire management has implications for the education of natural resource professionals. Specifically, when natural resource students graduate, they need to be knowledgeable about both the technical and social dimensions of fire management. They need to be aware of the social issues surrounding fire management, especially the issue of trust among all stakeholders involved in making decisions about fire management. Toward this end, we present the findings from an initial study that explores students’ understanding of trust and how it may influence collaboration and the practice of fire management. The context of our study includes computer-mediated communication, and therefore we also explore how electronic communication technologies may mediate trust among these students and, potentially, their constituents.

12.4 Public Views and Attitudes Concerning Managed Fire and Fuels Reduction Strategies in the Valles Caldera National Preserve, New Mexico

Carol Raish, Research Social Scientist, U.S.

Forest Service, Rocky Mountain Research Station

Kurt Anschuetz, Consulting Anthropologist/

Archaeologist

Abstract

As land management agencies move away from an emphasis on fire suppression toward greater use of fire for resource benefits, the complex issue of the public's attitudes toward managed fire and wildland fire use comes to the fore. Although many residents of adjacent communities are increasingly knowledgeable concerning the role and importance of fire in forested ecosystems, managers still interact with people who find that changing fire-management policies contradict powerful images and values learned as children. Consequently, the process of understanding the public's perceptions of and experiences with wildland fire continues.

In this paper, we explore the views, preferences, and suggestions concerning fire and fuels management among user groups and adjacent communities on the Valles Caldera National Preserve (VCNP), New Mexico. We conducted in-depth, expert interviews with 19 knowledgeable individuals who use the Preserve for grazing their cattle or for recreational activities, such as hiking, fishing, hunting, and providing tours. Environmental educators and a climate scientist studying fire effects in the region were also among the interviewees. Among the topics of discussion were perceptions of (1) wildfire,

(2) wildfire management and use, (3) prescribed fire, and (4) fuels management. Because Los Alamos, which was seriously impacted by the Cerro Grande Fire of 2000 (an escaped prescribed burn), is one of the communities close to the VCNP, we were especially interested in learning our informants' beliefs concerning wildfire suppression and prescribed fire use.

The study's participants showed considerable interest and sophistication in their discussions of the role of managed fire in maintaining forest health and reducing high fuel loads following many decades of fire suppression. They talked about problems with aggressive suppression, the role of both mechanical thinning and prescribed burning in the wildland-urban interface and the back country, the importance of community fire education, and responsible media coverage. Many expressed concerns over the possibility of escaped prescribed fires but argued for the importance of returning fire to the ecosystem. We discuss these views in light of changing fire policies in land management agencies, offering suggestions for public outreach and involvement concerning managed fire programs.

13.0 PRESCRIBED FIRE

13.1 Facilitating Prescribed Fire Through Communication with Air Quality Regulators: Sequoia and Kings Canyon National Parks

Deb Schweizer, Sequoia and Kings Canyon National Parks

Abstract

Summary: Air quality regulation represents a significant challenge to many fire management programs nationwide, especially in achieving prescribed fire treatment goals. The lessons learned at Sequoia and Kings Canyon National Parks can help fire managers break down barriers to operational success by improving relationships with air quality regulators.

Background: Sequoia and Kings Canyon National Parks, located in the southern Sierra Nevada Mountains, have a robust prescribed fire and managed fire program. They are neighbor to the San Joaquin Valley Unified Air Pollution Control District (“the district”), one of the most compromised air basins in the nation. The district is responsible for Clean Air Act compliance.

In 2004, strained relationships between the district and the parks culminated in a Notice of Violation and fine issued by the district for a prescribed fire. The district expressed additional concern over recent revisions of the federal fire-management policy. Over the past 5 years, however, a concerted effort by the parks and the district has vastly improved this relationship and promoted understanding of each program’s requirements and needs. This improved relationship has helped the parks accomplish their fuels-related projects.

Communication Strategies: The relationship is the investment of the fuels specialist, the fire management officer, and the fire education specialist for the parks and the compliance officer and meteorologists for the district. Strategies include:

- Identifying key representatives from the parks to communicate daily with the district when projects are underway or being planned
- Holding pre-season smoke management meetings to draft protocols for communication and operations for the upcoming year
- Expanding and sharing monitoring data

Presentations by the parks for the district, EPA, and California Air Resources Board have opened dialogue and are helping each agency understand the other’s missions and directives.

