Social Science to Improve Fuels Management: A Synthesis of Research on The Impacts of Wildland Fires on Communities

Wildland Fire Behavior & Forest Structure

Environmental Consequences

Economics

Social Concerns

Preface

This document is part of the Fuels Planning: Science Synthesis and Integration Project, a pilot project initiated by the USDA Forest Service to respond to the need for tools and information useful for planning site-specific fuel (vegetation) treatment projects. The information addresses fuel and forest conditions of the dry inland forests of the Western United States: those dominated by ponderosa pine, Douglas-fir, dry grand fir/white fir, and dry lodgepole pine potential vegetation types. Information was developed primarily for application at the stand level and is intended to be useful within this forest type regardless of ownership. Portions of the information also will be directly applicable to the pinyon pine/juniper potential vegetation types. Many of the concepts and tools developed by the project may be useful for planning fuel projects in other forest types. In particular, many of the social science findings would have direct applicability to fuel planning activities for forests throughout the United States. As is the case in the use of all models and information developed for specific purposes, our tools should be used with a full understanding of their limitations and applicability.

The science team, although organized functionally, worked hard at integrating the approaches, analyses, and tools. It is the collective effort of the team members that provides the depth and understanding of the work. The science team leadership included Deputy Science Team Leader Sarah McCaffrey (USDA FS, North Central Research Station); forest structure and fire behavior—Dave Peterson and Morris Johnson (USDA FS, Pacific Northwest Research Station); environmental consequences—Elaine Kennedy-Sutherland and Anne Black (USDA FS, Rocky Mountain Research Station); economic uses of materials—Jamie Barbour and Roger Fight (USDA FS, Pacific Northwest Research Station); public attitudes and beliefs—Pamela Jakes and Susan Barro (USDA FS, North Central Research Station); and technology transfer—John Szymoniak, (USDA FS, Pacific Southwest Research Station).

This project would not have been possible were it not for the vision and financial support of Janet Anderson and Leslie Sekavec of the Washington Office Fire and Aviation Management staff.

Russell T. Graham
USDA FS, Rocky Mountain Research Station
Science Team Leader

Welcome

This is one of several publications to be developed by the public attitudes and beliefs team of the Fuels Planning: Science Synthesis and Integration Project. To gather information relevant to public attitudes and beliefs about fuels planning, we posed six questions. These questions were developed around the tasks and challenges faced by fuels treatments planners:

- What information and tools are available to help land managers and communities collaborate in developing fuels treatments programs?
- What information and tools are available to help managers work with communities to communicate the risk and uncertainty of fuels treatments projects?
- What information and tools are available to evaluate the social acceptability of fuels treatments?
- What information and tools are available to describe and evaluate the aesthetic impacts of fuels treatments?
- What information and tools are available to encourage more active involvement of private property owners in the fuels management process?
- What information and tools are available to help us understand and evaluate the social impacts of wildfire?

Teams of scientists from universities and public agencies across the country were formed to address each question. Collectively we became known as the social science teams. Each team had approximately eight weeks to produce a synthesis of science relevant to its question and an annotated bibliography that supports the synthesis.

While the focus of the national project was on the dry inland forests of the Western United States, the research synthesized by the social science teams was not limited geographically. We felt the research question being addressed was more important than the location of the research. In addition, we felt that research addressing the human dimensions of a variety of management objectives is potentially applicable to fuels management. For example, we assumed that information and tools developed in Minnesota to bring together communities and agencies in addressing watershed management collaboratively, across boundaries, are applicable to fuels management.

In this publication we present the findings of the synthesis on the impacts of wildland fire on communities. Manager fact sheets are available online at:
http://www.fs.fed.us/fire/tech_transfer/synthesis/social_science_team/fact_sheet_ss.htm

Further information of the larger project is available online at:
http://www.fs.fed.us/fire/tech_transfer/synthesis/synthesis_index

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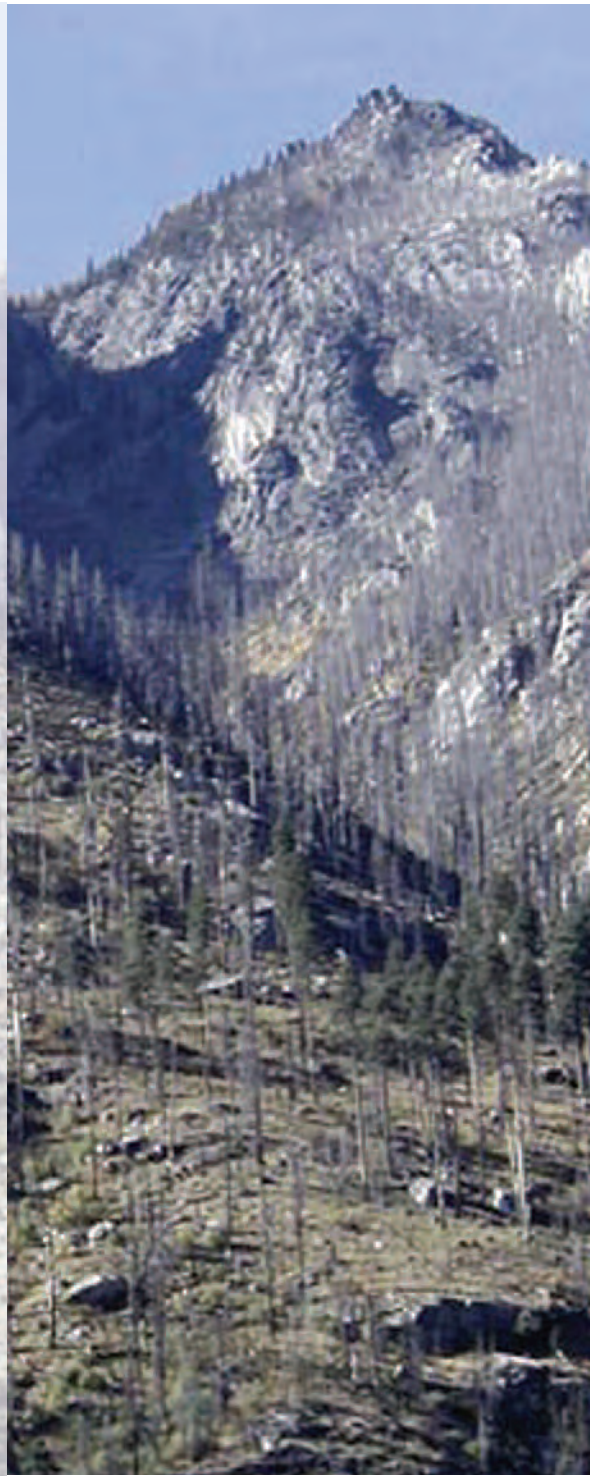
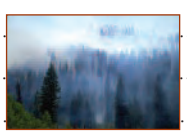


Table of Contents



Introduction

The story of wildland fire in the U.S. has been told in the popular media, academic press, and government reports (Aplet 2006, Arno and Allison-Bunnell 2002, Gorte 2003, Pyne 2001). However, in a synthesis of wildland fire impacts on communities, it is useful to review some significant events as they relate to communities. For much of the 20th century, public land management agencies successfully excluded wildland fire from the landscape. The consequences of this strategy became strikingly visible beginning in 1988. In that year, the public's attention was captured by the fires occurring in and around Yellowstone National Park, and many other natural and human-caused fires burned elsewhere in the northern Rockies. A total of 7.4 million acres burned in 1988, nearly 40 percent more than in any other year in the previous decade. In the following decades, other large, high intensity fires burned across the West. The National Interagency Fire Center (NIFC) maintains a list of "Historically Significant Wildfires"— fires that are significant in terms of acres burned, value of the resources destroyed, or lives or property lost dating back to 1804. Of the 62 significant fires listed by NIFC, 27 have occurred since 1988 (National Interagency Fire Center 2007). While the wildland firefighting agencies are eminently successful in controlling most fires—95 percent are extinguished when they are less than 2 acres in size (Graham et al. 1999)—the public is fascinated by the small percentage of fires that escape and grow into large conflagrations.