Lessons Learned: Regular dialogue is integral to the success of the parks’ fire management program and to the district’s compliance with the Clean Air Act. As a result of this dialogue, both agencies are cooperating to help each other achieve their goals. The district is now actively identifying more prescription windows, while the parks are helping the district achieve compliance through strategic timing of projects.

13.2 Socio-Economics of Ranching and Ecological Prescribed Fire on Refugio-Goliad Prairie, Texas

Ray Guse, Prescribed Fire Specialist,
The Nature Conservancy

Abstract

The Nature Conservancy (TNC) conducted its first prescribed fire in 1962, and in 1978 TNC began practicing fire management in Texas. From June 2008 to July 2009 TNC implemented ecological prescribed fire on 25,000 acres in Texas, and assisted federal and state agency partners with an additional 16,000 acres. Texas TNC fire crews also assist wildfire suppression throughout the state.

The Refugio-Goliad Prairie Conservation Area (660,000 acres) is a private-lands project that has created numerous partnerships among cooperating ranches, nongovernmental organizations, and state and federal agencies to further the goal of maintaining and restoring the largest remaining block of native prairie on the Texas Gulf Coast. Participation by ranchers is largely driven by socio-economics, whereas other partners have ecological goals. All too often economics and ecology conflict and are perceived as mutually exclusive. On this landscape, however, livestock production and fee hunting for wildlife game species, coupled with the restoration and maintenance of native prairie and repatriation of an endangered species through the application of prescribed fire,

have proven to be mutually advantageous. Attwater's prairie chicken, one of the most endangered species in North America, was extirpated from this landscape in the late 1990s. Through Safe Harbor Agreements, it is noteworthy that ranchers have allowed this species to be reintroduced on their lands.

Restored prairie must be maintained with prescribed fire on a 3- to 4-year return interval. Within this landscape it is believed that 200,000 acres of native prairie are needed to support a viable population of the prairie chickens; currently there are 119,500 acres. Through remote sensing TNC quantified change in the spatial extent of prairie between 2004 and 2008, and this work also documented private ranchers' having burned 23,000 acres in 2008. TNC burned an additional 10,000 acres. To reach the 200,000-acre goal, we must achieve further reinvigoration of the vanishing fire culture among ranchers. TNC is working to train and empower ranchers such that once again managing land with fire is a normal activity little different from fixing fences, calving, branding, and the other annual chores that are taken for granted.

13.3 Learning and Training on the Use of Prescribed Burning Techniques in Southern Europe

Maria Colaco, Institute of Agronomy,
Lisbon, Portugal

Abstract

The traditional use of fire by many rural communities in Europe was, and continues to be, a very important tool in shaping the landscape. While in general, the northern and central European countries currently are neglecting traditional fire uses, fire continues to be used in the Mediterranean countries.

Although in some cases the traditional use of fire can be a cause of destructive wildfires, prescribed burning performed by experienced practitioners has been known for a long time to be beneficial to the reduction of forest wildfire hazard.

In recent decades the use of prescribed fire for the reduction of wildfire hazard in Portugal, Spain, and France has increased, and valuable efforts have focused on operational training for prescribed burning.

The first attempts to promote training in prescribed burning for fire prevention in European forests date from the 1980s in Portugal. In Spain, the first prescribed burning training course was conducted in 1995. In France, fire professionals created a Prescribed Burning Network and the first “Charter of prescribed burning” in the early 1990s. Many of these early

efforts followed similar programs in the United States, Canada, and Australia, where the use and training of prescribed fire was more widely spread and developed than in Europe.

In all cases, many of the technicians who applied the technique of prescribed burning were forest and range managers, but they could also be firefighters, among other professions. We will use the term ‘fire professional’ for all of those trained in fire. In our point of view, fire professionals should have not only specific training on prescribed burning and practical experience in the field but also a good forest fire education through university courses.

Following this premise, we propose with this presentation to:

- Describe and assess the current context of prescribed burning training in Spain, Portugal, and France
- Describe and assess the current context of forest education at the university level in Spain and Portugal and compare it to forest education in the United States
- Propose new ways forward

13.4 What Do They Think of Burning In Texas?

Brian Hays, Extension Program Specialist,
Texas AgriLife Extension Service

Mark Moseley, Rangeland Management Specialist,
Natural Resources Conservation Service

Amy Hays, Extension Program Specialist,
Texas AgriLife Extension Service

Abstract

When it rains, we worry about flooding; when it is dry, we worry about fire. These concerns are justifiable because in the past 10 years, rangeland conditions have created greater potential for wildfire due to both natural and manmade causes. There have been many large wildfires with loss of life, property, livestock, and wildlife. Although very few of these were escaped prescribed burns, the perception of fire has played an important role in shaping management strategies for local communities as local county commissioners have the authority to invoke or lift burn bans. Various agencies, entities, and experts have written laws, guidelines, and recommendations on the use of prescribed fire, as well as on the implementation and removal of burn bans. With growing concerns of catastrophic wildfire, and severe drought conditions in part of the state, attitudes differ as to burn bans and prescribed fire. Courses of action lead to conflicting results—even in adjacent counties.

To understand local trends and needs, the Texas Grazing Lands Conservation Initiative has commissioned the Texas A&M Institute of Renewable Natural Resources to design and conduct a survey of county commissioners' courts. The survey is intended to capture attitudes and perceptions of burn-ban policy and prescribed fire management among county officials responsible for managing local community resources. The goal of the survey is to investigate how officials administer, use, and perceive fire-related policy in local communities. The outcome of the survey will help in identifying outreach and education opportunities, and policy shortfalls and benefits. Results also will help to understand how fire management at the local level is undertaken.

The survey was conducted in fall 2009; results were analyzed in January 2010. Results of the survey, as well as discussions and recommendations, will be presented.

14.0 SPECIAL SESSION: AN INTERDISCIPLINARY AND ORGANIZATIONAL PERFORMANCE APPROACH TO UNDERSTANDING THE INTERPLAY OF FIRE POLICY, INCIDENT STRATEGY, AND INCIDENT OUTCOMES

Anne Black, U.S. Forest Service,

Rocky Mountain Research Station

Krista Gebert, U.S. Forest Service,

Rocky Mountain Research Station

Toddi Steelman, North Carolina State University

Sarah McCaffrey, U.S. Forest Service,

Northern Research Station

The federal land management agencies of the United States are struggling to deal with a changing wildland fire environment. Increases in both area burned and suppression expenditures over the past two decades have led to greater scrutiny of federal fire management programs by the public, Congress, and government oversight agencies such as the Office of Management and Budget, the Government Accountability Office, and the Office of the Inspector General. In the past several years, reports and audits by these oversight agencies have recommended that the land management

agencies look more closely at the way fires are being managed and find ways to increase the efficiency of fire-management efforts. These reports often recommend the use of less aggressive suppression strategies, where appropriate, as a way of containing the rising costs of suppression as well as enabling land managers to meet other land management objectives, such as reducing hazardous fuels and restoring ecosystems. However, the effect of fire management strategies and tactics on suppression costs is not well understood.

14.1 Are Less Aggressive Strategies Cheaper?

Krista Gebert

Abstract

As part of a multi-disciplinary Joint Fire Science study, this study evaluated the effect of different fire-management strategies on the costs of suppression. Information was collected on the predominant management objective and strategy used on 1,330 U.S. Forest Service and Department of Interior fires from FYs 2006-2008. The effect of these objectives and strategies on suppression expenditures was assessed using regression and means analyses. Results indicate that management objectives and strategies do affect suppression costs, but the results vary both by agency and by the metric used to measure costs. For instance,

although less aggressive strategies may result in a lower cost per acre or daily cost, increased acreages or longer duration associated with less aggressive strategies may lead to total fire costs at least as high as those of more aggressive strategies. These results suggest that evaluations of cost performance need to reflect the objectives of the management effort and take into consideration much more than the cost of an incident, using more of a “balanced score card” approach to assess performance in light of other management objectives.