Many fires are significant because of where they occur on the landscape—in the wildland-urban interface. The wildland-urban interface (WUI) is where we find homes and other structures built adjacent to or within tracts of flammable vegetation (Winter and Fried 2000). Settlement patterns in the Western United States have taken a series of twists and turns over the past century. For a variety

Photo credit: Sarah McCaffrey

In recent decades the population has increased dramatically in the dry, low elevation forests of the inland West.

of reasons not clearly understood at this time, the early 1990s witnessed an impressive shift in human migration patterns with dramatic increases in population in the rural areas of the West, particularly those areas with high amenity values based on the natural environment (Johnson 1999, McCool and Kruger 2003, Rudzitis 1999). Much of this population growth did not occur in existing communities, but in the WUI, often in a complicated interfingering of public managed land and privately owned lands (Johnson and Fuigitt 2000).

Much of this newly settled WUI falls in the dry, low elevation forests of the West—forests that have been most susceptible to the consequences of the fire exclusion policies of the 20th century. In the past, low intensity fires frequently burned through these forests, and the species that made up these forests, such as ponderosa pine, were not damaged. But our efforts to exclude wildland fires have led to long-term vegetation changes, including the development of hazardous fuels. These fuels, coupled with a prolonged drought in the West, have resulted in fires that exhibit a dramatic shift in behavior. Low intensity fires have been replaced by massive stand-replacement fires that burn with such intensity they cannot be effectively attacked with traditional fire suppression strategies (Graham et al. 2004).

The effects of such fires on people and communities have increasingly become the focus of policy debates among members of neighborhood associations, county land commissioners, and extending all the way to the White House (see, for example, U.S. Department of Agriculture and U.S. Department of the Interior 2000). In this synthesis we step back from these debates and look at what science can tell us about the impacts of wildland fires on communities. We start with an overview of wildland fire and communities, followed by an event-based model of wildland fire and decisionmaking related to fire management. Finally, we present what social science tells us about the impacts of wildland fire on people and their communities.

Wildland Fires and Communities: An Overview

Contexts and Antecedent Conditions

The large fires of recent decades have resulted in a series of disasters to the individuals and communities in these WUI and wildland environments. These are disasters in the sense that they have significantly disrupted the ongoing social elements and processes within the communities affected, have resulted in large financial losses, and have led to expensive restoration activities. The effects of these disasters have been manifest in several ways. First, and most obvious, the loss of life and property has been significant. Second, wildland fires have changed how people value their property and their place within the communities—some residents have sold their properties, many have been forced to rebuild, others have relocated, and all are resigned to accept a highly disturbed landscape for years to come. Third, the community itself is affected, through loss of property values and the substitution of fire prevention and protection for other, ongoing community projects, processes, and challenges. Finally, large-scale wildland fires have provided yet another source of tension in the increasingly conflicted relationships between individuals and groups and the public agencies that manage much of the land upon which the fires occur.

Photo credit: Sarah McCaffrey

Families impacted by wildland fire have lost homes, and communities have lost property values.

Wildfires do not occur in a vacuum; rather, they are embedded in complex systems that provide the context for wildland fires. The biophysical and social contexts are composed of a number of interrelated elements that set the antecedent conditions for wildland fire (Table 1). Antecedent conditions are conditions existing before the wildland fire occurs. To understand the impacts of wildland fires, we must understand this context.

The context for wildland fire is extremely complex. Contributing to this complexity is the fact that the biophysical and social elements exist at different scales in a definite hierarchy (Beckley 1998), and the properties of the elements that emerge at larger scales cannot necessarily be predicted from properties at smaller scales. In addition, an element is more than the sum of its parts—we are not able to understand emergent properties of the whole by understanding the characteristics of the parts.

Table 1 **Examples of antecedent conditions that make up the biophysical and social contexts influencing how people and communities respond to wildland fire**

Antecedent Conditions in Biophysical Context	
Forest type	Fuel levels
Moisture conditions	Weather conditions
Historic fire interval	Recent fire history
Antecedent Conditions in the Social Context	
Individual-level conditions:	
Attitudes towards agencies	Patterns of recreational behavior
Attachment to place	Environmental attitudes/values
Knowledge of fire ecology	Previous fire experience/exposure
Family-level conditions:	
Socioeconomic status	
Group-level conditions:	
Intragroup relations	Intergroup relations
Neighborhood-level conditions:	
Social cohesion	
Community-level conditions:	
Population size	Population composition
Economic diversity	Leadership attributes
Public financial resources	Physical capital
Natural (environmental) capital	Economic (fiscal) capital
Human capital	Social capital
Linkages to extralocal authorities and organizations	
Wildland Fire Experience and Exposure	
(conditions occurring in both the biophysical and social contexts)	
Direct vs. indirect prior wildland fire exposure	
Magnitude of prior wildland fires	Recency of prior wildland fires
Patterns of wildland fire recurrence	

Photo credit: Ed Riley

The high uncertainty around wildland fire means we may be able to predict the consequences of some actions at a small scale in the short term, but we are not able to predict the consequences of a number of actions over longer timeframes.

There is great uncertainty surrounding complex systems. This uncertainty arises from three factors. First, knowledge about cause and effect relationships is lacking. Second, there are often time lags between an event and its effects, which makes it very difficult to understand the strength and direction of relationships. Third, with the social system in particular, many of the relationships between scales are undefined and poorly understood.

Fires are even difficult to predict at the smaller scales that are important for preparedness and response decisions. We may be able to state, for example, that a wildland fire will occur in Montana sometime in the next year, but we will have a hard time forecasting where, what size, and with what consequences. We may be able to predict the consequence of some action at a small scale in the short term, but we are not able to predict the consequences of the same action, or as is more likely, a number of actions over longer time scales. Finally, social and biophysical systems are nonlinearly dynamic—that is, at times, relatively small events may lead to relatively large consequences, and at other times a large event may not lead to any significant consequences.

The complexity and uncertainty described above apply to elements in the social and biophysical contexts. Wildland fires occur in the dynamic social context characterizing life in America. This context includes political and formalized relationships among Federal, State, and local fire suppression agencies, a community's previous experience with wildland fire, community residents' knowledge of and attitudes toward wildland fire, institutional plans and arrangements for dealing with fire, and technical preparedness of emergency agencies. Actions taken by agencies, institutions, groups, organizations, and individuals will affect how a wildland fire impacts a community. This social

context is not bad or good, it simply exists, and to understand the impacts of wildland fires this context must be recognized.

Thus, the combination of complexity, uncertainty, and our lack of knowledge about fires and communities makes it difficult to generalize about how any given wildland fire will affect any given community. The existing biophysical and social contexts will intensify or moderate impacts on communities. In addition, the biophysical and social consequences of a wildland fire will become the antecedent conditions for the next fire.

Federal Policy Response to Recent Wildland Fires

Photo credit: Bureau of Land Management

The National Fire Plan encouraged hazardous fuels reduction on public and private land.

Public agencies have experienced multiple political pressures to respond aggressively to the fire events of the last decade and have done so through a variety of new policies and programs. Prominent among these initiatives have been the National Fire Plan (NFP) and the Healthy Forest Restoration Act of 2003 (HFRA). Both initiatives emphasize the importance of involving communities in local wildland fire preparedness. Developed in 2000, the National Fire Plan focuses on five key points: firefighting, rehabilitation of forest lands, hazardous fuels reduction, community assistance, and accountability for NFP initiatives (National Fire Plan 2004). NFP provides financial assistance to communities to (1) support activities that educate citizens on the effects of wildland fire and what they can do to protect their homes, (2) facilitate community fire protection planning, and (3) train and equip rural and volunteer fire departments.