14.2 What's Really Driving Suppression Response – Public or Agency Pressure?

Toddi Steelman

Abstract

Public pressures—both real and perceived—are an important factor shaping flexibility in fire management. Thus, a better understanding of external constraints on fire-management options is essential. Gaining understanding entails validating or refuting the existing perceptions of agency administrators and fire managers about the constraints that political and community pressure place on their ability to implement more flexible fire-management options. In summer 2008, our research team traveled to three fires—the Gap (California), Cascade (Montana), and Gunbarrel (Wyoming)—each of which used a different strategy for managing the fire. At each site, we interviewed key agency individuals and asked them about the internal and external factors that influenced

how they managed their wildfires. Internal factors included Land and Resource Management Plans, Fire Management Plans, informal cultural practices, and existing practices. External factors included political and community pressures from citizens, who are often perceived to demand an aggressive suppression response. This paper details how the internal (Forest Service policy, planning, and attitudes) and external (community and political actions and expectations) factors influence flexibility in fire management. Conventional wisdom within the Forest Service suggests that external relationships are often key factors in driving up wildfire costs and circumscribing the ability to execute less aggressive fire-management strategies.

14.3 Costs from the Stakeholder's Perspective

Anne Black

Abstract

To address the rising cost of fire suppression activities, land management agencies, including the U.S. Forest Service, are exploring how selection of fire-management strategy might influence costs and conversely, how cost containment influences selection of strategy. The questions posed in this portion of the project were aimed at understanding how federal choice affects nonfederal partners, specifically, whether strategies and tactics aimed at less than full perimeter control reduce the costs or simply shift the cost burden to nonfederal entities.

During fall 2008 and winter 2009, our two-person interview team conducted 25 in-depth, unstructured interviews with 30 persons (agency administrators, incident commanders, state and local cooperators and county commissioners) whose jurisdictions were affected by one of five large wildland fires that

burned in the western United States in 2008. We used a written interview guide to direct and focus conversations on topics pertinent to the flexible suppression responses and their interaction with wildland fire costs. Strategies and tactics used on each of the five focus fires run the gamut from greater emphasis on aggressive suppression to minimal aggressive suppression activity. Final fire size ranged from 3,280 to 67,147 acres. All were long-duration fires, ranging from 18 to 60 days in length.

Narrative analysis of these data provides information about why cost shifting is of concern and where the concern may have originated. Better understanding of why such perceptions exist among state and local cooperators and stakeholders can better equip the Forest Service, and other federal fire agencies, to address these concerns.

14.4 Key Decisions in Incident Management from the Incident Management Team's Perspective

Anne Black

Abstract

For large fires, Incident Management Teams (IMT) are responsible for implementing the fire-management strategy determined by the land management unit's Agency administrator. They are often involved in assessing and recommending changes in strategy as well. IMTs are responsible for all aspects of incident management: from the directly operational issues (staffing, safety, tactics) to support functions (planning, logistics, finances) to managing social networks and interactions (public and media outreach, partner and stakeholder coordination), all the while supporting the unit's basic land-management mission. Understanding how this group frames its task is critical to understanding and potentially influencing the balance of, and trade-offs made among, the multiple competing objectives involved in any incident.

In 2009 we field-tested an incident documentation protocol—the Key Decision Log (KDL)—that sought to capture information about 'key' decisions—those incident management decisions, issues, or actions

the incident decisionmakers (IMT and/or Unit staff) thought could significantly affect the trajectory and final outcomes of that incident. The concept was that at an incident level, KDLs capture the implementation story that links intentions (as articulated in guiding documentation) with outcomes. At an organizational level, KDLs capture the mental models in use, revealing the on-the-ground perception of what is a significant event, drivers for these perceptions, key markers of the decisionmakers' critical thought processes for determining most effective actions to take, and the impact of their decisions on incident objectives. KDLs also provide insight into the tone of the community dialogue and business processes.

This presentation will summarize findings of the 427 entries from 41 wildland fire incidents in 2009, our interpretation of these findings, and thoughts on what these data suggest about understanding current incident management and improving it in the future.

15.0 SPECIAL SESSION: BEYOND THE BASICS: EMERGING AND UN- OR UNDER-UTILIZED METHODOLOGIES AND WHAT THEY CAN REVEAL

15.1 Understanding Information Flows During Wildfires: Methodological Insights from Social Network Analysis

Branda Nowell and Toddi Steelman
North Carolina State University

Abstract

A variety of theoretical and methodological perspectives can help inform fire management. In this presentation, we focus on framing information exchange during a wildfire as a problem of information asymmetry among those who supply information and those who demand it. Exchange mechanisms that link information suppliers with those who demand it are often unclear during wildfire events. Social networks provide a conceptual backbone to understand how such exchange could occur. Using data from a 2009 wildfire event, we demonstrate the theory, method, and

practical applications of this approach. Our approach is important both practically and theoretically. Practically, information flows are imperative in understanding how to manage the fire, avoid injury or loss of life, protect personal property and community assets, restore vital services, and build relationships and trust. Theoretically, we can better understand the dynamics of information flows by documenting asymmetries, understanding their consequences, and providing insight into how asymmetries might be addressed for better wildfire management.

15.2 Theory of Human Performance: From Post-Traumatic Stress Disorder to Elite Athletes

James Saveland, U.S. Forest Service,
Rocky Mountain Research Station

Abstract

This paper investigates how theories and field methods from the field of human performance may have implications for firefighter training with respect to fitness, resiliency, and performance. At one end of the distribution of human performance lies the dysfunction of Post-Traumatic Stress Disorder (PTSD). I will examine literature on PTSD along with the psychological interventions—cognitive behavioral therapies and sensori-motor psychology. Elite

athletics, at the other tail of the distribution of human performance, will be examined next. I will summarize the interventions of psychological skills training and the field of applied sports psychology. Current programs in the U.S. Army (comprehensive fitness) and Marines (mind fitness) will be reviewed. All of these facets will then be synthesized into a coherent theory that can inform the practice of wildland fire management.

15.3 Materiality and Communication in High-Reliability Organizations

Jody Jahn, University of California, Santa Barbara

Abstract

High-reliability organizations (HROs) operate in uncertain circumstances with thin margins of error, while consistently avoiding failure. A central tenet of Karl Weick's work is that small events do not stay small, but are amplified through processes and sequences of action within a system. To operate reliably, interdependent HRO members must navigate a complex social environment to communicate critical information with each other. Weick contends that reliability is accomplished through consistent awareness of potentially unstable situations and anomalies in the environment. He argues for the importance of communication in facilitating reliable operations, and acknowledges that such communication is difficult. Yet, his theorizing focuses on cognitions and action directed at the task-driven operating environment while failing to unpack complexities of the social environment. Communication is the crux of both theory and practice because it is through communication that crucial information is conveyed. Because HRO members coordinate in a social as well as an operational environment, there are costs, such as loss

of crewmember trust, associated with being overly sensitive to—or overly cavalier about—hazards.

I argue that cues from the social environment importantly mediate whether and how people interpret the potential and severity of emerging errors. Weick's theorizing can be fruitfully extended by examining how the material bodies of HRO members offer important cues that shape members' interpretations within the social environment. Thus, situational awareness must involve attunement to both operational and social environments. Members must feel at least somewhat confident that the issue they are bringing up actually warrants others' attention. This is not simply an issue of the mind making a rational choice, but rather an embodied experience that is grounded in "brute facts" of one's material body and is confirmed and disconfirmed by cues from the material bodies of others within an unforgiving social context. This paper identifies ways the material body cues interpretations of emerging situations, shapes situational awareness, and ultimately enables and constrains the passage of crucial information.

15.4 Safety in Wildland Fire: Leadership, Employee Voice, and the Application of Mindfulness for Future Research

Alexis Lewis, Oregon State University

Abstract

Firefighters and fire managers each have unique experiences fighting fires that are shaped by the individual's personality, personal background, training opportunities, affiliations with coworkers, and a host of other influences that help determine the capabilities a firefighter, or fire manager, will have to make good decisions, be an effective leader and communicator, and enhance safety on the fire line. Phenomenology allows the researcher to understand particular lived experiences of fire-line personnel, which can reveal many contextual factors that may not be apparent to the researcher otherwise; these factors are revealed through in-depth interviews. Hence, it allows for fuller descriptions of a phenomenon, and as researchers, we may be better able to understand important qualities and concepts in relation to the context in which they

occur (e.g., effective leadership qualities in the lived experiences of high-stress fire situations).

This presentation will use results of a phenomenological study of firefighters who had gone through intense, life-threatening wildland firefighting situations (burnovers, entrapments, close calls, near misses) to understand what qualities make an effective, safe leader in fire. Thirty-six participants discussed aspects of safe leadership in semi-structured interviews ranging from 15 to 90 minutes, at which point theoretical saturation was reached. Through a qualitative grounded-theory approach, 24 leadership characteristics emerged, with nine essential characteristics reported frequently.