The goal of the Healthy Forest Restoration Act is to help communities, States, tribes, and landowners restore healthy forest and rangeland conditions on their lands. A critical feature of HFRA is support for the development of Community Wildfire Protection Plans (CWPPs). These plans provide communities with important opportunities to influence where and how Federal agencies implement fuels reduction projects on Federal lands, and how funds are allocated for fuels reduction on non-Federal lands

(Society of American Foresters 2004). A CWPP (1) identifies areas to be treated, (2) recommends types and methods of treatment, and (3) recommends steps homeowners and communities can take to reduce the ignitability of structures. It must be developed collaboratively by local and state government representatives and other interested parties. Federal agencies are partners in the development, implementation, and monitoring of CWPPs "to the extent that a community desires, within budgetary constraints" (U.S. Department of Agriculture 2004, p.35).

Involvement in community planning and decision making related to wildland fire may be seen as an emerging area of responsibility for Federal agencies. Public agency presence in rural communities has historically focused on land management problems separate from fire. Little attention has been directed toward community preparedness, recovery, or emergency management surrounding a fire. Because fire management staffs have been dominated by a technically trained elite, many have perceived their mission as largely one of suppressing fires, not of facilitating community involvement in fire management. Both the NFP and HFRA envision an expanded partnership between communities and fire management agencies in community wildfire preparedness.

An Event-Based Framework for Understanding Decisions and Actions Relevant to Wildland Fire

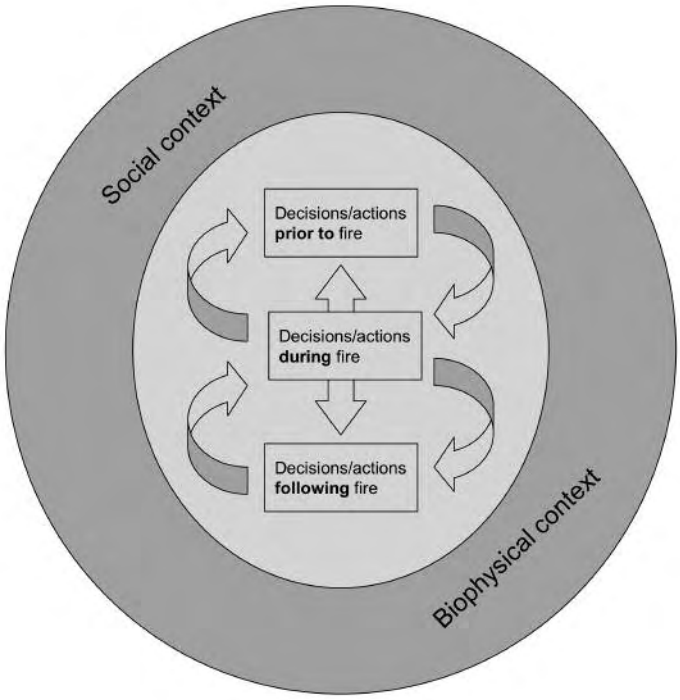
As the scale and human impact of fires grow, the need for community involvement in fire management and planning does, too. Communities can be surprised by the scale and intensity of wildland fires and overwhelmed by emergency tasks such as communication, evacuation, search and rescue, recovery, and restoration. Many communities at risk are small and lack not only the facilities and equipment to rapidly respond to a large fire, but also the leadership, training, and communications infrastructure to deal with an emergency. The complexity of wildland fire and its contextual elements and new Federal policies encouraging cooperation and collaboration between fire management agencies and local communities suggest that traditional relationships between agencies and communities are changing and will continue to do so. While a command-and-control approach may have been sufficient in the past, it is unlikely to be sufficient for all fire-related Federal-community interactions in the future. The uncertainty surrounding the effects of fires on communities calls for a more adaptive approach to fire management.

The uncertainty surrounding the effects of fires on communities calls for a more adaptive approach to fire management.

An event-based model provides a logical temporal view of the decisions and actions taken relevant to managing wildland fire and its consequences (McCool et al. 2006). The framework (Fig. 5) contains four major components: (1) the biophysical and social contexts (comprised of antecedent conditions) for fire management decisions, (2) decisions/actions that occur before a fire, (3) decisions/actions that occur during a fire, and (4) decisions/actions taken after a fire. Each decision/action has a number of consequences (represented by the arrows in Figure 5); these consequences occur across one or more elements, at various scales, and at different times.

The decision to take action within each phase is influenced by other decisions/actions and biophysical and social contexts. By using an adaptive management and learning approach, we can help ensure that the consequences of a decision/action provide insight and new knowledge that is fed back into decisions to take action in the future.

Figure 5 **A wildland fire occurs within social and biophysical contexts and involves a series of decisions and actions (boxes) that have consequences (arrows) in all phases.**



Decisions/Actions Taken Before, During, and After a Wildland Fire

A number of decisions/actions will be undertaken by a variety of actors before, during, and after a wildland fire. These decision/actions are summarized in Figure 6 and discussed in detail below.

Decisions/Actions Taken Before a Wildland Fire

Because fires are stochastic, or random, and unpredictable at the community level, bringing about changes in human behavior important to wildland fire management typically relies on the actual occurrence of a fire—either near the community or in other similar communities. The fires we have experienced since the 1990s in the Western U.S., however, have raised the profile of fire risk to many residents and communities. This change in context has increased sensitivity to the notions of defensible space at the household level and preparedness at the community level.

The ability of communities to respond to wildland fires and their consequences will be deeply affected by public knowledge about the role of fire in fire-adapted forest ecosystems. Before any change in behavior,

Figure 6 **Examples of decisions/actions taken before, during, and after a wildland fire.**

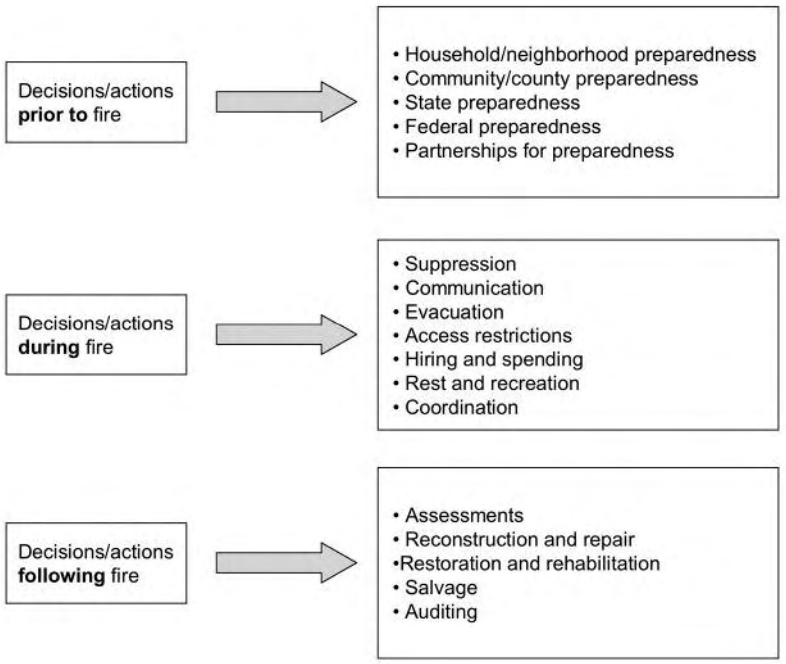


Photo credit: Pamela Jakes

Household and neighborhood preparedness actions include thinning around homes and in common areas for creating defensible space to reduce fire risk.

residents in at-risk communities will require a basic understanding of the patterns of wildland fire within the ecosystem in which they live and of the risks they face by living in this ecosystem. This understanding is critical to the adoption of new behaviors and to residents' participation in local efforts to partner with public land managers in community-based wildland fire management (Monroe et al. 2006).

Although it may seem obvious, we point out here that the decisions made before a wildland fire have consequences relating to the effects of wildland fires. For example, taking action to provide opportunities for residents to obtain knowledge related to fire ecology will affect how some individuals cope with the consequences of a disastrous fire and thereby the need for post-fire support programs for victims. In addition, many groups within the community share responsibility for helping to define and implement activities to decrease the potential negative impacts of a wildland fire before the fire event (David 1990, Jakes et al. 2004).

Household and Neighborhood Preparedness

Household and landowner preparedness is a growing and critical component of wildland fire management. Wildland fires occur on both public and private lands, although a major focus of community concern over fire damage rests on those privately held properties where people reside or conduct commerce. The patterns of development in the WUI are highly diverse and possess inherently variable levels of risk from wildland fire damage. However, certain characteristics of development within the design of both neighborhoods and individual structures can predispose a residential development to either high or low risk of loss during a wildland fire. For example, ongoing research (Cohen 2000) on the flammability of individual structures shows a strong relationship to two factors: (1) the presence of fine fuels or flammable materials in contact with the structure, and (2) moderate or heavy fuels within 60 m of the structure.

Property owners can reduce the risk of losing structures to wildland fire by treating common fuel problems such as trimming overhanging trees, moving firewood stacks on porches, clearing pine needles from windowsills and gutters, and eliminating woody vegetation adjacent to structures. They can also remove valuables from homes when the fire risk is high. Neighborhoods can work with emer-

gency management experts to plan evacuation routes and suppression strategies. Developments can be designed with road networks that allow passage of suppression equipment (fire engines and water tankers) so that they can be protected more quickly and with less risk to firefighters than neighborhoods built along narrow, dead-end roads. Neighborhoods can become more psychologically prepared for wildland fire through discussion groups that help residents identify the risk of fire and strategies to cope with fires. These activities also increase the cohesiveness within a neighborhood and the support households will receive from their neighborhoods if they do experiences losses from wildland fire.

Several programs and organizations provide literature and training programs that help homeowners and neighborhoods improve wildland fire preparedness. Among these groups are Firewise Communities USA (http://www.firewise.org/) and various local groups using the firewise term (for example, Florida Firewise Communities, http://www.floridadisaster.org/bpr/Response/Plans/Nathaz/firewise/index.htm, Arkansas FireWise, http://www.arkansasfirewise.com/, and Minnesota Firewise, http://www.dnr.state.mn.us/firewise/index.html), Fire Safe Councils in California (http://www.firesafecouncil.org/), and FireFree in Oregon (http://www.firefree.org/).

Community/County Preparedness

Communities and counties form another line of defense against the potential disastrous consequences of wildland fire. There is considerable literature on disaster preparedness, and following 9/11, communities have increased their attentiveness to preparedness. Communities and counties can reduce risk through administrative actions such as establishing planning and zoning ordinances governing roofing materials, subdivision design, transportation systems, and location of fire suppression facilities. Like neighborhoods, they can sponsor seminars and discussions to educate citizens on fire ecology and to increase public awareness of fire risks and the steps to reduce risks. Other education topics would address what to do during a fire—highlighting evacuation routes, establishing information centers, mobilizing mental health programs, establishing compensation programs (Gordon and Maida 1992). Through planning, communities and counties can establish a holistic framework for recovery following a fire, including restoring utilities and providing financial and technical assistance to businesses, homeowners, and governments (Monday 2002). Some counties handle wildland fire planning through a broader hazard mitigation plan, while other communities develop wildfire protection plans that stand alone. The community wildfire protection plans mandated under HFRA are developed at the community or county level, with local units of government having to sign off on each plan as representing the interests and priorities of that community.

Some counties handle wildland fire planning through a broader hazard mitigation plan, while other communities develop wildfire protection plans that stand alone.

FIREWISE Landscaping

Firewise Landscaping Checklist

When designing and installing a firewise landscape, consider the following:

- ❑ Local area fire history.
- ❑ Site location and overall terrain.
- ❑ Prevailing winds and seasonal weather.
- ❑ Property contours and boundaries.
- ❑ Native vegetation.
- ❑ Plant characteristics and placement (duffage, water and salt retention ability, aromatic oils, fuel load per area, and size).
- ❑ Irrigation requirements.

To create a firewise landscape, remember that the primary goal is fuel reduction. To this end, initiate the zone concept. Zone 1 is closest to the structure; Zones 2-4 move progressively further away.

- ❑ **Zone 1.** This well-irrigated area encircles the structure for at least 30' on all sides, providing space for fire suppression equipment in the event of an emergency. Plantings should be limited to carefully spaced low flammability species.
- ❑ **Zone 2.** Low flammability plant materials should be used here. Plants should be low-growing, and the irrigation system should extend into this section.
- ❑ **Zone 3.** Place low-growing plants and well-spaced trees in this area, remembering to keep the volume of vegetation (fuel) low.
- ❑ **Zone 4.** This furthest zone from the structure is a natural area. Selectively prune and thin all plants and remove highly flammable vegetation.

Also remember to:

- ❑ Be sure to leave a minimum of 30' around the house to accommodate fire equipment, if necessary.
- ❑ Widely space and carefully situate the trees you plant.
- ❑ Take out the "ladder fuels" — vegetation that serves as a link between grass and tree tops. This arrangement can carry fire to a structure or from a structure to vegetation.
- ❑ Give yourself added protection with "fuel breaks" like driveways, gravel walkways, and lawns.

When maintaining a landscape:

- ❑ Keep trees and shrubs properly pruned. Prune all trees so the lowest limbs are 6' to 10' from the ground.
- ❑ Remove leaf clutter and dead and overhanging branches.
- ❑ Mow the lawn regularly.
- ❑ Dispose of cuttings and debris promptly, according to local regulations.
- ❑ Store firewood away from the house.
- ❑ Be sure the irrigation system is well maintained.
- ❑ Use care when refueling garden equipment and maintain it regularly.
- ❑ Store and use flammable liquids properly.
- ❑ Dispose of smoking materials carefully.
- ❑ Become familiar with local regulations regarding vegetation clearances, disposal of debris, and fire safety requirements for equipment.
- ❑ Follow manufacturers' instructions when using fertilizers and pesticides.

Access additional information on the Firewise home page: ***www.firewise.org***

Please see the other side of this sheet for the ***Firewise Construction Checklist.***

Several programs and organizations provide educational materials to help homeowners improve wildland fire preparedness (http://www.firewise.org/usa/files/fwlistsz.pdf)

State Preparedness

State agencies often take the lead in wildland fire mitigation and preparation activities, especially in States with little Federal land. Many States manage significant acreages of forests and rangelands, and they are responsible for fuels management on these lands. They distribute funding to communities to help cover the costs of preparedness activities, develop programs and legislation to direct local action, and provide organizational arrangements to facilitate activities (Steelman et al. 2004). The National Association of State Foresters has been instrumental in implementing different aspects of HFRA. For example, the State forester gives the final approval to community wildfire protection plans developed under HFRA. Many States organize regional firefighter training programs and develop or sponsor landowner education programs, like those cited above as providing direction to homeowners on how to create defensible space around structures. Even in States with significant Federal acreage, State agencies are uniquely placed to serve as a conduit between Federal agencies and local communities (Jakes et al. 2004).

Photo credit: Pamela Jakes

Many counties are responsible for modeling fuels reduction on their own land.

Federal Preparedness

A variety of disaster preparedness, management, and recovery agencies exist at the Federal level. The most prominent of these are the Federal agencies that manage public lands and provide leadership in fire suppression and fuels management. In the wake of an increasing number of large western fires, the USDA Forest Service (Forest Service) faced emphatic political demands to reduce risk of large fires; the National Fire Plan and Health Forest Restoration Act (discussed earlier) were manifestations of those demands. The demand for changes is most pressing where fires are most frequent—in the low-elevation dry pine forests of the inland West, adjacent to rural communities. Difficult questions arise about the management of fire-adapted ecosystems, requiring strategies that allow fires to burn for ecological purposes, but not allowing these fires to grow beyond our ability to control them.