16.0 SPECIAL SESSION: ORGANIZATIONAL CHANGE, CONTINUOUS LEARNING, AND MANAGING ADAPTIVELY

16.1 Managing Adaptively to Improve Policy: Challenges and Opportunities for Integrating Science, Policy, and Decisionmaking

Toddi Steelman, North Carolina State University

Abstract

Policy-oriented research often is criticized for being untimely, poorly communicated, and irrelevant to the actual concerns of decision makers. Clearly science and research have important roles to play in informing policy. The challenge lies in creating a process that more constructively serves decision makers, while

not forsaking the strengths of the research enterprise. This presentation explores the obstacles to and opportunities for generating, transmitting, and using science and other types of knowledge through adaptive decisionmaking structures to create more adaptive policy.

16.2 Continuous Improvement in Decisionmaking in Fire Management

Marc Rounsaville, U.S. Forest Service,
Fire & Aviation Management

Abstract

The fire environment is a dynamic, continually changing system influenced by climate change, weather, fuels, vegetation, and humans. The intersection of these factors drives wildland fire impacts, responses, and reactions. Recent years have seen an emerging phenomenon referred to in a variety of ways, including “Mega Fire,” “0.25% Fires,” and “Fires of National Significance.” Forest Service leadership at all levels, along with partners, stakeholders, and cooperators, has taken up the challenge of improving both decisions about and management of these colossal fires. This process

should be viewed as a journey and not a destination. As with any journey, there are a number of steps. The first step in the process was to deconstruct and study fires to discover opportunities to change outcomes. It was recognized that decisions were driving outcomes, and with improved decisions leaders could expect better outcomes in safety, fire’s impact on the land, and cost. Science-based decision support tools have been improved and will be deployed to assist leaders in making better and more informed decisions. These tools do not replace leadership or excellent judgment.

16.3 Research Results, Challenges, and Opportunities from the 2008 and 2009 Fire Seasons

Anne Black, U.S. Forest Service,
Rocky Mountain Research Station
Toddi Steelman, North Carolina State University

Abstract

Black will review the process of developing, populating, and disseminating the Key Decision Log as a decision support tool for fire managers. Steelman will present findings from studies on community-

agency interaction and social networking. Special attention is given to the challenges of researchers working with managers in a timely and relevant fashion.

17.0 POSTER PRESENTATIONS

17.1 PAWS-MED: Pedagogic Work in the Forest

Maria Colaco, Institute of Agronomy, Lisbon, Portugal

Abstract

The need for a sound understanding of the multiple dimensions of forests and forestry is increasing in the context of increased urbanization, climate and environmental change, and globalization. Forest pedagogy or “Waldpädagogik” is a priority area for developing a shared understanding of forests and their role in helping to solve the enormous challenges we face.

Most foresters in the Mediterranean countries, however, have either a limited education in pedagogy or none at all. Therefore, the product developed by the former Leonardo daVinci project PAWS will be adapted to the needs of the Mediterranean countries. Among several themes missing from the former PAWS project is the subject of fire education.

Partners from Italy, Slovenia, Spain, Portugal, Greece, Cyprus, Austria, and Germany will work on the project. Ultimately, the PAWS material will be available in 10 languages and be used in 11 countries of the European Union.

The three basic aims of the PAWS course are:

- To increase foresters’ competence in the area of holistic pedagogy, psychology, and communication skills
- To enable foresters to improve the quality of their teaching
- To teach foresters how to plan and prepare pedagogically appropriate and efficient tours or seminars for individual target groups

17.2 Fire Communication and Education in the National Park Service

Rudy Evenson, National Park Service

Abstract

The National Park Service builds support for fire and aviation management through an outreach program managed by approximately 12 specialists nationwide based at the park, region, and national levels. These specialists leverage their efforts by: developing interpretive programs with staff at individual parks; working with local media outlets; cooperating in the interagency prevention and education arena; and developing Web-based social media projects. As active

fire practitioners, they have also brought innovations to the fire information function of the Incident Command System.

This poster summarizes best outreach practices developed by a land management agency widely recognized and trusted by the public as a leader in environmental education.