Agencies have two major approaches for reducing the negative consequences of wildland fire: fuels reduction and fire suppression. As mentioned earlier, Federal agencies are very successful at fire suppression, and the infrastructure to carry out these responsibilities is well established. Federal agencies design fuels reduction projects to meet one of three objectives: (1) reduce wildfire threats within the wildland-urban interface, (2) reduce wildfire threats outside the WUI where there is the greatest risk

of catastrophic wildland fire, and (3) maintain desired landscape conditions to retain various benefits. There is evidence that fuels reduction projects that include thinning to increase canopy base height, reduce canopy bulk density, reduce canopy continuity, and require a substantial reduction in surface fuels can be effective in reducing wildland fire hazard (Kalabokidis and Omi 1998, Peterson et al. 2005). Effectiveness of these treatments can be improved through long-term maintenance of fuels loading. Under the NFP and HFRA, Federal agencies have treated more than 15 million acres of Federal lands to achieve fuels reduction objectives (Healthy Forests Initiative 2006).

Photo credit: Terry Daniel

One of the major tools public agencies have for reducing the impacts of wildland fire is fuels reduction.

In addition to treating hazardous fuels, Federal agencies can take other steps before a wildland fire to mitigate potential negative consequences, including advance placement of resources (helicopters, trucks, firefighters) and staff training. They can participate in planning activities to increase emergency preparedness. Federal agencies also conduct and support research on fire behavior and social aspects of wildland fire.

Partnerships for Preparedness

While we have talked about the roles that individuals, neighborhoods, communities, counties, and State and Federal agencies can play in improving preparedness before a wildland fire, collaboration and partnerships among these agents are often cited as a key for increasing or improving wildland fire preparedness (Jakes et al. 2004, Sturtevant et al. 2005, Teie and Weatherford 2000). The NFP and HFRA highlight the need for federal agencies and communities to work together to plan and implement hazardous fuels reduction projects. As has been observed elsewhere, although there are many challenges and benefits of collaboration on fuels reduction projects, the fact is that collaboration results in better projects (Sturtevant et al. 2005).

Decisions/Actions Taken During a Wildland Fire

Wildland fires generate a number of decisions and actions that impact communities at different scales. Unlike most catastrophic events, many wildland fires involve a protracted period, from a few days to several months, during which authorities attempt to manage, mitigate, and control the spreading disaster.

Below we discuss seven types of actions that have potential to impact the local community. Evaluation of any of these actions after the fact would be useful to improving actions in future wildland fires.

Suppression

Suppression refers to decisions and actions directly related to attack on the wildland fire. Decisions involve basic strategies (for example, do firefighters work to contain the fire or focus on protecting property) and a host of tactical questions (for example, do we use backfires, what types of equipment should be deployed, what type of personnel are needed). In addition, there are likely important dimensions of timing and location of attack that impact local communities, neighborhoods, and individual residences. The many strategic and tactical decisions involved in managing a large wildland fire give communities plenty of opportunities to second-guess the decisions of the fire suppression team. Thus, while firefighters are often praised for their valiant efforts to protect local property, considerable controversy can develop over how the fire was managed (Carroll et al. 2000).

The cost of suppressing high intensity large fires in areas increasingly close to people is placing a burden on Federal budgets, and a debate is raging over the responsibilities of Federal land management agencies to protect natural resources from wildland fire versus homes and other structures. The General Accounting Office (2004) reported that the Forest Service and Department of the Interior transferred more than $2.7 billion from other agency programs to help fund wildfire suppression between 1999 and 2004. The GAO found that these transfers "caused numerous project delays and cancellations, strained relationships with state and local agency partners, and disrupted program management efforts" (General Accounting Office 2004, p. 3). There is real concern in some quarters that the USDA Forest Service is becoming the USDA Fire Service.

Both strategic and tactical decisions must be made on wildland fire suppression.

Photo credit: firehousetraining.com

Communication

Information is a critical element in managing and mitigating the impacts of wildland fire. Over the years, agencies such as the Forest Service have developed sophisticated communications strategies to keep information about a wildland fire flowing smoothly among firefighters on the front lines, fire

managers overseeing the operation, public affairs specialists monitoring the effort, and the public and media, whose cooperation is crucial to a safe outcome. The content and timing of communications are significant (Monroe et al. 2006). Information content and timing may affect different residents in different ways. Fire managers may emphasize different types of information at different times. As a fire develops, information needs change. Fire managers will need to know which media are best for which types of information.

Strategic purchasing and hiring can help minimize disruption and negative distributional impacts of changes in economic activity.

Evacuation

Evacuation of residents and businesses threatened by wildland fire and notification of possible evacuations are likely to be among the most disruptive aspects of a fire for a community (Cohn et al. 2006). Factors that appear to affect communities include how much time people have to prepare for evacuation and what opportunities evacuees have to gather their possessions. How evacuation decisions are made and communicated makes a big difference. A better understanding of evacuation and impacts would help mitigate impacts of evacuation actions and potentially improve relationships between the community and public safety institutions.

Access Restrictions

Access restrictions rival evacuation in their direct impacts on residents. These impacts may range from inconvenience to serious disruption of business activity and livelihoods. Restrictions are generally enforced by local public safety professionals or hired security personnel. The effectiveness of restrictions depends in part on how access rights are determined during a closure. It is important to be explicit about criteria used to determine areas to be closed and to determine when areas will be reopened.

Hiring and Spending

Wildland fires generate economic activity in a community; however, they do so in abnormal ways. Hiring equipment and people and purchasing supplies, lodging, and other goods and services can have major local impacts. Wildland fires can also call a halt to economic activity. While hotels operate at full capacity with firefighters, media, and evacuees needing temporary housing, recreational outfitters may see their business grind to a halt. Strategic purchasing and hiring can help minimize disruption and negative distributional impacts of changes in economic activity.

Rest and Recreation

Firefighters and support personnel are granted time off for rest and recreation during a wildland fire,

creating interactions between these temporary residents and locals. During long fire suppression efforts, firefighters and other outsiders (including media personnel) purchase supplies, get their hair cut, take in a movie, and otherwise live within the community. How these temporary residents behave in public will leave an important and lasting impression on community residents. Attention must be paid to ensuring this impression is positive.

Coordination

Managing interagency/organizational relations is a complex task. A large fire requires coordinating the activities of a variety of autonomous organizations with different institutional cultures and a variety of constituencies. The task may be among the most important for success of the overall firefighting effort. Research on organizational relationships and the other types of organizations involved would help ensure that potential positive impacts of coordination are maximized.

Decisions/Actions Taken After a Wildland Fire

Various decisions/actions made after the fire is controlled also affect communities.

Assessments

Assessments of wildland fire actions and decisions involve monitoring their impacts by collecting data for future reference. Post-fire assessments typically focus on collecting data that serve as indicators of the effectiveness or success of actions taken to suppress and control a wildland fire. However, as the intensity and scale of fires have increased, there has been more interest in broader, more inclusive assessment. Assessments of actions taken to implement evacuations, enforce entry restrictions, facilitate communication and the flow of information, and initiate interagency cooperation and coordination could all be documented. The community has become an increasingly important contributor to such assessments. Assessments have found that holistic community recovery efforts that address restoration of utilities and financial and technical assistance to businesses, homeowners, and governments to be most effective (Monday 2002).

Evacuations of residents and their pets and livestock present significant challenges during a wildland fire.

Photo provided by: Matt Carroll

Reconstruction and Repair

After a wildland fire, decisions need to be made about the reconstruction and repair of any infrastructure damaged by the fire. One area that may need immediate attention is repair of the municipal water

supply system—water reservoirs or watersheds feeding those reservoirs may have lost significant vegetative cover resulting in silting that can affect water quality and reservoir capacity (Graham 2002). New agencies, such as the Federal Emergency Management Agency (FEMA), may come to town to process claims and payments. Residents may no longer wish to continue to live in a landscape that has been dramatically altered by a fire; this situation can apply to residents who have lost their homes and those whose homes have been saved (Carroll et al. 2003, Graham 2002). This may result in neighborhoods that have been deserted. To be effective, the framework for community recovery should be holistic and should include issues such as restoration of utilities and provision of financial and technical assistance to businesses, property owners, and local governments.

Photo credit: V. Sturtevant

Residents may no longer wish to live in a landscape that has been dramatically altered by fire.

Restoration and Rehabilitation

Restoration and rehabilitation activities to restore natural resources following a wildland fire can seem overwhelming. Erosion is probable following the destruction of vegetative cover, resulting in damage to water supply systems (as mentioned above) and other damage from mudslides and flash floods. Restoration and rehabilitation projects can be extremely labor intensive. Community members are valuable partners in these projects, helping to keep costs down by providing volunteer labor, building a feeling of community ownership in the projects, and empowering the community to reshape their landscape.

Salvage

Burned trees and other commodities, although damaged by the fire, may still be usable, and there is often pressure to recover some value through salvage. Timber salvage proposals, in particular, can be contentious and divisive because some groups see salvage projects as an excuse to log in areas where they feel no logging should occur.

Auditing

Fire audits make use of data collected in assessments to examine decisions made before, during, and after a wildland fire. Auditing creates the opportunities to conduct the necessary deliberations and tradeoff analyses to make policy changes.

Research on the Consequences of Decisions Made Before, During, and After a Wildland Fire

The framework suggests a logical approach for considering the decisions and actions taken before, during, and after a wildland fire and the consequences of these decisions rippling through the event phases. Unfortunately, there is little research on the consequences of management decisions and actions before, during, and after a fire for communities. However, some lessons can be learned from the disaster or hazards literature (Kumagai et al. 2004a). In the synthesis that follows, we included research on social impacts of environmental hazards and disasters, and on the social impacts of planned environmental management typically requiring environmental impact assessments specified in the National Environmental Policy Act (NEPA).

Consequences of Decisions Made Before a Wildland Fire

A large body of research has developed on the actions taken by communities before a fire to improve preparedness; however, there is no research on the consequences of these actions. Research recommends a series of preparedness actions to be taken by homeowners to create defensible space, by neighborhoods to develop emergency egresses, by communities to pass new zoning and building ordinances, by States to model fuels management on their land, and by Federal agencies to provide cost-share funds or technical assistance for all these activities (Bailey 1991, Bradshaw 1987, Jakes et al. 2004, McCool and Kruger 2003). One critical need identified in several case studies was the need

Photo provided by: Jamie Barbour

Although members of the public may support prescribed burning to reduce hazardous fuels, the jury is still out on their acceptance of prescribed burning at the scale required to significantly reduce fuel loads in the inland West.

to train local firefighters, particularly firefighters in isolated rural areas, in wildland fire suppression in addition to structural fire suppression. In a number of large fires, the pre-fire inspection and certification of locally available firefighting equipment, such as bulldozers and water trucks, and local operators would mean they could be deployed more quickly than Federal equipment (Carroll et al. 2000, 2003; Graham 2002).

Many of the critical decisions made during a fire are made by firefighting agencies, so the limited research on the consequences of decisions during a fire focus on these agencies.

Various studies have examined homeowner and landowner perceptions for fire risk and acceptability of fuels treatment strategies—antecedent conditions for wildland fire. These studies found the following:

- The media have an important role to play in influencing the public's knowledge and beliefs about wildland fire, including perceptions of risk and willingness to engage in preparedness activities (Beebe and Omi 1993, Carpenter et al. 1986, Clark and Hardy 1997, Cortner et al. 1990).
- County officials who invest in personnel and hazard reduction plans are more likely to have prepared a wildland fire mitigation or preparedness strategy than are those who have not made these investments (Burby et al. 2000, Cook 1995).
- The negative consequences of natural hazards and disasters can be minimized when local governments are proactive in managing land use (Burby et al. 2000).
- The jury is still out on public acceptance of prescribed burning, at least at the scale that would be required to make meaningful inroads into problems of fuel condition in the inland West (Carpenter et al. 1986, Winter and Fried 2000).

Consequences of Decisions Made During a Wildland Fire

Many of the critical decisions made during a fire are made by firefighting agencies, so the limited research on the consequences of decisions during a fire focus on these agencies. These consequences can happen immediately or be delayed for several hours to several months. Unfortunately, little research has been conducted to gain an understanding of the consequences to communities of decisions made during a wildland fire.

Numerous studies have reported local-federal conflict over firefighting (Carroll et al. 2000, 2003; Graham 2002; Kumagai 2001; Kumagai et al. 2004b, c; Rodriquez-Mendez et al. 2003). Issues generally revolve around the aggressiveness of firefighting, protection of homes, prioritization of

resources and structures to be protected, and extent to which local personnel, knowledge, and resources are tapped. Reasons for such conflict are many including (Carroll et al. 2003, Cortner and Gale 1990):

- faulty causal attribution by fire victims
- confusion inherent in large fires, similar to the "fog of war"
- a focus on the general rather than the specific
- cultural differences between large government agencies and local communities
- differences in values and priorities
- differences in opinions about to how to fight fire
- disagreement over how much risk to firefighters will be/should be tolerated to protect homes and property

Photo credit: U.S. Marine Corps

Many studies have reported local-Federal conflict over the aggressiveness of firefighting efforts, protection of homes, and prioritization of resources.

One researcher suggested that disasters often produce in individuals a release of anxiety set off by the perception of a betrayal of trust by agencies and institutions (Horlick-Jones 1995). Studies of blaming behavior suggest that under some circumstances people tend to make oversimplified judgments about the cause of damage from wildland fires (Kumagai 2001; Kumagai et al. 2004b, c). Fire officials are blamed for events beyond their control or actions they did not undertake. Other studies suggest that trust of government may influence people's perceptions of risk of wildland fire (Baxter et al. 1992). The specific triggers of faulty causal attributions have yet to be fully identified. In some situations it can be hard to distinguish between unfair blaming and legitimate differences of opinion.

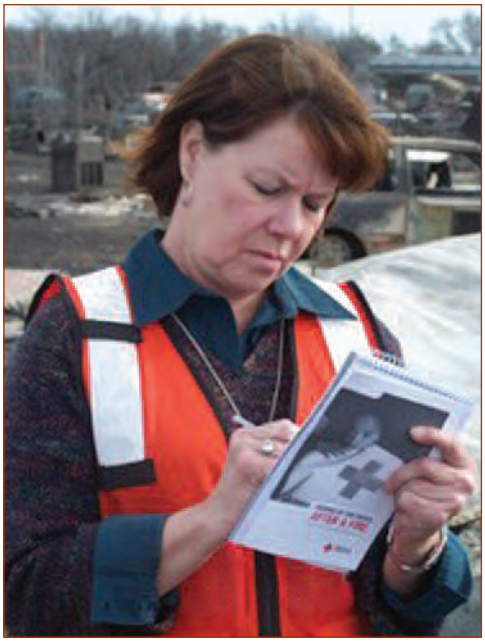


Photo credit: Anita Foster, American Red Cross

Agencies such as the American Red Cross provide support to families after a wildland fire.

Consequences of Decisions Made After a Wildland Fire

Decisions following a fire have consequences at several scales. For example, decisions at the individual level to seek mental health care may mean that demand for mental health professions following a fire exceeds supply. At the family or household level, a decision to rebuild a home rather than relocate allows existing social networks to be maintained (Gerrity and Steinglass 1994). The family may also draw on these networks for support in making their decision and for assistance in moving or rebuilding. Several studies report that the time and financial resources required by post-fire cleanup place a heavy burden on families whose properties are affected by fire. This burden is particularly difficult for elderly residents (Carroll et al. 2000, 2003; Graham et al. 2004).