17.3 Changing Roles to Change the Nature of Future Natural Resource Professionals: Providing Tools to Students to Teach the Public about Fire

Brian P. Oswald, Stephen F. Austin State University
Pat Stephens Williams,
Stephen F. Austin State University
David Kulhavy, Stephen F. Austin State University
Karen Stafford, Texas Forest Service
Justice Jones, Texas Forest Service

Abstract

A rapidly changing landscape of urban sprawl, expanding communities, and a resurgence of living “off the grid” have contributed to an increased potential for the loss of life and property to wildfires. The Arthur Temple College of Forestry and Agriculture at Stephen F. Austin State University is taking a proactive stance in preparing students to work closely with the public by using the program, “Changing Roles.” The program was introduced in the 2009 Forestry Field Station experience with the Texas Forest Service at the Piney Woods Conservation Center on Powell Point, TX. This program was part of the Firewise program to reduce fuel loads at the wildland-urban interface (WUI). Forestry students

were exposed to the program and interacted with practicing resource professionals and community members to learn how to partner and work with the public. The WUI Professional Development Program was created by the Southern Group of State Foresters; the U.S. Forest Service; Interface South; the University of Florida, School of Forest Resources and Conservation; and the U.S. Fish and Wildlife Service. Integrating this program into the classroom and the field station experience gives students the opportunity to develop skills preparing them for public involvement prior to professional employment. Forestry students responded well to the program.

17.4 Protecting San Augustine County Communities from the Impacts of Wildfire in East Texas

Brian P. Oswald, Stephen F. Austin State University

Abstract

The unprecedented growth and development occurring in east Texas are changing the historic role of fire in forested ecosystems, and are also creating a more volatile mix of fuels, threatening homes and lives. In addition, Hurricanes Rita and Ike added more heavy fuels to this already hazardous condition. During June 2006, concerned San Augustine County, TX, stakeholders, including individuals, county officials, the Texas Forest Service, the U.S. Forest Service, the U.S. Army Corps of Engineers, and local fire departments, met to discuss wildfire and

wildland-urban interface (WUI) hazards in San Augustine County. The result of this meeting was the development of a county-wide Community Wildfire Protection Plan; San Augustine was only the fourth county in Texas to complete such a plan. This living document will be updated and maintained to reflect current and future WUI conditions in the county. The inclusion of all concerned individuals assured more active participation from all entities, resulted in more efficient buy-in by the same groups, and suggests that the momentum initiated by this program will continue.

17.5 Restoring the Role of Fire in the Longleaf Pine Ecosystem of Upland Island Wilderness, Texas

Brian P. Oswald, Stephen F. Austin State University

Abstract

Upland Island Wilderness in Texas, encompassing approximately 13,250 acres, was established in 1984 and historically consisted of open and diverse longleaf pine ecosystems, which depend on frequent, low-intensity surface fires. Like many other small wilderness areas, the vegetation and fuel conditions have undergone extensive changes since wilderness designation. Lightning-caused wildfires no longer burn with the frequency or intensity that characterized the natural fire regime, resulting in the increase of shade-tolerant trees and shrubs, heavy accumulations of duff and pine litter, and loss of suitable habitat for several rare species, including the red-cockaded woodpecker. In addition, the unnatural fuel accumulations have created a serious fire hazard that threatens the safety of firefighters, private citizens, adjacent properties, and the wilderness resource. In response, the National Forests and Grassland in Texas is developing a fire

management plan for the wilderness in order to restore the ecological role of fire. The short-term goal is to utilize prescribed burning to reduce hazardous fuels that pose an unacceptable risk to lives and property and to restore the historic fuel and vegetation conditions. Long-term planning will consider the use of prescribed fire in conjunction with the management of lightning-caused wildfires in order to mimic the processes, patterns, and ecological effects of the natural fire regime. The inclusion of all stakeholders (including environmental organizations and private citizens) throughout the process has created a plan that addresses up-front the concerns of these entities prior to the official comment stage of the process, and should serve as a model on how to avoid lengthy legal battles since all involved agree on the general objective of the project in question.

17.6 Wildland Firefighters and Attention Deficit Hyperactivity Disorder (ADHD)

See full paper on page 9.