Much of the cleanup work on private land following a wildland fire happens at the neighborhood level and requires investments of both human and social capital (Carroll et al. 2000, 2003; Graham 2002). The amount of capital needed to support these efforts can vary by neighborhood (Carroll et al. 2003). In some cases the difference may be due to the presence or absence of one of two leaders who serve as the focal point of these activities. Social connections are critical in such circumstances (Lin et al. 2001).

Many studies report evidence of community cohesion or "pulling together" during and after wildland fire events (Carroll et al. 2000, 2003; Graham 2002; Kumagai 2001, Kumagai et al. 2004b, c; Rodriquez-Mendez et al. 2003). This pulling together includes neighbor-to-neighbor assistance, firefighting and safety providers working extraordinary hours, businesses donating food and merchandise, and dramatic pet rescues. There are also numerous examples of local organizations helping those affected by fires (Carroll et al. 2003, Graham 2002). For example, one group raised thousands of dollars to help families who were falling through the cracks in support provided by social service agencies (Graham 2002).

Community capacity has been defined as the ability of a community to meet the day-to-day needs of its residents (Forest Ecosystem Management Assessment Team 1993). Researchers are exploring the importance of various aspects of community capacity in helping communities cope with and recover from a wildland fire. Studies have identified community characteristics lacking in at least some communities affected by fire that could help in the recovery, including government infrastructure to

attract and disburse resources from sources outside the community (Carroll et al. 2003, Graham 2002). In some cases, churches, chambers of commerce, and other local groups step in to fill the void (Carroll et al. 2003).

Researchers have documented tension among communities when larger, more visible communities receive more attention and therefore more help than smaller, less visible communities that have suffered greater damage. One study found cultural tension in a situation in which a fire was allegedly started by a member of an Indian tribe on reservation land, and some people believed the Bureau of Indian Affairs and the tribe did not fight the fire aggressively enough during the first critical day (Carroll et al. 2003). Tensions were alleviated considerably by repeated statements from two local mayors that the fire might have burned their communities had it not been for previous prescribed burning done by the tribe near their communities.

Research Addressing the Community Impacts of a Wildland Fire

Consequences of the wildland fire itself are experienced at the individual, family, neighborhood, social group, and community levels. The research synthesized below is identified in Table 2. As will be obvious in the reading, much of what we know about community impacts of wildland fire comes from a very few studies.

Table 2 References to empirical research addressing the impacts of wildland fires on communities, by scale of impacts, types of impacts, and time of impacts (before (B), during (D), or after (A) a wildland fire)

Scale of impacts	Type of impacts	Empirical studies	B	D	A
Individual	Morbidity	Carroll et al. 2003, Graham 2002, Kumagai 2001		x	x
	Physical health	Carroll et al. 2003, Graham 2002, Mott et al. 2000		x	x
	Psychological health	Carroll et al. 2003, Graham 2002, Carroll et al. 2000, Maida et al. 1989	x	x	x
	Causal attribution	Kumagai et al. 2004b, c; Kumagai 2001, Carroll et al. 2000, Graham 2002, Horlick-Jones 1995		x	x
	Differential impacts on elderly	Graham 2002		x	x
Family	Income/Equity/Job	Carroll et al. 2003, Graham 2002			x
	Psychological health	Carroll et al. 2003, Graham 2002		x	x
	Home lost	Carroll et al. 2003; Graham 2002; Kumagai et al.2004a, c; Kumagai 2001; Duncan 1997		x	x
	Burden of insurance procedure	Carroll et al. 2003, Graham 2002			x
	Clean up work load	Carroll et al. 2003, Graham 2002			x
	Relocation	Gerrity and Steinglass 1994			x
Neighborhood	Conflict	Carroll et al. 2000, Graham 2002		x	x
	Clean up work load	Carroll et al. 2003			x

Table 2 *Continued*

Social group	Environmental conflict	Carroll et al. 2003	x	x	x
	Differential equity impact Renters, seasonal employee, elderly, low income household, uninsured household etc.)	Carroll et al. 2003, Graham 2002			x
Community	General impacts	Erikson 1976, Kroll-Smith and Couch 1990, Rood 2002	x	x	x
	Conflict	Kumagai et al. 2004b, Kumagai 2001, Carroll et al.2000, Rodriguez et al. 2003, Carroll et al. 2003		x	x
	Differential local business impacts	Carroll et al. 2003, Graham 2000, Kumagai 2001		x	x
	Local tax revenues	Carroll et al. 2003, Graham 2000, Carroll et al. 2000			x
	Lost/damage community infrastructure	Graham 2002			x
	Community capacity	Carroll et al. 2003			
	• Definition, importance Deficit/unmet needs	FEMAT 1993, Fischer 1998	x	x	x
	• Lack of local government infrastructure	Carroll et al. 2003	x	x	x
	• Mental health resources	Carroll et al. 2003	x	x	x
	• Public safety infrastructures (e.g., radio)	Carroll et al. 2003	x	x	x
	• Training for local firefighters in wildfire suppression				
	• Lack of preparedness: household/neighbors/ community	Carroll et al. 2003	x	x	x
	• Lack of coordination for "helping" resources	Carroll et al. 2003, Bradshaw 1987, Bailey 1991		x	x
Cross cutting	Place	Carroll et al. 2003, Graham 2002			x
	Common based recreation	Carroll et al. 2003, Graham 2002, Englin et al. 2001			x

Impacts of Wildland Fires on Individuals

Death is the ultimate individual impact of a wildland fire (Kumagai 2001). Fire can kill directly or indirectly through increased stress. Studies have found that elderly people appear to suffer disproportionately more stress, anxiety, and depression from a wildland fire than do individuals of other ages (Carroll et al. 2003, Graham 2002, Kumagai 2001). This finding was attributed to the fear that burned landscapes were not likely to recover in their lifetimes, and to what seemed to be the overwhelming task of cleaning up (Graham 2002).

Photo credit: National Interagency Fire Center

Smoke from wildland fire can be harmful to local residents, particularly those with preexisting medical conditions.

Smoke from wildland fire can harm residents, particularly those with preexisting cardiopulmonary conditions (Mott et al. 2002).

Fire can have psychosocial impacts too. In one study, community residents reported various mental health problems, including jumpiness, sleep disturbance, trouble concentrating, general lethargy, and loss of appetite (Maida et al. 1989). Greater effects were found for those who lost their homes. In another study, social service providers and mental health professionals reported dramatically increased need for mental health services (mostly counseling) in communities affected by fires (Carroll et al. 2003, Graham 2002). In most cases the needs were relatively short term; however, for a few individuals, the fire appeared to trigger or exacerbate more serious, longer term emotional problems.

Research has documented residents affected by wildland fires irrationally blaming firefighters and officials for their losses (Carroll et al. 2000; Kumagai 2001; Kumagai et al. 2004b, c). We should note these are not cases of legitimate differences of opinion over firefighting strategies and priorities, but rather, clear cases where fire victims made faulty attributions about the "real causes" of the fire damage to their property.

Impacts of Wildland Fires on Families

Short of injury or death of a family member, the loss of a home is perhaps the most dramatic impact a fire can have on a family. The big question for a family is whether to rebuild on the original site or to relocate.

Documenting losses for insurance purposes is a significant burden both from an emotional and time perspective (Carroll et al. 2003, Graham 2002). Some people seem to be satisfied with the outcome of insurance claims, while others suffer losses due to being underinsured and, in some cases, being deceived by insurance agents about the nature of their coverage. Some reported they thought they had full coverage, only to discover their policies contained reimbursement limits.

Short-term income and job losses have also been reported, with losses heaviest among those with seasonal or temporary employment and business owners whose busy season coincided with the fire event (Carroll et al. 2000, 2003; Graham 2002).

Impacts of Wildland Fires on Neighborhoods

Emotional impacts of fires tended to be distributed at the neighborhood level according to the fire's intensity and damage experienced (Carroll et al. 2000). The emotional and physical response of a neighborhood directly affected by the fire will differ from one that is nearby but physically unaltered.

Impacts of Wildland Fires on Social Groups

Wildland fires can provide the basis of extending and in some cases amplifying preexisting disagreements and conflicts between those for and against active forest management, including thinning and

Photo credit: Pamela Jakes

Seasonal businesses and those with perishable stock, such as this fruit stand, can be disproportionately impacted by a wildland fire.

timber harvest (Carroll et al. 2000, 2003; Graham 2002). The rhetoric on both sides tends to oversimplify the cause of the fire, with people on both sides emphasizing causal factors that fit with their worldview.

Members of some social groups are in a better position than others to absorb or replace losses due to wildland fires (Carroll et al. 2003, Graham 2002). For example, more homeowners than renters have replacement insurance. Homeowners can choose whether to rebuild homes, but renters have fewer options, particularly in areas where rental property is scarce. In one study, people with seasonal jobs tended to suffer more income loss than people with year-round employment (Carroll et al. 2000, 2003).

Elderly people who lose their homes appear to suffer disproportionately (Graham 2002). In one study, people who planned to use their now-burned vacation home as their primary residence after retirement experienced substantial grief. Those who did not have fire insurance and lost everything expressed helpless and desperate feelings about the rest of their lives. Younger people who lost their homes, on the other hand, tended to express greater resiliency.

Impacts of Wildland Fires on Communities

Some natural or human-caused disasters result in conflicts within communities that go on for years (Erikson 1976, Kroll-Smith and Couch 1990). This long-term conflict has rarely been shown for fires, although researchers have documented internal community tension and conflict due to wildland fires (Carroll et al. 2003, Graham 2002).

Those who did not have fire insurance and lost everything expressed helpless and desperate feelings about the rest of their lives.

Some business sectors suffer disproportional impacts from fire—for example, seasonal businesses, businesses with perishable stock (such as nurseries), and businesses that rely on seasonal tourist dollars (Carroll et al. 2000, 2003; Graham 2002). Tax revenues can drop when homes are destroyed (Graham 2002). The loss of community-owned infrastructure, such as a senior citizens' center or watershed supply water, can also harm a community (Carroll et al. 2003).

Local public safety infrastructure has been found to be pushed beyond existing limits by large fires. In particular, two-way radio and cell phone capacity can be overtaxed.

Photo credit: Pamela Jakes

The transformation of a landscape after a wildland fire can create feelings of loss in residents and visitors.

Another issue related to community capacity is overlap, gaps, and lack of coordination of helping resources (Carroll et al. 2003, Graham 2002). One study reported a quarrel between the Red Cross and Salvation Army over parking lot space (Carroll et al. 2003).

Cross-Cutting Impacts of Wildland Fires

Some impacts of fire cut across the levels of organization noted above. One of these has to do with the transformation of place as the result of a wildland fire. Depending on the scale of the fire, the loss of the landscape as it was can be felt at the level of the individual, family, neighborhood, and community (Carroll et al. 2003).

Another impact that crosses scales of social organization is the impact of fires on recreation. In one study, interviewees talked about losing a favorite hunting, hiking, or camping spot. Because recreational pursuits are generally carried out with family and friends, such impacts occur at multiple levels (Cohen et al. 2003, Graham 2002).

Discussion

Communities may be ill-prepared to deal with the problems of large wildland fires. Many are overwhelmed by the size and duration of the fire.

The fire management strategies agencies use to prepare communities for wildland fires, control these fires, and recover from fires are important for understanding the impacts of wildland fires. Such understanding, in turn, is needed in allocating funds for fire preparedness, prevention, suppression, restoration, and recovery among various levels of government. It serves as the foundation for mitigating fire effects and influences decisions made at individual, neighborhood, and community levels.

Minimizing impacts of wildland fires requires attention at multiple levels of organization. The current salience of the wildland fire issue in the West provides a valuable opportunity for communities and agencies to adopt more strategic and systematic approaches for organizing people to minimize losses due to fire. This discussion suggests a number of decisions and actions at various scales that such an effort should address.

The fire management strategies agencies use to prepare communities for wildland fires, control these fires, and recover from fires are important for understanding the impacts of wildland fires.

Across the phases of the wildland fire, four common social processes appear to require continuing attention: goal setting, communication, assignment of responsibility, and evaluation. Each process raises questions for research and wildland fire management.

Goal Setting

A key target for goal setting is determining the desired future condition of the forest and surrounding communities. After a wildland fire, restoration goals can be quite diverse; there can be a strict focus on native vegetation or natural recovers, or introduced species can be mixed into reforestation projects. Rebuilding homes destroyed by fires can by guided by new building codes or design criteria that meet other objectives in addition to wildland fire safety. Many questions remain that are critical to goal setting:

- What risks are acceptable?
- What vegetation management is preferred?
- Where are these actions limited by other constraints?
- What are the economic implications of remedial treatments?
- Who bears the cost of risk reduction?
- How can risks be reduced at all scales?

Communication

Communication between agencies and communities is important at all phases of the wildland fire event. There appears to be a wide range of protocols, some more effective than others, based on differing assumptions of communication intent. The Internet is an enormously powerful tool for communication during wildland fires; in a few instances officers have been able to post fire boundary maps daily.

Photo credit: V. Sturtevant

Goal setting involves communities coming together to identify what risks are acceptable and how risks can be managed.

Quality information is critical, and assurances that information will be delivered in an accessible and understandable format are fundamental to its effectiveness. However, communication is not an easy task. It is important to understand communication theory even though the effectiveness of different types of messages and media within a wildland fire remains uncertain.

Communication among residents, agency staff, and interest groups on goals, responsibilities, and implications of actions is important. It can help citizens and community groups understand the tradeoffs among preparatory measures or the procedures to receive compensation in the event of a loss. It may also lead to innovation and community-based solutions on issues such as fire prevention and recovery efforts.

Assignment of Responsibility

Communities and agencies need to work together to clarify who is responsible for what before, during, and after a wildland fire. Questions to be answered include

- To what extent does responsibility to reduce wildland fire risk around structures rest with the homeowner, neighborhood, and subdivision/community?
- Will county planning boards develop and approve zoning rules for new developments that address concerns about building materials, landscaping, and access for emergency vehicles?
- During a wildland fire, which agencies will be responsible for evacuation, reentry, and access management?

The assignment of responsibilities does not have to come from external experts; it can emerge from negotiations between fire management professionals and community organizations. Most significant assignments of responsibilities can occur before a wildland fire, if there is commitment by all key participants.

Evaluation

Evaluation, involving assessment and auditing of decisions during all phases of a wildland fire, is important for improving future responses. Auditing of the costs and benefits of loss prevention or mitigation can help determine its value. Similarly, assessment and mapping of the dynamics of forest conditions and the extent by which an action affects the relationship between fuels and fire behavior will guide future forest management. Evaluation after a wildland fire can provide information to prepare for future fires.

Overarching questions relevant to evaluation remain

- What criteria are used to measure the effectiveness of fire management decisions?
- How do we weigh the costs of preparedness against the losses incurred?
- How are lessons bounded in space and time across the range of potentially affected communities?

Like other lessons from the intersection of social and natural sciences, actions aimed at one purpose reverberate through the social and biophysical systems in unpredictable ways. The framework presented here provides a relatively straightforward way to look at the multiple, interlinked actions and consequences associated with wildland fire. Even if actions result in unanticipated outcomes, their impact can provide information for future decisions and actions. If we learn from past impacts of wildland fires on communities, we can reduce the fear, expense, and uncertainty associated with future fires.

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A series of syntheses were commissioned by the U.S. Forest Service to aid in fuels mitigation project planning. Focusing on research on the social impacts of wildland fire, this synthesis explores decisions and actions taken by communities before, during, and after a wildland fire to minimize its impacts. It then synthesizes the research studying (1) the consequences of these decisions and (2) the community impacts of wildland fire.

KEY WORDS: human dimensions of wildfire, community impacts of wildfire, social consequences of wildfire

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