17.7 The East Amarillo (Texas) Complex Survivors: Telling their Stories

Sandra Rideout-Hanzak, Assistant Professor
of Fire Ecology, Texas Tech University

Tina A. Oswald, Research Librarian,
Stephen F. Austin State University

Abstract

In March 2006, the East Amarillo (Texas) Complex burned over 900,000 acres in 4 days. More than 95 percent of the acreage burned was privately owned and much of it was rangeland. The fires were fought primarily by volunteer fire departments with limited air support from the Texas Forest Service. Twelve people were killed. More than 25 homes were destroyed. More than 4,000 head of livestock died.

Thousands of miles of fencing had to be replaced. We interviewed survivors to compile a collection of their stories in their own words. This poster will discuss the methods for interviewing and collecting their oral histories, transcribing the interviews, and archiving them in the Southwest Collections Library at Texas Tech University.

17.8 Prescribed Burning Associations Empower and Equip Land Managers to Manage Rangelands

Charles Taylor, Texas A&M University

Abstract

Prescribed fire in the Edwards Plateau region of Texas faces an uncertain future. The rapid rise in population and increased “urbanization” of Edwards Plateau rangeland has resulted in increased concerns over issues such as air quality and liability when prescribed fire is used as a management tool. These concerns will increase in the future. However, these problems should not lessen our enthusiasm for prescribed fire as a rangeland management practice. One response to these environmental and safety concerns is to form prescribed burn associations. A prescribed burn association is a group of landowners and landmanagers that form a partnership to conduct prescribed burns. Forming a prescribed burn association deals directly with the reasons that most people do not use prescribed fire. Insurance has to be purchased for liability, but risk is managed with proper training, experienced help, and proper equipment provided by the association. Members can attend prescribed burn workshops, and also have the opportunity to help other association

members conduct burns. This hands-on assistance allows membership to gain experience and confidence with prescribed fire. Members do not have to hire labor, because neighbors now are helping neighbors. Association members pool their equipment so that no one person has to buy all the equipment. With all of this equipment and labor, the membership can safely conduct prescribed burns. The Edwards Plateau Prescribed Burning Association, Inc., (EPPBA) is an example of a successful burn association operating in the Edwards Plateau region of Texas. EPPBA was started with 30 members in 1997 on the Texas AgriLife Research Station located between Sonora and Rocksprings. Current membership exceeds 500 in 10 different chapters spread over a 20-county area. EPPBA became a 501(c)(3) nonprofit organization in 2005, which has facilitated attempts to obtain grants and gifts. Another benefit of a prescribed burn association is its ability to have strength in numbers and influence politics.

17.9 Comparing Current Fire Records with Historical Fire Regimes for Fuel Mitigation Recommendations in the Wildland Urban Interface: A 10-year Case Study of the North Carolina Sandhills

Chris Ketchie, Graduate Student,
North Carolina State University

Abstract

To make the most of the stretched resources of our land management agencies, North Carolina fire managers must target the wildland-urban interface (WUI) areas at highest risk by understanding how to best address both management objectives, such as prescribed burning and mechanical thinning, and the equally important social objectives of public outreach and education. This project integrates wildland and prescribed fire data with current remote sensing data in a geographic information system modeling environment to provide North Carolina fire managers with the tools to make these informed decisions.

A 10-year comprehensive burn history of the North Carolina Sandhills region was compiled from records provided by the North Carolina Division of Forest Resources, The Nature Conservancy, Fort Bragg Military Base, Sandhills Game Land, and the Weymouth Woods Sandhills Nature Preserve. These data are weighted against WUI maps from Radeloff et al. (2005) and LANDFIRE data to determine areas in greatest need of fuel-mitigation efforts. The final output will not only allow North Carolina fire managers to more effectively use their resources, but it will also present a model that can be applied to other areas of the state.

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This proceedings contains articles, posters, and abstracts of presentations from the second Human Dimensions of Wildland Fire Conference held 27-29 April 2010 in San Antonio, Texas. The conference covered the social issues at the root of wildland fire management's most serious challenges. Specific topics included: firefighter and public safety; social acceptance of fuels treatments; community and homeowner fire hazard mitigation; public responses during fires and fire-related evacuations; fire communication and education; and the performance of fire management organizations—from operational efficiency to cost management and from community relations to risk management. The conference included 59 presentations, three special sessions, and nine poster presentations. Conference attendees included fire researchers and wildland fire management practitioners from the United States, Australia, Canada, Portugal, England, and The Netherlands.

KEY WORDS: Fire management, firefighting, mitigation, social acceptability, communication, defensible space, fuels management

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